NITI Aayog

DEVELOPMENT MONITORING AND EVALUATION OFFICE

Evaluation of Centrally Sponsored Schemes in Water Resources, Environment and Forest Sector

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Evaluation of Centrally Sponsored Schemes in Water Resources, Environment and Forest Sector

Volume 2: Water Resources

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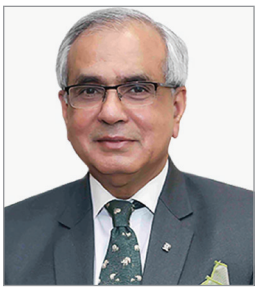
सत्यमेव जयते



MESSAGE

The sustainable use of natural resources is critical for our growing economy and the need is even more pronounced due to the effects of climate change. Alongside conservation of the environment, India needs policies and programs that ensure that the people dependent on environmental resources obtain better livelihoods from its conservation. Moreover, this would help in the climate-proofing of vulnerable sectors such as water resources, forestry, agriculture, fisheries and infrastructure.

Given that India has only 4% of the world's renewable water sources but hosts around 18% of the world's population, the Water Resources sector plays a vital role in ensuring water and food security and achieving our Sustainable Development Goals. Ensuring conjunctive use of surface and groundwater, substantial improvements in water use efficiencies and equitable supply to all sectors is at the forefront. The spatial and temporal variations need to be addressed by enhancing the country's water storage capacity by creating decentralized storage structures. A paradigm shift from an asset creation approach to a service-based approach needs to be adopted wherein the maintenance and management of the existing assets must be prioritized. Institutional reforms are warranted to contain the deepening water conflicts among user groups and ensure equitable water distribution and conjunctive use, like setting up state water resources regulatory authority and strengthening the participatory irrigation management practices and water use efficiency.

From a comprehensive inter-sectoral view, changes in extant policies of crop procurement and subsidized electricity are necessitated. These interventions need to be supplemented by robust data collection and monitoring mechanisms backed by new technological interventions. Given the strained financial resources, mobilization of resources through alternative means becomes critically important in funding and ensuring the adequate maintenance of the related infrastructure. Building public-private partnerships by incorporating experiences from related areas like sewage treatment, roads, highways, etc., is needed. Water being a state subject, requires the states to come forward to set up these institutional mechanisms.

In the environment and forest sector, India is among a few countries in the world where forest cover is consistently increasing. The population of tigers, a keystone species, has also doubled, much in advance of the 2022 deadline committed in the St. Petersburg Declaration. The evaluation of changes in biodiversity of forest ecosystems and the development of local forest-dependent communities are critical. But to supplement the government funding, innovative instruments such as domestic carbon offset markets, payment for ecosystem services, carbon taxes, and impact bond instruments need to be piloted and implemented.

This evaluation report is an important accomplishment in capturing the performance, strengths, and weaknesses of the sixteen different schemes. It makes streamlined suggestions for improvement to support India's water and food security while maintaining the environmental/ecological balance to become an Atmanirbhar Bharat.

DECEMBER, 2020
NEW DELHI
INDIA

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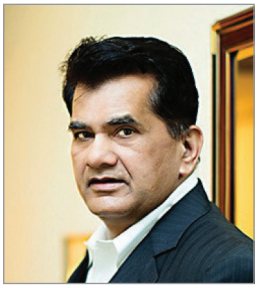

MESSAGE

NITI Aayog's mandate is to facilitate transformation in India, and through the Development Monitoring and Evaluation Office (DMEO), we are working towards institutionalizing evidence-based policy-making, to strengthen systems of governance in the country. While evaluations have been carried out in India since the 1950s, this evaluation has been different in both its scope and its methods. For the first time, all important sectors under the National Development Agenda covering all the Centrally Sponsored Schemes have been evaluated. Simultaneously conducting such large-scale multiple studies across sectors has allowed for rich cross-learning, standardization, and adoption of leading survey methodologies and data quality processes.

However, evidence generation is not enough – uptake must be ensured too. The findings from this study must now be used to drive reform and future policy initiatives across the Ministries and Departments within its remit. The study provides data-backed recommendations to improve government service delivery, at the scheme, Umbrella scheme, and sector level. The Ministry officials have been closely involved throughout the study, via a thorough consultative process, to optimize the robustness of the study and its recommendations.

It is also important to measure key outcomes so as to understand whether schemes deliver on key objectives or not. The D/o Water Resources, River Development and Ganga Rejuvenation, D/o Agriculture and Farmer's Welfare, and D/o Land Resources needs to collect regular data on important outcomes to finetune policies and program implementation. Some of these outcome indicators include the actual gap between irrigation potential created and utilized, change in crop yield and ground water level attributable to the projects, income enhancement of farmers, number of person-days of employment generated, among others. Similarly, the Ministry of Environment, Forest and Climate Change needs to measure amount of carbon sequestered, improvement of livelihood opportunities and diversification of income sources as outcomes.

In the larger context of the XVth Finance Commission and devolution of funds from the Centre towards States, these evaluation studies also play an important role in advancing NITI Aayog's goal of cooperative federalism. The study examines heterogeneous implementation of Centrally Sponsored Schemes and identifies sub-national best practices amenable to national scaling up, facilitating learning among States and with the Centre.

Finally, to make hard evidence the basis of policy decision-making in the country, there is a need at all the levels of the Government to measure outcomes and impacts regularly. This study is a step in that direction.

DECEMBER, 2020
NEW DELHI
INDIA

Amitabh Kant

Preface

The Government of India (GoI) spends close to Rs. 10 lakh Cr. annually on development activities, through nearly 750 schemes implemented by Union Ministries. Of these 750, a total of 128 are Centrally Sponsored Schemes (CSS), implying that they are funded jointly by the Centre and the States, and implemented by the States. Over the years, federalism and the expectations of government service delivery in India have evolved, and this vast proliferation of schemes is in sore need of rationalization. The rationalization of schemes is expected to improve Centre-State relations, the effectiveness and efficiency of public finance, and the quality of service delivery to citizens.

To this end, all schemes were mandated to undergo third party evaluations, to provide an evidentiary foundation to the 15th Finance Commission for scheme continuation from 2021-22 to 2025-26. The task of conducting these CSS evaluations was granted to NITI Aayog, specifically to Development Monitoring and Evaluation Office (DMEO). This volume is thus a part of a historic exercise undertaken between April 2019 and August 2020, to evaluate 128 CSS, under 28 Umbrella CSS, under 10 Packages or Sectors. The studies together cover close to 30% of the GoI's development expenditure, amounting to approximately Rs. 3 lakh Cr. (USD 43 billion) per annum.

In order to fulfill this mandate to the highest standard possible, to optimize both the robustness and the uptake of the evidence generated, DMEO adopted a nationally representative mixed-methods evaluation methodology and a consultative review process for the reports. Altogether, the project incorporates the direct input of approximately 33,000 individuals, through 17,500 household interviews, 7,100 key informant interviews, and 1,400 focus group discussions. The views of Central, State, district, block, ward, and village administrations, as well as non-governmental experts and civil society organizations, have been elicited. Through qualitative and quantitative analysis of secondary literature, validated by this primary data collection, the analysis was done at three levels: the sector, the umbrella CSS, and the scheme itself. The key parameters for analysis, including relevance, effectiveness, efficiency, sustainability, impact, and equity (REESIE), have been selected based on international best practices in evaluation. In addition, across 10 packages, certain cross-cutting themes have been identified for analysis, including transparency, sustainability, gender, technology, private sector etc. The reports thus produced then underwent a consultative review process involving NITI Aayog subject matter divisions, concerned Ministries and Departments, and external experts. The entire project was implemented through 10 consultant firm teams selected from the private sector through an open tender process, managed by my small but fiercely dedicated team at DMEO.

Throughout this project, hundreds of people across the country have pushed themselves through festivals, monsoon rains, cyclones, and a global pandemic, COVID-19, to present these volumes. DMEO owes a debt of gratitude to each one of these contributors, but especially to all the beneficiaries interviewed, for sharing their precious time and experiences with our teams. Ultimately, this exercise, like all others by the Government of India, is in service of the sovereign citizens of this country.

Acknowledgment

We would first of all like to express our deepest gratitude to the Ministry of Finance for recognizing the crucial need for evidence in the deliberations of the 15th Finance Commission and entrusting the conduction of these historic evaluations to NITI Aayog. Further, Dr. Rajiv Kumar, Vice-Chairman NITI Aayog, and Shri Amitabh Kant, Chief Executive Officer, have played a fundamental role, first in entrusting this weighty responsibility to the Development Monitoring and Evaluation Office (DMEO) and subsequently as mentors throughout the study, in providing all necessary support and guidance for the completion of the project.

Our invaluable partners in this exercise have been the Department of Water Resources, River Development & Ganga Rejuvenation (D/o WR, RD & GR), Department of Agriculture, Cooperation and Farmer's Welfare (DAC&FW), Department of Land Resources (DoLR), and Ministry of Environment, Forest and Climate Change (MoEFCC) and all its officials, without whose cooperation this evaluation would not have been possible. Sh. Upendra Prasad Singh, Secretary, Sh. K Guite, and Dr. R Sathish, Economic Advisor from D/o WR, RD & GR, Sh. Sanjay Agarwal, Secretary and Sh. B V N Rao, Deputy Commissioner from DAC&FW; Sh. Ajay Tirkey, Secretary and Sh. Umakant, Joint Secretary from DoLR; and various divisions under the Departments provided invaluable support for the Water Resources sub-package. Sh. Rameshwar Prasad Gupta, Secretary, , Sh. Yashvir Singh, Economic Advisor, the various divisions from MoEFCC provided invaluable support for the Environment and Forest Resources sub-package. We are grateful to them for giving us access to available data, for patiently sharing their expertise through Key Informant Interviews, and for providing their vital comments on the draft reports during various stages of the study. A detailed list of Key Informant Interviews can be found in the annexures to this report.

In the spirit of Centrally Sponsored Schemes in our federal structure, equally important partners in this endeavor have been the state governments of Assam, Andhra Pradesh, Bihar, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Maharashtra, Madhya Pradesh, Manipur, Mizoram, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttarakhand and West Bengal and their Chief Secretaries. They provided both ground support and operational independence to our field partners for the primary study. State Nodal Officers and other officials also provided invaluable support. We are deeply thankful for their gracious cooperation in completion of the study.

Next, we must thank our external expert, Dr. Amarjit Singh, ex-Secretary (D/o WR, RD & GR), and Dr. Deepak Khare, Professor (Department of Water Resources Development and Management, IIT Roorkee) for helping us refine and rationalize the report through their insightful comments, corrections and feedback at each stage. From deep fundamentals of the sector to the latest developments, these experts helped ensure that the report was as comprehensive, cogent, and technically robust as possible, within the short timeframes available.

Coming to the implementation teams, it goes without saying that the selected consultant firm, M/s KPMG Advisory Services Pvt. Ltd. has done a remarkable job, particularly given the significant challenges of scale, time, and resources presented by this project. Particular

appreciation is due to Mr. Sumouleendra Ghosh, Director, Mr. Manpreet Singh, Partner, and Mr. Anand Kulkarni, Technical Director and their full team. They conducted hundreds of interviews across 18 States of India, an extraordinary triumph of operational planning and logistics, through monsoons, festive seasons, a cyclone, and a pandemic.

At NITI Aayog, this exercise would not have gotten off the ground without the consistent support of the Procurement Management Committee and Bid Evaluation Committee, particularly Mr. Sonjoy Saha, Adviser (PPP/PAMD), Sh. Avinash Mishra, Adviser (Water & Land Resources), Sh. Jitendra Kumar, Adviser (Natural Resources & Environment), and Ms. Sanchita Shukla, Director, Internal Finance Division. Staff at the NITI Aayog Water & Land Resources vertical, particularly Sh. Mishra, Ms. Namrata Singh, Young Professional and Sh. Gopal Sharan, Scientist C, and NRE Adviser Sh. Jitendra Kumar have also been instrumental in seeing this project to fruition. The Internal Finance Division further merits special mention here for its extensive efforts.

DMEO team has been at the core of the evaluation studies - in this package specifically, Ms. Sumitra K, Monitoring and Evaluation Lead, Ms. Fatima Mumtaz, Young Professional and Sh. Kuldeep Pal, Economic Investigator worked on every last detail of this herculean endeavor, under the guidance of Deputy Director Generals Sh. Alok Mishra and Ms. Harkiran Sanjeevi. Across packages, Deputy Director General Sh. Ashutosh Jain also oversaw coordination, standardization and monitoring of the study design, analysis and implementation processes across packages. They were supported by the Evaluations Core Team: Dr. Shweta Sharma, Sh. Anand Trivedi, Ms. Sanjana Manaktala, Ms. Shruti Khanna, Ms. Vatsala Aggarwal, Sh. O.P. Thakur and Sh. Jayanta Patel. The Primary Data Quality Review team comprising Sh. Venugopal Mothkoor, Sh. Paresh Dhokad, Sh. Krishn Kant Sharma and Sh. Jayanta Patel contributed across packages in data quality and analysis. The DMEO administration and accounts officers, including Sh. D. Bandopadhyay, Sh. Munish Singhal, Sh. D.S. Sajwan, Sh. Manoj Kumar and others provided vital support on documentation, approvals, payments etc.

Given the massive scope and scale of the exercise, this report owes its successful completion to the dedicated efforts of a wide variety of stakeholders. The country is deeply grateful to each one of them.

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List of Acronyms

AAP	Annual Action Plan
AIBP	Accelerated Irrigation Benefits Programme
AWDO	Asian Water Development Outlook
BCM	billion cubic metre
BCR	Benefit Cost Ratio
Billion	100 crore
CA	Central Assistance
CAD	Command Area Development
CADWM	Command Area Development and Water Management
CAG	Comptroller and Auditor General
CAPI	Computer Assisted Personal Interview
CBO	Community Based Organization
CCA	Cultivable Command Area
CGWA	Central Ground Water Authority
CGWB	Central Ground Water Board
CPCB	Central Pollution Control Board
Cr.	Crore
CSR	Corporate Social Responsibility
CSS	Centrally Sponsored Schemes
CWC	Central Water Commission
CWMI	Composite Water Management Index
DDP	Desert Development Programme
DLIA	District Level Implementation Agency
DoLR	Department of Land Resources
DPAP	Drought Prone Area Programme
DPR	Detailed Project Report
EA	Enquiry Area

ETP	Effluent Treatment Plant
FGD	Focussed Group Discussion
FMBAP	Flood Management and Border Area Programme
GAP	Ganga Action Plan
GoI	Govt. of India
GW	Giga Watt
Ha	hectare
HAM	Hybrid Annuity Model
HKKP	Har Khet Ko Pani
IAP	Integrated Action Plan
IEC	Information, Education and Communication
IHHL	Individual Household Latrines
IMTI	Industrial Management & Training Institute
IPC	Irrigation Potential Created
IPU	Irrigation Potential Utilized
ISF	Irrigation Service Fee
IWMP	Integrated Watershed Management Programme
KBK	Koraput Bolangir and Kalahandi
KII	Key Informant Interview
KPI	Key Performance Indicator
lpcd	litre per capita per day
LTIF	Long Term Irrigation Fund
M&E	Monitoring & Evaluation
MAF	Million acre feet
MCM	million cubic metre
Million	0.1 crore
MLD	million litres per day
MoDWS	Ministry of Drinking Water and Sanitation
MoEF&CF	Ministry of Environment, Forest and Climate Change

MoJS	Ministry of Jal Shakti
MoWR	Ministry of Water Resources
MoWR, RD & GR	Ministry of Water Resources, River Development and Ganga Rejuvenation
NABARD	National Bank for Agriculture and Rural Development
NCIWRD	National Commission for Integrated Water Resources Development
NMCG	National Mission for Clean Ganga
NMMI	National Mission on Micro-irrigation
NMSA	National Mission on Sustainable Agriculture
NRAA	National Rainfed Area Authority
NRCP	National River Conservation Program
NRDWP	National Rural Drinking Water Programme
NRSC	National Remote Sensing Centre
NRW	non-revenue water
NWDA	National Water Development Agency
O&M	operations and maintenance
ODF	Open Defecation Free
OFD	On-farm Development
OI	Other Interventions
PDMC	Per Drop More Crop
PIA	Project Implementing Agency
PIM	Participatory Irrigation Management
PIRC	Project Implementation Review Committee
PMKSY	Pradhan Mantri Krishi Sinchai Yojana
REESIE	Relevance, Effectiveness, Efficiency, Sustainability, Impact and Equity
RRR	Repair, Renovation and Restoration
SCSP	Schedule Caste Sub-plan
SDG	Sustainable Development Goal
SHG	Self Help Group
SLNA	State Level Nodal Agency

SLSC	State Level Sanctioning Committee
SLWM	Solid and Liquid Waste Management
SMI	Surface Minor Irrigation
SPV	Special Purpose Vehicle
STAC	State Technical Advisory Committee
STP	Sewage Treatment Plant
SWMA	Supplementary Water Management Activities
SYL	Sutlej Yamuna Link
TSP	Tribal Sub-plan
UIP	Ultimate Irrigation Potential
ULB	urban local body
WALMI	Water and Land Management Institute
WC	Watershed Committee
WCDC	Watershed Cell cum Data Centre
WDC	Watershed Development Component
WDT	Watershed Development Team
WHS	Water Harvesting Structures
WUA	Water Users Association
ZLD	Zero Liquid Discharge

Executive Summary

The Government of India has mandated NITI Aayog to undertake an independent third-party evaluation of all Centrally Sponsored Schemes (CSS) with a view to ensure judicious use of public resources and effect a rationalization of CSS, especially in the context of the 15th Finance Commission. NITI Aayog has engaged KPMG Advisory Services Private Limited to undertake an evaluation of CSS in Water Resources, Environment and Forest sectors as part of Package 9. This is the Executive Summary of the Final Evaluation Report on Water Resources sector and related CSS. For this evaluation study, a Mixed-Method (MM) approach was adopted by combining the quantitative methods with qualitative ones and then 'triangulating' information from the two different approaches. The evaluation was undertaken through in-depth review of secondary literature, and primary research comprising interviews with 567 key informants and 100 focus group discussions as well as survey of 1,284 scheme beneficiaries.

The executive summary here covers the sector analysis for Water Resources sub-sector from both the demand and supply side perspectives and is followed by scheme-wise analysis and recommendations. Towards the end, it interlinks sector and scheme-level analysis to build sector-specific recommendations.

Sector analysis

The report analyses the Sector performance from mainly two perspectives – the supply side and the demand side.

Supply side

Water resources are critical national assets and are important for sustenance of life, food security, and maintaining ecological balance. Precipitation is the principal source of water and India receives a quite significant 3,880 billion cu. m. (BCM) of precipitation, most of it (around 70%) during the monsoon months of June to September. Of the total precipitation, much is lost to evapotranspiration and other factors with a net annual utilizable water availability of 1,122 BCM as summarized in the table below.

Table 1: Pan-India net available water resources

#		Water resource (BCM)
1	Total precipitation	3,880
2	Less: Loss to evapotranspiration	1,881
3	Less: non-utilizable water resources	877
4	Net available water resources [1 – (2 + 3)]	1,122 (100%)
4a	Groundwater	432 (39%)
4b	Surface water	690 (61%)

It is concerning to note that India with a population of around 1.3 billion is classified as water-stressed with a per capita availability of 1,508 cu. m. in 2015 down from 1,820 cu. m. in 2001, which is expected to further go down in the coming decades, unless water resources management is not improved in the country. Groundwater resources are the largest source of water for agriculture and drinking water purposes. It has been observed that extraction in 37% of GW assessment units exceeded safe limits in 2017 as compared to 31% in 2013 and the percentage of safe groundwater units has been decreasing over the years. Due to sustained over-exploitation of groundwater resources over the years, the groundwater table has fallen in many places in major states such as Uttar Pradesh, Karnataka, Tamil Nadu, Rajasthan, Punjab, and Haryana. Further, the quality of groundwater has deteriorated in several districts of India on account of a combination of anthropogenic (e.g. agricultural run-off) and geogenic reasons (e.g. presence of naturally occurring minerals in groundwater).

In the case of surface water, except for the Brahmaputra river basin, per capita water availability in most of the other river basins is either already below 1,000 cu. m. or expected to fall below 1,000 cu. m. by 2050. The total surface water storage capacity in India is 253 BCM (additional 51 BCM is in ongoing works). This translates into a per capita storage capacity of 209 cu. m. which is much lower than other countries such as Brazil – 3,347 cu. m.; Australia – 3,182 cu. m; USA – 2,268 cu. m.; China – 576 cu. m.). Pollution of rivers is another major cause for concern with 351 river stretches on 275 rivers being polluted, mainly due to untreated discharge of municipal and industrial wastewater.

The key issues and related recommendations (in brief) from the study in respect of supply side challenges are summarized below.

Key Issue	Recommendation
Low total water storage capacity leads to inadequate buffer stock during periods of droughts, summer months as well as high run-off	• Focus on creation of additional storage capacities at local level (decentralized). • De-siltation of all existing major and medium irrigation reservoirs to be taken up or dredging may be attempted. Extensive catchment area treatment should also be undertaken for all reservoirs • Study feasibility of increasing storage capacity of existing reservoirs through increase in dam height (based on such feasibility study). • O&M of large dams- a dedicated budget for O&M activities to be kept. • Integrated operations and monitoring system of dams to maximise water storage capacity of dams on the same river during monsoons • Using select groundwater storage aquifers for storage of water (Mega-scale Artificial Recharge Schemes)
Spatial variance in surface water availability leads to unequal distribution and availability	• Evaluate technical and environmental feasibility of river interlinking projects; wherever feasible, projects may be expedited through following measures: o Prioritize intra-state river inter-linking projects as these may be quick wins due to less political interventions o Create and empower an independent central agency to act as a referee in case of inter-state disputes o Alternatively, river basin authorities may be created as special bodies with representatives from all participating States. • Lift Irrigation (LI) projects to be taken up; use of solar power to reduce O&M cost and improve financial sustainability should be explored
Unregulated extraction of groundwater and	• Focus on decentralised and participatory enforcement of GW related regulations through WUAs and similar grassroot level organisations. • Use remote and real-time telemetry-based water sensors to improve accuracy and frequency of groundwater data.

Key Issue	Recommendation
inadequate monitoring wells	• Implement real-time telemetry-based meters for GWL measurement to monitor GW extraction through bore wells • Encourage participatory groundwater monitoring by involving SHGs, WUAs or volunteers who may be trained to monitor groundwater at GP level. • Additional analysis using satellite data (such as NASA's Gravity Recovery and Climate Experiment) of groundwater level changes may also be undertaken at regular intervals to measure seasonal changes in groundwater levels.
Inadequate micro level information of depleted aquifers	• GP level rainwater and groundwater level recording to be used as an aid for planning artificial groundwater recharge initiatives • Water budgeting at GP level by using micro level information to be undertaken • Digitize GWL data, integrate the data from all GWL recorders, use advanced mathematical techniques to check the quality of the data and use it for planning of GW recharge initiatives. Collaborate with IITs and NITs to undertake research on the GWL data collected.

Demand side

Overall demand for water resources consists of demand from agriculture (irrigation), municipal, industrial and other sectors. In addition to this, water resources are also used for maintaining environmental requirements (such as environmental flows in rivers and evaporation losses). The total demand for water in 2010 was in the range of 700-800 BCM with agriculture demand comprising 78 – 85%. By 2050, the demand for water is expected to rise to anywhere between 973 – 1,500 BCM with agriculture's share expected to reduce to as low as 68% while the share of industries (including the power sector), municipal and other (comprising environment, inland navigation and evaporation losses) demands is expected to be around 13%, 9% and 10% respectively.

Agriculture

Water is a critical input for food security. With India's population expected to touch around 1.5 billion by 2041, the demand for water is expected to rise drastically. Increasing demand for water will be among the key challenges facing the water sector as agriculture is the largest consumer of water resources (around 78%) in the country. Salient findings related to the water demand in the agriculture sector have been summarised below:

- The coverage of irrigation as represented through net irrigated area is 49% of 140 million hectares of net sown area, while the rest is rainfed area. 40% of the net sown area is expected to remain rainfed even after attainment of full irrigation potential of the country. With land productivity in rainfed areas being quite poor compared to canal irrigation (2-3x) and well irrigated areas (3-5x), this will further aggravate the food security challenges.
- By 2050, due to climate change net precipitation in the country may decrease by 0.1-0.5 mm/day leading to uneven rainfall distribution, intense and localized rainfall. This may negatively impact farmers cultivating on rainfed areas and flood plain zones.
- Groundwater is a major source of irrigation with estimates of a coverage ranging between 44% to 63% as per various sources, mainly due to availability of heavily subsidized power.
- Major portion (i.e. 76%) of minor irrigation is groundwater based, one of the key causes of groundwater depletion.
- There exists a long gestation period between the creation of irrigation assets and availability of water in farms as represented by the gap between Irrigation Potential Created and Utilized (currently around 20%).
- Conventional canal-based conveyance of irrigation water suffers from high water losses of anywhere between 25% to 45% compared to losses from groundwater-based irrigation, which is significantly lower. Approximately, 146 BCM savings is possible in the irrigation sector itself by reducing the conveyance losses.
- Water use efficiency in India in agricultural sector is poor- 4,060 m^3/ha, compared to other countries- China (2,839 m^3/ha); Bangladesh (3,665 m^3/ha); USA (1,138 m^3/ha).

The key issues and related recommendations (in brief) from the study in respect of agriculture sector (demand side) challenges are summarized below.

Key Issue	Recommendation
Large gap between IPC and IPU	• Develop standardized methodology for IPC and IPU measurement • Effective IPU monitoring through remote sensing • States to be incentivised for reduction of IPC-IPU gap
Unregulated extraction of groundwater for irrigation	• Remove subsidy on electricity supplied for agriculture; implement direct benefit transfer to farmers in convergence with PM-KISAN in lieu of power subsidy • Incentivize micro-irrigation and cultivation of water efficient crops
Low irrigation efficiency	• Promote piped irrigation networks over open canal irrigation, wherever feasible • Launch scheme to complete lining of unlined and old canals to reduce conveyance loss after cost benefit assessment. A detailed feasibility study including cost benefit analysis to determine impact of reduction of seepage on groundwater level may be conducted before undertaking such projects.

Industrial and municipal

Currently, industries consume about 8% (56 BCM) of the total water resources of the country with the energy sector being the most water intensive and the demand expected to go up to 70 BCM by 2050 for energy sector alone. Iron, steel and textile industries are the other water intensive industries. The major issues relevant for industries include growth in water demand from industries resulting in competing demands from agriculture and industry, inefficient pricing of water, and unregulated exploitation of groundwater resources.

Municipal or domestic water demand will see higher growth in demand compared to agriculture or industries and is expected to grow by as much as 158% from 2010 to 2050. Groundwater is by far the largest source of drinking water. Government of India has launched the Jal Jeevan Mission to increase coverage of rural households with piped drinking water to 100% (from the current level of 18%). JJM is expected to create additional demand for water, especially from groundwater sources. High water losses (un-accounted for water), poor water quality, drying up

or reduced yields of water sources (especially during summer months) are some of the key areas of concern in rural areas.

Another major issue is mismanagement of wastewater. Typically, 80% to 85% of water supplied to urban consumers returns as wastewater. As per estimates, lack of adequate STP capacity has led to approximately 38,791 MLD of untreated sewage (62% of the total sewage) being discharged directly into the environment. Such untreated wastewater is a major cause of contamination of ground and surface water. In case of industrial wastewater, recent reports suggest that around 60% of it gets treated before discharge. Use of treated wastewater in the country is also at a nascent stage, even though it has significant potential to reduce pressure on freshwater. In this regard, Gujarat has made significant progress on ground to implement their treated wastewater reuse policy.

The key issues and related recommendations (in brief) from the study in respect of industrial and municipal sectors (demand side) challenges are summarized below.

Key Issue	Recommendation
Low water use efficiency and pricing	• Promote water efficient processes across all water intensive industries. Implement appropriate water tariff and mandatory reuse of treated wastewater; especially in regions of water scarcity. • Encourage water savings by metering of domestic water and levying appropriate tariff rates. Intermediate tariff (until meters are installed) based on Built-up Area (BUA) of the property may be implemented. • Revenue collected by ULBs in respect of water services to be ring-fenced. ULBs to be mandated to have sub-budgets for water supply.
Inadequate O&M and financing of drinking water schemes	• O&M of common water supply network to be taken up by private/ professional agencies. • Water Audit for ULBs to be made mandatory and audit reports to be made available in public domain.

Key Issue	Recommendation
Wastewater treatment and reuse	• State level action plan may be prepared to identify STP requirements and mapping of the same with the possible demand centers in the state (industrial clusters, agriculture, etc.). • In line with NMCG, similar missions for pollution abatement in other rivers to be taken up • Wastewater treatment for rural and semi-urban areas through modular and decentralized wastewater treatment plants to be taken up • Reuse of wastewater to be made mandatory as part of NRCP, NMCG and similar schemes • Wastewater reuse roadmap may be prepared and extended to industrial and domestic sectors- gradually mandating reuse targets for industries as well as for large cities (starting with large commercial SEZs and housing complexes)

An analysis of the sector level objectives vis-à-vis current interventions reveals that most of the sectoral issues are being addressed through governmental or other interventions. The key issues pertaining to broad sectoral objectives and overall responsiveness of the sector are summarised below:

Key Issue	Recommendation
Absence of water regulator	• There is a need for state level regulatory authority for water. It may be authorised to set tariffs, evaluate performance of service providers, arbitrate on water related disputes. Attention should be given to the organisation structure of the Authority, by drawing members from all sectors of economy, such as industrial users, domestic users, agricultural users, groundwater and surface water management authorities, legal and financial experts, etc.

Financial sustainability of the sector	• Mandatory formation of WUAs (or their strengthening where they exist); • Stronger outreach, including training and capacity building of the WUAs may be given necessary importance and taken up • Strengthening of the Irrigation Act may be undertaken • Online or local collection of irrigation fees by WUAs should be encouraged • Linking of disbursal of agricultural loans/other govt. support to payment of irrigation fees should be considered • Promotion of PPP in micro-irrigation projects o Alternative financing mechanisms like Outcome financing and "Impact financing" may be explored
Issues related to planning and data management in the sector	• Pooling and collection of existing data related to the water resources sector through state WRD (like APWRIMS) is required; to include both water supply and use related data • In line with the NHP, which aims to improve supply side data availability, demand side data may also be collected • A separate scheme may be undertaken dedicated to comprehensive water resource planning at state level. • Water entitlement for all category of users should be encouraged • In Irrigation department at state level, three separate wings to be created: (1) Construction and Design Wing - focus on technical designs, asset creation, (2) Operations wing - focus on O&M of existing assets, and non-structural aspects like community mobilization and (3) Commercial Wing - focusing on commercial aspects like service fee collection A fixed percentage of capital expenses budget for the department may be allocated to O&M

Centrally Sponsored Schemes

This evaluation covers Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), an umbrella scheme comprising several related schemes, which was launched in the year of 2015-16 with an aim to enhance physical access of water on farm and expand cultivable area under assured irrigation, improve water use efficiency at farm level, introduce sustainable water conservation practices, among other things. In addition to schemes covered under PMKSY, evaluation was also undertaken for several other CSS as part of this study.

Each scheme was evaluated for Relevance, Effectiveness, Efficiency, Sustainability, Impact and Equity. The summary of this evaluation is presented in the table below.

Scheme Name	Relevance	Effectiveness	Efficiency	Sustainability	Impact	Equity
AIBP	🟢	🟡	🟢	🔴	🟢	🟢
CADWM	🟢	🟡	🟢	🟡	🟢	🟢
RRR	🟢	🟡	🟡	🟡	🟢	🟡
SMI	🟢	🟡	🟢	🟡	🟢	🟢
GWI	🟢	🟡	⚪	⚪	⚪	⚪
SPFM	🟢	🟡	🟡	⚪	⚪	⚪
PDMC	🟢	🟡	🟡	🔴	🟢	🟡
WDC	🟢	🟢	🟡	🔴	🟡	🟢
IC	🟢	🟢	🟢	🟡	🟡	🟡
LTIF	🟢	🟢	🟢	🟢	🟢	🟢
NRCP	🟢	🟡	🟡	🟡	🟢	🟢
FMBAP	🟢	🟢	🟢	🟡	🟢	🔴
IAS	🟢	🔴	⚪	⚪	⚪	⚪

REESI+E performance infographics legend

🟢 Satisfactory 🟡 Average 🔴 Needs Improvement ⚪ No information

In addition to the REESI+E framework, the schemes were further evaluated across certain cross-sectional themes. The summary of evaluation based on cross-sectional themes is presented in the table below.

Cross sectional theme	AIBP	CADWM	RRR	SMI	GWI	SPFM	PDMC	WDC	IC	LTIF	NRCP	FMBAP
Accountability & Transparency	🟢	🟡	🟡	🟡	🟡	🟡	🟡	🟢	🟢	🟡	🟡	🟡
Direct/Indirect Employment Generation	🟢	🟢	🟢	🟢	⚪	⚪	🟡	🟢	⚫	⚫	🟢	🟡
Gender mainstreaming	⚫	🟡	🟡	🟡	⚪	⚪	🟡	🟢	⚫	⚫	🟡	🔴
Building resilience to climate change (including but not limited to developing water disaster preparedness) & ensuring sustainability	🟡	🟡	🔴	🟡	🟡	⚪	⚫	🔴	⚫	⚫	🔴	🟡
Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population	🟡	🟡	⚫	🟢	⚪	⚪	🟡	🟢	⚫	⚫	🟢	🟡
Use of IT/Technology in driving efficiency	🟡	🟡	🟡	🟡	🟡	🟡	🟢	🟢	🟢	⚫	🟡	🟢
Stakeholder and Beneficiary behavioural change	⚫	🔴	🟡	🔴	⚪	⚪	🟡	🟡	🔴	⚫	🔴	🔴

Cross sectional theme	AIBP	CADWM	RRR	SMI	GWI	SPFM	PDMC	WDC	IC	LTIF	NRCP	FMBAP
Development, dissemination & adoption of innovative practices, technology & know-how	●	●	●	●	●	●	●	●	●	●	●	●
Research & Development	●	●	●	●	●	●	●	●	●	●	●	●
Water sharing treatise / agreements and diplomacy	●	●	●	●	●	●	●	●	●	●	●	●
Conjunctive use of water	●	●	●	●	●	●	●	●	●	●	●	●
Unlocking Synergies with other Government Program	●	●	●	●	●	●	●	●	●	●	●	●
Reforms, Regulations	●	●	●	●	●	●	●	●	●	●	●	●
Impact on and role of private sector, community/ collectives/ cooperatives (e.g. Farmer cooperatives, FPOs, Water User Associations, etc.) and civil society in the scheme	●	●	●	●	●	●	●	●	●	●	●	●

Cross-sectional themes performance infographics legend

● High ● Medium ● Low ● Not relevant ● No information

A brief summary of the analysis, issues and challenges, and recommendations for each of the major scheme evaluated as part of this study, is provided below. A more detailed analyses of these and other schemes are available in the main report.

Accelerated Irrigation Benefits Program (AIBP)

AIBP was launched in 1996-97 to accelerate major and medium irrigation projects that were in advanced stages of completion and became part of PMKSY in 2015-16. Currently, the scheme covers 99 projects at a total balance cost of Rs. 73,348 Cr. with balance central assistance of Rs. 16,965 Cr. (as on March 2016). 44 projects have been completed up to March 2020. During interviews with 255 beneficiaries, around 49% cultivators confirmed increase in crop yield, while around 40% and 25% confirmed increase in irrigated area and ability to sow multiple crops respectively. Some of the major issues and corresponding recommendations identified in this study are indicated below.

#	Issue and Recommendation
1.	**Issue:** Many of the ongoing PMKSY-AIBP projects are marred by delays owing to land acquisition and R&R issues. **Recommendation:** Creation of an inter-departmental task force in every state (with on-going projects) who should meet on a monthly basis to fast-track clearances and creation of a separate R&R wing under each state water resources department to expedite resolutions of R&R issue specific to the projects may be explored
2.	**Issue:** The economic utility of the capital intensive MMI projects has been called into question many a times because of their unreliability in delivering the envisaged benefits to the end beneficiaries. One of the main causes is negligible maintenance of the assets over the period which stems from lack of accountability of the schem owners to the beneficiaries. **Recommendation:** Adopt a progressive shift from construction based to service-based approach. This may be attempted by adopting the following approaches: • Change in funding approach: The eligibility criteria for selection of MMI projects receiving central grants could be made more favourable for ERM of old projects. Measures like canal automation (as part of ERM projects) is expected to deliver twin benefits of higher state regulation of water resources and better service delivery to the end beneficiaries. • Improvement in maintenances: The central government may explore introducing a new scheme through which central grants may be released to states for (non-establishment component of) maintenance expenditure for the maintenance of select MMI projects.

#	Issue and Recommendation
	Additional incentives may be provided to states that have adopted various water sector reforms like increase in state budget allocation for maintenances, setting up water resources regulatory authority,etc. • Change in organizational structure: The shift towards better service delivery and operation plan needs to be backed by change in current resource profile of the irrigation departments; resources from other disciplines like agro-economists, anthropologists/sociologists could be deployed along with those from engineering disciplines. Also, in view of the huge spread of irrigation projects, outsourcing of non-core works (like maintenance, revenue assessment and fees collection) to private agencies may be explored (as already being initiated by some states like Andhra Pradesh).
3.	**Issue:** Existing conveyances losses in irrigation systems in India (40% to 50%) is quite high compared to other countries like Philippines, Malaysia, Colombia, Egypt and others. **Recommendation:** Develop guidelines mandating states to explore feasibility of piped distribution networks in all branch and distributary networks for all new/ ongoing projects.
4.	**Issue:** Some of the outcome parameters as defined in the Ministry of Finance's 'Output Outcome Framework' are not tracked. Also, conduct of impact assessment studies was observed to be limited. **Recommendation:** Ensure transparency by conducting regular third party impact studies (under the Impact Assessment Studies scheme) along with holistic tracking of indicators (both output and outcome indicators) in MIS dashboard Standard guidelines may be developed for assessment of the parameters like IPC-IPU over the years, which should be followed by adequate dissemination of those guidelines to the relevant stakeholders and accordingly trainings of state personnel may be conducted to avoid disparities in methods of calculation across states. Creation of statistical cells at both central and state levels for reconciliation of project level data and use of remote sensing technologies (along the lines of Ministry's recent initiatives of remote crop assessment) may be explored to ensure timely update of IPC-IPU figures. Also, as short-term measures, linking the existing MIS dashboard with the CADWM MIS dashboard for IPU data and reconciliation of groundwater related data with state

#	Issue and Recommendation
	dashboards like APWRIMS/ monthly or quarterly reports by State Ground Water Boards are suggested.

Command Area Development and Water Management (CADWM)

CADWM was introduced in 1974 with the objective of addressing the increasing gap between irrigation potential created and utilized in major and minor irrigation projects. In 2016-17, after getting subsumed under Hat Khet Ko Paani (PMKSY), the scope of CADWM was restricted to pari-passu implementation of CAD works of 99 priority AIBP projects. The scheme involves two major components – structural interventions (encompassing on-farm development works, construction of field, intermediate and link drains, correction of system deficiencies and reclamation of water-logged areas) and non-structural interventions (setting up Water User's Association, conducting trainings and demonstrations and engagement of Social Facilitators). At present, CAD works are being implemented in 88 priority AIBP projects covering culturable command area (CCA) of 45 lakh ha. with Central Assistance of Rs. 8,300 Cr., CAD works covering CCA of 14 lakh ha have been completed till June 2020. The scheme has resulted in significant positive outcomes and facilitated shift from sustenance to commercial crops (in drought prone areas). During household survey involving 225 beneficiaries, around 60%, 45% and 18% confirmed increase in crop yield, irrigated land and crop intensity, respectively. Also, as long term impact, around 45%, 49%, 41% and 43% cultivators confirmed an increase in household income, access to education, improvement in health standards and employment opportunities, respectively. Some of the major issues and corresponding recommendations identified in this study are indicated below.

#	Issue and Recommendation
1.	**Issue:** Limited involvement of WUAs at the time of project inception/ planning stage and also in stages thereafter, which is further complicated by laxity in implementation of non-structural components like appointment of social facilitators **Recommendation:** Prioritize implementation of non-structural components over structural ones. To ensure acceptability of the scheme among the cultivators and

#	Issue and Recommendation
	sustenance of the WUAs and scheme, the release of 2nd CA instalment (or some portion thereof) for structural interventions may be made subject to the completion of the following: registration of the WUAs, appointment of social facilitator for the project, conduct of specified trainings by social facilitators and release of the one-time infrastructural component (in those areas already catered by the 1st instalment). A national pool of social facilitators may be created by integrating similar agencies working across related sectors like watershed development, rural drinking water (under Jal Jeevan Mission), etc.
2.	**Issue:** Progress under micro-irrigation component has been minimal; major issues being lack of awareness, cultivator's unwillingness and unreliable water availability **Recommendation:** Explore scheme rationalization by transferring the micro-irrigation component to the Other Interventions component under the existing Per Drop More Crop Scheme (of MoA&FW) and ensure assured water supply round the year through conjunctive use of groundwater measures. Construction of tube well or bore well structures under the MI component may be explored to ensure water availability in off seasons (say summer or Rabi season) in areas with adequate groundwater level.
3.	**Issue:** Inadequacy of prescribed cost norms for the non-structural interventions has been reported by most of the states. **Recommendation:** Revision of the existing cost norms (Rs. 35,000/ ha) for the structural interventions prescribed in the scheme guidelines (in 2016-17) by linking the norms with market prices and respective state's schedule of rates or through annual increment by indexing the major cost components to relevant inflation indices may be explored.
4.	**Issue:** Deficiencies in MIS dashboard updates have been noted for some of the non-structural interventions. **Recommendation**: To ensure regular and proper update of MIS dashboard, the following activities may be attempted: • Subsequent CA releases to be made contingent on the reflection of the physical and financial progresses on the MIS dashboard • CWC regional office to share monthly reports of data upload status, highlighting areas of deficiencies to the Ministry and state governments.

#	Issue and Recommendation
	• Training plan for the respective state level stakeholders to be developed by Ministry in consultation with NIC and the state governments
5.	**Issue:** Staff shortage under CAD department is reported in most of the states **Recommendation:** Outsourcing of non-core/ non-technical (particularly seasonal) works like revenue assessment, billing and collection of water taxes to third party agencies along with adoption of remote sensing technologies for surveying, monitoring and crop assessment to cut down on the manual interventions may be explored

Repair, Renovation and Restoration of water bodies (RRR)

Introduced during the XI Plan, Repair, Renovation and Restoration (RRR) of water bodies aims at increasing storage capacities of existing water bodies (including those of traditional water bodies) through comprehensive improvement and restoration. As on March 2019, an additional irrigation potential of 0.99 lakh ha (i.e. 53% of irrigation potential target) and additional storage capacity of 504.85 MCM (i.e. 51% of the target) has been achieved while 48% of the estimated cost has been incurred. Some of the major issues and corresponding recommendations identified in this study are indicated below.

#	Issue and Recommendation
1.	**Issue:** Output-outcome framework does not mention separate outcome for each scheme objective. **Recommendation:** There is a need to evolve a standardized methodology to carry out post project evaluation. Additional indicators (mainly outcome based) corresponding to scheme objectives like groundwater recharge, agricultural productivity, improvement of catchment area of tank commands, capacity building, revenue generation from fisheries, tourism, domestic and industrial water supply may be tracked to understand holistic benefits accruing from the scheme.
2.	**Issue:** Erratic rainfall pattern and climatic uncertainities pose a major risk to scheme sustainability, which is unaddressed under current scheme guidelines. **Recommendation:** To address this, power subsidies that favour indiscriminate abstraction of water resources should be reduced/removed and replaced by direct

#	Issue and Recommendation
	benefit transfer, as initiated by Telangana and Odisha. In addition, scope of work under RRR may be enhanced to include percolation tanks. Water bodies may be connected to adjacent canal system so that excess flood waters may be stored in these canals when water demand for irrigation is comparatively less. This would reduce the incidences of flooding while additional water stored may be gainfully utilized for irrigation and other allied purpose during dry season.
3.	**Issue:** Encroachment of water body limits scheme implementation and further contributes to adverse impacts like flash floods. **Recommendation:** Persistent challenges such as encroachment may be addressed through active involvement of WUAs since project inception. Encouraging the use of water body by the villagers for economic benefits like assured income generation activities may motivate villagers to protect them. Additionally, a certificate may be issued by the Gram Panchayat before inclusion of water bodies under RRR instead of waiting till the release of second instalment.
4.	**Issue:** The current checklist for benefits-cost ratio takes only irrigation potential into account, despite the scheme having multiple other objectives like groundwater recharge and provisioning of drinking water. **Recommendation:** The checklist for calculation needs to be revised to include other factors like provisioning of drinking water, groundwater recharge, livelihood generation activities like pisciculture and other direct-indirect benefits of the scheme, including socio economic benefits.

Surface Minor Irrigation (SMI)

With the launch of PMKSY in 2015-16, Surface Minor Irrigation Scheme (SMI), which includes projects with command area less than 2,000 ha were separated from AIBP and introduced under PMSKY – Har Khet Ko Pani (HKKP) component. As on March 2020, the scheme has achieved 64% of the target irrigation potential i.e. 6.77 lakh ha while 83% of the target expenditure has been incurred. Some of the major issues and corresponding recommendations identified in this study are indicated below.

#	Issue and Recommendation
1.	**Issue:** High seepage and transmission losses in unlined canals constructed under SMI in few states. Such canals are more prone to siltation, waterlogging and damages. **Recommendation:** Replacing earthen canals with lined canals/provisioning of pipe distribution network may be considered to improve water use efficiency. Canal lining may lead to increase in velocity and rugosity coefficient. Hence, the discharge carrying capacity of canal would increase, while seepage losses, water logging and maintenance cost would reduce. However, water losses from unlined canals and infiltration surplus of applied water has also been found to increase aquifer recharge. While canal lining augments the potential for groundwater development in some geographies; it contributes to issues like waterlogging and soil salinity in others. Hence, decision of canal lining and selection of lining material may be based on local aquifer characteristics likes soil permeability, watershed physiograpy and underlying climatic pattern.
2.	**Issue:** Temporary and permanent non-usage of the surface water schemes due to low discharge and drying up of water bodies. **Recommendation:** To ensure utility of SMI, the scheme design needs to be sequential in nature. Provisioning of conveyance system through creation of diversion structures like weirs should be considered only after there is adequate facility for water storage in the upstream. In this regard, the scheme could be operated in close coordination and convergence with RRR/other scheme, which includes component of creation/restoration of water storage.
3.	**Issue:** Despite the vast amount of untreated wastewater generated by the country, which is expected to grow further, there are no provisions for wastewater reuse in SMI guidelines. **Recommendation:** Inclusion of wastewater reuse as a part of scheme guideline would aid in creation of nutrient rich and reliable water supply for irrigation. Necessary studies in this regard may be undertaken to develop safety norms for use of treated wastewater in agriculture and from the perspective of public health.
4.	**Issue:** Envisaged aim/output/outcome/impact are not mentioned in HKKP -SMI scheme guidelines**.**

#	Issue and Recommendation
	Recommendation: Other challenges like unclear scheme guidelines; increasing pressure on groundwater resources and lack of O&M provisioning may be addressed by making the scheme guidelines more comprehensive with well-defined output, outcome and impact indicators; provisioning of IEC-BCC activities to create awareness and financial strengthening of WUAs.

Per Drop More Crop (PDMC)

'Per Drop More Crop' was launched in 2015, with a cumulative outlay of Rs. 16,300 Cr. for the period of 2015-16 to 2019-20, under the Ministry of Agriculture and Farmer's Welfare. The scheme aims to enhance water use efficiency in the agriculture sector and encourages farmers to use water saving and conservation technologies. The scheme mainly focuses on enhancing water use efficiency at farm level through micro-irrigation viz. Drip and Sprinkler Irrigation. Besides promoting precision irrigation and better on-farm water management practices to optimize the use of available water resources, this component also supports micro level water storage or water conservation/management activities as Other Interventions (OI) to supplement micro-irrigation. However, the OI activities must be linked with micro-irrigation to make potential use of the available funds for higher water use efficiency. The scheme has been able to cover around 48 lakh ha. area under micro-irrigation system during the period FY 15-16 to FY 19-20. Some of the major issues and corresponding recommendations identified in this study are indicated below.

#	Issue and Recommendation
1.	**Issue**: In some states, separate departments are responsible for MI and OI components (e.g. Agriculture/ Horticulture department is responsible for MI and Watershed department is responsible for OI component). Hence, there is either less focus on water storage structure creation under OI component or such structures under OI are not effectively linked to MI systems and it hampers the progress of MI cultivation. **Recommendation**: A single department should be accountable for implementing the entire PDMC scheme (both MI as well as OI components) at state level. This will help to integrate the water sources created under OI components with MI systems

#	Issue and Recommendation
	effectively, which is currently not happening in effective way across many states due to presence of two different departments for managing these two components. This arrangement would help to achieve better progress of MI. Similar arrangement is observed in some states (e.g. Maharashtra, Tamil Nadu), where single department (i.e. Horticulture department) manages both the components and there is no such challenge in linking water sources under OI with MI systems.
2.	**Issue**: There is huge variance between market prices and cost norms as per guidelines for the MI and OI components. **Recommendation**: Unit cost norms for material cost of MI system (such as drip, sprinkler, etc.) and material and installation cost of OI components (construction of tube well/ bore well, water lifting devices, construction of community tanks/ farm ponds, etc.) specified in the scheme guidelines should be revised so that base prices for all components reflect current market price. Then, base prices should be escalated annually using an appropriate index and escalation formula to take care of inflation.
3.	**Issue**: Many states (such as Bihar, Assam, Manipur etc.) have indicated fragmented landholding as an issue because more than 80-90% farmers are small and marginal in these states. The farm holding is as low as 0.1 acre. Since minimum area mentioned in the MI guideline is 0.4 ha (around 0.99 acre) and subsidy for farm size smaller than that is calculated on pro-rata basis, it leads to comparatively higher costs for MI systems in case of such smaller farms. **Recommendation**: Farm holding of less than 0.4 ha should be considered and appropriate cost norms for such farms to be provided in the guidelines. This will help to increase MI adoption rate among the farmers having fragmented landholdings.
4.	**Issue**: Subsidy allocation is currently made based on SC/ST population in a state. Some states are unable to utilize the entire funding allocated for SC/ST farmers since their landholding in the state is significantly lower compared to their population in the state. **Recommendation**: SC/ST fund allocation should be determined based on their landholding instead of their concentration in the overall population in the state. This will reduce instances of unutilized funds allocated for SC/ST farmers.
5.	**Issue**: There is lack of awareness campaign, training sessions, capacity building programs, which are essential to improve MI adoption rates, across many states (e.g.

#	Issue and Recommendation
	Assam, Manipur, Bihar, Jharkhand, Punjab, etc.). Additionally, some states (e.g. Maharashtra, Rajasthan, Tamil Nadu, Andhra Pradesh, etc.) have reported that absence of dedicated allocation for these activities could be possible reason for inadequate training and capacity building across some states. **Recommendation**: A separate allocation of fund for IEC and capacity building may be made considering their importance in improving awareness and adoption of MI technology. This fund may be carved out of the 5% funding currently provided for administrative expenses. The guideline should lay down the specific objectives of IEC and capacity building activities to be undertaken and how the outputs and outcomes of such activities will be tracked. Digital media should be adopted for awareness campaign, training programmes and capacity building activities. One innovative model could be awareness creation through social media platforms, such as Facebook, YouTube, etc. Short 5-minute videos (e.g. video for MI installation, system maintenance, Do's and Don'ts, crop wise cultivation using MI, etc.) can be uploaded over such digital platforms. It will increase reach while reducing cost of awareness programmes and capacity building activities. e.g. Andhra Pradesh has started such activities through displaying small videos and audio-visual sessions (e.g. installation, maintenance, benefits of MI, etc.) at village level kiosks of Rythu Bharosa Kendra (RBK). Key Performance Indicators (KPI) for the services being offered by the MI companies can be defined and the MI companies can be incentivized/disincentivized based on KPI ratings. This may help to improve monitoring of the work undertaken by the MI companies.
6.	**Issue**: High initial investment required to be made by farmers, especially small and marginal farmers, for MI system is one of the factors constraining its wider adoption. Some states (e.g. Assam, Andhra Pradesh, Himachal Pradesh, Jharkhand, Maharashtra, Manipur, Punjab, Rajasthan) find difficult to arrange their share of funds including the additional top-up subsidy in timely manner that leads to project delay. **Recommendation**:

#	Issue and Recommendation
	Short-term solution: The scheme guideline may include provision for drip system with class I grade of laterals along with class II or class III which are currently mandated in the guidelines for reducing the cost of drip system. In drip system, laterals account for around 65-70% cost of the entire drip system. Wall thickness of class II grade laterals of 16 mm dia. is 0.7 to 0.9 mm. Drip system with such class II grade laterals with 1.2 m spacing costs around Rs. 50,000 for 1-acre (~ 0.4 ha) land. Class I grade of laterals are also available in the market. It is used by the farmers who are not taking subsidy through this scheme. These laterals have wall thickness of 0.4-0.5 mm and rest of the specifications remain same. Drip system with Class I grade laterals costs around Rs. 28,000 for 1-acre (~0.4 ha) land; thus, around 44% less cost as compared to Class II (grade mandated in the guidelines). Hence, cost of drip system can be significantly reduced by using lower grade of laterals. Usage of thin walled lateral (0.4 mm wall thickness) is also observed in developed countries (such as US). However, there is caveat related to longevity. This Class I grade laterals last for around 3 years whereas Class II grade laterals last for 5-6 years. However, as per the key informants of the MI companies (e.g. Jain Irrigation, Netafim, Mahindra EPC, etc.), there are many instances where farmers have used class I grade laterals for 6-7 years with proper maintenance. Similarly, as a short-term measure, cost of sprinkler system can be reduced by using plastic nozzle instead of metal nozzle. Long-term solution: R&D on development of low-cost MI technology may be explored given the focus of the scheme is on small and marginal farmers. Also, a separate allocation may be considered for such R&D activities. Govt. can collaborate with MI companies and the research institutes to find out other ways to reduce the cost of MI systems. Low-cost technology can be expected to significantly improve the adoption rates since the target beneficiary group is usually unable to adopt MI technology on account of high investment required of them.

#	Issue and Recommendation
	If cost of MI system can be reduced, this will also reduce the subsidy requirement and thus, the financial burden on states.
7	**Issue**: Most states provide top-up subsidy over and above the stipulated limit (i.e. 55% for small and marginal farmers and 45% for others). However, some states (e.g. Assam, Andhra Pradesh, Himachal Pradesh, Jharkhand, Maharashtra, Manipur, Punjab, Rajasthan) find it difficult to arrange their share of funds including the additional subsidy in timely manner that leads to delay. **Recommendation**: Central Govt. may increase the central assistance by a certain percentage for small and marginal farmers and proportionately decrease it for general farmers considering the fact that the primary target is small and marginal farmers. It will help to reduce top-up subsidy provided by the states for small & marginal. State Govt. may reduce the top-up subsidy by a certain percentage for general farmers considering that they can afford the non-subsidy portion of MI cost. This will also reduce the overall funding requirements by the states.
8	**Issue**: PMKSY-PDMC MIS requires district wise and crop wise physical and financial progress data from the state and thus, the format is very lengthy. Apart from that, server issues are also there. Hence, many states find it very difficult to upload the data over the dashboard at regular interval as mandated in the scheme guidelines. **Recommendation**: PMKSY-PDMC MIS system at the central level may be integrated with the MIS system at the state level for the states which currently maintain separate MIS dashboard. This will help in seamless data flow without any lag. Also, this will reduce the effort made by the state officials for uploading district wise, crop wise data over the dashboard.

Watershed Development Component (WDC)

Rainfed agriculture is vital to the country's economy and food security as it also contributes to about 40% of the total food grain production. Rainfed regions support two-thirds of livestock and 40% of the human population. Moreover, 80% of small and marginal farmers that are most

vulnerable to monsoon failures depend on these areas for livelihoods. Watershed development aims to develop rainfed regions of net cultivated area, culturable wastelands and degraded lands. 6,382 projects have been taken up under WDC which had a total cost of Rs. 50,739 Cr. with a central assistance component of Rs. 33,642.24 Cr. Rs. 19185.26 Cr. has been released to states so far. As on date, 70.31 per cent of the projects have been completed. States such as Rajasthan, Nagaland, Karnataka, Tamil Nadu, Andhra Pradesh and Madhya Pradesh have performed well. States like Punjab, Himachal Pradesh and Uttar Pradesh have not performed as expected with respect to the implementation, utilization of funds and completion of the projects. Since 2014-15, WDC has led to benefits such as the creation of 0.690 million water harvesting structures, 1.467 million hectares have been brought under irrigation, benefited 3.115 million farmers and since 2018-19, generated 28.121 million man-days of employment. No new projects under WDC have been approved after 2014-15. The scheme is extremely relevant given the Sustainable Development Goals and vision of the government for agriculture productivity and socio-economic upliftment of farmers in rainfed areas. The scheme has been effective in realising benefits as shown by various end-line evaluation reports. There is a need to encourage convergence and effective fund flow and utilisation to garner efficiencies. Sustainability of the scheme needs to be strengthened by addressing climate change issues, post-project natural resource management of water and forest and O&M deficiencies. The scheme is based on the 'principle of equity' which has benefited individuals across caste/tribe and gender. Some of the major issues and corresponding recommendations identified in this study are indicated below.

#	Issue and Recommendation
1.	**Issue:** Proper documentation of Community participation in WDC projects is not there **Recommendation:** Extensive community involvement should be there in entry-level activities and in planning and execution of watershed projects. To ensure adequate community participation, there should be proper documentation of community oversight (digitized attendance registers, photo/video uploads of meetings with timestamps). Further, before and during project implementation, the project benefits should be properly disseminated, and awareness created. The social audit should be performed, and beneficiaries and stakeholders should be encouraged to report any deviation during project implementation.
2.	**Issue:** Inter-Departmental Coordination needs to be strengthened for better convergence.

#	Issue and Recommendation
	Recommendation: In order to ensure convergence in project implementation, the responsibility of implementation at the watershed level should be entrusted with an inter-departmental team/committee consisting of members from following line departments: • Agriculture Department • Panchayati Raj/Rural Development Department • Land Resource Department • Water Resources Department • Forest Department • PHE/RWSS Department Further, projects which are easily doable ("quick wins") should be prioritized and there should be a focus on timely delivery and dissemination of benefits of these projects so as to create awareness and interest in communities and stakeholder/s.
3.	**Issue:** Poor maintenance of assets created under the WDC scheme during the O&M phase. **Recommendation:** In the O&M phase of the watershed projects, proper monitoring should be carried out and awareness should be created among the beneficiaries and handholding support should be provided after the implementation of the scheme to ensure proper maintenance of project assets by the beneficiaries. Extensive capacity building can be undertaken by looping in reputable institutes at the state level and cascading the training downwards to the village level.
4.	**Issue:** Poor quality of DPR leads to implementation challenges in watershed projects. **Recommendation:** Quality of DPRs and project implementation can be improved in multiple ways like engaging reputable agencies to create DPRs, having robust DPR guidelines, preparation of model DPR or DPR toolkit and using modern technologies like satellite data/ IT tools, etc. Further, robust monitoring of entire implementation (DPR and infrastructure creation) can be achieved using digital technologies and involvement of a national level PMU.
5.	**Issue:** There is a need to establish dedicated watershed department/cell at the state level

#	Issue and Recommendation
	Recommendation: It is observed that the states, which have dedicated watershed development departments have performed better than other states. Therefore, other states which have a very high percentage of rainfed area may explore setting up of a dedicated watershed department or watershed cell (under an existing department) to undertake watershed development activities. States such as Rajasthan, Karnataka, Nagaland and Odisha have established dedicated cell and have performed better than other states.
6.	**Issue:** Lack of guidelines for utilisation of Watershed Development Fund **Recommendation:** The scope of work is not clear for the O&M phase; therefore, there should be clear guidelines to ensure the utilization of Watershed Development Fund (WDF) for maintenance of assets during the O&M period. DoLR has communicated to the states on multiple occasions to formulate guidelines for the utilisation of WDF and this should be further encouraged in all forums. The model template of WDF guidelines has been circulated by DoLR among all the Sates for customization and adoption as per States specific conditions. It needs better monitoring from Central as well as from state levels.

Irrigation Census (IC)

Irrigation Census is an important source of data on minor irrigation assets created. So far five Minor Irrigation Censuses have been completed with reference years – 1986-87, 1993-94, 2000-01, 2006-07, 2013-14 while the 6th Census is currently under progress. The Irrigation Census till date have been supported through 100% central funding. The 6thIrrigation Census has added the component of Census of Water Bodies. The total estimated cost for 6th Irrigation Census is around Rs. 258 Cr., of which the cost of conducting the 6th Irrigation Census is Rs.168 Cr. and Rs. 90 Cr. is allocated for Census of Water Bodies.

Irrigation Census has evolved over the years and has increased in coverage over the five MI censuses conducted so far. There are around five schedules that are being canvassed for all minor irrigation sources and water bodies in rural and urban areas. Some of the states like Andhra Pradesh and West Bengal have also adopted newer technologies for data collection, validation,

tabulation and analysis. Irrigation Census thus have been a significant source of data for schemes like Atal Bhujal Yojana and RRR and the key parameters like IPC, IPU, CCA are being used frequently by water resources department and agriculture departments in the States.

#	Issue and Recommendation
1.	**Issue:** Manual enumeration of Village and Scheme level schedules lead to errors and increase of time-lag. **Recommendation:** The enumeration process may be made "paperless" i.e., the schedules should be entered on a tab or similar equipment where all the fields will be entered electronically as practised in states like Andhra Pradesh. The data collection module should have in-built validation mechanism. This will help in reducing the time spent for field level validation. Hence, data entry part will be taken care of during enumeration itself. The validated data will be ready for tabulation, which is currently done through a software.
2.	**Issue:** Analysis of MI Census data is restricted to technical aspects of Minor Irrigation and socio-economic issues are not addressed. **Recommendation:** It is necessary to carry out socio-economic survey with basic indicators pertaining to socio-economic parameters like migration, change in earnings, spending on education and health, insurance penetration, etc. Along with the MI census, socio-economic survey should also be conducted, and the report should include analyses of the parameters to find out correlation with data from minor irrigation.
3.	**Issue:** Dissemination of analyses to the agrarian population and MI scheme owners is not done as dissemination of report results are restricted to policy makers. **Recommendation:** The results e.g. major parameters like IPC -IPU gap, groundwater and surface water consumption and a few others should be communicated back to the villagers in form of simple messages. Information, Education and Communication (IEC) strategies should be worked out to effectively communicate and bring out behavioural change amongst the farmers and MI scheme owners. This will also help in initiating participatory planning process for MI schemes. In addition, MI census results may be shared with other departments like Fisheries, Tribal Welfare, MSME,

#	Issue and Recommendation
	etc. to address the specific needs of industries, drinking water, pisciculture, among others.
4.	**Issue:** Irrigation Census is restricted to minor irrigation sources only. **Recommendation:** The scope of Irrigation Census should be expanded to cover Medium, Minor and Micro-irrigation. Such a comprehensive census of all types of irrigation schemes in India would provide a better scenario of irrigation status as a whole. Data points like IPC, IPU, CCA, etc. would provide the macro picture. In such a scenario the schedule designing, database and table modules need to be modified appropriately.
5.	**Issue:** Comprehensive process monitoring dashboards depicting the existing scenario of each State, District, Block and Village is lacking. **Recommendation:** A dashboard should be developed to present the census data that is currently available on the website of MI Stat Wing. The dashboard should contain real-time progress of enumeration and supervision process, newer initiatives by the States, infographics on major indicators and indices and basic data analyses facility.

National River Conservation Plan (NRCP)

Water pollution is one of the biggest challenges in the water resources sector due to rapid urbanization, industrialization and increase in population. As per a report by the Central Pollution Control Board, around 61,948 MLD sewage was generated by Class I and II towns against a treatment capacity of 23,277 MLD. CPCB has also identified 351 polluted river stretches of 275 rivers across the country. The objective of NRCP is to reduce the pollution load in rivers by implementing various pollution abatement measures and improving the quality of river water which in turn shall improve the biodiversity and ecosystem of the river and also improve the environmental condition of the habitations situated on the river bank.

States like Punjab, Telangana, Tamil Nadu and Gujarat have performed well in creation of sewage treatment capacity during the period FY 2014-15 to 2018-19. Between FY2014-15 and FY 2018-19, a sewage treatment capacity of 359.62 MLD has been created at a cost of Rs. 641.95 Cr. against a target capacity of 566 MLD and allocated budget of Rs. 765.53 Cr. Till September 2019,

the National River Conservation Plan has created 85 STPs over 34 polluted river stretches (excluding Ganga and its tributaries) across 77 towns spread over 16 states . Some of the major issues and corresponding recommendations identified in this study are indicated below.

#	Issue and Recommendation
1.	**Issue:** Inadequate capacity of sewage treatment infrastructure due to lack of ULB capacity and unavailability of financial resources with the states **Recommendation**: NRCP guidelines should include the following components: - • Creating city level sewerage master plan with population projection • Developing phase wise plan for creation of sewer networks, STPs, integrating existing septage systems • Exploring alternate funding options for rapid capacity addition – PPP HAM, IFI funding, philanthropic organizations, CSR funds of private players • Exploring innovative models such as - One City One Operator • Creating enabling structure for long term tripartite agreements for PPP
2.	**Issue**: Lack of measures for holistic river conservation and abatement of other sources of pollution **Recommendation:** • Maintaining min e-flow in rivers throughout the year • Non-structural approaches for protecting river basins during floods – floodplain zoning, catchment area treatment • Treatment of sewage from all sources – septage treatment plants, organic farming, afforestation • Knowledge sharing of best practices available with NMCG
3.	**Issue:** Lack of capacity utilization of STPs due to lack of backend sewer network **Recommendation:** • Increase in capacity utilization of STPs through construction of I&D network • Convergence with AMRUT to ensure STPs and I&D structures are created in conjunction with future planning of sewer networks, household connections
4.	**Issue**: Lack of O&M in constructed assets due to unavailability of fund and manpower causing STPs to become defunct **Recommendation**:

#	Issue and Recommendation
	• Exploring private sector participation – HAM or EPC with long term O&M • Execution of performance-based contracts or technology neutral contracts to ensure operational efficiency of STP • Including revenue generation options for contractor – selling of treated wastewater, treated sludge, agreements with thermal power plants
5.	**Issue**: Non-compliance with recent revisions in NGT norms and discharge standards of sewage treatment **Recommendation**: • Inventorisation of STPs by treatment technology, output parameters & compliance • Earmarking of funds for modernization of STPs for compliance with revised NGT norms post notification of NGT order by MoEF&CC
6.	**Issue**: Mixing of industrial effluents with domestic sewage **Recommendation:** • Inventorisation of non-compliant industrial units, notification to CPCB/ SPCB • Mandatory policies to ensure self-regulation & control by industries
7.	**Issue**: Lack of holistic river basin pollution monitoring infrastructure **Recommendation**: • Setting up of Real-time Water Quality Monitoring Stations (RTWQMS) • Monitoring of river health through biodiversity index, assimilative capacities, etc. • Development of a central dashboard with indicators from RTWQMS and tracking parameters in planning, works and post–construction phases

Flood Management and Border Area Programme (FMBAP)

Flood Management and Border Area Programme was created through the merger of two erstwhile schemes: Flood Management Programme (FMP) and River Management Activities & Works related to Border Areas (RMBA). The objective of the scheme is to assist the State governments in providing reasonable degree of protection against floods through structural and non-structural measures. The activities under FMBAP have been implemented during the period 2017-2020. The Flood Management component of FMBAP includes residual works already

approved under FMP during XI & XII Plan whereas RMBA incudes activities like flood forecasting, hydrological observations, maintenance of flood protection works for transboundary rivers (i.e. rivers which traverse India's border withNepal, Bhutan, Bangladesh and Pakistan).

Out of the total outlay of Rs. 18,000 Cr., (Rs. 8,000 Cr. During XI Plan and Rs. 10,000 Cr. during XII Plan), a total of Rs. 13,238 Cr. has been approved towards activities under FMP, out of which Rs. 6,410 Cr. has already been released to 25 States. On the other hand, a total of Rs. 700 Cr. has been sanctioned for RMBA component of FMBAP out of which 485.33 Cr. has been released as 100% grant to States/UTs. The Union Cabinet has approved FMBAP for the entire country for Flood Management measures and River Management and Border Area activities for the period 2017 – 2020 with a release of Central Assistance of Rs. 2022.28 Cr. The total area protected so far through 2007 – 2020 is 49.87 lakh ha and the population protected was around 520 lakh. Some of the major issues and corresponding recommendations identified in this study are indicated below.

#	Issue and Recommendation
1.	**Issue:** Lack of Basin level planning and monitoring of flood management measures for 20 River Basins in India **Recommendation:** Formation of River Basin Organization (RBO) at National and Basin level may be expored to facilitate planning of flood management measures. Considering physical integrity of the river systems and its relations with the socio-cultural aspects of the people in the basin, it is important to constitute River Basin Organization at National level and at the respective River Basins. The RBOs involved in managing the river systems should provide an 'enabling environment' for understanding the dynamic and complex river systems through an 'interactive approach' to scale-up and scale-out participatory management. This will require the government institutions to restructure with a view to devolve powers to community institutions for evolving rational options for river basin development in respect of flood management.
2.	**Issue:** Scientific assessment of flood prone areas due absence of State specific Master Plans

#	Issue and Recommendation
	Recommendation: There should be a mandate to prepare State specific Master Plans. Necessary support for preparation of Master Plans need to be given by the Monitoring Agencies. The Master Plans will help in demarcating various flood zones digitally. The Master Plans will also include interlinking of rivers, which would help in beneficially diverting the flood waters.
3.	**Issue:** Enactment of Flood Plain Zoning Bill 1975 across all States, **Recommendation:** Flood-plain zoning measures aim at demarcating zones or areas likely to be affected by floods of different magnitudes or frequencies and probability levels, and specify the types of permissible developments in these zones, so that whenever floods actually occur, the damage can be minimised, if not avoided.
4.	**Issue:** Lack of planning at grassroot level for structural measures **Recommendation:** Formation of village level committees or involvement of existing committees like WUAs along with building the capacities of such committees is required. Substantial planning for flood management structures and non-structural measures is done at the State level with technical support from CWC, GFCC and BB. However, community involvement in planning of structural measures along with the technical support from block level technical person and monitoring the progress of the structures will help in increasing the ownership towards flood management as a whole. The issues of operations and maintenance can also be effectively looked after by the community-based organizations so formed or existing CBOs. Capacity Building in form of training to the villagers on monitoring, operations and maintenance is required.
5.	**Issue:** Flood Management Plans do not consider the socio-economic factors like reducing migration, sustaining livelihood, health and sanitation issues/ **Recommendation:** Inclusion of the socio-economic parameters into the Flood Management Plans and into the scope of concurrent and impact evaluations is required. Such measures will help in planning and ascertain fund allocation towards activities for livelihood generation, reducing incidences of diseases and will intrinsically involve other departments like health, social welfare, education and other departments. The evaluations should also look into the correlation of flood management measures with social sectors like livelihood, health, sanitation, education etc.

#	Issue and Recommendation
6.	**Issue:** Lack of a comprehensive database and real-time data analysis on flood occurrences and flood management measures **Recommendation:** Significant quantum of structural and non-structural measures have already been taken through X, XI, XII plan and for the period 2017 – 20, the progress and performance of which need to be available in public domain for effective decision support system. Flood databases in our country are scattered and available with different department. At present data on different aspects of floods are collected by various agencies, but mostly these remain confined to official files and sometimes periodicals and bulletins. There is no unified source of statistics on the hazard and flood losses at the national/sub-national levels in India. Similarly, data on development indicators and vulnerability is also not available from any single source. Therefore, there is a need for development of a comprehensive database on disasters which would facilitate formulation of area specific disaster risk profile, assessment of long-term impacts of disasters, development of policies, strategies and frameworks, preparation of proper plans for disaster preparedness and allocation of adequate funds for the prevention, mitigation and Disaster Risk Reduction (DRR) .
7.	**Issue:** Structural measures like construction of embankments do not sufficiently reduce the damages caused by floods. Issues like heavy siltation on river beds causes massive inflow of water from dams to the adjacent low lying areas. **Recommendation:** Apart from the structural measures undertaken so far within the scope of FMBAP, additional activities / interventions like River Dredging and Catchment Area Treatment should be actively considered. River Dredging: Silting at places where the rivers emerge from the hills into the plains, at convex bends and near their outfall into another river or lake or sea, is a natural phenomenon. Accordingly, rivers exhibit a tendency to braid/meander/form deltas. Dredging of the river would dig out sediments from the river-bed and will increase the water retention capacity of the river. Consequently, the pressure on the banks would be reduced minimizing the chances of flood and erosion. Selective desilting/dredging at outfalls/confluences or local reaches can, however, can be adopted as a measure to tackle the problem locally.

#	Issue and Recommendation
	Catchment Area Treatment: The rivers bring heavy sediment load from the catchments. These coupled with inadequate carrying capacity of the rivers are responsible for causing floods, drainage congestion and erosion of riverbanks. Inadequate capacity of the rivers to contain within their banks, the high flows brought down from the upper catchment areas following heavy rainfall, leads to flooding. The state governments/SDMAs should, therefore, take up appropriate watershed management measures including afforestation, check dams, detention basins, etc. in the catchment of rivers to prevent soil erosion, enhance water conservation and minimize water and sediment runoff.

Sector-scheme linkages and gap map

An analysis of the CSS being evaluated as part of this study and their mapping with the key sector issues are summarized below:

- Issue of low water storage capacity is being attempted to address through RRR of water bodies (decentralized storages) and also completion of multi-purpose MMI projects through the PMKSY-AIBP scheme. However, encroachment of water bodies, dumping of sewages and poor O&M practices continue to affect the storage capacities.

- A significant portion of the financial outlays of the Ministry has been allotted to enhance the country's irrigation coverage through Major and Medium irrigation project and their command area development (PMKSY-AIBP and CADWM, SPFM) and Minor Irrigation projects (PMKSY SMI, RRR and GWI). However, the rainfed area water resources management is currently catered through a single scheme viz PMKSY-WDC scheme; though a substantial portion of the farmers are perennially dependent on the rains.

- Improving agricultural water efficiency at the farm level is aimed through PDMC scheme and mandatory coverage of 10% CCA with MI facilities under CADWM scheme. Further, lining of water courses below outlets through CADWM scheme is expected to enhance the water utilization and irrigation coverage. However, high conveyance losses as reported in many major and minor unlined canals continue to undermine the realizable

benefits from the scheme. This is further exacerbated by lack of any dedicated O&M fund.

- In terms of sustainability, schemes like AIBP (through canal seepages), WDC (through rain water harvesting and groundwater recharging) and RRR (through tanks and water bodies restoration) have contributed to increase in groundwater level. However, unabated groundwater extraction, fuelled by subsidized power and increasing shift towards water intensive crops, poses serious sectoral challenges.

Scope for scheme rationalization

Some potential opportunities for scheme rationalization have been identified based on the study as listed below.

1. In view of the slow progress under Micro-irrigation (MI) component of CADWM scheme, it is suggested to transfer and merge this MI component with 'Other Interventions' component under PDMC scheme. Noticeably, both these components under the two schemes have similar objectives and such a rationalization would ensure streamlining of subsidy flow for the MI equipment and necessary hand-holding support for the cultivators.
2. SMI may be planned in close coordination with RRR since the objective of RRR viz; improvement and enhancement of storage capacity of water bodies are critical to ensure utility of SMI during periods of low/no flows. Rationalisation of the two schemes is suggested to allow for better coordination and accountability.

***

1 Sector Level Analysis: Water resources

In this section, a sectoral analysis of the water resources sector in India has been undertaken using an end-to-end value chain framework for the sector where areas of enquiry have been identified and analysed in respect of each element of the value chain. A summary of the value chain of the water resources sector and key issues in each component is shown in the figure below. Performance of the water resources sector as well as key issues in both supply and demand sides of the water resources value chain have been discussed in further detail in this section of the report.

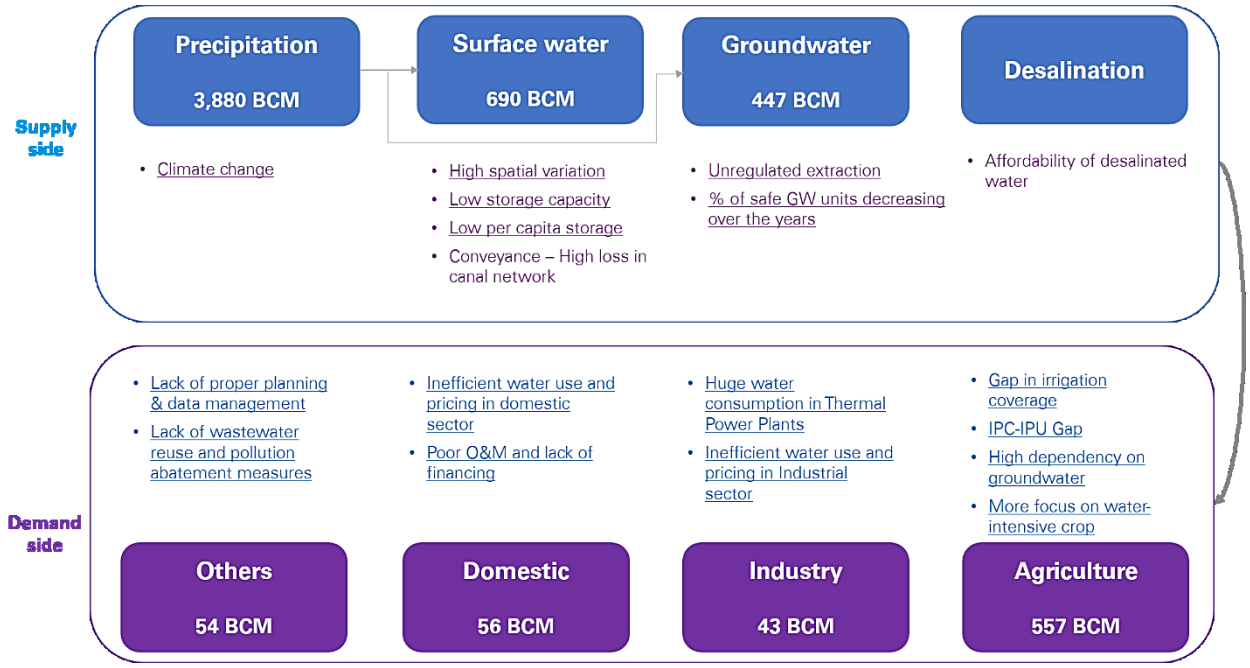


Figure 1: Water Resources sector- Value Chain with key issues

1.1 Background of the sector

1.1.1 Water resources in India - Supply Side

Water resource is an important national asset and is of foundational importance for sustenance of life, food security, and maintaining ecological balance. Over the past two decades, the demand for freshwater in India has increased significantly on account of growing population, rapid urbanization, industrial development and inefficient agricultural practices. The per capita availability of water in India has been on a decline – from 1,820 cubic metres in 2001 to 1,508

cubic metres in 2015[2]. Further, there is wide spatial variance in the availability of water – per capita availability in major Indian river basins varies widely from a mere 300 to about 2,000 cubic meter per person per year. Water pollution is another major cause for concern with 351 river stretches on 275 rivers across the country being polluted due to untreated discharge of both municipal and industrial wastewater over the years[1].

As per Falkenmark Water Stress Indicator, per capita availability of less than 1,700 cubic metres (m^3) indicates water stress, while per capita availability below 1,000 cubic metres (m^3) indicates water scarcity condition. India is currently classified as water-stressed as per this indicator. If water resources are not managed sustainably, there is an imminent possibility of India turning into a water scarce region with its attendant consequences such as food insecurity, among other things. The Falkenmark Water Stress Indicator for India projected till the year 2051 is shown below[2].

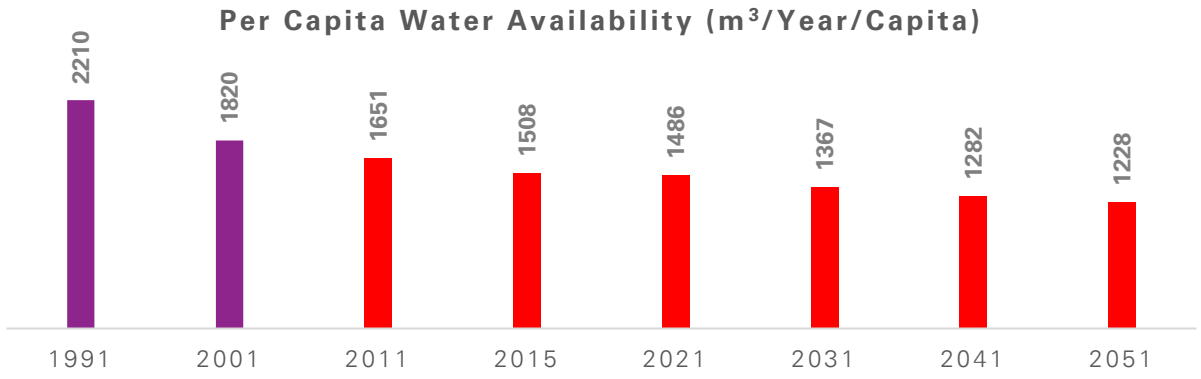


Figure 2: Per capita water availability (m^3/year/capita)

The reasons of overall water stress can be traced to issues related to both water supply and demand. A detailed analysis for each value chain component in the supply side is provided in the following sub-sections.

1.1.1.1 Precipitation

[1] Order issued by National Green Tribunal date 08th April 2019

[2] Reassessment of water availability in basins using space inputs, Central Water Commission, June 2019

Current Precipitation patterns in the country

India receives an annual precipitation of around 3,880 billion cubic metres (BCM)[2] and has an abundant system of rivers and snow-clad mountains. The forecast of water resources sector with such natural endowments ought to have been brighter. However, India is geographically diverse and there is a marked variation in rainfall across various parts of the country. Key observations and issues in this area have been described below.

Variations in Annual Rainfall Pattern

While the average annual rainfall is 119 cm; places near the Western Ghats and the sub-Himalayan areas in north-east India receive heavy rainfall of over 250 cm annually, whereas the areas of northern parts of Kashmir and western Rajasthan receive rainfall less than 40 cm. The following figure depicts the annual normal rainfall. [3]

[3] IMD Records of 50 years (1951-2000) of a network of 2412 stations all over the India.

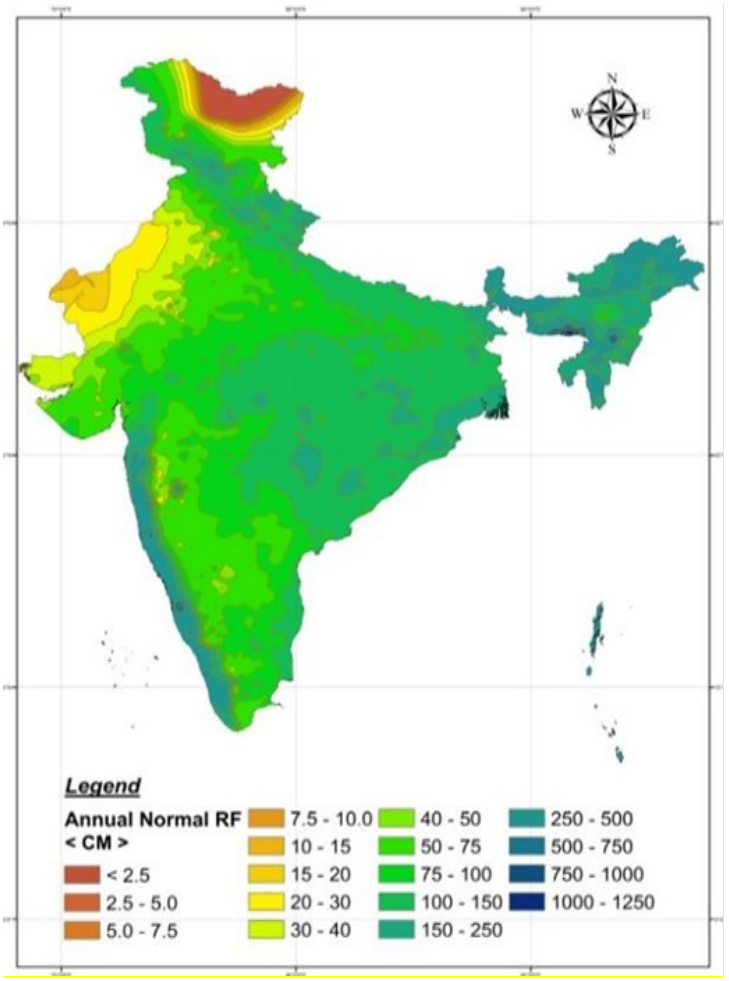


Figure 3: Annual Rainfall pattern over the country

About 70% of the annual rainfall is received during the monsoon from June to September. In recent times, every year there has been large variation in rainfall across the country resulting in phenomenon of widespread floods in a few regions as well as drought in a few others. Although the overall monsoon variations across the country have been in the range +6% to -14% (in the last five years) compared to average, in four of these five years around 30% of the sub-divisions[4] received rainfall of less than 20%. This means these deficits have been adjusted with much excess rains causing floods in a few other sub-divisions.

[4] There are 36 meteorological subdivisions of India.

Table 2: Sub-division wise rainfall variations (excess/deficit)[5]

Years	Sub-divisions with excess rains (+20% -+59%)	Sub-division with deficient rains (-20% - -59%)
2014	0	11
2015	4	12
2016	1	12
2017	3	7
2018	1	12

This fact is also evident from the following statistics of the deviation (%) in annual rainfall from the normal long-term average. It is observed that rains have been deficient in most years of the last two decades with only a few exceptions (i.e. 2005, 2010 and 2013)[6].

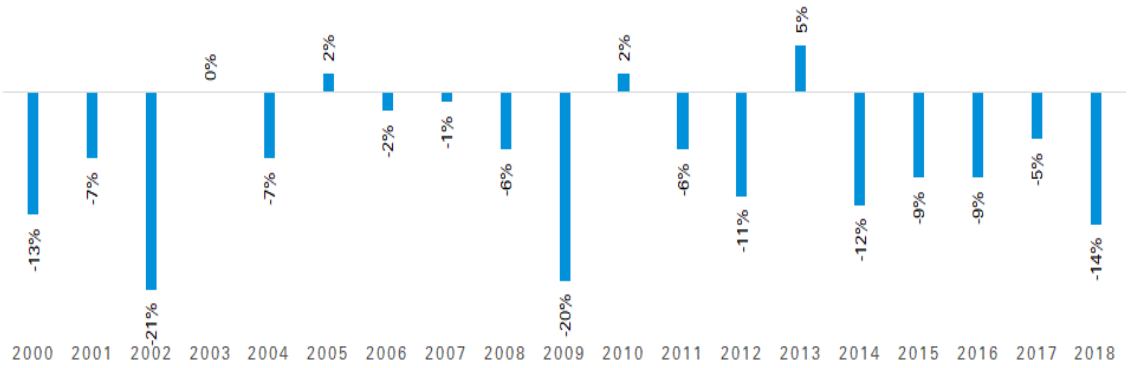


Figure 4: Departure in annual rainfall in % since 2000

Out of the total precipitation in India of 3,880 BCM, around 48.5% is lost to evapotranspiration, which leaves a balance of 1,999 BCM water in the country. Further, about 43% of the potential available water cannot be put to beneficial use due to topographical constraints and uneven distribution of water resources over space and time. This makes the utilizable water potential of the country around 1,122 BCM consisting of 690 BCM of surface water and 432 BCM of groundwater (Source for groundwater data: National Compilation on Dynamic Ground Water Resources of India, Central Ground Water Board, 2017) [2]. The figure below depicts the Water resources availability in India.

[5] Indian Meteorological Department-Customized Rainfall Information System

[6] EnviStats India 2018 - Supplement on Environmental Accounts, Ministry of Statistics and Programme Implementation, 2018 and Indian Meteorological Department-Customized Rainfall Information System

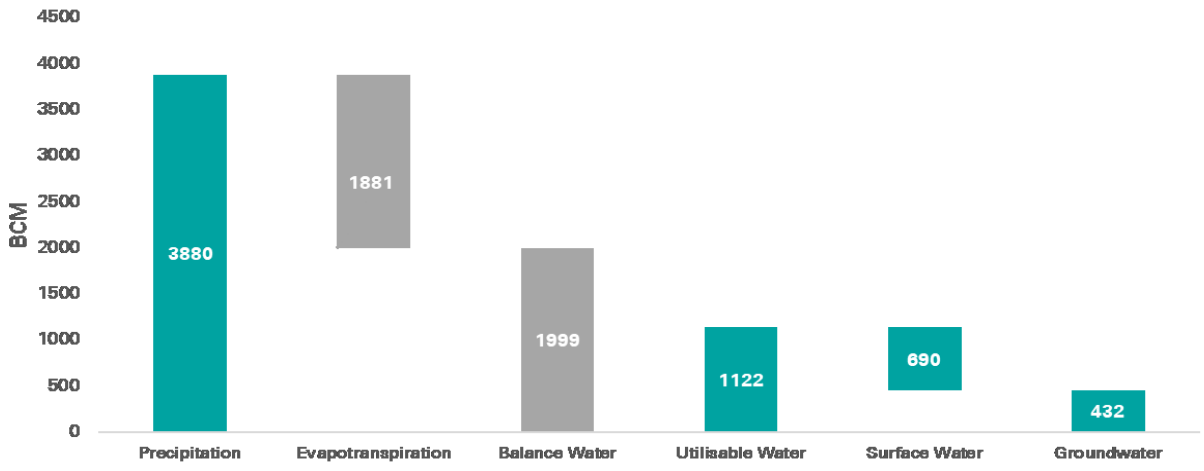


Figure 5: Water Resources Availability

This deficiency in annual rainfall in recent years is a cause for concern, since in India, monsoon rainfall is the main source of groundwater recharge, contributing about 58% of the total annual replenishable resource[7]. Even regional rainfall variations directly impact water availability. The annual replenishable groundwater resources is the sum of recharge during monsoon and non-monsoon seasons and these resources are used mainly for irrigation and domestic uses.

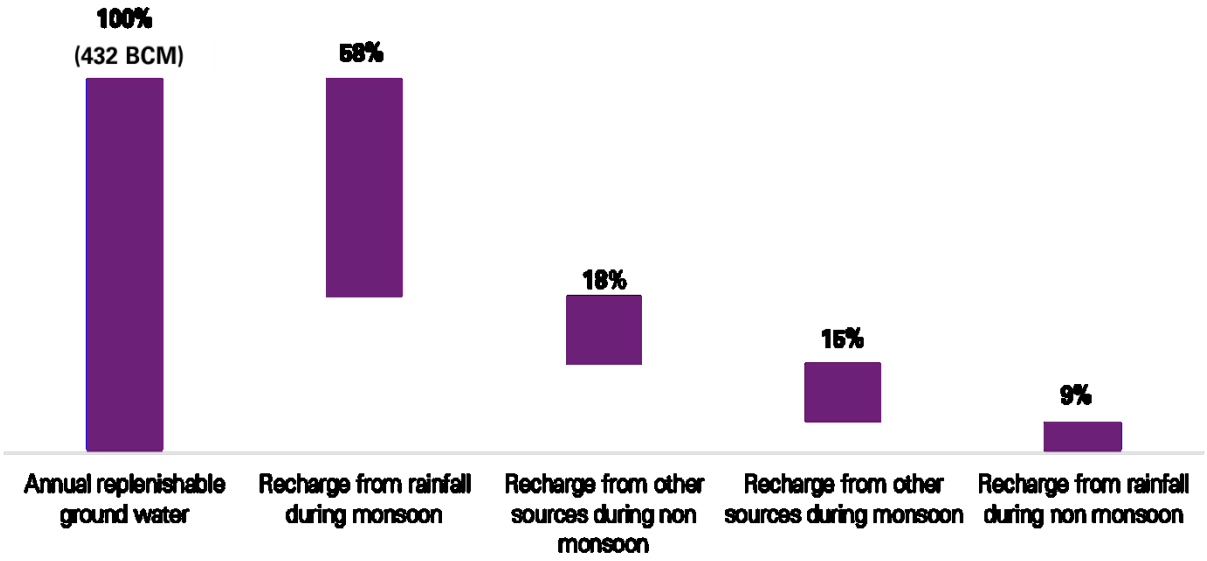


Figure 6: Sources of annual replenishable groundwater

[7] Dynamic Groundwater Resources of India, 2017 (Published on July 2019), Central Groundwater Board, Ministry of Water Resources and Reassessment of water availability in basins using space inputs, Central Water Commission, June 2019

It is evident from the above depiction that any deficiency in monsoon can significantly reduce annual replenishable groundwater.

Impact of Climate Change

Climate change in the form of changes in temperature and precipitation have come about as a result of global warming. This has impacted in the form of uneven rainfall distribution and water related disasters such as floods and droughts. Globally, average water stress[8] is 11%. India is among the 31 countries experiencing water stress in the range of 25-70%. It is forecasted that India will be among the worst affected countries with respect to change in net precipitation by 2050 vis-à-vis 2010. Net precipitation in significant parts of north, central and west India is expected to decrease by at least 0.5 mm per day while the rest of the country will witness a decrease between 0.1 to 0.5 mm per day[9].

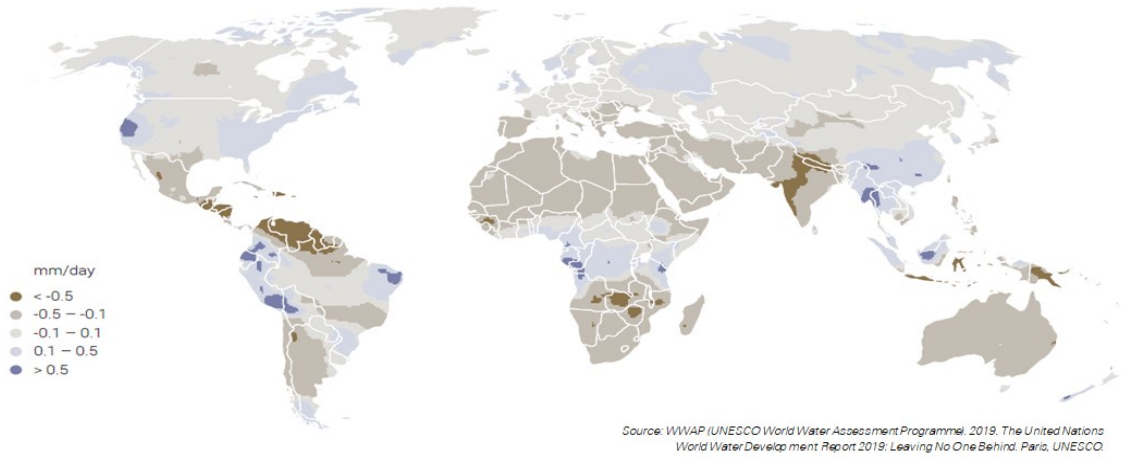


Figure 7: Change in net precipitation patterns

Growing water stress indicates increasing exploitation of water resources, with adverse impacts on resource sustainability, and a rising probability for conflicts among users. The overall water availability is discussed in respect of surface water and groundwater sources.

[8] Water stress for purpose of discussion in the above paragraph is defined as the ratio of total freshwater withdrawn annually by all major sectors, including environmental water requirements, to the total amount of renewable freshwater resources, expressed as a percentage. Source: UN (2018a, p. 72, based on data from AQUASTAT).

[9] Adapted from PBL Netherlands Environmental Assessment Agency (2018, p. 23)

1.1.1.2 Surface Water Resources

The analytical unit for the purpose of surface water analysis is a river basin. India can be broadly divided into 20 river basins. As indicated earlier, a reassessment of water resources potential has been carried out by Central Water Commission in a recent study "*Reassessment of Water Availability in India using Space Inputs*" dated June 2019 with support from National Remote Sensing Centre (NRSC). This study estimates the total water resource potential of India at 1,999 BCM with water availability being the highest in the Brahmaputra basin (527.28 BCM) followed by the Ganges basin (509.52 BCM).

This clearly shows that India is not a water deficient country. Lack of better planning and management of water resources have, however, led to several regions in the country experiencing water stress. Increase in population and associated economic activity in the future will lead to most river basins experiencing rising water stress.

Water Stress Characterization of River Basins

A river basin wise analysis of water stress is presented below by adapting the Falkenmark Water Stress Indicator and by using available population projections for 2025 and 2050.

Table 3: Categorization of river basins by water stress

Water availability (m^3/year/capita)	Category
>=1700 both in 2025 and 2050	Safe
>=1700 in 2025 but < 1700 in 2050	Moderately stressed
<1700 both in 2025 and 2050	Critically stressed
<1700 in 2025 and <1000 in 2050	Moderately scarce
<1000 in 2025 and <1000 in 2050	Critically scarce

Water Availability and Coverage of River Basins

The state-wise breakup of available resources vis-à-vis projected population depicts as many as 12 river basins in India will have critically or moderately water scarce scenario by 2050:

Table 4: River basin wise per capita Average Annual Water Availability (m^3)[10]

#	River Basin	Avg. annual Water Resources Potential (BCM)	Est. population (Mn)[11]		Est. per capita annual water availability (m^3)	
			2025	2050	2025	2050
1	Indus (up to Border)	45.53	69.2	81.41	658	559
2	Ganga-Brahmaputra-Meghna					
a	Ganga	509.52	593.04	697.69	859	730
b	Brahmaputra	527.28	48.06	56.54	10,971	9,326
c	Barak & Others	86.67	10.24	12.05	8,464	7,193
3	Godavari	117.74	89.18	104.92	1,320	1,122
4	Krishna	89.04	100.41	118.13	887	754
5	Cauvery	27.67	48.39	56.93	572	486
6	Subernarekha	15.05	15.52	18.26	970	824
7	Brahmani & Baitarani	35.35	16.18	19.04	2,185	1,857
8	Mahanadi	73.00	43.93	51.68	1,662	1,413
9	Pennar	11.02	16.02	18.85	688	585
10	Mahi	14.96	17.34	20.4	863	733
11	Sabarmati	12.96	17.34	20.4	747	635
12	Narmada	58.21	24.28	28.56	2,397	2,038
13	Tapi	26.24	24.44	28.75	1,074	913
14	West Flowing Rivers from Tapi to Tadri	118.35	42.61	50.13	2,778	2,361

[10] Reassessment of water availability in basins using space inputs- Central Water Commission- 2019 Study

[11] Report of the Standing Sub-Committee for assessment of availability and requirement of water for diverse uses in the country, 2000

#	River Basin	Avg. annual Water Resources Potential (BCM)	Est. population (Mn)[11]		Est. per capita annual water availability (m^3)	
			2025	2050	2025	2050
15	West Flowing Rivers from Tadri to Kanyakumari	119.06	53.84	63.34	2,211	1,880
16	East Flowing Rivers Between Mahanadi & Pennar	26.41	38.97	45.85	678	576
17	East Flowing Rivers Between Pennar And Kanyakumari	26.74	74.32	87.43	360	306
18	West Flowing Rivers of Kutch and Saurashtra including Luni	26.93	36.5	42.94	738	627
19	Area of Inland drainage in Rajasthan	Negligible	11.73	13.79	NA	NA
20	Minor River Draining into Myanmar (Burma) & Bangladesh	31.17	2.48	2.91	12,569	10,711

Water scarcity in these 12 basins may lead to around 11 states having critically water scarce scenario in future as per the above analysis. This is based on the area of coverage of the water basins in the respective states.

Table 5: State-wise riven basin coverage

State	River Basins covered[12]	Possible future scenario based on projected status of predominant basins[12]
Punjab	Indus	Critically Scarce
Rajasthan	Indus, Mahi, Sabarmati, West Flowing Rivers of Kutch and Saurashtra including Luni	Critically Scarce
Haryana	Indus, Ganga	Critically Scarce

[12] KPMG Analysis

State	River Basins covered[12]	Possible future scenario based on projected status of predominant basins[12]
Delhi	Ganga	Critically Scarce
Himachal Pradesh	Indus, Ganga	Moderately Scarce
Tamil Nadu	Cauvery, East Flowing Rivers Between Pennar And Kanyakumari, West Flowing Rivers from Tadri to Kanyakumari	Critically Scarce
Puducherry	East Flowing Rivers Between Pennar And Kanyakumari	Critically Scarce
Uttar Pradesh	Ganga	Critically Scarce
Karnataka	Godavari, Krishna, Cauvery, Pennar, East Flowing Rivers Between Mahanadi & Pennar, East Flowing Rivers Between Pennar And Kanyakumari, West Flowing Rivers from Tapi to Tadri	Critically Scarce
Gujarat	Mahi, Sabarmati, Narmada, Tapi, West Flowing Rivers of Kutch and Saurashtra including Luni, West Flowing Rivers from Tapi to Tadri	Moderately scarce
Uttarakhand	Ganga	Critically Scarce
Madhya Pradesh	Ganga, Godavari, Mahanadi, Tapi, Narmada	Critically stressed
Maharashtra	Godavari, Krishna, Mahanadi, Narmada, Tapi	Critically stressed
Kerala	Cauvery, West Flowing Rivers from Tadri to Kanyakumari	Moderately stressed
Bihar	Ganga	Critically Scarce
Chhattisgarh	Ganga, Godavari, Narmada, Brahmani & Baitarani	Critically Scarce
Andhra Pradesh	East Flowing Rivers Between Mahanadi & Pennar, East Flowing Rivers Between Pennar And Kanyakumari	Critically Scarce

State	River Basins covered[12]	Possible future scenario based on projected status of predominant basins[12]
Odisha	Mahanadi, Godavari, Subarnarekha, Brahmani & Baitarani, East Flowing Rivers Mahanadi & Pennar	Moderately Stressed
Goa	West Flowing Rivers from Tapi to Tadri	Safe
Jharkhand	Ganga, Mahanadi, Subarnarekha, Brahmani & Baitarani	Critically Scarce
Assam	Brahmaputra, Barak & Others	Safe
Tripura	Barak & Others, Minor River Draining into Myanmar (Burma) & Bangladesh	Safe
Meghalaya	Brahmaputra, Barak & Others	Safe
Nagaland	Brahmaputra, Barak & Others	Safe
Arunachal Pradesh	Brahmaputra	Safe
Sikkim	Brahmaputra	Safe
West Bengal	Brahmaputra, Ganga, Subarnarekha	Moderately scarce
Jammu & Kashmir	Indus	Moderately scarce
Manipur	Minor River Draining into Myanmar (Burma) & Bangladesh, Barak & Others	Safe
Mizoram	Minor River Draining into Myanmar (Burma) & Bangladesh, Barak & Others	Safe

Storage Capacities

At present, the storage capacity in basins with large water potential such as the Ganga, Brahmaputra, Indus, Godavari, Mahanadi, etc. is quite low. As of 2015, the storage capacity

created is only 253.4 BCM under major and medium irrigation projects and an additional capacity of 51 BCM is likely to be created by the ongoing projects. Hence, 304.4 BCM will be available storage once the projects are completed which is not even 45% of the total available surface water resources potential in the country. The storage capacities in major basins vis-à-vis their respective water resources potential based on the previous estimate of 1,869 BCM of Average Annual Availability are shown herewith[6]:

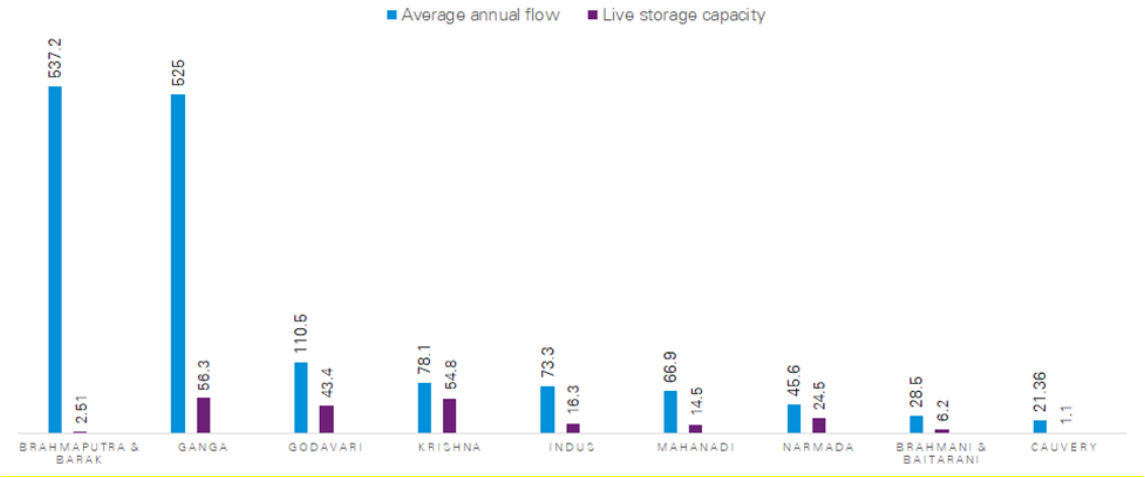


Figure 8: Storage capacities across major river basins in India (in BCM)

A comparison of water storage capacity of India against other countries is provided in the section below on "Benchmarking of Broad Sectoral Outcomes". However, it may be mentioned here that the storage capacity mentioned includes all major and medium irrigation projects while that from minor structures is not reflected in the above analysis.

1.1.1.3 Groundwater Resources

Groundwater is one resource which is replenishable and dynamic in nature. It is of utmost importance to periodically assess and monitor groundwater levels to understand availability and quality of water resources over time and across aquifers. The natural phenomena which impacts groundwater apart from rainfall include evapotranspiration, runoff, anthropogenic influences like withdrawal from the aquifer, recharge due to irrigation systems and other practices like water conservation.

Groundwater Levels in India

Central Groundwater Board (CGWB) monitors groundwater levels four times a year - in April/May, August, November and January through a network of 23,125 observation wells[13] across the country. In 2017, observations were carried out which depict the following with respect to the groundwater levels.

Table 6: Observations on groundwater levels throughout the year 2017

Depth (m) below GL	Pre-monsoon	August 2017	Post Monsoon	January 2018
0-2	Only 4%. A few states, such as Assam, Goa and Himachal Pradesh	27% falls under this range including small pockets of states of Assam, Chhattisgarh, Maharashtra, Bihar, Odisha, West Bengal and Uttar Pradesh, mostly in isolated areas	21% depicts this range including certain pockets in states of Assam, Odisha, Andhra Pradesh, Maharashtra, and Uttar Pradesh and isolated pockets in Jharkhand and Madhya Pradesh	10% falls under this range including pockets of states Assam, Odisha, Andhra Pradesh and Gujarat
2-5	24% depicts this range, mainly in the central and parts of eastern Indian states	32% falls under range, mainly in the states of Uttar Pradesh, Bihar, Odisha, Chhattisgarh and Assam	38% depicts this range, mainly in the states of Uttar Pradesh (eastern part), Bihar, Odisha, Chhattisgarh, Assam, Jharkhand, West	36% has shown this range, mainly in the areas of Sub-Himalayan area, north of river Ganges, northern and eastern parts of Uttar Pradesh, almost whole of

[13] As on March 31, 2017.

Depth (m) below GL	Pre-monsoon	August 2017	Post Monsoon	January 2018
			Bengal, Andhra Pradesh, Telangana, Karnataka and Maharashtra	Bihar, Andhra Pradesh, Odisha, Assam, coastal parts of Maharashtra
5-10	43% depicts this range, mainly in parts of peninsular India	24% falls under this range, mainly in the states of Andhra Pradesh, Maharashtra, Karnataka, Telangana, Tamil Nadu, Kerala, north western part of Uttar Pradesh and West Bengal	26% depicts this range, mainly parts of central and peninsular India	35% has shown this range, mainly parts of central India, peninsular India
10-20	23% falls under this range, including few parts of north-western and western states	11% depicts this range, including central part of West Bengal	11% has shown this range, including central part of West Bengal and central India	14% falls under this range, including peninsular part of country
20-40	5% has shown this range, including major parts of north-western and western states	3% depicts this range, including major parts of central and western India	3% has shown this range, including major parts of north-western states	4% falls under this range, including major parts of north-western states

Depth (m) below GL	Pre-monsoon	August 2017	Post Monsoon	January 2018
>40	2% falls under this range, including parts Delhi, Chandigarh and Rajasthan	1% depicts this range, including in some parts of Delhi and Rajasthan	1% has shown this range, including in Haryana, and Delhi and almost major parts of Rajasthan	1% depicts this range, including in some parts of Haryana, and Delhi and almost major parts of Rajasthan

It is quite evident that the sporadic rainfall patterns impact the groundwater level across various parts of the country. We observe that even in a few states where average rainfall is much below country average, certain areas witness shallow water level during monsoon on account of sporadic heavy rainfall. However, rainfall during monsoon acts as the main source of replenishment of groundwater, with substantial parts (more than 55%) of the country reporting groundwater depth of 0-10 mduring monsoon . However, states like Haryana, Rajasthan, Delhi show consistently higher depths of groundwater levels during entire year showcasing the obvious water scarcity in these states.

Variance in Groundwater level over years

Over the last couple of decades, there has been gradual depletion of groundwater levels in India primarily due to unregulated extraction of groundwater. The following figure depicts the consistent increase in depth of groundwater availability in India.

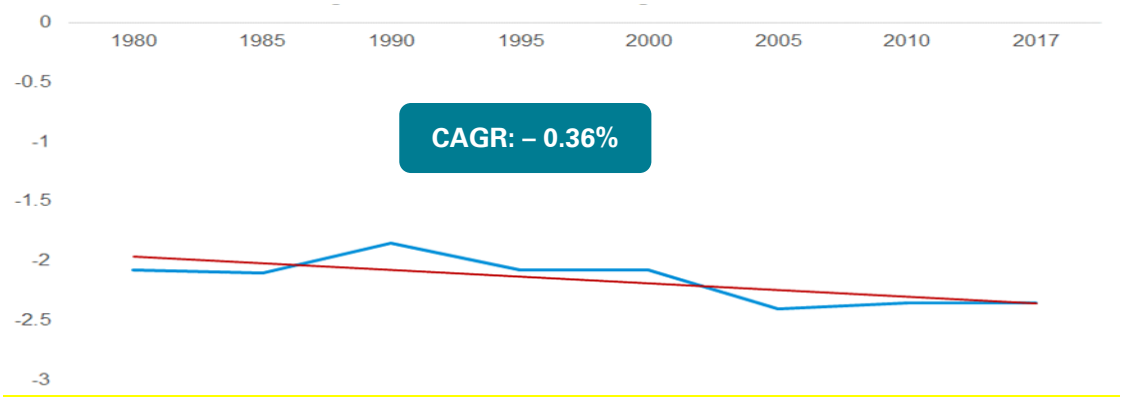


Figure 9: Average groundwater table levels in metres[14]

Since groundwater is a decentralized water source, the challenge lies in sustainable and equitable use of this common pool resource. Groundwater is highly exploited for irrigation wherein high levels of extraction happens due to availability of heavily subsidized power (used to operate bore wells) and implicit preference for cultivation of water intensive crops such as paddy and wheat (because ofGovernment procurement for PDS). The same has been dealt in further detail in the section on agriculture sector water demand. The over-extraction of groundwater in some coastal areas has led to saline water intrusion, thereby, resulting in quality deterioration of freshwater aquifers. In case of private landowners, any amount of water can be extracted from groundwater sources and the individual rights to groundwater are indirectly granted through property rights. These factors have resulted in the reducing numbers of safe groundwater units over the years.

Table 7: Percentage of safe groundwater units decreasing over the years[15]

Categorization of blocks/ mandals/ talukas	2004	2009	2011	2013	2017
Safe	4,078 **(72%)**	4,277 **(74%)**	4,503 **(69%)**	4,519 **(70%)**	4,310 **(63%)**
Semi-critical	550	523	697	681	972
Critical	226	169	217	253	313
Over-exploited	839	802	1,071	1,034	1,186

Characterization of Groundwater Development

[14] Central Groundwater Board data

[15] National Compilation on Dynamic Groundwater Resources of India, Central Groundwater Board, 2017

In addition to the variance in groundwater levels over years, it is also important to assess the current and future groundwater stress in the country. An indicator of the stress on groundwater is the stage of groundwater development, which is denoted by the percentage of utilization with respect to recharge and can be computed as follows:

Stage of development (%) = (existing gross draft for all uses ÷ net annual groundwater availability) x 100%

As per the Central Groundwater Board, the overall stage of groundwater development in the country is 62%. States of Delhi, Haryana, Punjab and Rajasthan report more than 100%, which implies that in these states the annual groundwater consumption is more than annual groundwater recharge. In states like Madhya Pradesh, Maharashtra, Gujarat and Himachal Pradesh the stage of groundwater development has increased and is gradually moving to a high utilization range of 50 -100%. Based on the stage of groundwater development and percentage of safe blocks/mandals/talukas available in each state, the states are categorized as follows:

Table 8: Categorization of groundwater development

Categorization	Stage of groundwater development	Colour
Safe	<=70%	
Semi-Critical	>70% & <= 90%	
Critical	>90% & <= 100%	
Over exploited	>100%	

The following table depicts the state-wise situation with respect to the stage of groundwater extraction along with the assessment of the over-exploited & critical blocks[7].

Table 9: State-wise stage of groundwater development

State	Category	Stage of GW extraction (%)	% of over-exploited & critical blocks
Punjab	Over-exploited	166%	80%
Rajasthan		140%	74%
Haryana		137%	63%
Delhi		120%	71%
Not Applicable	Critical	[90-100%]	NA
Himachal Pradesh	Semi-critical	86%	50%
Tamil Nadu		81%	46%

State	Category	Stage of GW extraction (%)	% of over-exploited & critical blocks
Puducherry		74%	25%
Uttar Pradesh		70%	17%
Karnataka		70%	30%
Telangana	Safe	66%	23%
Gujarat		64%	12%
Uttarakhand		57%	0%
Madhya Pradesh		55%	9%
Maharashtra		55%	6%
Kerala		51%	2%
Bihar		46%	6%
West Bengal		45%	NA
Chhattisgarh		44%	1%
Andhra Pradesh		44%	0%
Odisha		42%	0%
Goa		34%	0%
Jammu & Kashmir		29%	NA
Jharkhand		28%	2%
Assam		11%	0%
Tripura		8%	0%
Mizoram		4%	NA
Meghalaya		2%	0%
Manipur		1%	NA
Nagaland		1%	0%
Arunachal Pradesh		<1%	0%
Sikkim		<1%	0%

Of the 6,584 assessment units (viz. blocks/firkas/valleys/taluks/mandals/districts), as much as 32% are classified as over-exploited, critical or semi critical. The number of over-exploited and critical administrative units is significantly higher in Delhi, Haryana, Himachal Pradesh, Karnataka, Punjab, Rajasthan, Tamil Nadu and Uttar Pradesh.

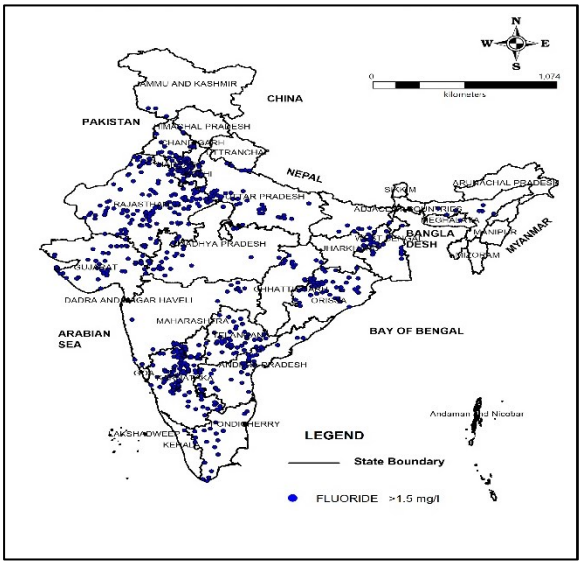
Quality of Groundwater

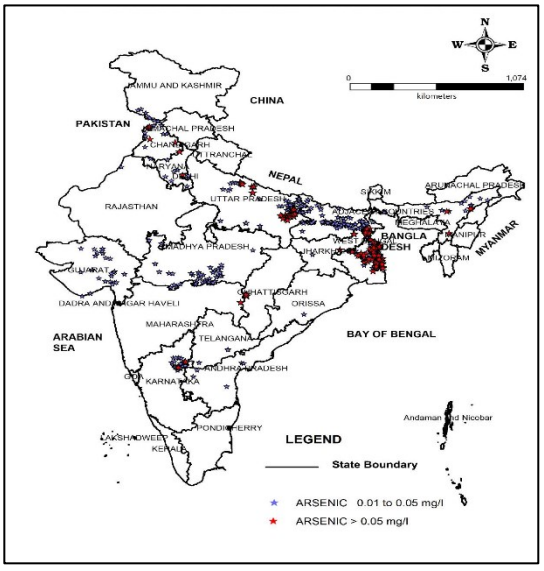
The natural chemical content of groundwater is dependent on the depth of the soil and sub-surface geological formations with which groundwater remains in contact. In addition to the increase in exploitation of groundwater over the years, there have also been occurrences of quality related issues for groundwater. "Geogenic pollution" of groundwater, which refers to naturally occurring elevated concentration of certain elements in groundwater having negative

health effects, is more prevalent in India. In India, geogenic contamination by fluoride and arsenic affecting several parts of the country is a major concern and remains a challenge for safe water supply in the contaminated areas. High concentrations of parameters like salinity, iron, manganese, uranium, radon and chromium, in groundwater, may also be of geogenic origin.

High concentration of fluoride in groundwater beyond the permissible limit of 1.5 mg/l poses health problems. In many districts of India, this permissible limit has been breached. Arsenic as a contaminant is significant in terms of its toxic nature and dangerous effects on the human body. As per BIS 2012 (IS 10500:2012), the acceptable limit of arsenic is 0.01 mg/l and the permissible limit in absence of alternate source is 0.05 mg/l. Large parts of the Ganga-Brahmaputra plains have breached the permissible limits of arsenic. Other types of groundwater pollutants include iron and nitrates. High concentration of iron (>1.0 mg/l) in groundwater has been observed in more than 1.1 lakh habitations in the country. Iron contamination has been reported from the states of Andhra Pradesh, Assam, Bihar, Chhattisgarh, Goa, Gujarat, Haryana, J&K, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal and the UT of Andaman & Nicobar. High nitrate concentration in groundwater in India has been found in almost all hydrogeological formations and is indicative of high use of chemicals in agriculture[16].

The following figures show the arsenic and fluoride hotspots in India.[16]





[16] http://cgwb.gov.in/wqoverview.html

1.1.1.4 Desalination

Desalination is a major technology, which can potentially augment availability of water resources. Desalination is a process that removes salts and other impurities from water. While desalination technology (thermal) has been known to man for long, it has steadily gained in popularity and application as an alternative source of water for human consumption over the last three decades or so. This is because with ever increasing population and economic activity our demand for fresh water has increased while the growth in fresh water sources have not matched that growth.

Desalination has the potential to permanently bridge the ever-rising demand-supply gap of fresh water. Around 97% of the total water available on Earth is in the oceans and is saline; and, provides for a virtually unlimited stock of raw material for desalination. In addition to saline water from sea, brackish water found in river estuaries where sea and river waters meet, is also used for desalination. Desalinated water is consumed for industrial, domestic and agricultural purposes. Currently, the installed capacity of desalination plants across the world is around 86,572 MLD of which 44% is in the Middle East and North Africa. Currently, desalinated water is used by 1% of the global population on a daily basis. By 2025, around 14% of the world population is expected to start using desalinated water[17]. Desalination can be a suitable technology for coastal regions and port cities to meet their industrial and domestic water demand.

Figure 10: Arsenic and Fluorides hotspots in India

India too ranks reasonably high in the use of desalination, particularly for industrial use. At present, India has around 182 desalination plants located in different states. Gujarat has the maximum desalinated water generation capacity in the country with plants located at Kutch, Jamnagar and Metapur. Tamil Nadu is the country's second highest desalinated water producer with plants at Minjur and Nemmeli, each with a capacity of 100 MLD[18]. In fact, an additional

[17] Article titled "Desalination industry enjoys growth spurt as scarcity starts to bit" published by Global Water Intel https://www.globalwaterintel.com/desalination-industry-enjoys-growth-spurt-scarcity-starts-bite/

[18] Report titled "Desalination- Easing India's Water woes" published by EPC World.

capacity of 400 MLD is planned to be installed at the Nemmeli plant. In addition, a greenfield desalination plant with a capacity of 400 MLD is also being planned at Porur (Chennai).

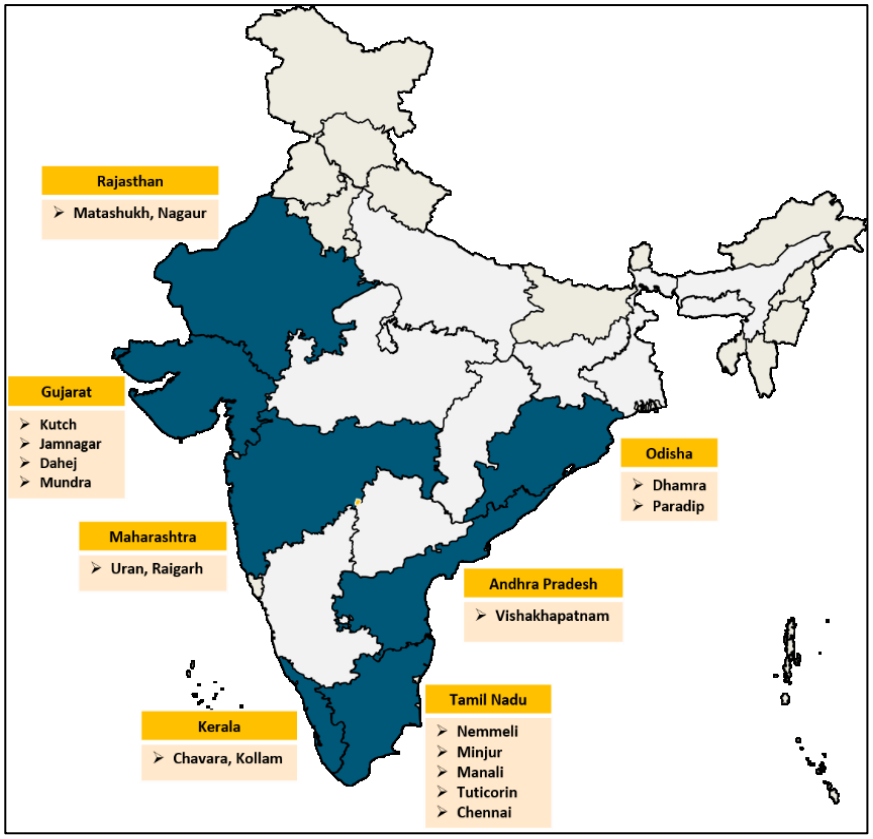


Figure 11: Desalinated Water Generation States in India

The challenge in the water desalination industry is the large gap between affordability and willingness to pay for water vis-à-vis the cost of desalination. Traditionally, in India, citizens pay very less or often nothing for water supply. Currently, the acceptable water tariff in India is estimated to be around Rs. 20-25 per kilolitre. In contrast, desalinated water costs four times this tariff at around Rs. 70-80 per kilolitre. However, this tariff includes annualised capex and O&M expenses. In fact, if capex is taken care of by programs like AMRUT, then a tariff for O&M cost recovery should be around Rs. 35-40, which is not too far from the average tariff prevailing in the country. The technological challenge at hand is to bring down the cost of desalinated water further down to the acceptable levels. With the emergence of newer energy efficient technologies and innovative solutions, desalination can be expected to become an economical alternative for meeting our water supply needs.

1.1.2 Utilization of Water Resources- Demand Side

The previous sub-section described the supply side of the water resources sector in terms of availability of water resources in India. However, to get an overall sector perspective, we will now discuss the demand side of the value chain which deals with the utilization of water resources in India.

1.1.2.1 Overview of Water Resources utilization

The key uses of water resources may be broadly clubbed under four major heads - irrigation, domestic, industrial and others (includes environmental requirements and evaporation losses). Among these, irrigation is by far the largest consumer of water resources. The latest available data related to estimated total water demand or withdrawal or utilisation is available for the year 2010. The figures from two key sources are presented below.

Table 10: Water resource utilisation in 2010 (in BCM)

Water demand by uses in 2010	Standing Sub-Committee of MoWR, RD & GR[20] Estimates	National Commission for Integrated Water Resources Development (NCIWRD) Estimates[19]
Irrigation	688	557
Domestic	56	43
Industrial	17	56
Others	52	54
Total	**813**	**710**

As evident from the table above a difference of 100 BCM exists between the two estimates. The sectoral split of water consumption as per NCIWRD estimates and its change from 2010 to 2050 is further shown in the figures below.[19]

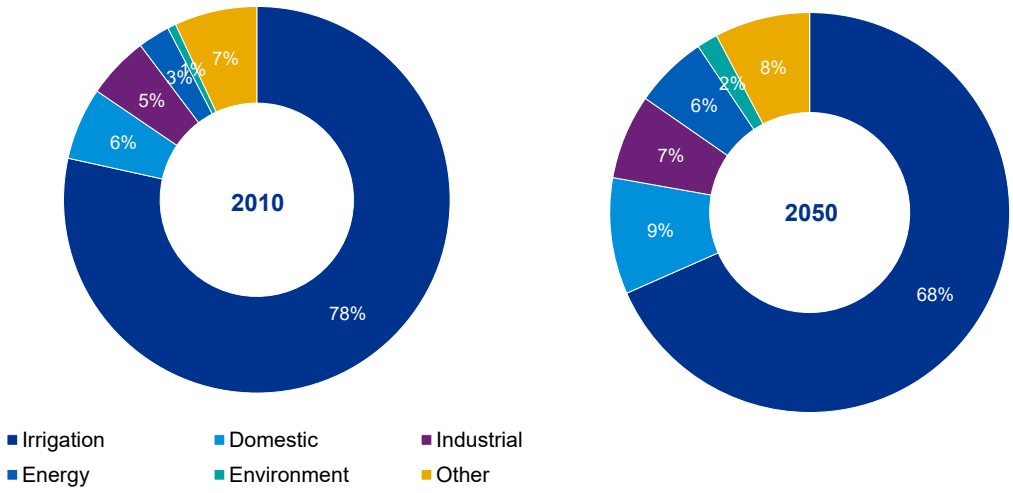


Figure 12: Changes in sectoral demand for water from 2010 to 2050

Further, water resources utilisation or future water demand estimation has been performed by multiple organisations. The National Commission for Integrated Water Resources Development (NCIWRD) has projected the demand for water for the various sectors, viz. Irrigation, Domestic, Industries, Power, Inland Navigation, Flood Control, Environment Afforestation, Environment Ecology and Evaporation Losses for the year 2025 and 2050. The demand for all the sectors were projected for both low and high demand scenarios. According to estimates, by the year 2050, the total demand of water is expected to be 973 BCM for low demand scenario and 1,180 BCM for high demand scenario. Moreover, the projected demand share is dominated by agriculture (68%) followed by domestic (9%) and industries (7%) by 2050. The detailed demand breakup is summarized in the table below[19].

Table 11: Future estimates of Water Requirement by uses (in BCM)

#	Use	Water Demand (BCM)			
		2025		2050	
		Low	High	Low	High
1.	Irrigation	561	611	628	807
2.	Domestic	55	62	90	111

[19] Report of the National Commission on Integrated Water Resources Development (NCIWRD) - 1999

#	Use	Water Demand (BCM)			
		2025		2050	
		Low	High	Low	High
3.	Industries	67	67	81	81
4.	Power	31	33	63	70
5.	Inland Navigation	10	10	15	15
6.	Flood Control	0	0	0	0
7.	Environment Afforestation	0	0	0	0
8.	Environment ecology	10	10	20	20
9.	Evaporation Losses	50	50	76	76
	Total	**784**	**843**	**973**	**1,180**

Water demand has also been estimated by multiple other authors or organisations over the period. These have been summarized below.

Table 12: Water Requirement or demand estimation by uses (in BCM)- Other sources

Projections as per Standing Sub-Committee of MoWR, RD & GR[20]		
Water demand by uses	**2025**	**2050**
Irrigation	910	1,072
Domestic	73	102
Industrial	23	63
Power	15	130
Others	72	80
Total	**1,093**	**1,447**
Business as usual scenario- Water Demand projections- Paper on "India's Water Supply and Demand from 2025-2050", International Water Management Institute[21]		

[20] Standing Sub-committee of MoWR, RD and GR Report- Basin Planning Directorate, CWC, XI Plan Document; Report of the Standing Sub-Committee on "Assessment of Availability & requirement of Water for Diverse uses-2000

[21] India's Water Supply and Demand from 2025-2050", International Water Management Institute

Projections as per Standing Sub-Committee of MoWR, RD & GR[20]		
Water demand by uses	**2025**	**2050**
Water demand by uses	**2025**	**2050**
Irrigation	675	637
Domestic	66	101
Industrial	92	161
Total	**833**	**899**
Business as usual scenario- Charting Our Water Future (McKinsey & WRG, 2009)[22]		
Water demand by uses	**2030**	
Irrigation	1,198	
Domestic	105	
Industrial	195	
Total	**1,498**	

As evident from the tables above, the major reason for the difference in total demand estimation is the varied projections of water consumption in the irrigation sector. Compared to the future demand estimates provided by the MoWR Standing Sub-Committee, the requirement estimated by NCIWRD is on a lower side since NCIWRD estimates were based on assumptions that the overall irrigation efficiency in the country will increase to 60% from the present level of 35 to 40%. Since the probability of increase in irrigation efficiency (in the future) is very high, the recommendations of NCIWRD has been accepted by the government.[20]

The total amount of water withdrawn per capita annually is a metric calculated by dividing the annual quantity of water withdrawn for agricultural, industrial and municipal purposes by the population. It includes water from primary renewable and secondary freshwater resources, as well as water from over-abstraction of renewable groundwater or withdrawal from fossil groundwater, direct use of agricultural drainage water, direct use of (treated) wastewater, and desalinated water. It does not include in-stream uses, which are characterized by a very low net consumption rate, such as recreation, navigation, hydropower, inland capture fisheries, etc[23]. The

[22] Charting Our Water Future (McKinsey & WRG, 2009)

[23] AQUASTAT database of the Food and Agricultural Organization of the United Nations

estimated values of total water withdrawal per capita in India for year 2025 and 2050 are shown in the figure below[24].

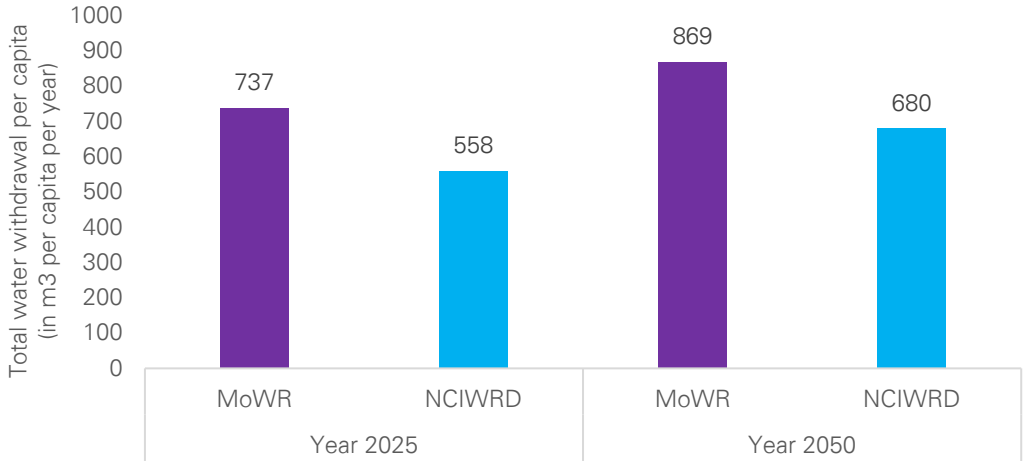


Figure 13: Projections of annual amount of water withdrawn per capita

As evident from the figure above, the projections show that the amount of water withdrawn per capita should be increasing with time in India. The figures for water withdrawn per capita as of 2011 stood at 629 m^3 per inhabitant per year based on MoWR estimates and 542 m^3 per inhabitant per year based on NCIWRD estimates.

1.1.2.2 Agriculture sector

Agriculture sector is the largest water consumer in India. Agricultural growth is necessary to support the food security of the growing population in India. Agriculture accounted for 23% of India's GDP and the sector employed 59% of the country's total workforce in 2016[26]. As per latest data available, agriculture (forestry and fishing) sector had 16% share in Gross Value Added at current prices during FY 2018-19[25]. Traditionally, India had been an agriculture dependent economy. However, as the Indian economy has diversified and grown since independence, agriculture's contribution to GDP has steadily declined steadily during the period of 1951 to 2011. Agriculture in India has achieved self-sufficiency in grain production. However, the production is,

[24] The population projection has been done basis data available in Economic Survey 2018-19

[25] Agriculture Statistics at a glance, 2018, Ministry of Agriculture and Family Welfare, GoI

resource intensive, cereal centric and regionally biased. To make future agriculture growth sustainable, efficient use of water resources will be necessary.[26]

Irrigation, which is defined as the application of water to soil for supplying the moisture essential for plant growth, has a major impact on agriculture production and the wider economy. Irrigation plays a vital role in bringing more area under cultivation, increasing crop yields and stabilizing production. Depending on multiple factors like soil type, land topography, water availability, nearby sources of water, size of the area being irrigated, etc., various types of irrigation technologies/systems are implemented. Irrigation in India broadly includes well water irrigation system, reservoir water irrigation system, canal irrigation system and water from multipurpose river valley projects. These systems encompass a network of canals (major and minor), groundwater, wells, tanks, pool, basin, lake, dams, rainwater harvesting projects, etc. Further, irrigation involves diverse methodologies like flood irrigation, piped irrigation, manual irrigation, surface irrigation, drip and sprinkler irrigation among others.[27]

The overall irrigated area and land use statistics of India is summarised in the table below.

Table 13: Land use statistics (2014-15)

Land use	Area[25] (in Million hectares)
Geographical Area	328.73
Agricultural Land/ Cultivable land/ Culturable land/ Arable land	181.87
Cultivated Land	155.22
Net Area Sown	140.13
Total cropped Area	198.36

[26] India at a glance- FAO, United Nations

[27] FAO, United Nations; Review of Accelerated Benefits Programme, 2016-17

Land use	Area[25] (in Million hectares)
Area sown more than once	58.23
Net Irrigated Area	68.38
Gross Irrigated Area	**96.46**
Area Irrigated more than once	28.07

As evident from the table above, actual cultivated land comprised 85% of the total agricultural land/cultivable land/culturable land/arable land. Moreover, the net area sown, and the net irrigated area was 90% and 44% of the cultivated land respectively. Approximately, 49% of the agriculture land was sown from various irrigation sources whereas the remaining 51% was rainfed.

Irrigation sector water demand

Irrigation water demand from over approximately 100 million hectares (Gross Irrigated Area) makes it the major consumer of water resources in India. As described in the overview section above, water consumption for irrigation may reduce from 78% of the total water use to 68% of the total water consumption by 2050. As per the Mihir Shah Committee report (2016), historically, for the first two decades after independence, water required for Irrigation across the country was mainly supplied through large and medium irrigation dams constructed on our major river systems. However, over the last four decades it is groundwater that has been the main source of water. [28] The figure below summarises sources of water for irrigation in India and shows how groundwater (irrigation largely carried out through wells including dug wells, shallow tube wells and deep tube wells) has become the main source of irrigation at present. As shown in the figure below, groundwater today provides more than 63% of water for irrigation[29].

[28] Mihir Shah Committee Report, 2016

[29] Irrigation- Statistical Year Book India 2018

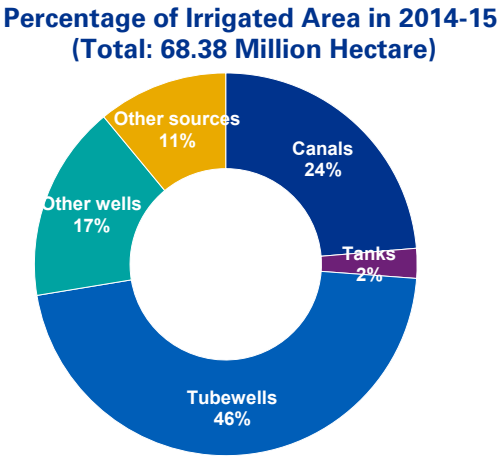


Figure 14: Area under irrigation by source

Irrigation sector water supply

Irrigation projects in India are classified based on culturable command area (CCA) of the project. A project having CCA of more than 10,000 hectares is termed as major irrigation project while a project having CCA between 2,000 and 10,000 hectares is called a medium irrigation project. A project/scheme having CCA up to 2,000 hectares is termed as minor irrigation scheme. The minor irrigation projects (schemes) are further divided into two categories viz. surface water schemes and groundwater schemes. Major and medium irrigation projects are generally surface water projects. The overall irrigation development status as on March 2012 is summarised in the figure below[30]. It depicts the Ultimate Irrigation Potential (UIP), Irrigation Potential Created (IPC) and Irrigation Potential Utilized (IPU). As evident from the figure below, the IPC in India comprises 56% from surface water sources and the remaining 44% from groundwater sources. Moreover, groundwater contributes more than 76% of the total irrigation potential created through minor irrigation projects. The created irrigation potential has also not been fully utilized and there exists a gap of around 23 million hectares (21%) between the IPC and IPU. The IPC-IPU gap has existed since 1974-75 as per the Mihir Shah Committee Report and measures are necessary to bring down this gap.

[30] UIP data based on Planning Commission (2009) Report of the Task Force on Irrigation; IPC and IPU data till the end of XI Plan (up to March 2012)

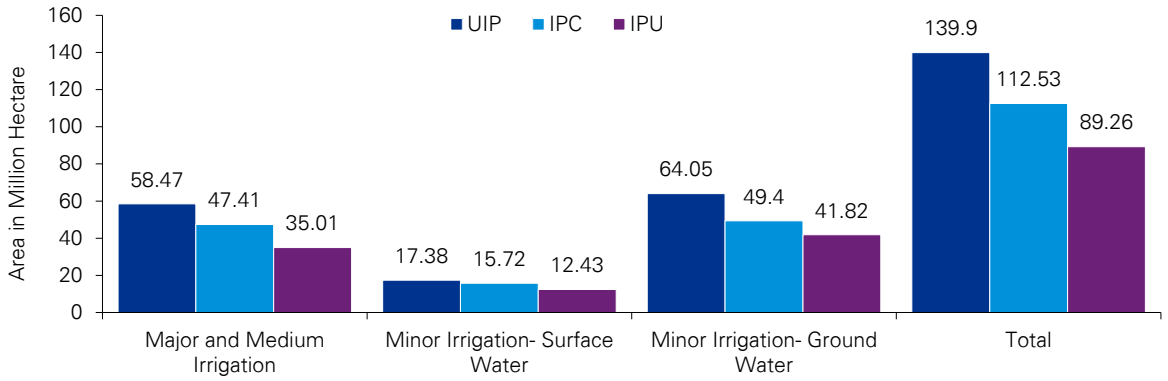


Figure 15: Irrigation water supply status

Comparison of Water Conveyance Efficiency

As discussed in the above section, Irrigation Potential Created in India comprises 56% from surface water sources and the remaining 44% is from groundwater sources. However, groundwater today actually provides more than 63% of water for irrigation. This signifies high dependence on groundwater for irrigation.

Conventional irrigation network incurs high losses as water travels from the point of extraction (in case of groundwater) or source of surface water supply to the point of water consumption at the farm. The network comprises multiple facilities/systems comprising reservoirs, diversion structures, canals, pump houses, piped supply systems, etc. in the irrigation water supply system- each with its own conveyance or storage efficiency. The typical efficiencies for various facilities or under different methods of application in the irrigation sector are summarised in the table below[31].

Table 14: Efficiency of various Irrigation system

Water usage method or system	Efficiency (%)
Water Conveyance System	
Conveyance through unlined canal for surface water	55-60

[31] Guidelines for improving water use efficiency in Irrigation, Domestic and Industrial sectors, Central Water Commission

Water usage method or system	Efficiency (%)
Conveyance through lined canal for surface water	70-75
Piped Distribution network[32]	90
Water application System	
Flood Irrigation	65
Furrow Irrigation	80
Sprinkler Irrigation	85
Drip Irrigation	90
Overall	
Surface Water System	30-65
Groundwater System	65-75

As evident from the table above, irrigation using groundwater system is more efficient compared to irrigation using surface water system. However, in addition to the above, the existing irrigation systems in India do not operate at the designed levels of efficiency mainly due to inefficient operation, poor/deferred maintenance and other factors. Overcoming these issues will result in significant water savings in the sector. As per a CWC report, approximately 146 BCM[31] savings is possible in the irrigation sector itself.

1.1.2.3 Industrial sector

The Industrial sector in India is the second largest consumer of water resources in the country. Further, energy sub-sector within the industrial sector is the largest industrial consumer of water. Industrial water demand has been increasing with the pace of industrial development. In addition to the energy sector, the growth in some of the other water intensive industries like iron & steel, paper, textile, etc. has been quite significant, putting further pressure on the available water resource. As per latest data available, industry (includes mining and quarrying, manufacturing, electricity and other utility services and construction) sector had 29.80% share in Gross Value Added at Current Prices during FY 2018-19[33]. As described in the overview section above, water consumption in the industrial sector may increase from 8% to 13% of the total water

[32] Guidelines for planning and design of Piped Irrigation Network, MoWR- July 2017

[33] Central Statistics Office (As per Press Release dated 28.02.2019)

consumption by 2050. Growing population as well as rising standard of living may further increase the demand for industrial products, leading to an increase in future industrial water requirement. At present, industrial sector in India consumes about 2 to 3.5 times more water per unit of production compared to similar plants operating in developed countries[34].

Shortage of water, in the form of insufficient or erratic water supply is already impacting, and will continue to impact, the industrial sector. This not only impacts the production processes of the industry but also its efficiency. The Small-to-Medium Enterprise (SME) and Micro, Small and Medium Enterprise (MSME) segment will be one of the worst affected due to the shortage and increased cost of water. The most severely affected industries are likely to include water-intensive sectors such as food & beverages, textiles, and paper and paper products. Amongst these, the textiles industry alone contributes 4% towards India's GDP, 14% to national industrial production, and accounts for 17% of the country's foreign exchange earnings[35].

Industrial sector water demand

Water requirements of major water intensive industries (other than power) in India is summarised in the table below[36].

Table 15: Water requirement of various industries (in Million m^3)

Category	2010	2025	2050
Iron & Steel	5,838	6,013	12,035
Smelters	24	32	44
Textiles & Jute	19,019	36,701	46,924
Leather Products	66	93	148
Inorganic Chemicals	1,600	3,346	615
Pharmaceuticals	209	276	429

[34] Socio-economic impact of commercial exploitation of water by industries, Standing Committee Report, MoWR, 2018

[35] Composite Water Management Index, 2019, Niti Aayog

[36] National Water Mission under National Action Plan for Climate Change- Volume II, 2008

Category	2010	2025	2050
Distillery	66	318	5,204
Paper & Pulp	207	10,240	19,490

Three major water intensive industrial sectors – power, iron & steel, and textile have been discussed in this section. Power sector is the most water intensive industrial sector in India and is often estimated and mentioned separately during water demand estimation exercises. As per NCIWRD estimates cited in the overview section, as on 2010, power sector water demand is 34% of the total water demand for industrial sector. This will further go up to 46% (70 BCM) by 2050. Thermal power generation dominates energy production in India and is the major water consuming sub-sector. As on March 2019, all India installed capacity of thermal power plants was 226 GW which comprises 64% of the total installed capacity of power stations in India.[37] Approximately, 86% of India's electricity is generated from thermal power plants that rely significantly on water for cooling. Another 11% of electricity is generated from hydroelectric plants, which depend on water completely.[38] Due to unavailability of water, the operations of thermal power plants have been severely affected and the power plants may be forced to shut down or cut down generation in future. While generation from India's thermal utilities grew by 40% from 2011 to 2016, freshwater consumption in the thermal utilities sector increased by 43%, from 1.5 BCM in 2011 to 2.1 BCM in 2016. However, water consumption in the thermal power generation sector is estimated to stay below its 2016 level by 2027 if India's renewable energy goals are successfully achieved and the notified stringent water regulations are implemented. [39]

In addition to power sector, the iron & steel sector is another large consumer of India's water resources. Government has been monitoring the water consumption in the sector and has been focused on reducing the discharge water and implementation of innovative solutions to recycle

[37] Central Electricity Authority report as on 31st March 2019

[38] Central Electricity Authority report, March 2019

[39] Luo, Tianyi, Deepak Krishnan, and Shreyan Sen. 2018. "Parched Power: Water Demands, Risks, and Opportunities for India's Power Sector." Working Paper. Washington, DC: World Resources Institute. (http://www.wri.org/publication/parched-power)

and reuse water in the industry. The steel industry has also been planning to pursue strategies to reduce specific water consumption per tonne of steel produced. According to the National Steel Policy 2017, by 2030-31, the steel industry is annually estimated to require approximately 1.5 BCM of water[40].

Textile industry in India is another highly water intensive industry. Water is a key input for the industry as textile production involves large amount of water consumed in the supply chain as well as during direct operations. Moreover, the textile industry is largely dependent on the availability of raw material, such as cotton, which itself is a highly water-intensive crop. Study by the Centre for Science and Environment (CSE) had revealed that the water consumption by the Indian textile industry alone was about 200-250 m^3 of water per tonne cotton cloth in comparison to the global best of less than 100 m^3 per tonne cotton cloth. In addition, it is known that the textile industry is mainly concentrated in a water-scarce region of India. Therefore, the long-term viability and sustainability of the Indian textile industry hinges heavily on sustainable water management practices[41].

Industrial sector water supply

Industrial demand for water is served by both groundwater (open wells, bore/ tube wells, etc.) and surface water (Rivers, streams, lakes, reservoirs, ponds, etc.). Choice of source of water for any industry often depends on the availability of adequate and regular supply of water as well as the cost of water, as per requirement of the specific industry. Groundwater has emerged as an important/preferred source to meet the water requirements of the industrial sector due to its availability and private ownership.[34]

The analysis of water supplied to the Industrial sector in India by source of water is presented in the figure below. As evident, surface water is the main source of water for the industries (41%) followed by groundwater (35%). Usage of municipal water (24%) is mainly limited to industries located in urban and peri-urban areas. In addition to the above, majority of industries use surface water in conjunction with groundwater to cater to its needs. Groundwater often augments the

[40] National Steel Policy, 2017

[41] Water governance mapping report: Textile industry water use in India, Stockholm International Water Institute, 2016

surface water requirement of an industry in instances when surface water availability is on a decline or is impacted by water pollution, which in turn may have an impact on the downstream industrial process.[42]

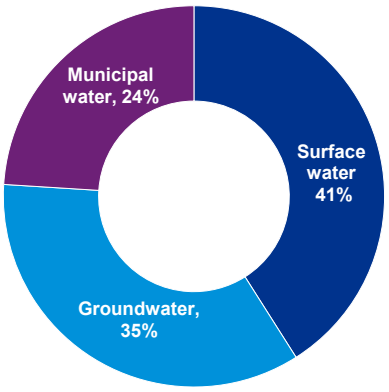


Figure 16: Source of water supplied to industrial sector

1.1.2.4 Domestic sector

The Domestic sector is the third largest (excluding environmental consumption) consumer of water resources in the country. As per estimates of NCIWRD, the percentage growth in water resources utilisation in the domestic sector is estimated to be the highest when compared to that in irrigation and industrial sector. From 2010 to 2050, the domestic sector demand is estimated to increase by 158%. Despite lower absolute demand of the sector (43 BCM as per NCIWRD), this is the most important water consuming sector.

Domestic water demand mainly comprises requirement of water for drinking as well as for other routine activities like, cooking, bathing, washing, flushing of toilet, gardening, etc. Moreover, domestic water demand includes water required for both – human beings and livestock. Domestic water demand is regulated primarily by the total number of people (or livestock) in an area and their daily water requirement. Moreover, water consumption in rural and urban areas is

[42] Water use in Indian Industry Survey, FICCI, 2011

different due to the inherent lifestyle of the population. The National Water Policy (2012), allocates highest priority to ensuring safe water availability for drinking, followed by water allocated for other domestic uses (including needs of animals)[43].

Domestic sector water demand

As discussed above, drinking water is the primary component within domestic sector demand and is of utmost priority to the government. Consumption in domestic water currently is and is expected to be unequally distributed between the urban and rural population of India. While the urban population's consumption is at 195 litres per person per day (global average of 135 litres), the rural population of India consumes as low as 50 litres per person per day[44]. However, reports also suggest that actual quantity of water reaching the consumers is much lower due to high NRW losses in urban water supply networks across the country. The actual water available for the users is less than 100 lpcd in the various urban centres.[45]

As on 2014, no major city in India supplied 24x7 water to its entire urban population and only 35% of urban households in India had piped water in their dwelling as the primary source to support drinking water needs. The remaining rely on piped water to plot/yard, tube wells, and public taps, among other sources[35]. Increasing urbanisation coupled with rise in the consumption pattern among the urban population, would mean a new challenge for water resources[46].

About 77%[47] of rural households in India do not have individual piped water supply connections; however physical rural water coverage is estimated to be 79%[48]. Enormous progress has been achieved in the rural drinking water sector due to increase in budget with 39 million people gaining fully covered status each year. The Jal Jeevan Mission, announced in 2019, targets a Functional Household Tap Connection (FHTC) for every rural household in the country by 2024, supplying water at 55 lpcd on a regular basis and of prescribed quality (BIS: 10500 standard).

[43] National Water Policy 2012, MoWR

[44] Water for the Future- Challenges for India and its industries, 2012, Frost & Sullivan

[45] Centre for Science and Environment (2017), Water Efficiency and Conservation in Urban India, Reference link: Link

[46] UNICEF, FAO and SaciWATERs. 2013. Water in India: Situation and Prospects

[47] Format C36 - No. of Individual households with PWS Connections, IMIS Reports, e-JalShakti website, as accessed on 07th July, 2020

[48] Format 1 - Target & Achievement of Habitation, IMIS Reports, e-JalShakti website, as accessed on 07th July, 2020

Domestic sector water supply

The main sources of water for the Domestic sector are groundwater (open wells, bore wells, tube wells, etc.) and surface water (rivers, streams, lakes, reservoirs, ponds, etc.). Although groundwater for domestic use comprised 9% of the total extracted groundwater in India, 50% of urban domestic water requirements and 85% of rural domestic water requirements are fulfilled by groundwater.[49]

1.1.2.5 Wastewater

Wastewater is defined as "used water from any combination of domestic, industrial, commercial or agricultural activities, surface runoff/stormwater, and any sewer inflow/infiltration".[50] Domestic wastewater may be tapped and treated for reuse. Approximately 80% of the water supplied for domestic use, comes out as wastewater. In majority of cases, wastewater is discharged untreated and it either sinks into the ground as a potential pollutant of groundwater or is discharged into the natural drainage system causing pollution in downstream areas. Sewage Treatment Plants should be used to treat sewage generated from residential, institutional, commercial and industrial establishments.[51]

Wastewater generation

During 2015, the estimated sewage generation in the country was 61,754 MLD (~23 BCM annually) as against the developed sewage treatment capacity of 22,963 MLD (~8 BCM annually). Low installed sewage treatment capacity has led to approximately 38,791 MLD of untreated sewage (62% of the total sewage) being discharged directly into the environment[52]. Out of the total municipal wastewater generation, the sewage generation in metropolitan cities, Class I cities and Class II towns account for 62% of the total sewage generated in the country. The treatment capacity developed in the cities is only about 31% of the total wastewater generated from the cities.[51]

[49] Overview of Ground Water in India, February 2016, PRS

[50] Tilley, E., Ulrich, L., Lüthi, C., Reymond, Ph., Schertenleib, R. and Zurbrügg, C., 2014. Compendium of Sanitation Systems and Technologies. 2nd Revised Edition. Swiss Federal Institute of Aquatic Science and Technology (Eawag). Dübendorf, Switzerland

[51] Inventorization of Sewage Treatment Plants, March 2015, CPCB

[52] CPCB Bulletin, Volume-1, July 2016

Reports suggest approximately 60% of industrial wastewater generated (mostly from large industries) in India is treated[53].

Wastewater reuse for circular economy

As India's per capita water consumption grows rapidly, the quantum of the wastewater generated will also rise. Untreated wastewater is the prime contributor of surface and groundwater pollution in the country. The large volume of wastewater offers tremendous potential for urban local bodies (ULBs) to recycle water within the cities and minimize their dependency on bulk freshwater sources. While freshwater is required for human consumption, wastewater can be treated up to the desired quality required for its subsequent utilisation and can be safely reused for numerous purposes. Water recycling is generally interpreted as reutilising or reusing treated wastewater for beneficial purposes such as agricultural and landscaping irrigation, industrial processes, toilet flushing and several similar activities. Water recycling not only offers additional resource but also leads to financial savings. Wastewater treatment can also be tailored to meet the water quality requirements for a planned reuse. For instance, recycled water for landscape irrigation would require less treatment than recycled water used for cooling tower make-up. Currently, reuse of treated wastewater in the irrigation sector is mostly prevalent across the world with 32% of reuse application. However, the major challenge in using recycled water for agriculture is to shift from informal and unplanned use of partially or untreated wastewater to planned safe uses[54]. Additionally, as per orders from the Ministry of Power, from March 2020, all Thermal Power Plants have been mandated to use treated wastewater as per the provisions of the Tariff Policy 2016, provided there is an STP within 50 km radius of the power plant.

Numbers related to wastewater reuse in India are not available. However, many states in India have formulated wastewater treatment and reuse policy. The figure below summarises the wastewater reuse policy of various states in India. Once adopted on a massive scale, reuse of treated wastewater can certainly minimize our dependency on bulk freshwater resources.

[53] R Kaur, SP Wani, AK Singh and K Lal, Wastewater production, treatment and use in India.

[54] WWAP (United Nations World Water Assessment Programme). 2017. *The United Nations World Water Development Report 2017. Wastewater: The Untapped Resource. Paris*, UNESCO

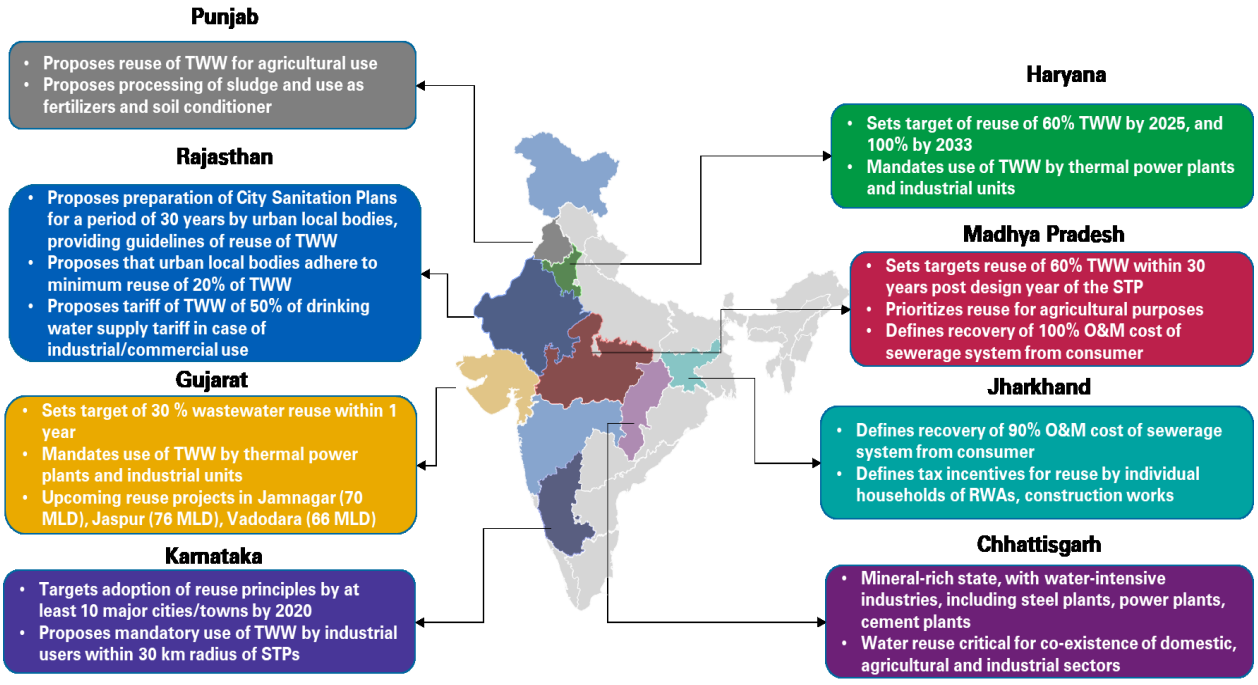


Figure 17: Summary of wastewater treatment and reuse policy across states in India

1.2 Performance of the sector

1.2.1 Analysis based on key enquiry areas

The study of the sector background in the preceding section has enabled in identification of multiple key enquiry areas related to the sector. In this section, we intend to undertake a deeper analysis of the performance of the sector with respect to enquiry areas identified through secondary literature and data collected through primary research (viz. key informant interviews with various stakeholders associated with the sector, focus group discussions and household surveys). The table below presents a summary of the evaluation objectives, specific areas of enquiry and findings from secondary literature as well as primary research.

Table 16: Performance of the sector with respect to key enquiry areas

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
Adequacy		Secondary:

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
	Overall water storage capacity as well as water storage capacity per capita in dams	• Storage capacity is low in large basins (Ganga, Brahmaputra, Indus, Godavari, Mahanadi) • Storage of 253 BCM under major and medium irrigation projects created with additional 51 BCM under works (2015) • Storage of less than 45% of total available surface water potential of 690 BCM Source- EnviStat India 2018, MOSPI
		Primary: <u>Increasing water storage in existing storage structures</u> • Siltation of reservoirs is a cause of reduction in water storage capacity. A national level stakeholder clarified that de-siltation of reservoirs is not taken up at the central level since this comes under the purview of states • The GoI is however looking at improving dam management through a World Bank supported program called Dam Rehabilitation and Improvement Programme (DRIP). The project aims at improving the safety and operational performance of existing dams through repair and rehabilitation of about 223 dam projects across seven states, namely, Jharkhand (DVC), Karnataka, Kerala, Madhya Pradesh, Odisha, Tamil Nadu, and Uttarakhand (UJVNL). The program was initiated in April 2012 and scheduled to complete in June 2020 at a cost of

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		Rs, 3,466 Cr. [55] However, the existing project did not have any specific component to increase the storage capacity of the dams; instead it focussed on dam safety and O&M aspects. • Phase 2 and 3 of DRIP is proposed to be launched soon across 18 states at an estimated cost of Rs. 10,200 Cr., over a duration of 10 years. The key components should be (a) Rehabilitation and improvement of dams (b) Dam safety institutional strengthening (c) Revenue generation for sustainable O&M (d) Project Management[56] • As per CWC, currently in most states, budgets for dam O&M are part of the larger budget for irrigation and canal maintenance which is decided based on irrigated area. In practice, irrigation and canal maintenance tend to get greater priority, with the result that dam O&M is relatively neglected. Allocations for dam O&M need to be more in line with need-based assessments.[57] Moreover, an independent expert also pointed out, all state WRDs should have scheduled, pre-planned maintenance budget for dams.

[55] Website of DRIP

[56] DRIP Phase 2 and 3 project brochure

[57] Financial Management Manual- Dam Rehabilitation & Improvement Project, Central Water Commission

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		Case Study: Efficient O&M by the Bhakra Beas Management Board (BBMB) The BBMB was formed in 1966 in the state of Punjab to undertake administration, maintenance and operation of Bhakra Nangal Project. As on date, the BBMB is responsible for administration, Operations & Maintenance of large dams- the Bhakra-Nangal Project, Beas Project Unit-I (Beas Sutlej Link Project) and Beas Project Unit- II (Pong Dam) in Northern India. BBMB generates its own revenue (mainly from power generation), and they have their own team and dedicated staff to perform the required O&M activities based on maintenance manual and a schedule of O&M activities. BBMB was awarded the most prestigious National Level Award for 'Bhakra Dam', as "Best Maintained Project (Functional for more than 50 years)". Source: BBMB website • Another common issue which the Expert pointed is that often multiple organizations are involved in operations of the dams on a river and they don't have enough coordination mechanism for operations & data sharing. This often is a major hurdle and the dam owners are not able to maximise storage utilisation of dams or reservoirs on the same river basin

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		Case Study: Resilient Kerala Program- World Bank World Bank has sanctioned a loan of USD 90 Mn in 2019 to the Government of Kerala for the Resilient Kerala Program. The Program Development Objective (PDO) is to enhance the State of Kerala's resilience against the impacts of natural disasters and climate change. An integrated river basin planning and management based on the River Basin Conservation and Management Act is being undertaken as part of the program. The major activities include (i) Developing and operating modern information and analytical systems to improve the quality and reliability of data and information, enhance real-time monitoring, and improve the scientific basis for informed decision making in the water sector; (ii) Integrating planning across all water-related sectors on a basin or sub-basin basis, including developing water allocation and use strategies; (iii) Strengthening systems for coordinated real-time water infrastructure (for example, dams and irrigation networks), including rolling out state-wide flood forecasting and early warning systems and improving the integrated operation of

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		reservoirs in the State through updated cross-sectoral operation guidelines. Source: Program Document- Resilient Kerala Program- World Bank • In the state of Manipur, the height of one of the major dams has been increased by 1m to increase the overall storage capacity and results have been satisfactory. However, no desilting activities have been undertaken <u>Construction of new storage structures</u> • A national level stakeholder suggested that the priority of the Central Government in recent years has been to focus on creation of smaller decentralised storage structures across the country. An Independent Expert supported the view of the government • Multiple national level stakeholders mentioned that construction of large dams have large environmental impact and high rehabilitation costs. Moreover, they take a significant amount of time for completion. For instance, planning of additional dams on Ganges and Yamuna may now pose significant environmental concerns since it is essential to maintain an optimal inflow to ensure river health (environmental flow). Moreover, in the absence of inflow, the groundwater availability also suffers

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		Case Study: Catch the Rain- NWM National Water Mission (NWM) started the campaign "Catch The Rain" in March 2020 to nudge the states and the various stakeholders to create appropriate Rain Water Harvesting Structures suitable to the climatic conditions and sub-soil strata before monsoon. Under this campaign, implementation of check dams, water harvesting pits, rooftop RWHS etc; removal of encroachments and de-silting of tanks to increase their storage capacity; removal of obstructions in the channels which bring water to them from the catchment areas etc; repairs to step-wells and using defunct bore wells and unused wells to put water back to aquifers are being taken up with the active participation of people. The basic aim is to limit the water to flow out of the compound and improve soil moisture and groundwater table. In urban areas it will reduce water gushing onto roads, damaging them and will prevent urban flooding. All District Collectors, heads of institutions like IIMs, IITs, Central Universities, Private Universities, Chairmen of Railways, Airport Authority, PSUs; DGs of Central Armed Police Force, etc having large tracts of lands with them

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		have been requested to take steps to "Catch the Rain". Source: NWM website • The stakeholder also mentioned that going forward, there is a need to measure the water storage capacity of smaller storage structures in addition to large irrigation projects. The 6th Minor Irrigation Census along with first Census of Water Bodies being conducted with Reference Year 2017-18 and scheduled to be released in FY 2020-21 is an important data point in this aspect. • Two national level stakeholders have mentioned that small barrages, check dams may continue to be developed (wherever feasible) since these involve less land acquisition and are more cost-effective ways of increasing the existing storage capacity. • The states of Bihar and Manipur have also mentioned that the focus is now on creating smaller decentralized storage structures. This is mainly since creation of large dams involve high rehabilitation costs, delays due to land acquisition issues and environmental concerns. • In the case of Himachal Pradesh it was mentioned, that since it is a hilly state, check dams and gully plugs may be used to capture

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		rainfall water that otherwise runs off. Additional storage capacity needs to be created to store this water.
		Inference: • There are no specific schemes or initiatives targeted at increasing the storage capacity of dams. However, states are taking some initiatives like increasing dam height. Desilting, catchment area treatment, etc. are yet to be systematically adopted and has the effect of reclaiming lost storage capacity. • DRIP-Dam Rehabilitation and Improvement Programme (World Bank funded) has been implemented in select states and aims at rehabilitation and maintenance of select existing dams. Phase 2 and 3 of DRIP aims to bring more dams under its purview. • The focus is on creating small decentralised storage structures across the nation. This is mainly since creation of large dams involve high rehabilitation costs, suffer from delays due to land acquisition issues and environmental concerns. • Budgets for dam O&M are part of the larger budget for irrigation and canal maintenance. In practice, irrigation and canal maintenance tend to get greater priority, with the result that dam O&M is relatively neglected.

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• Small barrages, check dams may continue to be developed (wherever feasible) since these involve less land acquisition and are more cost-effective ways of increasing the existing storage capacity
Access	IPC-IPU Gap	Secondary: • IPC-IPU gap of 23 M ha (i.e. 21%) • Faulty designs, unlined canals, lack of desilting, poor O&M of distribution channels and ineffective WUAs key factors • Shift in cropping pattern towards water intensive crops at upper end of command area another major factor. Source: UIP data based on Planning Commission (2009) Report of the Task Force on Irrigation; IPC and IPU data till the end of XI Plan (up to March 2012)
		Primary: <u>Measures to reduce the Gap</u> • The national level stakeholder shared that the AIBP and CADWM components of PMKSY with 99 priority projects are the focus projects of GoI. These intend to address the gaps between UIP-IPC and IPC-IPU respectively. The delay between construction of dam and main canal vis-à-vis field channels and developing the command area is a key reason for the IPC-IPU gap. Ensuring that the last mile connectivity of

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		the canal network to farms is necessary to reduce this gap. • The completion of the PMKSY projects and focus on micro-irrigation by the GoI, will improve water use efficiency and help in reducing the IPC and IPU gap • An Independent Expert shared that often farmers (especially in head-end of a canal) switch to water-intensive crops once canal water is available. This leads to greater quantity of actual water requirement than the design requirement. As a result downstream farmer will not receive the designed water quantity and lead to increase in the IPC-IPU Gap • In Manipur, to reduce the gap, piped irrigation network project is being piloted and micro-irrigation is being focussed upon. • However, post construction of canals in Manipur and Bihar, O&M funds are not available with the department to undertake regular maintenance activities. Due to the same, lining works for old canals have also been pending. This leads to seepage losses during conveyance which further increases the IPC-IPU gap. <u>Assessment related methodology</u> • Independent Experts shared that due to the inherent design and conveyance inefficiency of canal irrigation network, a significant quantity of

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		groundwater recharge occurs in the command area. The present calculations of irrigation potential utilized does not take into consideration the additional water available for pumping due to seepage losses of the canal system. **Case Study: Sina Irrigation system Maharashtra- IWMI study** A study in Maharashtra by the International Water Management Institute to assesses the irrigation performance of Sina Irrigation project has demonstrated the following 1) The analysis based on satellite data shows the actual water influence zone (WIZ) of Sina irrigation system is substantially larger than the designed canal command area. 2) Satellite-data based estimate of the ratio of IPU to IPC is considerably larger than the official estimate, primarily due to conjunctive use of groundwater. 3) The existing cropping patterns generate a substantially higher value of output

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		than that based on the designed cropping patterns. It is evident from the above study that in the same irrigation command area after the introduction of canal, farmers started using the GW in the command area extensively. This is mainly due to the natural recharge of the groundwater from the return flow of the canal irrigation system. Source: Abstracts- 2nd International Conference on Sustainable Water Management, WRD, GoM • The state of Manipur shared that coordination and data management issues between departments often lead to mis-calculations related to IPC and IPU. It is therefore undertaking remote sensing studies and aerial surveys to measure and quantify the IPU on scientific basis. North East Water Resources Information Base – a geoportal funded by World Bank has been created for this purpose. The actual command area related data should now be available on a real-time basis.
		Inference: • The IPC-IPU gap can be reduced by focusing on last mile connectivity and completing the AIBP and CADWM projects

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• Innovative technologies like piped irrigation and micro-irrigation can help in reducing the gap further. The switching of head-end farmers to water -intensive crops also leads to IPC-IPU gap as tail-end farmers remain deprived of water (which was theoretical IPC of the project as per initial designs and planning) • Due to lack of O&M funds, lining activities and other maintenance activities remain incomplete causing water losses • Coordination and data gaps between departments at the state level leads to improper assessment of IPC and IPU; remote sensing and aerial survey activities can help in this aspect. • The present calculations of irrigation potential utilized does not take into consideration the water made available for additional pumping due to groundwater recharge from the seepage losses of the canal system.
Equity	Spatial variance in surface water availability and River interlinking	Secondary: • Avg. surface water potential – 1,999 BCM (at 75% dependability – 1,750 BCM) from 20 river basins • Avg. per capita surface water potential –1,537 cu. m. • High spatial variance – 7 river basins endowed with 49% of water resources but with only 14% of country's population

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		Source: Reassessment of water availability in basins using space inputs- Central Water Commission- 2019 Study
		Primary: • National level stakeholder shared that river-interlinking projects to reduce the spatial variance is the focus of GoI. Accordingly, 38 links have been identified in peninsular and Himalayan rivers • DPRs and technical work have been completed for these river interlinking projects and there are four link projects that are ready to be implemented • For instance, the Ken-Betwa link is ready to be implemented. However, there are unresolved issues between the state governments of Madhya Pradesh and Uttar Pradesh. Perception issues and reservations over water sharing, have led to delays in implementation. Several rounds of negotiations are being undertaken to solve the issues. • Despite high level of technical preparedness, the political issues around the interlinking of river projects are leading to delays. • Water being a state subject, coordination among states is required. The central government has been acting as the mediator • For every interlinking project, detailed environmental impact assessments, social

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		impact assessment in terms of rehabilitation requirement, are evaluated. There are multiple safeguards and range of clearances which are required. It takes about 4 to 5 years to get clearances for any one link. The Independent Expert further added that comprehensive cost-benefit analysis (including socio-economic cost) must be undertaken prior to implementation of any ILP. • In Andhra Pradesh's Rayalaseema region (drought-prone area), after Godavari-Krishna River interlinking, groundwater levels have improved significantly, and water availability has increased to a great extent.
		Inference: • Managing the coordination between states and the political processes around interlinking of rivers has been challenging. This has further led to delays in implementation, • Detailed technical and environment impact studies are being undertaken for each link. Detailed cost benefit analysis (including socio-economic cost) may also be undertaken for such projects. • Multiple environmental and social clearances are being taken; this leads to delay in implementation
Sustainability		Secondary:

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
	Extraction of groundwater and its regulation	• Extraction in 37% of GW assessment units exceeded safe limits (2017); in 2013, this was 31% • High levels of extraction is due to availability of heavily subsidized power, impetus to paddy and wheat from PDS • While a decentralized water source, challenge lies in sustainable & equitable use of common pool resource • Percentage of safe GW units has been decreasing over the years Source: National Compilation on Dynamic Ground Water Resources of India, Central Ground Water Board, 2017 Source: Central Ground Water Board
		Primary: <u>Over-extraction of GW related:</u> • In the state of Himachal Pradesh, over-extraction of GW has been in selective blocks where private bore wells have been installed to cater to the industrial clusters and high-density population (due to tourism). In addition, growing of water-intensive crops like paddy with GW (especially in valley areas), has led to over extraction in some pockets. • In Karnataka, free electricity to farmers, subsidy on bore well connections, non-availability of reliable surface water source in certain pockets-

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		have led to over extraction of GW. Especially for rainfed areas, insufficient and irregular rainfall has led to increasing reliance on GW. • In Andhra Pradesh, increase in agricultural land, cropping intensity, monsoon failures, reduction in surface water availability, inequitable distribution of surface water (especially for tail end farmers) and easy availability of GW are the key reasons for over extraction of Groundwater • In Uttar Pradesh due to subsidised electricity and poor regulations, GW extraction for irrigation has been high. • In Punjab, despite good network of canals, GW extraction has taken place since it is a very dense agricultural area. In addition, the traditional cropping pattern includes paddy and wheat, which require significant quantity of water **Case Study- Participatory watershed management at Ralegan Siddhi in Ahmednagar, Maharashtra** Ralegan Siddhi village is in a drought-prone and resource poor area with annual rainfall ranging between 50-700 mm. In 1975, the GWL in the village was poor (upto 65 feet) and most of the wells used to dry up during summer and the drinking water had to be fetched from the neighbouring village. The key reason for the

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		same was poor rainfall and high rate of surface run off, due to high degree of slope and lack of vegetative cover. Scarcity of water was a key distress which limited the prospects of agriculture in the village. Post 1975, under the leadership of Mr. Anna Hazare, a popular figure in the area, the village promoted and implemented participatory watershed management initiatives.. Key initiatives undertaken were rainwater harvesting and management of the four village watersheds. Every drop of rain was trapped by developing a drainage system, trenches, check dams, drainage plugs, percolation tank, etc. and by developing and designing micro-watershed specific schemes. These initiatives recharged the groundwater and now adequate water is available throughout the year at 21 feet depth. Improved GWL and water availability improved the agricultural produce and socio-economic status of the farmers and the village. Impact of the project: • Irrigation potential increased from 0.5 % in 1975 to 70 % in 1985. • Agriculture production increased by four times. Overall socio-economic status of the village has improved- now there is an intermediate college, post office, bank, cooperative societies, solar street lights, low-

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		cost latrines, bio-gas plants, training centre for watershed management etc. in the village. Source: A successful case of participatory watershed management at Ralegan Siddhi Village in district Ahmednagar, Maharashtra, India- as published on FAO website <u>Regulation of GW:</u> • The national level stakeholder mentioned that regulation of groundwater is being undertaken by either Central Ground Water Authority or by the state groundwater authority (wherever it has been formed). However, the main aspect of the regulation is primarily controlling the industrial water use. Regulation of Irrigation and domestic use is not the focus, because of various socio-economic and political reasons. Moreover, the monitoring agencies do not have adequate manpower to monitor compliance. • Only 17 states in India have a dedicated groundwater department/directorate/agency and in other states the same is being handled by other departments like PWD, Irrigation, WRD, etc. • In addition, the National Level stakeholder mentioned that in this regard an order was released by NGT on 20th July 2020 which has put curbs on over-exploitation of groundwater.

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		In this order, NGT has focused on industrial exploitation and has asked CGWA being a statutory regulator for the country, to exercise overriding power in the form of statutory regulatory orders. The order also mentions that no general permission for withdrawal of groundwater should be provided, (particularly to any commercial entity) without environmental impact assessment of such activity. Moreover, the order also mentions that any permission should be for specified times and for the specified quantity of water and not in perpetuity.[58] • In Himachal Pradesh, the groundwater related regulations have been notified by the state government. The CGWB is providing technical inputs required including GWL monitoring. • In Karnataka, the state GW authorities regulate GW as per the Karnataka GW Act 2011. They issue NOCs for usage of GW based on the priorities. Drinking Water gets the highest priority followed by Irrigation and then Industries. Moreover, the critical/semi-critical/safe status of the block is also looked at. However, the enforcement was weak and after issuance of NOC, monitoring (compliance) is poor due to lack of institutional capacity. Later,

[58] NGT Order dated 20 July 2020- Shailesh Singh versus Hotel Holiday Regency, Moradabad & Ors.

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		as per National Water Policy 2012, decentralised and participatory approach was undertaken- where selective powers have been given to District Collectors and district level committees. • In Andhra Pradesh, The Andhra Pradesh Water, Land and Trees Act, 2002 is used to regulate GW extraction. • In Maharashtra, as per the Maharashtra Groundwater (Development and Management) Rules, 2018, it is mandatory to establish watershed committees at district level and at tehsil level. Farmers need to obtain permissions from the committee before digging the wells • The national level stakeholder further shared that a new Model groundwater bill is being prepared by the MoJS and it will incorporate certain observations, which have been given by the NGT related to the over-extraction of GW • The Model Ground Water Bill 2016, which focuses on further decentralised regulation of groundwater and enforcement by local GPs, has not been adopted by Karnataka. • The Central Ground Water Authority maintains an online portal (NOCAP) where application for issuance of NOC for GW abstraction can be made online. The same is in use in Karnataka and Punjab.

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		Inference: • Over extraction of water by the irrigation sector across the states of Karnataka, Himachal Pradesh, Uttar Pradesh, Punjab and Andhra Pradesh is mainly due to free/subsidised electricity available to farmers, subsidy on bore well connections, non-availability of reliable surface water source, prevalence of cultivation of water-intensive crops, monsoon failures, reduction in SW capacity, unequal distribution of SW (especially for tail end farmers) and easy availability of GW. Other reasons for over extraction of GW include its easy accessibility and availability in many geographical regions, cheap and easy availability of bore well drilling and construction technology as well as absence of GW regulations. • Although the state groundwater authorities have GW abstraction related regulations and acts, the enforcement and adequate monitoring of the same remains a challenge. Only 17 states in India have a dedicated groundwater department/directorate/agency. • CGWA regulations on industries may also be further imroved. The quality of data and impact analysis studies (required to obtain NOC by industries) conducted by third part agencies, need to be further improved.

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• The Model Ground Water Bill 2016, which focuses on further decentralised regulation of groundwater and enforcement by local GPs has not been adopted by majority states. A new Model groundwater bill is being prepared by the MoJS incorporating certain observations which have been given by the NGT related to the over-extraction of GW.
Equity	Efficiency of canal network	Secondary: • Canal-based irrigation prone to high losses to evaporation, seepage • Over-extraction by head-end farmers through canal breach, unauthorized pumping • Around 4-5% of command area needs to be acquired for project – leads to project delays Source: Guidelines for improving water use efficiency in Irrigation, Domestic and Industrial sectors, Central Water Commission
		Primary: • The national level stakeholder shared that the GoI is currently encouraging all states to go for piped irrigation networks. This is mainly to avoid the inefficiency related to the canal network and high land acquisition costs. Odisha, Maharashtra, Karnataka, Telangana, Manipur have been implementing such projects. Independent experts supported this view and added that piped irrigation will help in better

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		accountability and monitoring and control of water supply (if SCADA and automatic valves are installed). **Case Study- Telangana Piped Irrigation Network** A sub-surface piped irrigation network to irrigate over 800 mn sq. m. (2 lakh acres) is being implemented in Nizamabad and Jagtial districts in Telangana. The project is being implemented as a part of the Kaleshwaram Lift Irrigation Project (Package 21). The estimated capital cost of the project is Rs. 2,400 Cr. The project implementing agency, the Irrigation and CAD Department, Government of Telangana has engaged a contractor, selected through a competitive tender process, to provide its services under Design-Build-Operate-Transfer (DBOT) mode and undertake O&M for a period of 15 years. The contract was awarded in April 2018 and implementation of the same is under progress. The project has been designed to reduce losses and improve water conveyance efficiency and leverage technology to allow remote monitoring and control of water supply across their networks through SCADA based Outlet Management system.

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		Technology will allow the project operators to monitor consumption, manage demand and match supply to demand to reduce waste and contribute to additional water savings. Remote monitoring and control of the networks reduces the number of personnel required to manage the networks and thereby reduce O&M cost. Source: KPMG Analysis • The GoI also extends necessary support to increase efficiency of canals and provides financial support for re-lining, gate maintenance and better management of select old canals on a case to case basis and there is no specific scheme dedicated to this. • For instance, in 2018 the centre provided financial assistance for re-lining of Sirhind and Rajasthan feeder canal (in Punjab) over five years till 2022-23. They were issues related to water logging and huge seepage losses • The centre has also been encouraging states to laterally assess their canal networks • In Manipur, piped irrigation network project is being piloted and micro-irrigation is being focussed upon. • However, post construction of canals in Manipur and Bihar, O&M funds are not available

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		with the department to undertake regular maintenance activities. Due to the same, lining works for old canals have also been pending. This leads to losses and decrease in efficiency of the canals in the states • In Punjab, due to low efficiency of the canal network, water is not able to reach the tail ends of canal. Therefore, the state is focusing on increasing efficiency using underground pipeline network and micro-irrigation.
		Inference: • Canal-based irrigation is prone to high losses due to evaporation and seepage • The central government is assisting the states and promoting the implementation of piped irrigation networks and micro-irrigation systems to improve the irrigation efficiency. • The GoI is also assisting in re-lining and better management of select old canals on a case to case basis. However, there is no specific scheme dedicated to this. • Post construction of canals in Manipur and Bihar, O&M funds are not available with the department to undertake regular maintenance activities. Due to the same, lining works for old canals have also been pending.

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• Punjab is focusing on increasing efficiency using underground pipeline network and micro-irrigation.
Access	Irrigation coverage status	Secondary: • Ultimate Irrigation Potential is approx. 140 M ha whereas only 68 M ha (i.e. 49%) is net irrigated area • Land productivity remains low in rainfed areas compared to 2 - 3x in canal and 3 – 5x in well irrigated areas • Need to close gap in irrigation coverage to improve food production Source: Agriculture Statistics at a glance, 2018, Ministry of Agriculture and Family Welfare, GoI
		Primary: <u>Irrigation coverage</u> • In the state of Andhra Pradesh, difference in spatial availability of surface water is one of the key reasons for inadequate irrigation coverage. The state government is undertaking large lift irrigation projects to bring irrigation access to water deficient regions in the state. • Moreover, in AP, the rainfall pattern is not beneficial- very high rainfall concentrated over fewer days does not benefit the crops. Additionally, during very heavy rains- runoff is more and percolation to GW aquifer is less. Therefore, there is not much of an increase in

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		GW levels. The state government is focussing on water conservation and creating small storage structures under PMKSY/MGNREGA to increase irrigation coverage. • In Bihar, floods during monsoon often lead to crop damage especially in North Bihar; whereas in South Bihar is often affected by droughts. The state government is planning the Ganga Water Lift Project to solve this. Although the initial focus of the project is on drinking water, the same is expected to be extended to the irrigation sector in the future. • In Punjab, the irrigation coverage is high due to availability of SW and GW sources. Certain hilly areas do not have access to irrigation due to the terrain. The state government has implemented lift irrigation projects in these regions. However, O&M costs of such projects are high; farmers may not be able to bear the Electricity charges in the long term • In Jharkhand, small existing ponds in villages are being desilted and thereafter rainwater harvesting is being promoted to improve irrigation coverage. • In Uttar Pradesh, creation of more command area is required to increase the irrigation coverage. <u>Cropping Intensity</u>

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• In Manipur, assured irrigation has started recently and now the agriculture department is motivating farmers to take two crops • In Andhra Pradesh, surface water in canals are released in the month of August, one month after the start of monsoon. During the Rabi season, farmers are mostly dependent on GW since SW is not available reliably. • In Punjab, most of the farmers cultivate 2 crops in a year and aim to cultivate 3 crops going forward <u>Household Survey insights</u> Household Survey conducted across 11 states revealed 34% of the farmers still undertake mono-cropping.
		Inference: • Due to unavailability of assured surface water sources, under-developed command area of canals and depleting GW levels, the irrigation coverage needs improvement in the states of Bihar, Uttar Pradesh and Andhra Pradesh • The cropping intensity is also expected to increase after assured irrigation is available in Manipur • Development of decentralised storage structures, desilting of ponds and rainwater

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		harvesting structures are being undertaken to increase irrigation coverage in Jharkhand
Sustainability	Dependence on groundwater for irrigation	Secondary: • As per the Mihir Shah Committee the first two decades after independence, water required for irrigation was mainly supplied through large and medium irrigation dams. In last four decades groundwater (mainly irrigation through wells), has become the main source of irrigation • Groundwater today provides more than 63% of water for irrigation • Heavy subsidies for agriculture power consumption encouraged wasteful use Source: Irrigation- Statistical Year Book India 2018
		Primary: • The National level stakeholder highlighted that electricity cost subsidy provided by majority states to farmers is the main reason for overdependence on draftgroundwater. • In Himachal Pradesh, farmers depend on GW for irrigation since it is an assured source of supply, power for bore wells is available at a subsidised rate and GW is available in the field itself. The Independent Experts also highlighted this as the major reason for dependence on GW for irrigation. In addition, the experts felt economic aspirations have led to farmers

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		making investments in their farms and that has led to more installation and use of diesel pumps or electric pumps for irrigation. • In Karnataka, free electricity, subsidy on bore wells and non-availability of assured SW has led to preference of GW by farmers. Moreover, in some cases, it has been observed that power subsidy has led to over pumping and over irrigation. Also, sometimes there are no switches and the pumps keep on running as long as power is there; this leads to wastage of GW. IEC and capacity building activities are being undertaken for the farmers to avoid such issues. • In Andhra Pradesh, approximately 80% of the GW is being used for agriculture. Implementation of AIBP and CAD projects as well as focus on micro-irrigation is helping in reducing the dependence on GW. Moreover, lift irrigation projects are being undertaken to bring assured SW supply to the dry areas of the state. AP also faces SW shortage in low monsoon seasons due to the presence of dams in the Krishna Basin (upstream in Karnataka) • In Andhra Pradesh, under the NTR Jala Siri scheme solar powered bore wells have been installed to pump GW and use for irrigation. • Punjab is also attempting lift irrigation projects in hilly areas of the state

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• In Maharashtra, lack of access to surface water has resulted in the over extraction of groundwater. Tendency to grow sugarcane (due to the presence of multiple sugar cooperatives) and assured price (MSP) have further aggravated the situation. The farmers also lack awareness in this subject. **Case Study- "Pani Bachao Paisa Kamao" scheme- Punjab** "Pani Bachao Paise Kamao" scheme has been launched by Government of Punjab with an aim to motivate farmers to improve efficiency in the use of groundwater for agriculture by providing them monetary incentives. The State Government had launched the Pilot for the scheme in June 2018 on 6 Agriculture feeders in Fatehgarh Sahib, Jalandhar and Hoshiarpur Districts. After the initial success during the pilot phase, the same was extended to 250 additional feeders in June 2019. The scheme is being implemented by the Punjab State Power Corporation Limited (PSPCL) and Agriculture Department and supported by The World Bank and J-PAL. The provisions of the scheme are such that farmers would be given a fixed electricity entitlement (kWh) for every month of the year which would vary by season (paddy and non-

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		paddy) and would depend on sanctioned load of the consumer. The energy entitlement would be based on average consumption of the previous year. Any consumption measured from individual metres lower than the fixed settlement will be reimbursed at the rate of Rs. 4 per kWh, while excess consumption above the fixed entitlement will attract no charge from the farmers. No bills will be issued, and the farmers will be intimated through SMS about their saving bimonthly and electricity consumption fortnightly and the amount (of saving) will be transferred directly to the consumer's bank account. Source: PSPCL website <u>FGD insights</u> • From the various Focus Group Discussions held with the farmers, the following points emerged related to the groundwater usage for irrigation: o In areas where SW source or assured irrigation facilities are available, farmers have reduced dependence on GW. However, they often use GW conjunctively especially during low rainfall days/ Rabi season/ days in which SW is not available, to maintain better crop productivity o In some areas of Assam, where the socio-economic status of the farmers is low,

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		farmers are largely dependent on rainfall or SW (if available), as they do not have personal bore wells. o In difficult terrains (select districts of MP, AP, TN and Assam), where GW abstraction using bore well is not feasible, farmers have no dependency on GW. Instead they rely on SW sources (if available) and rainfall for irrigation. o Dependence on GW (from bore well/dug wells) as a source of water for MI systems, was observed in the various states adopting micro-irrigation (like Karnataka, Uttar Pradesh, Andhra Pradesh, etc)
		Inference: • Free/subsidised electricity, subsidy on bore wells and non-availability of assured SW has led to greater dependence on GW by farmers • Power subsidy has led to over extraction and over irrigation and wastage of GW • Implementation of AIBP and CAD projects as well as focus on micro-irrigation and Lift Irrigation projects is helping in reducing the dependence on GW. • In addition, economic aspirations have led to farmers making investments in their farms and that has led to more installation and use of diesel pumps or electric pumps for irrigation

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
Sustainability	Cropping pattern and crop diversification	Secondary: • Preference of farmers to cultivate water intensive crops such as paddy even in areas of water stress • Rice, wheat and sugarcane consume almost 80% of freshwater available for irrigation leading to inequity in irrigation water availability for other crops • Large scale procurement of rice and wheat by the public distribution system at assured minimum support prices ensures demand for such water intensive crops Source: Agriculture Statistics 2018, Stress category based on CGWB data
		Primary: <u>Crop diversification</u> • A national level stakeholder pointed out that MSPs for a variety of crops exist. However, not all food grains / crops are procured for distribution through PDS. In contrast, cultivation of crops that have assured MSPs and supported by PDS procurement is high. • The NWM has started a campaign called "Sahi Fasal" which is nudging the states to look at water efficient crops or diversification of crops and asking/requesting the farmers to cultivate alternate crops which consume less water

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• In Andhra Pradesh, it has been observed that market of the new crops and buy back arrangement of the new crop under diversification by the government are the key factors affecting crop diversification plans. Often it has been observed that lack of buy back makes farmers sceptical and unwilling in adopting crop diversification. The same logic of inadequate market linkages being the main hurdle for crop diversification on a large scale, and was corroborated by multiple Independent Experts • To address these issues, online agriculture trading platform has been implemented- e-NAM platform (GoI initiative); also in Andhra Pradesh, e-Rythu application has been created to connect- buyers, farmers and agents in the agricultural value chain. These market mechanisms provide assured prices to the farmers for a large variety of crops **Case Study- Ramthal Drip Irrigation Project** Ramthal Drip Irrigation project in Bagalkote district in Karnataka is the largest drip irrigation project in Asia. With commencement of water supply in 2017, the project currently caters to 24,000 ha comprising 15,000 farmers across 30 villages. The project was executed by private players and their scope also includes O&M for a

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		period of five years along with the responsibility of creating WUAs. The project involves bulk water supply through fully automated drip irrigation systems. Farmers are provided water in their respective farmlands through installed cylinders, which have provisions for mixing the required fertilizers and pesticides. The project is expected to alleviate the water scarcity related issues of farmers in Ramthal Marola region. It is envisaged that installation of drip irrigation equipment shall result in improved water-use efficiency, reduction in pesticide and fertilizer usages and increase in crop yields. The project is further benefitted by the initiative of Government of Karnataka's (GoK) Agriculture, Horticulture and Water Resources departments in establishing market linkages by signing MoUs with 14 private sector agri-companies for offtake of agricultural produce. To facilitate the scaling of this drip irrigation technology, Drip-to-Market Agro Corridor (DMAC) has also been established for promoting market-based mechanisms. Source: Multiple news articles related to the project and KPMG Analysis

Case Study- Market linkage support by FieldFresh Foods, Punjab

Field Fresh Foods Private Limited made its entry into horticulture in September 2004 in Punjab. A 300-acre Agri Centre of Excellence (ACE) government-leased model farm was established at Ludhiana to develop it as an R&D farm. The agency currently works with over 5,000 farmers and provides them the required technology support and offtake supply chain to grow baby corn, sweet corn and a variety of herbs and chillies using drip irrigation technique.

The firm also has a joint venture between Bharti Enterprises & Del Monte Pacific Limited and exports fresh and processed vegetables like Baby Corn, Sweet Corn, Chillies etc to UK and western Europe.

Source: KIIs with stakeholders in Punjab and website of FieldFresh

- In Punjab, it was observed that farmers are sticking to the traditional crops mainly due to the assured prices and procurement. Procurement of crops by private traders often suffers from price fluctuations. However, attempts are being made to grow maize instead of paddy. The presence of food processing industry has further supported this.

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• Crop diversification attempts are also being undertaken by the states of Jharkhand (maize instead of paddy), Assam (maize, pulses, mustard instead of paddy), Karnataka (pulses, pigeon peas instead of sugarcane), Maharashtra (various horticulture crops), Tamil Nadu (groundnut) and Telangana (soya bean, groundnut and Bengal gram) • In the state of Telangana, the state government is attempting to introduce the "Crop colony concept". Under this initiative, the state government has studied per capita consumption of all major agricultural produce in each district of the state and identified the crops for which surplus production exists currently. Based on the demand-supply gap, market demand, price of the crops, and other factors, the Agriculture Department advises the farmers (using various channels including social media), to grow specific remunerative crops only, prior to the start of the Kharif and Rabi season. The aim is to grow crops based on demand-supply gap of crops. The implementation of the concept is being done in coordination with Rythu Samanvaya Samithis (Farmers' Coordination Committee).

Case Study- "Mera Pani Meri Virasat" scheme, Haryana

The department of Agriculture, Govt of Haryana started the "Mera Pani Meri Virasat" scheme from FY19-20 to promote crop diversification in the state. Under this scheme, farmers who cultivate alternate crops like maize, bajra, cotton, pulses, vegetables, etc. (instead of paddy), in more than 50% of the land parcel available with them, are eligible to receive subsidy at Rs. 7,000 per acre. The government has also assured procurement of the produce at reasonable price. The government is also providing crop insurance as part of the scheme. The required irrigation equipment is also being supplied by the government at subsidised rates.

Source: Mera Pani Meri Virasat web portal

<u>Reduce water consumption of water-intensive crops</u>

- To reduce the water consumption for paddy cultivation, Punjab has experimented with direct seeding technology. It consumes around 20-30% less water than the traditional methods. Trials have given good results and the yield remains almost same (within a range of +/- 5-10%)
- However, in direct seeding of paddy, farmers need to use appropriate machines which plant the seedling directly into soil. The state is moving towards this technology especially due

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		to labour shortage. This is easier for larger farmers to adopt. • Punjab has also conducted trials for micro-irrigation of paddy. However, it is cost intensive and does not increase the yield <u>FGD insights</u> • From the various Focus Group Discussions held with the farmers, the following points emerged related to crop diversification: o In areas where SW source or assured irrigation facilities are available, farmers have a general tendency to shift to water-intensive cropping pattern o In areas where MI has been adopted (such as states like Karnataka, Uttar Pradesh, Andhra Pradesh, etc), farmers have started to grow various fruits and vegetables. In addition, traditional crops like sugarcane and wheat are also being cultivated using MI techniques. <u>Household Survey insights</u> • Household Survey conducted across 11 states revealed 49% of the farmers stick to water intensive crops due to the profitability factor. • Moreover, 51% of the farmers were growing paddy as a primary crop across 11 states • Among the mono-cropping farmers, 72% were willing to change the cropping pattern

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• Among those not willing to change the cropping pattern, profitability was the main reason cited for the same.
		Inference: • In order to promote crop diversification, in addition to declaring an MSP, it is important to ensure that procurement of such crops happen and adequate market linkages are established for offtake of these alternate crops. • Alternatively, assured price needs to be ascertained for the alternate crops by adopting online agriculture trading platform like- e-NAM platform (GoI initiative). Moreover, e-Rythu application in AP has been created to connect-buyers, farmers and agents in the agricultural value chain. These assure fair prices to the farmers for a large variety of crops • Most states have tried to adopt crop diversification techniques. However, stronger market linkages and procurement supply chain can further strengthen such initiatives • To reduce the water consumption in paddy, direct seeding of paddy has been tried. It consumes around 20-30% less water than the traditional methods. Trials have given good results and the yield remains almost same (+/-5 to10%)

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
Water Security	Agriculture water use efficiency	Secondary: • The ratio of water consumption and area cultivated is an important metrics as it signifies the water use efficiency in the agricultural sector • India is one of the highest water consuming countries Source: World Resources Institute (AQUEDUCT) database
		Primary: • A national level stakeholder mentioned that dedicated "Micro-irrigation fund" has been set up (Rs. 5,000 Cr. Corpus -NABARD) by the MoA&FW, GoI under PMKSY. Some of the states have come forward to take up various innovative projects with these funds related to micro-irrigation and water-use efficiency improvement. • The NWM is also assisting the state government and the various stakeholders to increase water-use efficiency. • In Punjab, power supply to the agriculture sector is being provided free of cost. This is the major impediment to increasing the adoption of micro-irrigation

		Case Study- Gujarat Solar Irrigation Cooperative to promote water use efficiency The Dhundi Solar Pump Irrigators' Cooperative Enterprise (SPICE) provides the proof of concept for promoting Solar Power as a Remunerative Crop (SPaRC). Supported by International Water Management Institute (IWMI), the model has tried to provide a solution to western India's groundwater woes as well as curtailing the carbon footprint of agriculture in India and aims at creating a risk-free source of cash income for India's farmers. The SPICE, which began operating in May 2016, is the world's first solar irrigation cooperative formed in Dhundi village in Gujarat's Kheda district, about 90 km from Ahmedabad. Through this initiative, the farmers not only made a switch from diesel to solar pumps but also adopted net metering–selling excess power to the local electricity utility. Members now have an incentive to save power and curtail their groundwater use (thereby promoting water use efficiency), as any leftover power is sold to the Madhya Gujarat Vij Company Limited (MGVCL @ Rs. 4.63/kWh under 25-year power purchase agreement), the local power utility, thereby creating a parallel revenue stream. Source: "Solar Power as a remunerative Crop" by Tushar Shah et al. and various news articles

Case Study- Solar powered MI project- Punjab

The Solar Powered Community Lift Micro-irrigation Project (SCMIP) was conceptualised in Punjab, India by the Department of Soil and Water Conservation (DSWC), Government of Punjab. The project, situated in the district of Hoshiarpur, irrigates 6.64 mn sq. m (1,641 acres) of farmland located on the foothills of Shivalik mountain range and adjacent to the Kandi canal, the source of water for the project. The project was completed and O&M commenced in August 2017.

The key project components comprise: i) pumping of water from Kandi canal to the command area using solar energy, ii) water distribution network, iii) on-farm micro-irrigation equipment and iv) SCADA powered automation. The project was implemented by a contractor selected through a competitive tender process. The scope of the contractor includes construction of the project and operations and maintenance for a period of seven years.

In order to reduce the cost of operations and to make the project financially sustainable, the entire project is designed to exclusively rely on solar energy.

Source: KII with stakeholders in Punjab and KPMG Analysis

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• In paddy growing areas; Punjab is going for underground pipelines to increase agricultural water use efficiency. Direct seeding of paddy using machinery is also being practiced as it consumes 20-30% less water • In Jharkhand, PDMC under PMKSY is being popularised for adoption among farmers • In Andhra Pradesh, surface water release and flows using SCADA control system has led to efficiency gains • Across the states of Manipur, Bihar, Assam, Tamil Nadu, Telangana, Maharashtra, increased adoption of micro-irrigation among the farmers, has been reported • The Independent Expert mentioned that we need not focus resources on adoption of micro-irrigation in the Gangetic basin, which has robust canal network and shallow aquifers.
		Inference: • Free power supply to agriculture sector is a major impediment for farmers to adopt micro-irrigation. • In paddy growing areas: underground piped irrigation network and direct seeding of paddy using machines may increase agricultural water use efficiency.

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• Large scale adoption of PDMC (MI) and use of SCADA system leads to an increase in agricultural water use efficiency. • The authorities may prioritise resources and not focus on adoption of micro-irrigation in the Gangetic basin, which has robust canal network and shallow aquifers. However, even in Gangetic basin, periodic assessment of the aquifers using suitable technology may be undertaken before deciding on the adoption of MI.
Water Security	Agriculture Sector Contribution	Secondary: • India is one of the highest water-stressed country with 18% of the GDP from agriculture and 52% of the country area under cultivation • With increase in area under cultivation/ value of produce/ cropping intensity India can further increase contribution to GDP from the sector • However, to avoid facing severe scarcity in the future; India must focus on water use efficiency in Irrigation Source: Food and Agricultural Organization-AQUASTAT database; World Resources Institute (AQUEDUCT) database for Water Stress scores
		Primary: • No additional insights gained during primary research on this enquiry area

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		Inference: • India needs to ramp up the land productivity by growing high value crops, increasing water use efficiency, area under cultivation and cropping intensity
Sustainability	Water consumption in Thermal Power Plants	Secondary: • Power sector water demand is 34% of the total water consumption for industrial sector • Thermal power plants rely on water for cooling • Plants failing to adhere water consumption regulations as per MoEF&CC • There is less focus on reducing water footprint since water costs constitute a miniscule portion of the overall variable costs of a thermal plant Source: CERC Reports, WRI Working Paper
		Primary: • The Ministry of Power, GoI has made it mandatory for all the thermal power plants which are lying within 50 km of any sewage treatment plant, to take the treated wastewater from the treatment plant • In Maharashtra, the regulatory authority (MWRRA) has set standard water usage norms by the thermal power plants in terms of their power generation (water consumption per MW power generation). The water allocation to power plants are done in accordance to these norms. Any additional water consumption by the

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		thermal power plants attracts penal charges. These norms are revised every 3 years
		Inference: • Water consumption in Thermal Power plants across the country needs to be monitored and regulated in line with Maharashtra.
Sustainability	Efficiency in water use and pricing in Industrial sector	Secondary: • Water consumption in industrial sector may increase from 8% to 13% by 2050 • Inefficient use of water and water pricing in the industrial sector • Lack of effective regulations and coordination between regulatory bodies of centre and states • Lack of incentives provided to industry for efficient water use • Low tariffs for industrial consumption Source: NCIWRD data, National Steel Policy 2017; Water governance mapping report: Textile industry water use in India, Stockholm International Water Institute, 2016
		Primary: • NWM is promoting Water audit for industries. In association with TERI, benchmarking studies for optimum water usage and water audit are being undertaken for various industries such as paper and pulp, leather and tannery.

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• In Maharashtra, the regulatory authority (MWRRA) has set standard water usage norms for every industry type/category. in terms of their volume of water per unit output. The water allocation to each industry is done in accordance to these norms. Any additional water consumption by the industries attracts penal charges. These norms are revised every 3 years. Volumetric pricing has been adopted for all industries
		Inference: • Inefficient use of water and water pricing in the industrial sector • Lack of effective regulations and coordination between regulatory bodies of centre and states • Water consumption in all industries across the country need to be monitored and regulated in line with Maharashtra
Sustainability	Efficiency in water use and pricing in domestic sector	Secondary: • Inefficient use of water and water pricing in the domestic sector • Changing lifestyles will further increase consumption of domestic water. • Poor water pricing has led to inefficient utilization of water resources • More than 40% of water produced in Indian cities does not earn any revenue (NRW losses) • Arbitrary tariff setting in most ULBs across India

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• From 2010 to 2050, the domestic sector demand is estimated to increase by 158%. Source: NCIWRD and Water for the Future-Challenges for India and its industries, 2012
		Primary: • In Karnataka, currently water tariff in ULBs is levied as per GO of 2011 and it should be revised every 3 years to take care of the increment in electricity and other costs. However collection efficiency is poor. • In some of the ULBs in the state of Karnataka, bulk water meter and domestic water meters have been installed (approx. 45%-50%); however, still lot of work on metering needs to be done • In some ULBs up to 40% NRW losses have been observed. • As per 74th Constitution Amendment, after construction, the Karnataka Urban Water Supply and Drainage Board hands over the assets to ULBs for maintenance. Only as per Government mandate, in 10 out of 230 ULBs, the authority is also maintaining the schemes on pilot basis. • In HP, high wastage of water in commercial uses (tourism, hotels) is there. Telescopic water tariff has been implemented in Shimla. Metering has been undertaken in multiple cities/urban centres across the state.

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• In Maharashtra, the water regulatory authority fixes bulk tariff for drawing surface water from rivers/dams by the RLBs/ULBs for domestic sector. The responsibilities of retail tariff setting are vested with the RLBs/ULBs • In Odisha and Rajasthan, the main reasons for inefficient consumption are lack of awareness in public, old distribution system and associated NRW losses. In Rajasthan, under AMRUT replacement of non-functional water meters and IEC activities are being undertaken. **Case Study- Drink from Tap Mission, Odisha** In October 2019, to provide quality drinking water to every urban household in the state, the Housing and Urban Development Department, Govt of Odisha has initiated a program on "drink from tap mission". UNICEF will provide technical cooperation to the government of Odisha for implementation of the program which aims at providing piped quality drinking water supply to each household on a 24-hour basis, to 1.20 lakh people (in Phase 1). The program envisages to adopt community-based water management system at ward-level, involving Women Self-help Groups, which will ensure the household connection for every household, meter reading, billing, collection of

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		water tariff, complaint management and field quality testing by using standard tools. Source: Various news articles and KII with stakeholder in Odisha • The Independent Expert shared non-metered connections and low tariff (non-volumetric) are the major issues related to water use efficiency in the domestic (urban) sector. Transparency in meter reading and maintenance of meters should also be undertaken to ensure sustainability.
		Inference: • Currently water tariff in ULBs in Karnataka is levied as per State Government Orders. The same is required to be revised every 3 years to take care of the increase in electricity and other costs. However, collection of tariff is not adequate. • Adequate metering, volumetric tariff setting and awareness generation among consumers need to be undertaken
Sustainability	O&M and financing	Secondary: • Estimated NRW is between 40-70% of the water distributed in Urban areas • As of 2014, no major city in India supplied 24x7 water to its entire urban population

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• Urban water O&M cost recovery through tariff is not more than 30-40% • 35% of urban households in India have piped water Source: Urban Water Supply and Sanitation, The World Bank
		Primary: <u>O&M related- Domestic Water:</u> • In some ULBs in Karnataka up to 40% NRW losses have been observed • In Karnataka, only in 3 ULBs, 24x7 water supply has been established on a demo basis. • As per 74th Constitution Amendment; after construction, the authority hands over the assets to ULBs for operations and maintenance. • The capability of the ULBs (especially ULBs within 50,000 population range) in undertaking O&M needs to be ramped up • Due to poor O&M, after 4-5 years the benefits are not fully realised and the projects deteriorates • In HP, despite tariff collection, lack in O&M funds exists since tariff is not adequate to meet the high O&M costs (high power bills due to terrain) • In Rajasthan, the authority is working on the strategy to reduce NRW losses. Study is going

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		on by forming DMA under pilot project in some areas. **Case Study- Water Corporation of Odisha (WATCO)** WATCO is a wholly-owned, not-for-profit Company of the Government of Odisha, established in 2015 to provide water supply and sewerage services in the cities of Bhubaneswar, Jatni and Khordha on behalf of the respective municipal bodies. The corporation manages the overall water production, treatment, and distribution and sewerage collection, treatment and disposal activities. It also levies and collects tariff from the consumers. WATCO is currently providing services in 3 cities in Odisha, however it is planning to expand its services to the entire state very soon. Source: WATCO website <u>O&M related- Irrigation:</u> • The national level stakeholder mentioned majority of the states focus on creation of new infrastructure and neglect O&M. They propose ERM (Extension/renovation/modernization) projects and propose the same to be funded by PMKSY. ERM projects are accorded priority since these can be completed quickly with

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		minimum funds. The same view was supported by an Independent Expert • In AP, O&M of canals for lining in 19 medium irrigation projects and one major irrigation project is being undertaken with JICA funding. Under Nagarjuna Sagar project, lining is being done with financial assistance from World Bank • In Maharashtra, WRD has been able to recover the entire O&M costs in FY 18-19 due to the various tariff provisions of MWRRA <u>Financing- Domestic water</u> • In Karnataka, cost recovery is very poor- since the collection of tariff is inadequate. Additionally, no one is willing to implement and levy tariff and the issue is highly politicised • ULBs currently sighs away from their responsibility especially when it comes to collection of tariff required for funding the O&M of the water supply schemes. They ask the authority or the contractor to collect from the state government. Therefore, the state government currently deducts the electricity cost from GoI's Finance commission funds. • Urban Water Supply PPP has been tried but without significant success as financial feasibility is poor.

Case Study- PPP in Bulk Water Supply, Odisha

The Public Health Engineering Organisation (Urban), Govt of Odisha has engaged a private player and various stakeholders to implement a bulk water supply project in Bhubaneshwar at a cost of Rs. 188 Cr. in public-private partnership mode. The project started commercial operations from September 2017 and currently supplies water to the Indian Institute of Technology (IIT), National Institute of Science Education and Research (NISER) and various industrial establishments, including Infocity-II in Bhubaneshwar.

This project has benefited a population of more than two lakh with uninterrupted supply of clean drinking water at an affordable rate. The project, financed under the Viability Gap Funding of the central government, has been provided with Rs. 50 Cr. to be shared jointly by the Centre and the state government.

Source: Various newspaper reports

<u>Financing- Irrigation</u>

- The Independent Experts shared that strong and active WUAs can collect irrigation service fee. However, it is imperative that the canals are transferred to WUAs in good conditions. It is however challenging since groundwater abstraction is free in most of the states

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		Inference: • The O&M of the urban water supply schemes has been inadequate mainly due to the lack of capacity, the unwillingness to levy tariffs and inadequate collection of tariff (where tariff is levied) • High NRW and poor service levels further worsens the situation • The state government subsidises the O&M costs to cover for poor collection efficiency • O&M for irrigation projects is also a challenge due to low ISF collection and subsidised GW. The state governments are also focused more on asset creation rather than O&M
Overall nature and responsiveness of Water sector planning	Planning and data management in the sector	Secondary: • Lack of holistic planning and management, MIS and poor / dated data on sector • Siloed approach to water management – ground and surface water departments are separate • Lack of capacity in water sector institutions • Lack of regulation, private sector participation and innovative financing mechanism
		Primary: • National level stakeholders shared that the National Hydrology Project is the flagship program of GoI which is aimed at pooling and maintaining real-time and updated data related to the sector. The same view was confirmed by

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		the Independent experts. Experts additionally commented that utilization of the data for the analysis and research is lacking. • In addition, the National Water Information Centre (NWIC) has been set up recently and is being strengthened. The idea is to bring in all states as stakeholders. • The NWM has been trying to promote State specific action plans for water budgeting. • The Government of Punjab has recently engaged a leading private sector company to prepare a comprehensive water sector plan for the state. It should cover all aspects including improving water use efficiency, water supply, water demand, and measures to increase efficiency in agriculture, industrial, domestic sectors • In Punjab, as on date accurate data of water consumption in various sectors is not available. Authentic data about the volume of water consumed by industrial sector, or domestic sector is also not available because metered water supply is only in urban area. • In AP, the GW department has been renamed as Groundwater and Water Audit department and they plan to undertake comprehensive water audit activities • In Maharashtra, multiple water resources related departments have been mandated to

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		maintain and submit data in specific standardised formats by MWRRA • For wastewater related data in the Ganga basin, in addition to the manual stations, special cell for ganga monitoring under CPCB has been set up. Online Continuous Emission & Effluent Monitoring Systems (OCEMS) is being set up under NMCG and integration of data from the SCADA system of new STPs is being attempted **Case Study- Maharashtra: Hydro-Economic Analysis by WRG 2030** The complexity of the interaction between water resource management and economic indicators can be demonstrated through integrated mathematical (hydro-economic) models. The use of hydro-economic models in water management helps in defining the physical behaviour of the system, with a realistic representation of surface water and groundwater resources, including their interaction, and estimating the spatial and temporal variability of their availability. In 2015, WRG 2030 conducted a hydro-economic analysis to prepare a comprehensive planning by analysis of opportunities to improve Water Use in Agriculture Sector for Maharashtra. The hydro-economic analysis

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		report captures various key elements related to the sector including diagnosis of water challenge in Maharashtra's agriculture, understanding agriculture growth in Maharashtra, and identifies the challenges and opportunities for agricultural growth in rainfed areas. A detailed Water Balance and Water Demand Forecasting was undertaken as part of this exercise. Such detailed studies help in comprehensive planning for the sector. Source: 2030 WRG – Hydro-economic Analysis for Maharashtra – Agriculture sector
		Inference: • The National Hydrology Project is the flagship program of GoI which is aimed at pooling and maintaining real-time and updated data related to the sector • Accurate and updated data, especially related to the demand side for Irrigation, Domestic and Industrial sectors are not available • Attempts are being made to pool data under the NWIC and NMCG projects (for wastewater)
Quality	Wastewater reuse & pollution abatement measures	Secondary: • Inadequate capacity of STPs generating approximately 38,791 MLD of untreated sewage

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• Lack of ETP facilities causing 40% of industrial wastewater to be untreated • 317 polluted river stretches on 293 rivers and tributaries have been identified by CPCB Sources: CPCB Bulletin, Volume-1, July 2016; Kaur et al., Wastewater production, treatment and use in India; India Water Portal (https://www.indiawaterportal.org/articles/80-indias-surface-water-polluted); Restoration of Polluted River Stretches, CPCB, 2017

		Primary:
		• A national level stakeholder shared that NMCG has been the flagship program in this sector.
		• Another national level stakeholder commented that NMCG has been able to bring in both financial and technical innovations to reduce the wastewater infrastructure gap in the Ganga basin. Some of these are as mentioned below
		  ○ Assured financial commitment (pre-NMCG annual budget Rs. 200-400 Cr; currently Rs. 1,600-2,200 Cr annual budget
		  ○ HAM model- concept of long-term operations and maintenance introduced with delayed capex annuity payment
		  ○ NMCG- technology neutral tenders
		  ○ One city one operator model

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		○ Installation of OCEMS – (Online Continuous Effluent Monitoring systems) for polluting industries ○ Focus on pollution abatement plus *Aviral Dhara, Nirmal Dhara*, bio-diversity – lot of public outreach activities undertaken ○ To avoid mixing of effluent from industries, which is a major challenge for operating STPs- NMCG conducted inventory of all industries and undertook CETP projects ○ Policies – In recent times NMCG is trying to improve usage of treated wastewater – e.g. in Mathura project – 20 MLD treated wastewater is being purchased by Indian Oil. Moreover, in Haridwar STP, canals are being built to carry treated wastewater to agricultural fields **Case Study- Kanpur CETP set up by NMCG for tannery** Kanpur's tanneries are perceived to be the primary source of industrial pollution in the Ganga. To solve the pollution issue, National Mission for Clean Ganga (NMCG) is undertaking projects worth approx. Rs. 4,000 Cr. which includes a 20 MLD Common Effluent Treatment Plant (CETP) for tannery cluster at Jajmau in Kanpur, Uttar Pradesh.

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		This 3-phase project at an estimated cost of Rs. 629 Cr. includes pre-treatment unit in 380 individual tannery units, a 20 CETP with physical, biological and tertiary treatment and installation of Zero Liquid Discharge (ZLD)-based pilot plant of 200 KLD capacity among other components. The central share of this project is Rs. 472 Cr. This is a major step forward in arresting the pollution in Ganga emanating from the crucial industrial town of Kanpur. The project will be executed by a Special Purpose Vehicle (SPV) – Jajmau Tannery Effluent Treatment Association. Source: PIB release dated 22 February 2018 • In Maharashtra, the state government has planned to treat 100% of domestic and industrial water and reuse at least 30-40% by 2022 **Case Study- Wastewater reuse in Israel** The constraints of water scarcity, combined with a fast-growing population and the decision to stop over-exploitation of the aquifers, has made it imperative for Israel to engage in a massive program of reuse of treated wastewater. Gradually, reclaimed wastewater has become a major source of water for farmers, supplying more than 40 percent of the country's needs for

		irrigation and more than 87 percent (approx. 500 MCM) of wastewater being reused. Favourable pricing policies have been put in place to give farmers a strong incentive to use treated reclaimed wastewater for irrigation instead of freshwater. Wastewater is priced at US$0.3 per cubic meter for unrestricted irrigation and US$ 0.25 per cubic for restricted irrigation, less than half the tariff for freshwater for agriculture which stands at $0.66 per cubic meter. As an additional incentive for farmers to use reclaimed wastewater, they were also initially offered to convert their allocation of fresh water to reclaimed water using a ratio of 1 : 1.2 (20 percent higher allocated water volume). Source: Marin, Philippe, Shimon Tal, Joshua Yeres, and Klas Ringskog. 2017. Water Management in Israel: Key Innovations and Lessons Learned for Water-Scarce Countries. World Bank, Washington, DC. • In Karnataka, an attempt is being made to reuse wastewater in 4 ULBs. Focus is on treatment of wastewater and attempt to supply treated wastewater for reuse in industries • In Punjab, STPs are being developed all across the state. Currently from around 100 sewage treatment plants around 2000 million litres per day of treated wastewater is available. However major part of this treated wastewater is not being reused

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• Currently Punjab is using around 300 MLD (implemented using state funds) of treated water in agriculture. Under this project, underground pipes have been installed in the areas adjoining the sewage treatment plants and that water is supplied to agriculture sector • The same need to be scaled up because Punjab has a silver lining due to vast urbanization, adequate amount of water supply to households, piped water availability in almost every rural household in Punjab. For organised use, an action plan has been formed in the state and the same includes existing plus proposed STPs
		Inference: • NMCG has been the flagship program in this sector. Numerous technological and financial innovations have been implemented by the Mission. Reuse component is also being included in some recent projects, wherever feasible. • Certain states like Punjab and Maharashtra are aiming to undertake reuse of treated wastewater on a larger scale • Karnataka is also trying to supply treated wastewater to the industrial sector.
Sustainability	Climate Change	Secondary:

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• Change in temperature and precipitation due to global warming • Uneven rainfall distribution, intense & localized rainfall • Water related disasters like flood, drought Source: WWAP (UNESCO World Water Assessment Programme), 2019. The United Nations World Water Development Reports 2019: Leaving No One Behind. Paris, UNESCO
		Primary: • Independent experts mentioned the following related to climate change impact on the sector: o Climate change will lead to India requiring even more storage capacity as even if the total rainfall remains same, erratic rainfall patterns (decrease in number of rainfall days) should require more storage since surplus days should be lower and the amount of surplus each day should be high o Multiple studies in India have been undertaken related to climate change and several schemes related to the same are being administered by MOEF&CC related to issues such as impact on river basins due to climate (both the volume and the flow)

		Case Study- Ohio River Basin climate change study In USA, the Huntington Engineer District in cooperation with the Pittsburgh, Louisville and Nashville districts, and the Great Lakes and Ohio River Division, prepared an adaptation pilot study to address the effects of climate change within the Ohio River Basin, in 2017. The Ohio River Basin Climate Change Pilot Report investigated potential climate change impacts to basin infrastructure. Infrastructure components include federal facilities operated for reduction of flood damages, navigation, local protection, water supply and hydroelectric power production. The study also investigated the potential impacts on terrestrial and aquatic ecosystems that are influenced by operation of these infrastructure components. The study provides downscaled climate modelling information for the entire basin with forecasts of future precipitation and temperature changes, as well as forecasts of future streamflow. These forecasts, according to the report, are presented through three 30-year time periods between 2011 and 2099. Strategies to overcome potential impacts of climate change on the river basin are proposed in the study Source: The Waterways Journal

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		○ Wastewater reuse is potent solution to counter climate change since supply of wastewater is assured throughout the year
		Inference: • Climate change may lead to uneven rainfall distribution, intense & localized rainfall • Frequency of water related disasters like flood, drought is likely to increase • Climate change will lead to India requiring even more storage capacity due to erratic rainfall patterns • Wastewater reuse is potent solution to counter climate change since supply of wastewater is assured throughout the year
Sustainability	Micro level information on all depleted aquifers	Secondary: Lack of micro level information on all depleted aquifers. Currently only broad macro level information is available which is not suitable for making plans for artificial recharging of all depleted aquifers
		Primary: • Himachal Pradesh, being a hilly state, the number of monitoring wells are not enough to gather detailed information on depleted aquifers. • The National Project on Aquifer Management (NAQUIM), is a flagship program of the CGWB, was initiated as a part of the Ground Water

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		Management and Regulation scheme to delineate and characterize the aquifers to develop plans for groundwater management across India. As per data received from CGWB, out of the total 24.8 lakh km^2 area identified for aquifer mapping under the scheme, an area of 13 lakh km^2 (52%) has been covered up to March 2020. As a part of this programme, region specific groundwater management plans have been prepared, which suggest appropriate demand and supply side management interventions to improve sustainability of groundwater resources. However, NAQUIM is undertaking mapping at 1:50000 scale and may not provide village level aquifer level data • In Karnataka, Atal Bhujal Yojana is being implemented which has a mapping component. For selected GPs (almost 1,200 GPs) micro level water security is being planned. • In Karnataka, artificial recharge is also currently done at GP level by convergence with MGNREGA- however more scientific project preparation is needed • In Andhra Pradesh, 6 hourly data from 1,254 piezometers are being measured, recorded and reported through APWRIMS website. However, there is scope for further analysis using the available data. The funds for O&M of the APWRIMS infrastructure including field

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		equipment is currently being arranged through World Bank NHP. • Under National Hydrology Project of the GoI, real-time GWL monitoring is being implemented through telemetry system • The national level stakeholder commented that the various Groundwater recharge structures being created across the country (under MGNREGA and other schemes), are currently being undertaken by multiple state government departments or local administration. These structures are often created without any coordination, proper planning or technical knowledge. Guidelines of CGWB need to be compulsorily followed for the effectiveness of recharge structures. Moreover, O&M of these structures have also been lacking. The independent experts supported these views and added that recharge structures should not hamper the downstream water availability **Case Study- Groundwater Recharge planning and implementation in Madhya Pradesh** The aquifer mapping program undertaken by CGWB, has been beneficially utilised by the state government of Madhya Pradesh to plan and implement various GW recharge initiatives

		across the state. Select such cases provided below: • Based on the recommendations of NAQUIM, state govt. has finalized Water conservation/ Artificial Recharge sites in 9 blocks in districts of Chattarpur (3), Tikamgarh (3), Panna (1), Damoh (1) and Sagar (1) • 18 successful wells were constructed and handed over to the State Govt for water supply based on NAQUIM studies in parts of Bundelkhand region • Madhya Pradesh State Employment Guarantee Council is implementing water conservation and artificial recharge interventions as per NAQUIM studies reports for Ujjain District. Source: CGWB • However Independent experts commented that in addition to improving the quantity we need to improve the quality, reliability and availability of data related to depleted aquifers. It is also important that we analyse the data and prepare actionable recommendations based on the data. **Case Study- Groundwater Management in Palla Well Field of Delhi Using Numerical Modelling Technique**

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		The Palla well field of Delhi is a model of sustainable groundwater development and management practices. A battery of ninety tube wells extract around 25-30 MGD (41-49 million m^3/day) of groundwater to augment drinking water needs of Delhi. The groundwater management policy for groundwater abstraction from the well field is based on a numerical modelling study. Source: CGWB • In Punjab, a master plan for implementation of artificial recharge structures was prepared in 2013.
		Inference: • The NAQUIM and NHP are flagship programs aimed at aquifer mapping and real-time GWL monitoring • The Atal Bhujal Yojana is being implemented in seven states across India also has an aquifer mapping component • APWRIMS capture 6 hourly data from 1,254 piezometers in Andhra Pradesh • In addition to improving the quantity we need to improve the quality, reliability and availability of data related to depleted aquifers. It is also important that we analyse the data and prepare actionable recommendations based on the data.

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• The implementation of GW recharge structures needs to be improved and O&M of the structures must be mandated.
Quality	Groundwater quality	Secondary: • In addition to the increase in exploitation of groundwater over the years, there have also been occurrences of quality related issues for groundwater. Large parts of the Ganga-Brahmaputra plains have breached the permissible limits of arsenic. High concentration of Iron (>1.0 mg/l) in groundwater has been observed in more than 1.1 lakh habitations in the country. In addition, several Arsenic and fluoride hotspots have emerged across India. Source: Central Ground Water Board
		Primary: • The national level stakeholder shared that in some coastal areas, over extraction has led to ingress of saline water. Moreover, in some states in the Ganga basin (10-15 km on either side of Ganga) like in states UP, Bihar, WB-arsenic contamination has been observed in some blocks.

		Case Study- Use of deeper aquifers in arsenic affected areas for community water supply In India, the problem of arsenic contamination of groundwater from the state of West Bengal, initially reported during the 1980's is widely known. Subsequently, the contamination was also reported from several other areas. The largest contiguous belt of high arsenic in groundwater in India is reported from the shallow alluvial aquifers in the Ganga Plain. In this part arsenic contamination has been reported from nearly 66 Districts in 6 States (West Bengal, Uttar Pradesh, Bihar, Jharkhand, Haryana and Delhi). The problem is compounded by the fact that the drinking water supply in these densely populated areas is dependent on shallow aquifers, which are found to be contaminated. In detailed investigations undertaken by CGWB under the NAQUIM, it has been found that wherever the deeper aquifers are separated from the shallow aquifers through a clay barrier, these are safe from arsenic contamination. A suitable well design has been developed by CGWB for tapping the deeper aquifers for arsenic safe water supply. The wells are constructed by tapping the arsenic safe deeper aquifer zones and separating the tapped deeper aquifer zones in the wells from the overlying contaminated shallow aquifers through cement sealing technology.

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		The States of Uttar Pradesh and West Bengal are replicating the well design proposed by CGWB for construction of arsenic safe wells for public water supply. Source: CGWB
		• In the industrial clusters in Himachal Pradesh, GW pollution is mainly due to ineffective handling effluents by the industries • In Karnataka, over exploitation of GW and no natural/artificial recharge has led to quality degradation with time in some blocks. The quality of groundwater is envisaged to be controlled by preventing industrial pollution, wastewater treatment, rainwater harvesting and artificial recharge • In Andhra Pradesh, industrial pollution has led to quality issues in some pockets. In coastal areas, below 500-600 ft saline ingress is observed • In some parts of south-west Punjab, salinity problems have been observed.
		Inference: • The quality of groundwater can be improved by preventing industrial pollution and undertaking wastewater treatment, rainwater harvesting and artificial recharge.

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• Salinity problems in coastal areas (due to over-extraction) and arsenic problems in gangetic plains exist but some of problems can be alleviated by adoption of suitable innovative measures like specially designed wells.
Water Security	Using recycled water for agriculture	Secondary: • Reuse of treated wastewater in the irrigation sector is mostly prevalent across the world with 32% of reuse application. However, the major challenge in using recycled water for agriculture is to shift from informal and unplanned use of partially or untreated wastewater to planned safe uses Source: WWAP (United Nations World Water Assessment Programme). 2017. The United Nations World Water Development Report 2017. Wastewater: The Untapped Resource. Paris, UNESCO
		Primary: • In Andhra Pradesh, not much has been done especially since wastewater collection in rural areas is not prevalent • In Uttar Pradesh, STPs have been installed as a part of NMCG. However, for reuse of treated wastewater, awareness should be generated at the community level • A national level stakeholder shared that NMCG has been the flagship program in this sector. . In

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		recent times NMCG is trying to improve use of treated wastewater in agriculture – e.g. in Haridwar STP, canals are being built to carry treated wastewater to agricultural fields • The independent experts pointed out that, reuse in peri-urban areas and areas near STPs may be easier from implementation perspective. However initial pricing is required to be low to encourage adoption. Moreover, treated wastewater can act as an assured source of supply for the farmers. • Currently Punjab is using around 300 MLD (implemented using state funds) of treated water in agriculture. In the intervention underground pipes have been installed in the areas adjoining the sewage treatment plants and that water is supplied to agriculture sector **Case Study- Reuse of wastewater in Punjab** The state government of Punjab is using treated wastewater in agriculture. The treated water from the STPs goes directly to the farmland via underground pipelines, from which farmers can irrigate their agricultural land. Currently the STPs are located in Mukerian (4MLD), Talwara (4MLD), and Sham Chaurasi (3 MLD). In addition, in Shahpur a 30 MLD STP is being constructed (under AMRUT) and its treated wastewater is being used for agriculture.

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		Farmers are happy to use the treated wastewater because earlier they were using the untreated water. Treated wastewater is more nutritious than the groundwater and they are getting good yield. The treated wastewater quality is examined through the labs every quarter. This water is rich in nutrients and consumption of fertilisers has also decreased. Source: KII with Punjab stakeholder • In Maharashtra, wastewater reuse for agriculture has been attempted from 3 STPs in Solapur • However, planned reuse of treated wastewater in agriculture has not been attempted in large scale in Assam, Jharkhand, Rajasthan, Tamil Nadu, Manipur, and Telangana <u>Household Survey insights</u> • Household Survey conducted across 11 states revealed 70% of the farmers are willing to use recycled wastewater in case the government mandates the same. • Among farmers not willing to use treated wastewater for agriculture, fear of losing crops was cited as the main reason for the same.

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		Inference: • NMCG has been the flagship program in this sector. In recent times, NMCG is trying to initiate/incentivize use of treated wastewater in agriculture. • Certain states like Punjab and Maharashtra are aiming to undertake reuse of treated wastewater in agricultural sector on a larger scale • Huge potential of wastewater reuse exists in Uttar Pradesh due to the NMCG projects • Reuse in peri-urban areas and areas near STPs may be easier to be implemented. However initial pricing is required to be low to encourage adoption. Treated wastewater can act as an assured source of supply for the farmers.
Overall nature and responsiveness of Water sector planning	Coordination between the various central government level organisations and the state government departments	Secondary: Water is a state subject as per the Constitution of India. Therefore, the institutional structure and departments at state level for implementation of water resources sector related planning, are key to ensure efficient planning and implementation in the area. Greater coordination between the various central government level organisations and the state government departments is required going forward.
		Primary: • A national level stakeholder has mentioned that water being a state subject, coordination

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		among states is required. The central government has been acting as the mediator in implementing various river interlinking projects • In Andhra Pradesh, stakeholder suggested that role of rural development department should be reduced in water sector related activities. The Irrigation and Agriculture department can take up these activities. Implementation of SCADA in select projects has led to better coordination between irrigation and agriculture departments • For better coordination, fortnightly meetings may be undertaken. Currently there exist coordination issues • In Karnataka, multiple agencies and department undertake water conservation and artificial recharge initiatives. This may lead to duplication of effort. • Two different departments operate in Manipur - WR and CADA. Coordination issues exist between Water Resources, CADA, Agriculture and Horticulture departments • In Punjab, stakeholder mentioned that irrigation being the pivot of agriculture, there is need for much more coordination between water resources department and agriculture department. • In Uttar Pradesh, coordination among state departments is good, however the stakeholder

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		mentioned that liaison with Central Government can be further improved • In Maharashtra, government had formed river basin organizations and 5 such organisations (or corporations) exist. These Multi-disciplinary organizations consisting of agriculture, groundwater, surface water and all other related departments working together. However, the integration expected in the river basin organizations did not materialise. **Case Study- Tennessee Valley Authority – a River Basin Organisation** The Tennessee Valley Authority (TVA) is a federally owned corporation in the United States created in the year 1933 to provide navigation, flood control, and land management for the Tennessee river system as well as undertake electricity generation, fertilizer manufacturing, environmental and economic development of the Tennessee Valley region. TVA was envisioned not only as a provider, but also as a regional economic development agency that would use federal experts and rural electrification to help modernize the rural region's economy and society. Since 1933, TVA has worked to make life better for the people of the Tennessee Valley region, which spans

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		80,000 square miles across parts of seven states in the Southeast USA. Source: TVA website **Case Study- Damodar Valley Corporation – a River Basin Organisation in India** The Damodar Valley Corporation (DVC), established in the year 1948, came into existence as the first multi-purpose river valley project of independent India. As on date, DVC functions as a river basin authority, of the Damodar valley area spanning across the states of West Bengal and Jharkhand. DVC undertakes the following key activities with the ultimate objective of socio-economic development of the Damodar Valley area: • Power supply including hydro-power generation in the area • Flood control activities • Irrigation and water supply related activities • Soil conservation in the valley Source: DVC website
		Inference: • Overall, most states stated that greater coordination between irrigation and agriculture department is required

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• Water being a state subject, in case of inter-state river disputes and river interlinking projects, better coordination is necessary
Sustainability	Gap between demand and supply of water	Secondary: • A WRG 2030 study states India may be facing a supply deficit of 50% vis-à-vis actual demand by 2030, driven by rapid growth in agricultural, municipal and domestic sector demand • India should face the worst scarcity in terms of percentage of demand when compared to the other countries • 6% loss in the country's GDP anticipated by 2050 due to water scarcity (CWMI, 2018) Source: 2030 WRG
		Primary: • National level stakeholders and independent experts suggested the following to decrease the demand supply gap o Improved GW management o Better regulatory system o Improve water use efficiency in agriculture o Strengthening micro-irrigation o Working on crop diversification o Reuse of treated wastewater in agriculture/industry o Recharge and conservation of water o River rejuvenation

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		○ Design, management and O&M of irrigation infrastructure keeping in view various climate change aspects • The stakeholder from Punjab also agreed that the gap between demand and supply of water needs to be addressed by the following: ○ Reduce area under water intensive crops like paddy ○ Promoting micro-irrigation of alternate crops like cotton and horticulture ○ Reuse of treated wastewater
		Inference: • The gap between demand and supply of water needs to be reduced through interventions related to both supply and demand side of water
Gaps in broad sectoral outcomes	Efficient groundwater management and technologies	Secondary: • India is one of the world's largest groundwater users, accounting for more than 25% of the global total. As per the estimates of the Central Groundwater Board, share of bore well irrigation went up from just 1% (1960-1961) to 60% (2006-2007).
		Primary: • Stakeholder from Himachal Pradesh suggested that better technology and more scientific

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		instruments are required to improve groundwater management • In Andhra Pradesh, 6 hourly data from 1,254 piezometers are being measured and recorded in the APWRIMS website. In addition, geo-tagging of approx. 14 lakh bore wells spread across the state has been achieved. The department further plans to perform yield test and aquifer performance tests based on available field data **Case Study- APWRIMS- Water information system of Andhra Pradesh** Andhra Pradesh Water Resources Information and Management System (APWRIMS), is a comprehensive water information system, developed by the Water Resources Department, Government of Andhra Pradesh. APWRIMS not only includes real-time information on reservoir water storages of Major and Medium Projects, but also storages in minor projects, minor tanks, water conservation structures (check dams, percolation tanks). Additionally, APWRIMS also provides data related to groundwater from 1,254 piezometers (6-hourly data) and soil moisture. Under this project, geo-tagging of approx. 14 lakh bore wells spread across the state has also been achieved. The information related to the various aspects of the water

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		sector is collected in real-time from diverse information sources including on ground measurements, satellite-based assessments from Satellites/ models/ IMD/ ISRO/ WRD, among other sources. The WRD, GoAP was also awarded the first prize in the NWM 2019 awards (Category-Comprehensive Water Data Base in Public Domain) for APWRIMS. Source: APWRIMS website and KIIs with stakeholders in Andhra Pradesh • Under National Hydrology Project of the GoI, real-time GWL monitoring is being implemented through telemetry system
		Inference: • Real-time data for GWL monitoring using advanced telemetry is required for efficient management of groundwater resources.
Gaps in broad sectoral outcomes	Wastewater reuse policy	Secondary: Wastewater reuse policy mandating the use of treated wastewater especially for industrial sector is required for all states
		Primary: • NMCG is working with GIZ to develop a framework for treated wastewater reuse

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• Wastewater reuse policy exists for the states of Karnataka, Jharkhand and Punjab- implementation needs to be further strengthened • HP is planning to introduce wastewater reuse policy
		Inference: Wastewater reuse policy exists in a few states and the implementation of the reuse initiatives needs to be strengthened. More states need to adopt wastewater reuse policy.
Gaps in broad sectoral outcomes	Need for water regulator for all states and /or central	Secondary: The national water policy 2012 talks about setting up a water regulator to manage various issues around water. Considering the enormous challenges in water sector, lack of a water regulatory authority is hampering the growth of this sector. With multiple disputes around water resources, supplies etc., there is an urgent need of a regulator to create proper legislation, regulations for private sector participation and innovative financing mechanism
		Primary: • National level stakeholder and Independent Experts suggested that there is scope and need for a regulator to issue such as competing uses of water and allocating water resources across drinking, industrial and irrigation sectors • Karnataka suggested that a state level regulator is required to levy tariff

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• Independent water regulator is required to look into various issues like tariff setting, water quota allocation, equitable distribution, dispute resolution, water use efficiency promotion, etc. The regulator being third party (neither part of government nor from other stakeholders) can perform effectively without bias. **Case Study- Maharashtra Water Resources Regulatory Authority (MWRRA)** The Maharashtra Water Resources Regulatory Authority formed in the year 2005 is the first independent water regulatory body in India. The Established under the MWRRA Act, the authority establishes a regulatory mechanism for overseeing the relationship between the service provider and water user entities as well as among the various water user entities, in terms of determination, enforcement and dispute resolution of entitlements and fixing of water charges, in the state of Maharashtra. The regulator regulates activities across the water sector in Maharashtra- starting from supply side- surface water and groundwater as well as the demand side- industrial sector, domestic sector, agricultural sector and commercial sector. MWRRA also regulates

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		wastewater treatment and wastewater reuse related activities. Challenge: MWRRA currently does not have any field agencies to monitor the implementation of the various initiatives and check compliance of the same. Source: MWRRA website; KII with stakeholder
		Inference: Independent Water regulator is necessary to address issues such as competing uses of water and allocating water across drinking, industrial and irrigation sectors
Gaps in broad sectoral outcomes	Capacity building of the organisations/utilities creating and managing Water Resources infrastructure and providing service	Secondary: Lack of capacity of the departments / utilities managing water resources and the service delivery is leading to poor water management. There is a serious need of involving the community (end beneficiary) in the process of management of these infrastructures for optimum use. Similarly, the capacity available in the private also should be tapped for bringing in efficiency in the management systems.
		Primary: • The national level stakeholder mentioned that Krishi Vikas Kendras situated across the country impart training to the farmers and the government officials at the state/district level

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• Independent Expert shared that knowledge or capacity needs to be built in areas related to climate modelling, hydrological modelling and similar advanced aspects • In Bihar, more capacity building activities are required for micro-irrigation and crop diversification aspects. WALMI is currently providing trainings in Bihar • In Karnataka, capacity building to undertake O&M of water supply and sewerage assets of ULBs is necessary • In Manipur, capacity building in latest technologies and new instruments being installed as a part of NHP is required • In Punjab, local awareness generation programs are regularly held by Punjab Agricultural University • In HP, engineers in the PHE or other engineering departments need capacity building in social skills. **Case Study- Odisha – AMRUT Orientation Program** The Government of Odisha in association with MoHUA (GoI) organises structured capacity building at regular intervals, for the various Municipal functionaries across the state who oversee implementation of the various AMRUT projects in the state. The various agencies who

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		have provided required capacity building activities for AMRUT (both technical and managerial) are: 1) Centre for Science and Environment, New Delhi 2) Indian Institute for Human Settlements, Bangalore 3) All India Institute Of Local Self Government, Mumbai 4) National Institute of Urban Affairs (NIUA), New Delhi 5) World Bank (under Capacity Building for Urban Development- CBUD) Source: KII with Odisha stakeholder
		Inference: Capacity building of departments, ULBs and organizations involved in management of water resources is essential in areas such as soft skills, new technologies, micro-irrigation and crop diversification.
Convergence	Scheme convergence	Secondary: • The major objective of PMKSY has been to achieve convergence of investments in irrigation sector. However, seeing the irrigation sector in isolation has led to duplication of efforts. There are several central government ministries in addition to MoJS like MoA&FW,

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		MoHUA, MoRD, etc implementing programs related to water sector. Source: Refer to Fig 22,23 and 24 of Inception report for further details
		Primary: • The national level stakeholder mentioned that the GoI is striving to achieve greater convergence among schemes. Creation of new small storage structures and water bodies in convergence with MGNREGA is being attempted • Greater convergence is being attempted between Jal Jeevan Mission and Atal Bhujal Yojana • Greater convergence is being attempted with MNRE for solar interventions in the sector • The NWM is trying to promote and implement "Catch the Rain" initiative (decentralised rainwater harvesting structures) in convergence with MGNREGA • In Punjab, Uttar Pradesh and Andhra Pradesh, convergence is being tried with MGNREGA **Case Study- NMCG Convergence** The National Mission for Clean Ganga (NMCG), is trying to converge various available fund

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		sources to achieve its objective of clean Ganga. Some key initiatives are: 1) Programme for promotion of afforestation in convergence with MoEF&CC (with CAMPA funds) to attend to the issue related to agricultural runoff and pollution 2) Program for Organic farming all along ganga river in convergence with Ministry of Agriculture and Farmer Welfare. Under the initiative, there are plans to undertake organic riverbed farming in 5-7 km belt along the river Ganga. Source: KII with stakeholder
		Inference: • There is increasing focus on convergence both at National and state levels. Creation of new small storage structures and water bodies in convergence with MGNREGA is being attempted. Other areas are use of solar power and agriculture, which are also being tried.
Gaps in broad sectoral outcomes	Staffing levels	Secondary: • Present staffing levels are ten times that of international norms, and most public funds are now spent feeding the administrative machinery, not maintaining the stock of infrastructure or providing services.

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		Source: India's Water Economy: Bracing for a Turbulent Future – WBG
		Primary: • In Bihar, there was no regular recruitment after 1994. So the WRD department is under staffed • In Karnataka, the stakeholder mentioned that in terms of permanent staff, the authority was under staffed • In Manipur, the stakeholder informed that staff numbers at lower levels were less • A national level stakeholder shared that CWC and its regional offices are understaffed • Another national level stakeholder mentioned that state groundwater departments are understaffed and have a very skeletal structure. AP state GWD stakeholder confirmed the same. • HP stakeholder shared that field staff were less in number. **Case Study- Telangana agriculture staffing** The Department of Agriculture, Government of Telangana had envisaged to increase the staff strength in its department including extension and district offices. Therefore, from 2017 onwards, for every 5,000 farmers, one agricultural extension officer was recruited. For instance, the state has 77 agricultural extension officers working in one district

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		(Narayanpet) and around 1,800-2,000 farmers come under each officer's jurisdiction. Earlier one officer used to cater to around 40,000 farmers. Due to fresh recruitments, that gap has been reduced and the farmers are benefiting as the department is able to provide better service. Source: KII with stakeholder
		Inference: • Most states mentioned that they are under-staffed during the primary survey. This is in contrary to the findings from the secondary research.
Gaps in broad sectoral outcomes	Financing in the sector	Secondary: • Staffing levels are ten times international norms, and most public funds are now spent feeding the administrative machinery, not maintaining the stock of infrastructure or providing services. On the "supply side" there are ultimately only two sources of financing – tax revenues and user charges • Poor management and maintenance of water supply projects leading the system to be termed to have the implicit philosophy of Build-Neglect-Rebuild Source: India's Water Economy: Bracing for a Turbulent Future – WBG

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		Primary: • The National level stakeholder informed that due to no revenue collection and low payment by WUAs, PPPs in the sector has not been possible **Case Study- PPP- Guerdane Irrigation Project, Morocco** To confront the growing environmental damage and help farmers achieve sustainable growth, IFC assisted Moroccan officials in 2004 to design the world's first irrigation public-private partnership (PPP). IFC structured a project introducing drip irrigation that brought nearly $40 million in private investment into the region and created hundreds of local jobs. Key features of the project are mentioned below: • Design-Build-Operate based on a 30-year concession contract • Government subsidy provided in form of 25% initial investment and soft loans to the tune of $25 million (total estimated cost was $105 million); balance was borne by the private contractor • To minimize revenue risks, users needed to pay an upfront subscription fees plus a variable component; revenue deficit due to water shortages (the project being

		in a drought prone area) to be shared between the parties with private concessionaire's loss capped to 15% while users need to partly bear the loss through increase in water charges • Concessionaire agreement was signed in 2006 and the project achieved a 100 percent connection rate by 2009 Source: Public-Private Partnership Impact Stories- Morocco: Guerdane Irrigation- IFC • Independent Expert shared that for dams revenue generation from tourism is a possibility • In Bihar, Revenue collection has not been adequate due to less manpower and farmers often don't come to the office to pay since it is far away and they will incur costs. • In Bihar, under Participatory Irrigation Management (PIM); the department is handing over certain canals to the empanelled agencies after construction for O&M only. They are mandated to collect the required revenue. 30% of the fees is to be shared with Govt and the remaining 70% is to be used for O&M. However, collection has been inadequate and the contractor has defaulted in payments • In Karnataka, urban water supply related schemes have received capex funding from various Central government and state government schemes like AMRUT. The O&M funds are however to be met only from tariff

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		which has been inadequate. Therefore, currently electricity bills are directly paid by the Government after deducting from Finance Commission grants • In AP, rural water supply schemes are receiving capex funds primarily from the State Government and select IFIs (in addition to JJM where Central funding is being provided to provide HH connections to all rural HHs across all states). For O&M GP/ZP funds (Finance Commission grants) are utilised • In case of NMCG- CSR funding and Clean Ganga Fund are being used in addition to Central Govt fund. • In Manipur, WUAs have been formed, however collection remains poor. There is lack of O&M funds
		Inference: • Funds for O&M of assets created both in Irrigation and Drinking water have been an issue • Poor collection is an issue • PPPs in irrigation has not been attempted in a significant way
Gaps in broad sectoral outcomes	Project Management issues and slow project execution	Secondary: • Project Management issues and Slow project execution are teething issues

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		Source: Report of the working group, MoWR • Currently majority of the irrigation projects in the country face issues related to time and cost overruns. The major and medium irrigation projects in India suffered from cost overrun to the extent of Rs. 1.20 Lakh Cr. In addition, approximately 105 projects faced time overrun issues with the duration of time overrun ranging up to 18 years Source: Report of the Comptroller and Auditor General of India on AIBP, 2018
		Primary: • Karnataka and HP stakeholders mentioned that projects are delayed mainly due to government approval and land acquisition issues. The independent expert supported these reasons • In HP natural calamities and long winter seasons also lead to delays • In Odisha, implementation delays occur partly on account of inadequate quality of DPR and initial cost estimates • Manipur stakeholder informed that land acquisition, rehabilitation and environment clearance issues delay projects

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		Inference: • Land acquisition and rehabilitation leads to delay in water sector related projects
Gaps in broad sectoral outcomes	Enforceable water entitlements	Secondary: • Lack of stringent governance on water use inefficiency, unregulated groundwater extraction, negligence of traditional and low-cost water bodies. Inadequate legal and financial checks to ensure groundwater resources are developed only in safe and semi-critical areas Source: Water Resources Development in India: Critical Issues and Strategic Options
		Primary: • In Karnataka and Himachal Pradesh, State GW authorities have regulations to monitor and control withdrawal of GW. • However enforcement has not been very good primarily due to capacity issues • In Maharashtra, user wise Water entitlements, have been decided by MWRRA. However, MWRRA does not have adequate staff to make sure enforcement is done. They are planning to have enforcement commissioners in the future to attend to this.

Case Study- Water entitlement and trading in Murray Darling Basin, Australia

The Murray–Darling Basin Authority operates the River Murray on behalf of New South Wales, Victoria and South Australia. Under the Murray–Darling Basin Agreement, the Murray–Darling Basin Authority determines the amount of water available to each state each year. The various state governments work with the Authority to provide an allocation of water to their entitlement holders. To access water in the River Murray, an entitlement holder places a water order directly with their state water agency.

Water in the Murray–Darling Basin can be bought and sold. This water is traded on markets – within catchments, between catchments (where possible) or along river systems. This form of trading allows water users to buy and sell water in response to their individual needs (mainly surface water and some groundwater).

Water trading (from the entitlement) helps Murray–Darling Basin farmers to make more productive use of water and contributes to sustainable water management. Water trading in the Basin is worth about $2 billion annually.

Source: Website of Murray–Darling Basin Authority

Inference:

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• State GW authorities have regulations to monitor and control withdrawal of GW. However, enforcement has not been very good primarily due to capacity issues • MWRRA has allocated water entitlements to the various category of users, however the enforcement of the same requires improvement.
Sustainability	Urban Water Consumption	Secondary: • The urban population consumption is at 195 litres per person per day (global average of 135 litres) Source: Water for the Future- Challenges for India and its industries, 2012, Frost & Sullivan
		Primary: • In Karnataka, studies have revealed approximately 110 lpcd water is supplied 24x7 in a specific ULB. The quantity increases by 15% during summers. The NRW losses ranged from 15% to 40% in some of the ULBs. The lpcd calculations were done at the supply end and therefore includes NRW losses • In HP, currently 135 lpcd water is supplied in the urban areas. However, this includes NRW losses. The authority has tried to reduce wastage by billing all public taps. In addition, meters are installed at all consumption points (including bulk water meters). The department

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		gets to know the leakages in the main line due to this. So, leakage detection in the primary grid is being done. However leakage detection in distribution network is yet to be undertaken • In Rajasthan urban water supply goes up to 275 lpcd • In Odisha, urban water supply is around 275 lpcd and includes high NRW losses
		Inference: • High NRW losses inflate the per capita consumption by urban water users. Consumer-end metering would indicate actual consumption.
Sustainability	O&M and lack of financing- rural water supply	Secondary: • Estimated NRW is between 40-70% of the water distributed. About 82% of rural households in India do not have individual piped water supply; however physical rural water coverage is estimated to be 81%. Government of India has recently launched Jal Jeevan Mission (JJM) which targets to provide piped water supply connections to 100% of the households by 2024 Source: Urban Water Supply and Sanitation, The World Bank
		Primary:

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		• In AP, O&M of rural water supply schemes are primarily done using Finance commission funds (received by GPs/ZPs). Improvement in metering and tariff collection can further augment the existing O&M funding sources • Currently in AP, metering is being done only in a few pilot projects • For O&M financing- NABARD and in some cases CSR funds are being utilised. In most cases GP/ZP funds (Finance Commission) funds are being used **Case Study- Efficient rural water supply O&M in Maharashtra** Maharashtra Water Supply and Sewerage Board (MWSSB) was established as per MWSSB Act 1976 for rapid development and proper regularization of water supply and sewerage services in the state. MWSSB was subsequently named as Maharashtra Jeevan Pradhikaran (MJP) in 1997. The authority is responsible for implementing the rural water supply schemes and undertakes O&M of multiple rural water schemes. It hands over some rural water schemes to GPs but many schemes are being managed by them. The authority also collects tariff from the users in case it undertakes the O&M itself. In case O&M is undertaken by the GP/ZP, they collect

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		the appropriate tariff charge from the GP/ZP, who in turn recovers it from the consumers. Source: MJP website and KII with stakeholder
		Inference: • The JJM will aim to provide household connection to all rural households by 2024 • Sustainable O&M of RWS schemes is currently a major issue
Overall nature and responsiveness of Water sector planning	Groundwater Level Monitoring	Secondary: • Currently, CGWB monitors groundwater levels four times a year through a network of 23,125 observation wells as on 31.03.2017, which are spread throughout the country. Moreover, the CGWB undertakes detailed groundwater assessment studies across 6,881 assessment units (Blocks/Mandals/Talukas/Firkas) in the country (2017) Source: Dynamic Ground Water Resources of India, 2017 (Published on July 2019), Central Ground Water Board, Ministry of Water Resources and Reassessment of water availability in basins using space inputs, Central Water Commission, June 2019
		Primary: • As per data received from CGWB, as on March 2020, CGWB has a total of 22,730 monitoring

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		wells throughout India which includes 16,375 Dug Wells and 6,355 Piezometers for monitoring GWL. The national level stakeholder mentioned that in addition to the above, approx. 50,000+ monitoring wells have been installed by various state level monitoring agencies. The density of monitoring wells may be further improved. However, it depends upon the aim of monitoring • Both the states of Himachal Pradesh and Karnataka have suggested that number of monitoring points need to be increased • Automatic GWL recorders based on telemetry are required • In hilly areas, separate study needs to be done to determine the adequate number of piezometers • In Punjab, both manual and automatic monitoring systems for recording GWL are in place. Participatory monitoring is also undertaken. NHP is further strengthening the monitoring ecosystem **Case Study- National Hydrology project for innovative GWL monitoring** In order to strengthen the monitoring program, under National Hydrology Project (a World Bank aided project), all the State agencies and central agency (CGWB) are installing DWLRs

		(Automatic Digital Water Level Recorder) and data is being acquired through telemetry. In CGWB, bids have already been floated for 3,400 DWLRs with telemetry for acquiring data through telemetry two times a day (0600 Hrs & 1800 Hrs) and bids for 60 DWLRs with water quality probes are to be floated. Similarly, in other States, the bidding processes are in various stages and in total about 6,000 DWLRs are proposed to be procured by various States under NHP. The water level monitored by DWLRs would be transmitted to various data centers of State and CGWB and thereafter transmitted to Water Resources Information System (WIMS), a common database being maintained by NPMU and thereafter sent to India- Water Resources Information System (India-WRIS) for data dissemination. The manual data collection will continue till the automatic measurement is strengthened with higher requisite numbers to make the monitoring more robust. Source: CGWB • In Karnataka- State GWB and CGWB together have monitoring stations. However, based on analysis, additional 50 stations are required • In Karnataka technology used for GWL monitoring are ○ Manual monitoring by officials

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		○ Participatory monitoring involving SHGs and volunteers who have been trained to monitor- GP etc- based on nominal payment; the same is being recorded locally and shared by phone, postcard etc. Numbers are being ramped up ○ Automatic recording using telemetry- there are a few, more is being procured; given the higher cost, there is a need to optimize.
		Inference: • The number of GWL monitoring wells need to be increased based on the terrain and specific requirements • Automatic GWL recorders may be installed and optimised
Overall nature and responsiveness of Water sector planning	Conjunctive use of surface and groundwater	Secondary: • Conjunctive use of surface and groundwater consists of harmoniously combining the use of both sources of water in order to minimize the undesirable physical, environmental and economic effects of each solution and to optimize the water demand/supply balance. Usually conjunctive use of surface and groundwater is considered within a river basin management programme Source: FAO

Key Evaluation sectoral objective	Area of enquiry	Findings from the research
		Primary: • National level stakeholder suggested that conjunctive use of SW and GW is happening. However due to different implementing agencies, unification for better planning is required • In Punjab, conjunctive use of SW and GW is undertaken in areas where there is the issue of soil salinity
		Inference: • Conjunctive use of SW and GW may be strengthened, better coordination between agencies and unification for better planning is required
Overall nature and responsiveness of Water sector planning	Water for environmental needs	Secondary: • Environmental water requirement was 5 BCM is 2010 and estimated to increase to 10 BCM in 2025 and 20 BCM in 2050 Source: NCIWRD estimates
		Primary: • No additional insights on this enquiry area
		Inference: • There is need to provide for environmental water requirement

1.2.2 Benchmarking of Broad Sectoral Outcomes

This section has been used to benchmark the broad sectoral outcomes with focus on Irrigation sub-sector. Key observations from each benchmarking exercise has also been summarised.

Water storage capacity

Total water storage capacity of all dams in the country is an important indicator as stored water serves as a buffer stock for water during scarcity periods. Stored water takes care of seasonal, geographical and annual variation in availability of water resources in the country since unavailability of adequate storage of substantial quantity of water, especially during monsoon season, remains unused and flows into sea. As illustrated in the figure below[23], India's total dam storage capacity of 253 BCM is considerably less when compared to other countries. Further per capita water storage is also low in India. This makes it possible to store small quantity of water from the seasonal rainfall.[59]

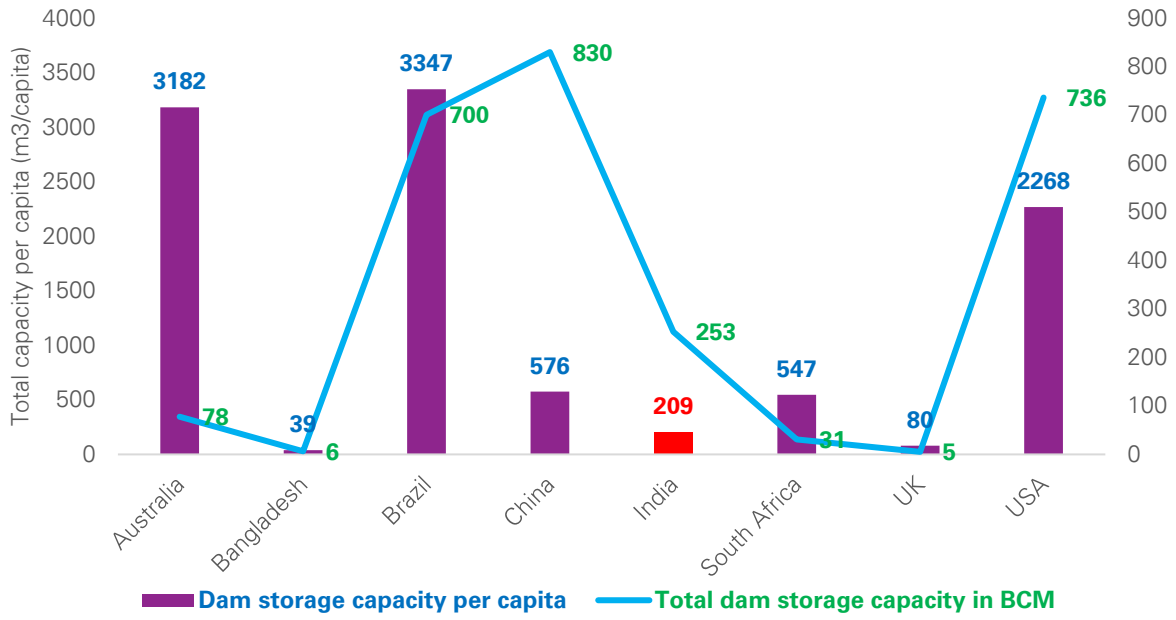


Figure 18: Water storage capacity comparison

Water resource utilization

[59] Press Release from MoWR, 2012

Comparison of India with other major countries in the world in terms of the total water withdrawal per capita and GDP per capita (in current USD per capita) is provided in the figure below. It is evident from the figure below, that India is among the low performing countries when it comes to efficient water resource utilisation per unit GDP. For example, while USA's GDP per capita is approximately 35 times that of India's, its annual water withdrawal per capita is approximately only two times that of India. In fact, countries such as UK, Australia, and China have GDP per capita higher than that of India but similar or lower capita water withdrawal[60]. India therefore has made its economic activities highly water intensive.

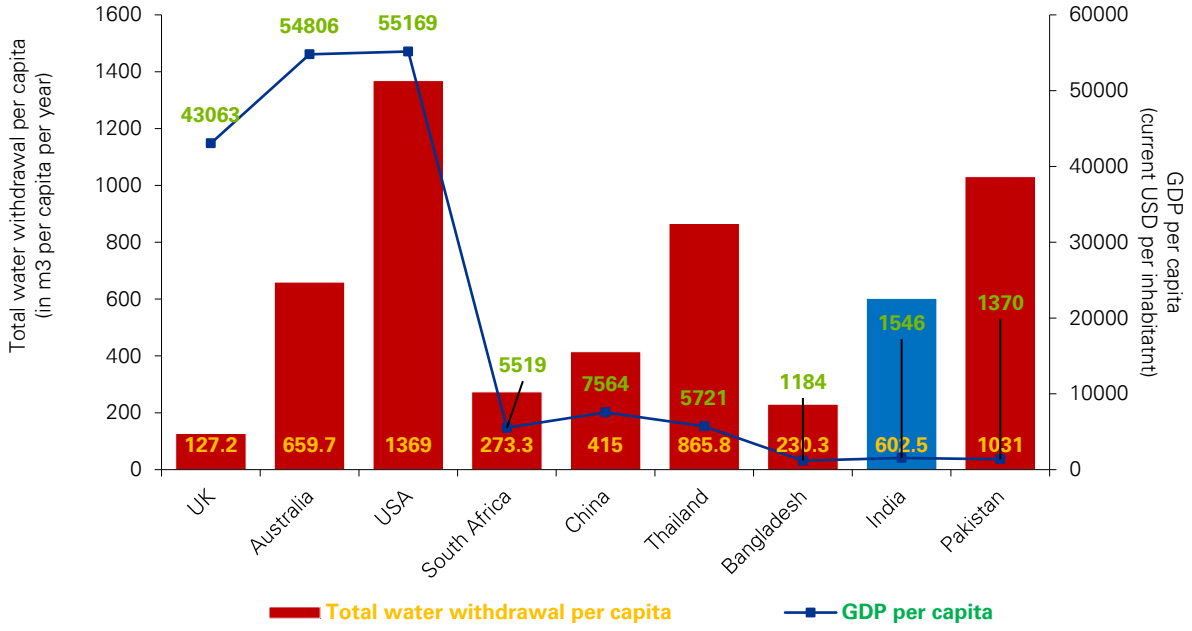


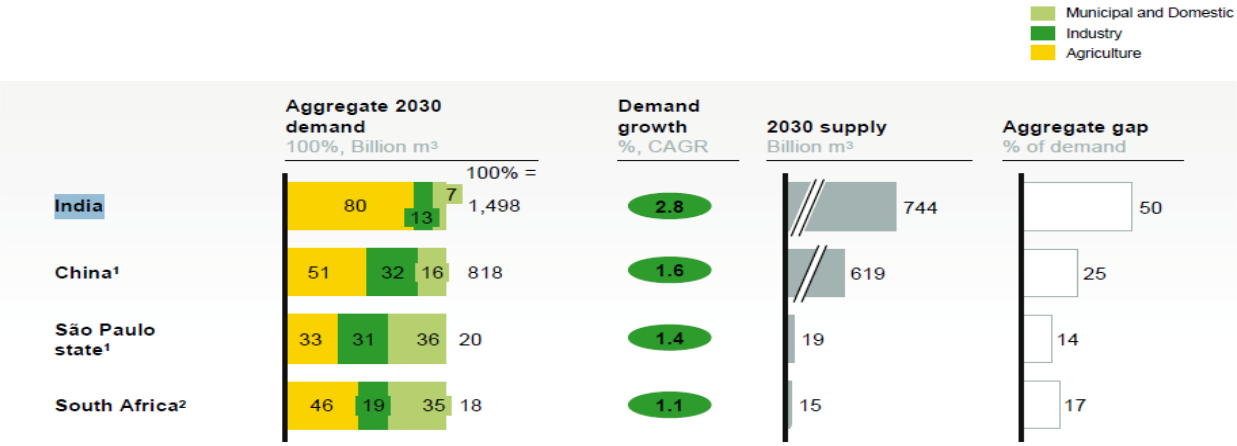
Figure 19: Country comparison on total water withdrawal per capita

Demand supply gap

Various estimates related to the demand supply gap of water resources in India in the future are available. The absolute numbers vary based on the models considered during water demand or supply estimation. However, the increasing gap between demand and supply of water is an

[60] AQUASTAT database of the Food and Agricultural Organisation of the United Nations

established fact, not only for India but also for other countries. The figure below compares the demand supply gap for four countries. The model calculated the gap between projected 2030 demand and existing supply based on commonly accepted projections of economic and population growth. As estimated by the author, India may be facing an aggregate gap of 50% of the actual demand by 2030, mainly driven by rapid growth in agricultural, municipal & domestic sector demand. India faces a large gap between current supply and projected. Climate change effects can further worsen the situation for India. The gap as projected by the author, shows that India should face the worst scarcity in terms of percentage of demand when compared to the other countries[22].



1 Gap greater than demand-supply difference due to mismatch between supply and demand at basin level
2 South Africa agricultural demand includes a 3% contribution from afforestation
SOURCE: 2030 Water Resources Group

Figure 20: Demand supply gap of water resources

Agriculture sector contribution to GDP

The World Resources Institute has modelled water stress for various countries and assigned water stress scores (out of 5) to all the countries[61]. India is one of the most stressed country in terms of water availability with 18% of the GDP from agriculture and 52% of the country area under cultivation[23]. With increase in area under cultivation or value of produce or cropping

[61] World Resources Institute (AQUEDUCT) database

intensity, India can further increase contribution to GDP from the sector. However, to avoid facing severe scarcity in the future; India must focus on water use efficiency in irrigation sector.

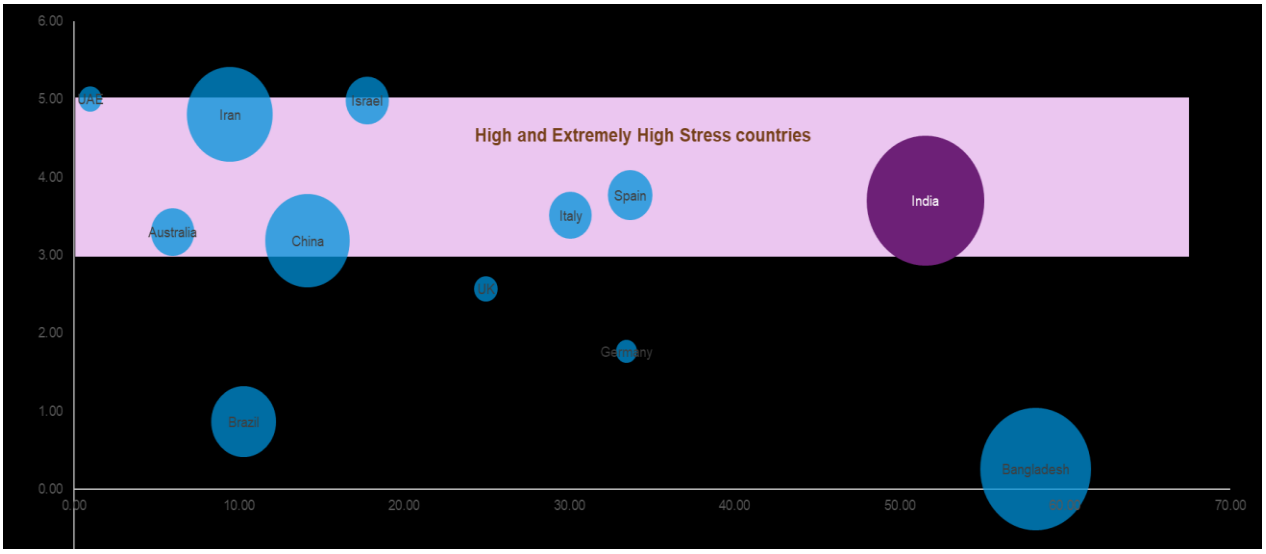


Figure 21: Agriculture sector contribution to GDP

Agriculture sector Water Use Efficiency

As per Food and Agricultural Organisation of the United Nations, the total water consumption in the agricultural sector is defined as the "*Annual quantity of self-supplied water withdrawn for irrigation, livestock and aquaculture purposes. It can include water from primary renewable and secondary freshwater resources, as well as water from over-abstraction of renewable groundwater or withdrawal from fossil groundwater, direct use of agricultural drainage water, direct use of (treated) wastewater, and desalinated water*". The total cultivated land is defined as the "*The sum of the arable land area and the area under permanent crop*". The ratio of water consumption and area cultivated is an important metrics as it signifies the water use efficiency in the agricultural sector. As evident in the figure below, India is one of the highest water consuming countries[23].

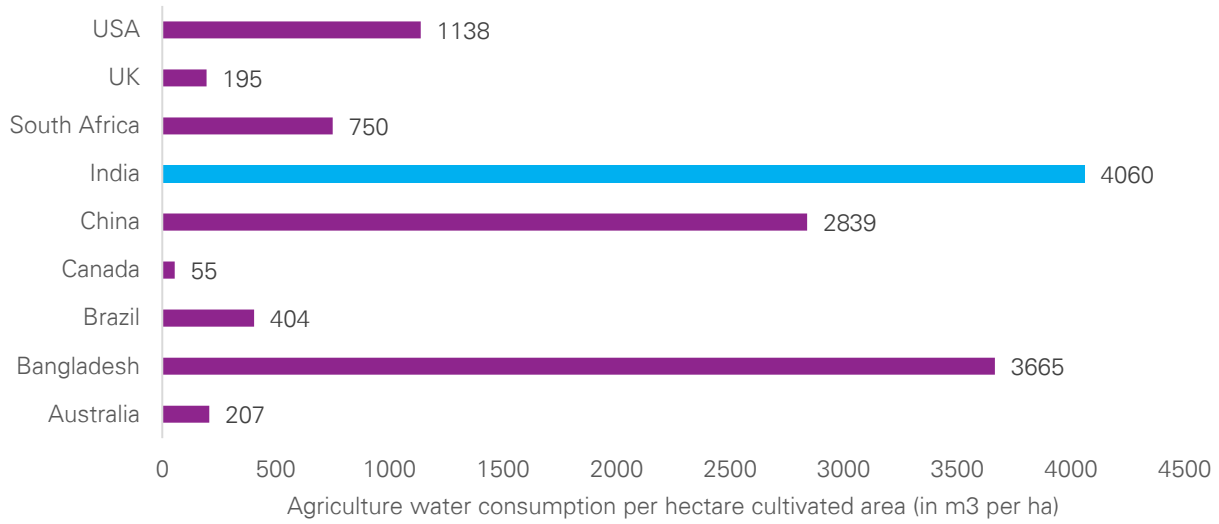


Figure 22: Comparison of water use efficiency in the agriculture sector

1.2.3 Water Security Assessment

The rapid growth and urbanization of India is unique as well as dynamic. It is currently holding the centre stage with respect to economic and population growth. However, with this growth comes increasing demands of natural resources consumption including water. This places finite water resources into an even more perilous situation. The most daunting challenge will be to increase food production in the next two decades for the growing population, while also providing water for users and at the same time meeting industrial and energy demands. The impacts of climate change as well as increasing climate variability and water-related disasters also culminate in a more challenging horizon than we have experienced in the past.

The Asian Water Development Outlook (AWDO) provides a framework along with suitable indicators to understand the current water security in a country by sub-dividing it into Household, Economic, Urban and Environmental water security. It thus captures the issues related to overall demand and supply sides of the water cycle through this assessment.

Many definitions of water security exist and most have a certain sector bias. The following definitions are the most comprehensive and most referenced as per the AWDO study:

"The reliable availability of an acceptable quantity and quality of water for production, livelihoods and health, coupled with an acceptable level of risk to society of unpredictable water-related impacts."

"The capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socioeconomic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability."

As per the AWDO 2013 study, the following shared vision of water security was formulated:

Societies can enjoy water security when they successfully manage their water resources and services to

- *satisfy household water and sanitation needs in all communities;*
- *support productive economies in agriculture, industry, and energy;*
- *develop vibrant, liveable cities and towns;*
- *restore healthy rivers and ecosystems*

From this shared vision different dimensions under the Household, Economic, Urban and Environmental water security have been examined with respect to their current status, issues and government interventions.

1.2.3.1 Household Water Security

The foundation of water security happens at the household level. Providing the entire population with reliable, safe water, and sanitation services should be the top priority of any country. From the perspective of poverty eradication and economic development, household water security is an essential foundation.

Accordingly, the key indicators of Household Water Security are:

- Access to piped water
- Access to improved sanitation

On both these fronts, India has been making progress, however with varying degree of outcomes and successes. Let us look at the current situation in the country and upcoming government initiatives.

Table 17: Summary of current status, issues and current government initiatives- Household

Current Status	Key issues	Current government initiatives
▪ In rural India only 18% of households are provided with piped water supply connections[62]	▪ In rural areas issues are manifold; few key issues include: o Limited co-ordination between the water resources department and the rural drinking water supply department during planning of water supply schemes o Lack of capacity of Panchayati Raj Institutions for management for asset ownership and long-term maintenance o Lack of innovative financing structures attracting private sector involvement in development and long-term O&M of the assets	▪ National Rural Development Programme was focused towards providing piped water supply connections to rural households. This programme is likely to be subsumed by Jal Jeevan Mission which targets to provide piped water supply connections to 100% of the households by 2024
▪ 100% of households had access to toilets[63]	▪ Possible slip backs due to lack of maintenance or falling back to old habits	Swachh Bharat's future focus areas include

[62] National Rural Drinking Water Programme database accessed on 7 November 2019

[63] Swachh Bharat Mission-Gramin Dashboard, Department of Drinking Water and Sanitation, Ministry of Jal Shakti, Government of India, accessed October 11, 2019, https://sbm.gov.in/sbmdashboard/IHHL.aspx

Current Status	Key issues	Current government initiatives
▪ 96.5% of the people with access to toilets used them ▪ 90.7% of villages which were previously declared and verified as ODF were confirmed to be ODF. The remaining villages had sanitation coverage of about 93% ▪ 97.5% households did not report to have visible garbage or litter within the premises	▪ Ensuring availability of water in rural areas is critical in sustaining the usage of toilets ▪ Solid and Liquid Waste Management – The scheme's focus on emptying and transportation, and treatment and disposal, and SLWM was relatively limited. o 63.3% of villages in India practice Solid & Liquid Waste Management (SLWM) which was far below the figures for ODF outcomes.	▪ Sustained usage of Individual Household Latrines (IHHL) ▪ Sanitation coverage of public spaces (through public and community toilets) ▪ Enhanced focus on Solid and Liquid waste management (SLWM)

1.2.3.2 Economic Water Security

Water can be treated as one of main fuel which powers any economy. The use of water in all sectors like Agriculture, Industry and Domestic is critical in enabling value addition to our GDP.

The use of water in these sectors should no longer be seen in isolation from each other. Debate about the water–food–energy nexus has begun to raise general awareness about the critical interface among water uses to support the various economic activities.

Accordingly, the key indicators of Economic Water Security are:

- Agricultural Water Productivity
- Energy and Industrial Water Productivity

Table 18: Summary of status, issues and current government initiatives- Economic

Current Status	Key issues	Current government initiatives
▪ Water productivity of main water guzzling crops like rice, wheat & sugarcane.[64] o Rice- Irrigation Water Productivity- 0.22-0.48 kg/m3 o Wheat- Irrigation Water Productivity- 0.84 kg/m3 o Sugarcane- Irrigation Water Productivity- 4.38 kg/m3	▪ Rice, wheat and sugarcane consume almost 80% of freshwater available for irrigation leading to inequity in irrigation water availability for other crops ▪ In addition to this inequity, it is worth noting that these water guzzler crops are concentrated in some of the most water scarce regions of the country like Punjab and Haryana which is leading to massive depletion of groundwater in these states o The irrigation water productivity of rice,	▪ With schemes like "Per Drop More Crop", and related policies the government is looking towards o Shifting towards production of less water guzzling crops like pulses, oil seeds o Improving water use efficiency through encouraging micro-irrigation, sprinklers, drip irrigation

[64] NABARD- WATER PRODUCTIVITY MAPPIN of MAJOR INDIAN CROPS Bharat R. Sharma, Ashok Gulati, Gayathri Mohan, Stuti Manchanda, Indro Ray, and Upali Amarasinghe

Current Status	Key issues	Current government initiatives
	wheat and sugarcane with their corresponding land productivity across major states, are nonaligned with respect to cropping patterns and available water resource	○ Increasing usage of solar power in irrigation
▪ Current specific water consumption in power sector is 5-7 m^3/MWh as per NITI Aayog estimates[65]	▪ More than 80% of the water consumption in industries is on account of thermal power plants ▪ Thermal Power Plant are failing to adhere to the regulations of the limits of water consumption as set by the Ministry of Environment, Forest & Climate Change (MoEF&CC) ○ There is less focus on reducing water footprint since water costs constitute a miniscule portion of the overall variable	▪ MoEF&CC has regulated the water consumption limit of thermal power plant to be 3.5 m3/MWh- However despite this regulation, multiple power plants are failing to adhere to these norms ▪ The government has mandated the power plants which are within 50 Kms radius of a Sewage Treatment Plant (STP) to use treated wastewater from those STPs ▪ Current focus on increasing the share of

[65] Study on Assessment of Water Foot Prints of India's Long-Term Energy Scenarios by TERI sponsored by Niti Aayog

Current Status	Key issues	Current government initiatives
	costs of a thermal power plant	renewable energy deployment will reduce dependencies on Thermal Power Plants and in turn lead to water savings
Apart from Power, two most water consuming industries are Iron & Steel and Textiles. The specific water consumption figures are: ▪ Ratio of water to textile production is 200-250 m^3 of water per tonne cotton cloth ▪ 3.5 m^3/tonne for Iron & Steel	▪ Lack of effective regulations and coordination between regulatory bodies of centre and states ▪ Lack of incentives provided to industry for efficient water use ▪ Low water tariffs even for industrial consumption	▪ Ministry of Environment Forest &Climate Change (MOEF&CC) has set a regulation for Zero Liquid Discharge (ZLD) four industrial sectors (textile (wet processing), distilleries, pulp and paper and tanneries) ▪ Multiple states like Gujarat, Chhattisgarh, Jharkhand, Karnataka, Madhya Pradesh, Haryana, Punjab and Rajasthan have come up with policies which mandates industries within a certain range of a STP to use treated wastewater to reduce the burden on freshwater sources

India's water productivity in all major segments of the economy (agriculture, industry and domestic) is poor. This is primarily on the account of the lack of appreciation towards the value of water.

It needs to be deliberated on how an adequate price should be attached to water for it to get the value it deserves. Also, it needs to be debated on how to make the economic value of water appreciated by all segments of consumers. Water costs although constitute a minor item in O&M for industries, a water scarce situation can lead to a complete shutdown.

1.2.3.3 Urban Water Security

In India, over the next few decades increasing population will start to migrate to cities as it slowly transforms from its agrarian rural societies to urban centres. Many cities will become important drivers of the economy soon in years to come.

The urban water security indicators measure the creation of better water management and services to support vibrant and liveable water-sensitive cities.

Accordingly, the key indicators of Urban Water Security are:

- Access to water supply
- Non-revenue water
- Water consumption per capita
- Percentage of wastewater treatment
- Percentage of sewerage network facilities

Table 19: Summary of status, issues and current government initiatives- Urban

Current Status	Key issues	Current government initiatives
▪ 54% of urban households have access to tap	▪ In Urban areas, the urban local bodies suffer from financial distress, lack of capacity, poor cost	▪ Ministry of Housing & Urban Affairs (MoHUA) has set targets of minimum water consumption of 135 lpcd,

Current Status	Key issues	Current government initiatives
water within households[66] ▪ Municipal water consumption per capita- 125 lpcd[67] ▪ NRW losses in cities ranges between 30-50%[68]	recovery of existing assets, high Non-Revenue Water (NRW) losses ▪ Inadequate pricing of water in many cities leading financial distress of the utilities as well as the projects ▪ Lack of adequate metering infrastructure	to reduce NRW losses to a level of 20% and provide 100% metering ▪ Programmes like Smart Cities Mission, AMRUT, HRIDAY are focused towards improvement in urban water supply schemes especially focusing on 24 X 7 water supply, reduction of NRW losses, creation of metering infrastructure ▪ Focus on innovative PPP models
▪ 51% of the domestic wastewater generated remains untreated[69] ▪ 74% of India's urban population is not connected to a sewerage network	▪ Lack of sewerage network makes many of the installed STPs non-operational since there was lack of proper planning during the development stage ▪ Lack of ULB capacity in carrying out O&M	▪ The government through National River Conservation Plan, National Mission for Clean Ganga programme is trying to: o Delink the sewerage network with the development of STPs through developing

[66] https://www.wateraidindia.in/sites/g/files/jkxoof336/files/state-of-urban-water-supply.pdf accessed on 7 November 2019

[67] White Paper for 2012 Environment and Energy Conclave by The Bengal Chamber of Commerce and Industry (BCCI) 31st August - 1st September 2012

[68] Water in India-Situation & Prospects by UNICEF

[69] Composite Water Management Index, NITI Aayog, 2018

Current Status	Key issues	Current government initiatives
	of STPs renders failure of the same ▪ Outdated technologies of existing STPs which needs renovation to adhere to the current water quality norms	Interception & Diversion Structures which will carry the sewage to the STPs o Adopting innovative business models like Hybrid Annuity Model (HAM) through which makes the private sector responsible for O& M of the assets ▪ Programmes such as AMRUT will continue to be focused towards o Development of sewerage network o Development of Faecal Solid Waste Management in cities currently without sewerage networks o Development of decentralized models of STPs

India's urban population is expected to reach 600 million by 2030. This will lead to increase in demand supply gap and will lead city administration to focus on recycle, reuse in addition to improving efficiencies of water supply, reduction of losses and attaching a deserved value to water.

1.2.3.4 Environmental Water Security

With its economic growth as priority, often environment and precious natural resources take a back seat. However, India being at the cusp of its economic growth is focused on sustainable development and inclusive growth. The water cycle is such that it ends up in the rivers after usage on all fronts of the economy. Hence without proper treatment prior to its disposal it can impact the river health which is again a source of our water consumption.

Accordingly, the key indicator of Environmental Water Security is:

- River Pollution
- Surface Water Quality

Table 20: Summary of current status, issues and current government initiatives- Environmental

Current Status	Key issues	Current government initiatives
▪ 317 polluted river stretches on 293 rivers and tributaries have been identified by CPCB ▪ About 70% of surface water resource in India are polluted. ▪ According to WHO Water quality data from CPCB shows that organic and bacterial contamination are becoming increasingly critical	▪ Outdated technologies of existing STPs which needs renovation to adhere to the current water quality norms ▪ Dumping of Industrial pollutants in addition to inadequately treated sewage leading to increase in river pollution ▪ Lack of online monitoring system in the industrial units leading to violations of regulations by the industries ▪ Inadequate capacities of Effluent Treatment Plants (ETPs)	▪ Government is following river basin approach in developing the current infrastructure through programmes such as National Mission for Clean Ganga with a focus to clean the river and maintain the flow ▪ Recent NGT guidelines recommends stringer water quality parameters for disposal into the surface water sources

Current Status	Key issues	Current government initiatives
in water bodies leading to gradual degradation of water quality. Biological Oxygen Demand (BOD) for most of the rivers of India are increasing and exceeding the standards		▪ Other rives like Godavari, Cauvery is considering following the same approach as that of NMCG ▪ Directions issued for ZLD in respect of distillery units and specific plan is under implementation with respect to Pulp& Paper Sector, Textile Sector and Sugar Sector

It will be important to create an ideation of moving away from the linear water economy to a circular economy that focuses on restoration and regeneration of a natural resource like water. Focus towards this will automatically lead to lowering of environmental pollution and at the same time will lead to creation of additional economic value through the recycling of possible polluting water.

Climate Change and its impact on Water Security issues

Climate Change in the form of global warming leads to changes in temperature and precipitation which has serious impacts on hydrological processes and regional water resources of India. It impacts the supply and demand of water as well as its quality, especially in arid and semi-arid areas.

Rising temperature contributes to glacial melts which results in its retreat and in turn impacts the water availability in Himalayan rivers including the entire Gangetic belt, thus threatening the water

supplies on which hundreds of millions of people depend. In the last few decades, nearly 67% of the Himalayan glaciers have retreated due to global warming.

Another profound impact of climate change in the increase in the frequency of heavy precipitation events. Increase in precipitation intensity within a short period leads to increasing flood events per year over the last decade. It is predicted extreme rainfall events are very likely in three major river basins viz. Krishna, Godavari and Ganga by 2100 with dry season becoming drier and wet wetter. Over the last five decades there has been increasing events of natural disasters in the country which is testimony to the fact that climate change is a reality and it can have profound impact to our country's economy.

India[70] has faced 649 disasters in last 100 years out of which 302 were caused by flood with an average of 3 floods per year. This accounted approximately 47% of total disasters took place in India in last 100 years. The average annual flood damage during the period 1996-2005 was Rs. 4,745 Cr. as compared to Rs. 1,805 Cr., the corresponding average for the previous 53 years which shows the trend of increasing events of floods in the recent years.

As per the assessments carried out by *INCCA: Indian Network For Climate Change Assessment in 2010*[71]*,* which deliberated on the possible impacts of climate on Indian Water Resources in 2030, the following were the key observations:

- Due to increase in precipitation, the water yield in the Himalayan region, mainly covered by river Indus, is likely to increase by 5%–20% in most of the areas, with some areas of Jammu and Kashmir and Uttarakhand showing an increase of up to 50% with respect to the 1970s
- The Western Ghats region exhibit wide variability in water yield in the 2030s. The northern portion of the Western Ghats shows a decrease in the water yield, ranging from 10%– 50% in the 2030s with respect to the 1970s
- North-Eastern region except for Mizoram, Tripura, Manipur and Assam shows an increase in the evapotranspiration in the 2030s. As a result, a reduction in water yield

[70] https://www.adriindia.org/adri/india_water_facts

[71] Reference Link

by up to 20% is projected for Arunachal Pradesh. The increase in the water yield in Assam and Manipur is projected to increase by 40%

- The reduction in water yield in coastal areas of West Bengal & Orissa in the 2030s is as less as 40%. However, in the southern parts of Andhra Pradesh and northern parts of Tamil Nadu, the water yield is projected to rise by 10%–40%
- Moderate to extreme drought severity has been pronounced for the Himalayan region where the increase is more than 20% in many areas despite the overall increase in precipitation.
- Flooding may vary from 10% to over 30% of the existing magnitudes in most of the regions. This will have a very severe implication for existing infrastructures such as dams, bridges, roads, etc., in the areas and will require appropriate adaptation measures to be taken up

Summing up it is quite evident that climate change considerations will need to be a part of mainstream water resources planning in this country. Few possible actions could involve:

- Spatial development of existing models to allow greater precision in climate change predictions.
- Agricultural policy will require more flexible food policies that can anticipate the selection of crops for the planting season.
- Forest policy will need to account for erosion mitigation measures in areas where precipitation is predicted to be high.
- Wastewater treatment and sewerage planning will need to address overflow and capacity issues related to intense precipitation
- Development of water-intensive industries will need to take account of siting issues related to changes in precipitation

1.2.4 Government interventions in the sector

1.2.4.1 Overall nature and responsiveness of water resources planning in the country

The water resources planning has been receiving increased policy attention over the past few years. In this decade the Indian government has been taking several key steps to revitalise water resources planning in the country. The major initiatives related to the water resources are highlighted in the figure below.

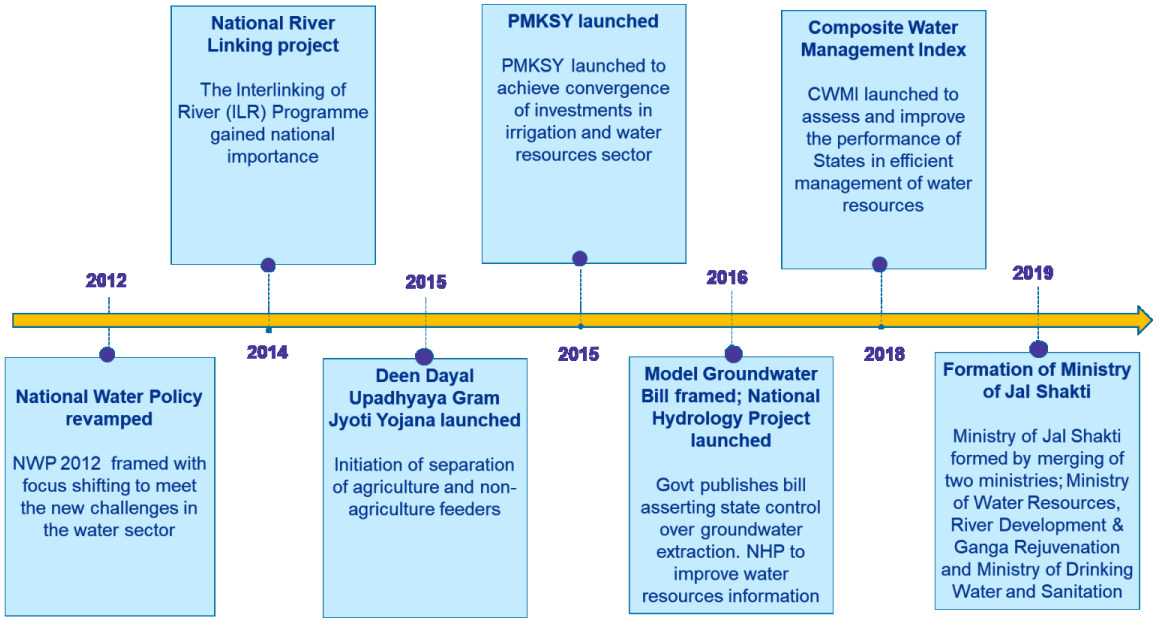


Figure 23: Planning in the water resources sector

In the present scenario, water resources planning is of utmost importance. At institutional level, the major water resources sector related planning in the country is undertaken at both the central government as well as state government level. Since water is a state subject, planning at state level is equally (if not more) important. The key central government departments or organisations and their responsibilities with respect to planning for the water resources sector are mentioned below.

Central Water Commission- The Central Water Commission is a technical organization in the field of Water Resources development and planning in India. It is currently functioning as an attached office of the Ministry of Jal Shakti, Department of Water Resources, River Development and Ganga Rejuvenation, Government of India. Key responsibilities of the commission include initiating, coordinating and furthering in consultation of the State Governments concerned, schemes for control, conservation and utilization of water resources in areas related to Flood Control, Irrigation, Navigation, Drinking Water Supply and Hydro Power Development[72].

[72] Website of the Central Water Commission

Department of Water Resources, River development and Ganga rejuvenation- Earlier a ministry, the Department of Water Resources, River development and Ganga rejuvenation has currently been merged with MoDWS under the Ministry of Jal Shakti. The department is responsible for laying down policy guidelines and programmes for the development and regulation of country's water resources. Its key function is overall planning, policy formulation, coordination and guidance in the water resources sector.[73]

Central Groundwater Board- The Central Groundwater Board is the key nodal agency responsible for groundwater related planning. It is a subordinate office under the Ministry of Jal Shakti responsible for sustainable development and management of groundwater resources of the country. Its key mandate is to develop, monitor and implement national level policies for the scientific and sustainable development as well as management of India's groundwater resources.[74]

In addition to the above-mentioned central government agencies, designated departments at state level are responsible for water resources planning at state level. The water resource planning departments for few select states are mentioned below.

Table 21: State level water resources planning

State Name	Name of Organization	Brief role related to planning of water resources in the state
Andhra Pradesh	Water Resources Department	Hydrological assessment of availability of water in the river basins including water allocation to the Irrigation and other purposes, Planning & design of Irrigation systems
Arunachal Pradesh	Water Resources Department	Nodal Department for Water resources Management. Survey and Investigation of Major Water resources in the State and planning for its utilization

[73] Website of the Ministry of Water Resources, GoI

[74] Website of the Central Groundwater Board

State Name	Name of Organization	Brief role related to planning of water resources in the state
Bihar	Water Resources Department	Creation of irrigation potential and utilization of created potential through construction, maintenance and regulation of major and medium irrigation schemes
Gujarat	Narmada and Water Resources, Water Supply and Kalpsar Department	Effective planning of utilization of available water resources in accordance with state water policy.
Karnataka	Water Resources Department	Harnesses Surface Water for Irrigation and Drinking Water Purposes
Madhya Pradesh	Water Resources Department	Responsible for creation and maintenance of irrigation potential through construction of water resources projects.
Maharashtra	Water Resources Department and Rural Development & Water Conservation Department	Survey, planning & design, construction & management of major, medium and minor projects
Punjab	Water Resources Department	Develop, plan, conserve, utilize and manage both surface and groundwater resource
Rajasthan	Water Resources Department	Construction of major, medium and minor irrigation projects, operations and maintenance of existing tanks, canals and other irrigation structures
Uttar Pradesh	Irrigation & Water Resources Department	Development and construction of dams, canals and wells; ensure adequate irrigation facility; execution of flood prevention works

1.2.4.2 Major central government schemes in the water resources sector

Water resources is a vast sector composed of multiple vital sub-components. The key sub-sectors or sub-components within the larger sector are- Groundwater, Surface Water, Reservoirs, Micro-irrigation Tanks, Water consumption and wastewater. Various central government ministries are responsible for implementation of multiple schemes under each sub-sector or component as listed above. A brief overview of major central government schemes in the water resources sector is shown in the figure below. The list is indicative in nature and not exhaustive.

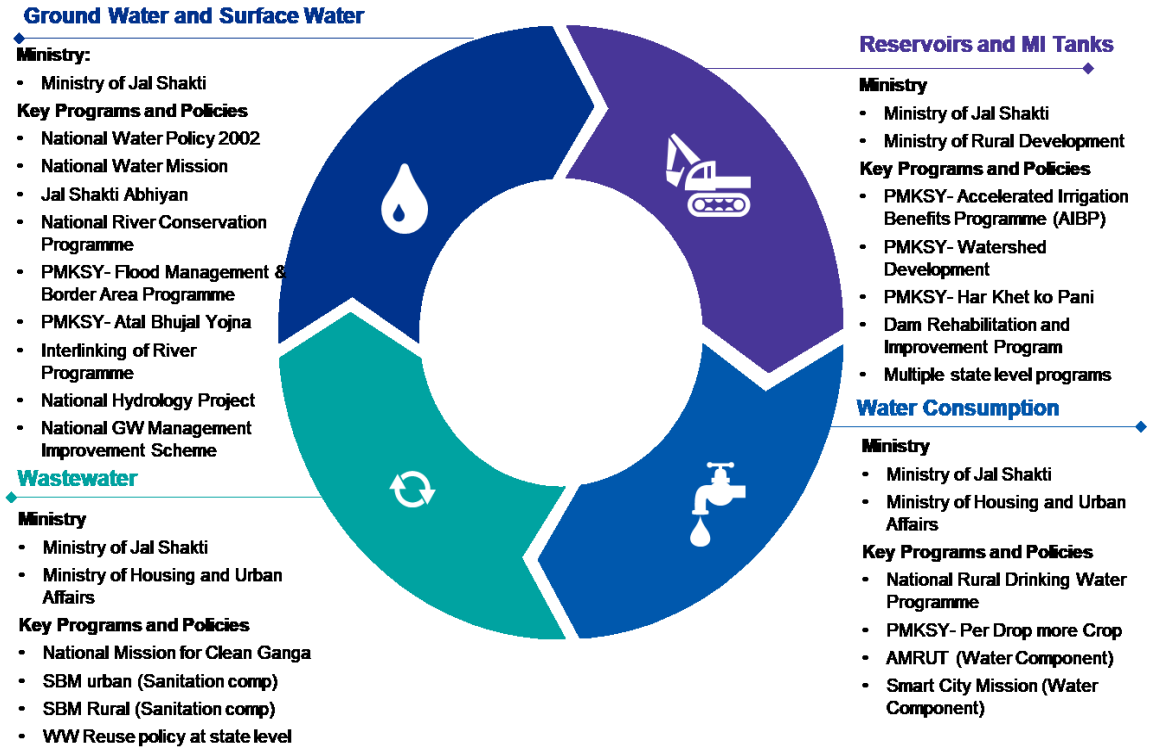


Figure 24: Major government schemes

As shown in the figure above, there are multiple central government ministries related to various sub-components of the water resources sub sector. Ministry of Jal Shakti is the major ministry within the central government and is responsible for laying down policy guidelines and planning as well as implementing programmes for the development and regulation of country's water resources.

1.2.4.3 Externalities and relation to other sectors

The Sustainable Development Goals (SDGs) have been pledged to be implemented by all United Nations Member states in 2015 as a universal call to action to end poverty. The SDGs once implemented should protect the planet and ensure that all people enjoy peace and prosperity by 2030. Total 17 SDGs are integrated and improvement in one area is bound to impact outcomes in others[75]. A deep dive into the multiple SDGs including the sub goals within each SDG is useful in discovering externalities for the water resources sector. Among the 17 SDGs, the 6th SDG pertains to Clean Water and Sanitation and is directly related to water resources sector. However, as explained in the figure below, multiple goals within other SDGs are dependent or related to the water resources sector.

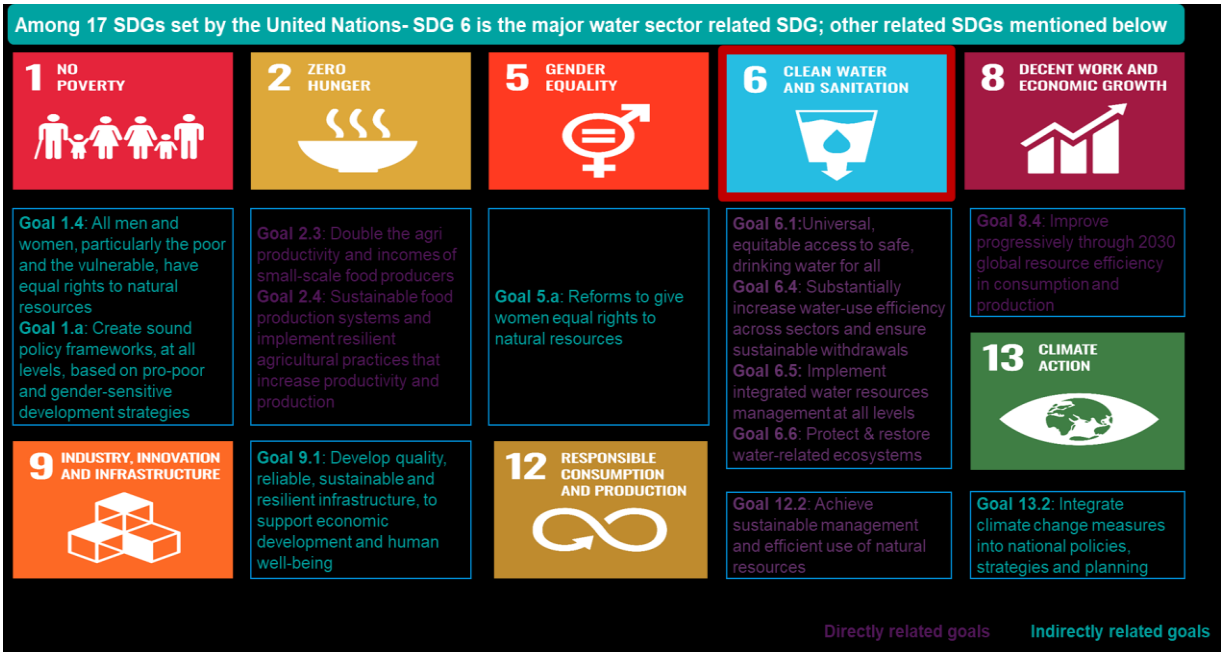


Figure 25: SDGs related to water resources sector

As mentioned in the figure above, directly and indirectly related thematic areas with the water resources sector, makes it an important focus area for development. The related ministries in India implementing programs in the identified related sectors have been further derived in the figure below. Key programs with respect to each ministry which can directly impact the water resources sector are mentioned below.

[75] United Nations Development Programme, Sustainable Development Goals web page

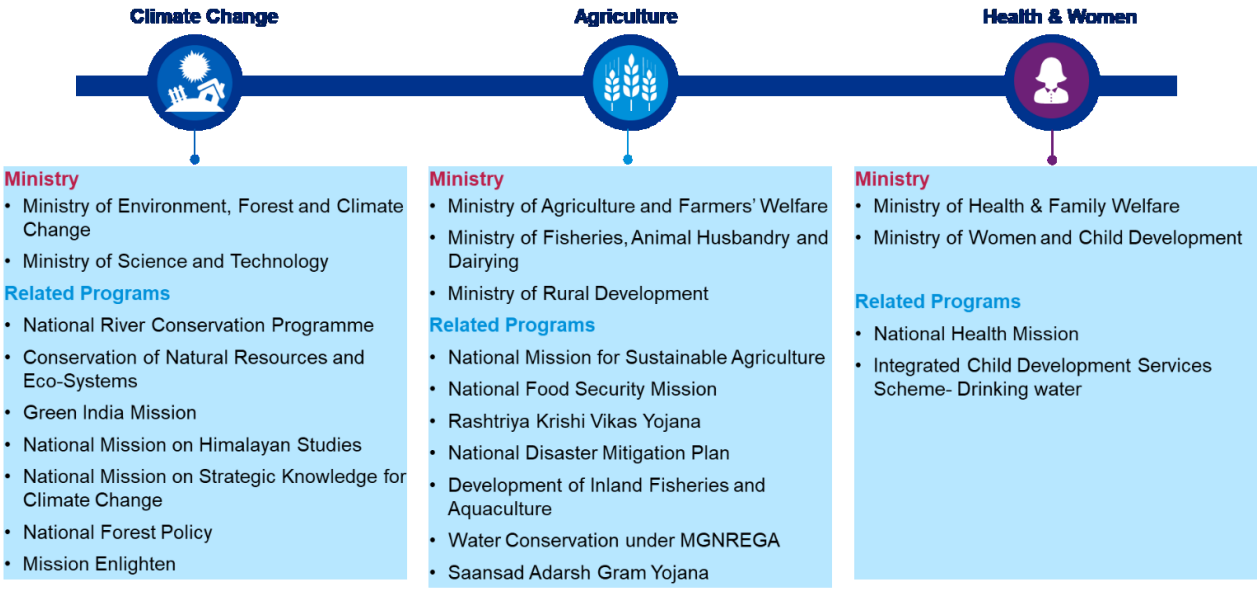


Figure 26: Related ministries and key related programs

The related programs listed above are not only linked with the water resources sector, but also share certain commonalities with the Pradhan Mantri Krishi Sinchayee Yojana.

1.3 Issues and challenges

Table 22: Water resources Sector – issues and challenges

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
Supply Side					
WR-F1	**Water Storage Capacity**	• Low total water storage capacity as well as water storage capacity per capita in dams is one of the key issues. This leads to inadequate buffer stock during periods of droughts, summer months and seasonal, geographical and annual variation as well as high run-off of surface water into sea in the absence of adequate storage			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
WR-F2	**Spatial Variance in SW**	• High spatial variance in surface water availability leads to unequal distribution and availability of surface water			
WR-F3	**Unregulated extraction of GW**	• Unregulated extraction of groundwater has led to decrease in percentage safe groundwater units over the years			
WR-F4	**GWL monitoring**	• Over dependence on groundwater for various uses has led to over extraction of groundwater. Currently, the Central Groundwater Board (CGWB) monitors groundwater levels four times a year through a network of 22,730 observation wells as on March 2020, which are spread throughout the country. In addition, the states have 50,000+monitoring wells. Moreover, the CGWB undertakes detailed groundwater assessment studies across 6,881 assessment units (Blocks/ Mandals/ Talukas/ Firkas) in the country (2017)[7]. Although the number of observation wells as well as the number of assessment units has increased over years, groundwater level monitoring needs to be further ramped up for a country given the country's size.			
WR-F5	**Micro level information**	• There is a lack of micro level information on all depleted aquifers. Currently only broad macro level			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
	of depleted aquifers	information is available which is not suitable for making plans for artificial recharging of depleted aquifers. The analysis of data to plan GW recharge initiatives and formulate other actionable recommendations, is lacking			
Demand Side- Irrigation					
WR-F6	**IPC IPU Gap**	• There is a large gap between IPC and IPU leads to low utilization of expensive irrigation assets (viz. major and medium irrigation projects) and impedes irrigation coverage. There are several reasons for the large gap between IPC and IPU such as non-completion of command area works, high water loss during conveyance through open canal networks, switching to water-intensive cropping pattern on project completion (esp. head end farmers), faulty designs, unlined canals, lack of desilting, poor O&M of distribution channels and ineffective WUAs. Closing the gap can substantially improve irrigation coverage at low incremental cost			
WR-F7	**Irrigation Coverage**	• India's Ultimate Irrigation Potential is estimated at approximately 140 million hectares as evident from Land-use statistics. However, with only 68			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
		Million Hectare of net irrigated area and 97 million hectares of Gross Irrigated Area[76]; there is an urgent need to close this gap and bring more cropped area under assured irrigation as well as increase the cropping intensity and thereby increase agriculture productivity and production			
WR-F8	**Water Demand increase**	• India's population is estimated to be 1.5 billion by 2041[77], one of the largest in the world. Feeding such a large population will require increase in food production and therefore in water demand. With growing affluence, the demand for food is expected to increase by twice the population growth. Even if we assume that specific water consumption for crops in India will decrease in the future, the absolute water quantity will still increase by 2% every year. The challenge will be to meet this demand through existing water resources			
WR-F9	**Irrigation Efficiency**	• Indian irrigation suffers from low water use efficiencies. To increase the irrigation coverage, more irrigation infrastructure will need to be created.			

[76] Source: Agriculture Statistics at a glance, 2018, Ministry of Agriculture and Family Welfare, GoI

[77] Economic Survey 2018-19, Chapter 7

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
		But with poor water use efficiency, this new infrastructure will lead to more water losses. The other issue with poor water use efficiency is that farmers at the tail-end of the canal network receive much less (or no water) compared to farmers at the head. This leads to inequity with tail-end farmers forced to cultivate dry crops that are less remunerative than crops grown by farmers upstream			
WR-F10	**Cropping pattern**	• Farmers prefer to cultivate water intensive crops such as paddy even in areas of water stress. Gains from improvements in water use efficiency is lost to increased cropping of water intensive crops. Large scale procurement of rice and wheat for distribution through public distribution system at subsidized rates encourage market for such water intensive crops.			
WR-F11	**GW Irrigation**	• Unregulated and over extraction of groundwater is leading to severe water crisis with groundwater catering to more than 63% of water required for irrigation. Heavy subsidies for agriculture power consumption has encouraged wasteful use of both water and power. Farmers have been encouraged to extract water from			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
		deep aquifers leading to rapid depletion of groundwater			
Demand Side- Industrial					
WR-F12	**Water demand**	• India's population is estimated to be one of the largest in the world 40 years from now. Industrial water demand will also be increasing with the pace of industrial development. Despite evolving water-efficient industrial processes, the challenge would be to meet this demand through existing water resources. Water deficiency in the country can hinder industrial output and other economic activity in the future and lead to subdued economic growth			
WR-F13	**Efficient use and pricing**	• Water is used by many industries as an input, like all other inputs during the process of production. Therefore, the demand for water is directly linked with the demand for the final products. Moreover, the efficiency of water usage in multiple sectors is quite low compared to global standards. On the contrary, the price of water that any industry pays for water consumption also controls the demand for it to a considerable level. Poor water pricing is one of the major reasons for inefficient utilisation of water			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
		resources by the industrial sector[78]. Differential pricing between freshwater and treated municipal wastewater for reuse may also be explored on a larger scale to promote use of treated wastewater and reduce demand for freshwater			
WR-F14	**GW policy**	• Usage of groundwater as a source of water resources in the industrial sector may lead to severe water crisis in the future. Unabated extraction of groundwater may lead to inefficient water resources utilisation in the industrial sector and encourage wasteful use			
WR-F15	**Energy production**	86% of India's electricity is generated from thermal power plants that rely significantly on water for cooling. As power generated from thermal power plants continues to remain major source of energy for all industrial and commercial activities, exposure to high water stress may hamper India's energy production and economic activity[39]. Wastewater reuse in the sector may be further explored to combat the scarcity.			

[78] Industrial Water Demand in India- IDFC

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
WR-F16	**Impact on Banking sector**	Water scarcity may pose significant impact on the Indian economy through the banking sector as the portfolio of banks is exposed to the Industrial sector, which may be facing operational risks (production as well as regulatory risks) due to water scarcity[35].			
Demand Side- Domestic					
WR-F17	**Water Demand**	India's population is estimated to be one of the largest in the world 40 years from now. Domestic water demand will also be increasing with the increase in population, changing lifestyle and urbanisation. Supply of adequate (or 24x7) safe treated drinking water at household level (using piped water supply) to the increasing population of India is therefore a challenge.			
WR-F18	**Water quality**	• In addition to the increase in exploitation of groundwater over the years, there have also been occurrences of quality related issues for groundwater. Therefore, quality of water for domestic use must be monitored strictly.			
WR-F19	**Efficient use and pricing**	• There exists a difference in the amount of water consumed by rural and urban population in India. Changing lifestyles will further increase consumption of domestic water. Poor water pricing			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
		may lead to inefficient utilisation of water resources. Differential pricing between freshwater and treated municipal wastewater for reuse may be explored for domestic sector to promote reuse of treated wastewater for non-potable domestic purposes.			
WR-F20	**Water Scarcity**	• The urban population across the various urban hubs in India is expected to increase to 600 million in the year 2030 and 877 million by the year 2050[79]. With the increase in population, pressure on water resources will substantially increase. Water supply infrastructure in the major urban centres of the country should be facing this stress as these were never designed to cater to such large population sizes and may not be well equipped to handle such demand. As of 2014, none of the major cities in India have been able to supply 24x7 water to its entire urban population[35].			
WR-F21	**O&M and NRW**	Water supply system especially in urban areas, suffer high non-revenue water due to leakages, unauthorized connections, billing and collection inefficiencies.			

[79] United Nations, Department of Economic and Social Affairs, Population Division (2018). World Urbanization Prospects: The 2018 Revision, Online Edition

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
		Estimated NRW is between 40-70% of the water distributed and leads to loss of water resources. High NRW is due to system inefficiencies as most urban water supply operations survive on large operating subsidies and capital grants and O&M cost recovery through tariff is not more than 30-40%.[80] Further since capital investments on drinking water supply networks are expensive, reducing leakages will reduce or delay the need for new investments as the saved water can be used to improve coverage.			
Wastewater					
WR-F22	**WW treatment capacity**	• Inadequate capacity of STPs has led to discharge of 62% of the total sewage generated (38,791 MLD) directly into the environment • Lack of ETP facilities in the industrial sector leads to discharge of 40% of industrial wastewater in untreated form • Release of untreated wastewater into the environment has led to pollution of 80% of surface water resources in India and 317 polluted river stretches			

[80] Urban Water Supply and Sanitation, The World Bank

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
WR-F23	**Use of recycled water for agriculture**	• Currently, reuse of treated wastewater in the irrigation sector is mostly prevalent across the world with 32% of reuse application. However, in India, planned reuse of wastewater is still to take off.			
Broad sectoral outcomes					
WR-F24	**Agricultural Water Use efficiency**	• The ratio of water consumption and area cultivated is an important metrics as it signifies the water use efficiency in the agricultural sector. India is one of the highest water consuming countries with an approximate agriculture water consumption of 4,060 m^3 per hectare of cultivated area			
WR-F25	**Water regulator**	• The national water policy 2012 talks about setting up a water regulator to manage various issues around water. Considering the enormous challenges in water sector, lack of a water regulatory authority is hampering the growth of this sector. With multiple disputes around water sources, supplies etc., there is an urgent need of water regulators to create proper legislation, and regulations			
WR-F26	**Capacity Building**	• Lack of capacity building of the various agencies managing water			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
		resources infrastructure and the service delivery is leading to poor water resources management.			
WR-F27	**Convergence**	• Multiple central government ministries have been implementing programs related to water sector with scope to reduce duplication in effort and fund utilization. Greater convergence across scheme is necessary			
WR-F28	**Staffing levels**	• Staffing levels are ten times international norms, and most public funds are now spent feeding the administrative machinery, not maintaining the stock of infrastructure or providing services.			
WR-F29	**Financing**	• There is an ever-increasing funding gap in the sector due to poor tariff collection and absence of alternative financing mechanisms			
WR-F30	**Project Management**	• Currently majority of the irrigation projects in the country face issues related to time and cost overruns. The major and medium irrigation projects in India suffered from cost overrun to the extent of Rs. 1.20 Lakh Cr. In addition, approximately 105 projects faced time			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
		overrun issues with the duration of time overrun ranging up to 18 years			
Overall nature and responsiveness of Water sector					
WR-F31	**Planning and Data Management**	• Water is a state subject as per the Constitution of India. Therefore, the institutional structure and departments at state level for implementation of water resources sector related planning are key to ensuring efficient planning and implementation in the area. Due to the involvement of multiple agencies both at national and state levels, there is poor data collection, management and sharing.			
WR-F32	**Coordination between agencies**	• Water is a state subject as per constitution of India. Greater coordination between the various central government level organisations and the state government departments is required going forward.			
WR-F33	**Conjunctive use of SW and GW**	• Further promotion and awareness related to conjunctive use of surface water and groundwater is required			
WR-F34	**Water sharing treaties and disputes**	• The water sharing treaties and disputes among states have led to delays in implementation of river interlinking projects			

Issue relevance legend

	Supported		Partially supported		Not supported		Not applicable

1.4 Recommendations and solutions

The recommendations and solutions and their mapping to the issues/findings mentioned in the above sub-section, are summarised in the table below.

Table 23: Water resources sector – recommendations and solutions

Sl.no	Recommendations	Finding
Supply Side		
WR-R1	**Increase overall water storage capacity** Increasing the overall water storage capacity across the country is very vital to ensure water security. The following approach may be adopted: • Focus on creating additional decentralised storage structures across the country. Construction of such decentralised storage structures may be taken up on large scale and such structures created at village levels can also be implemented with minimum land acquisition costs if the beneficiaries are educated and their support is sought for the same. The same can also be planned in barren or waste land in or near the villages. Local GP Pradhans may be taken into confidence and small to medium size water storage structures can be created across the country. Existing village ponds may also be rejuvenated, desilted and/or expanded as part of this initiative. Water from these storage structures may be supplied to the nearby agricultural fields during rainfall deficient periods. Design and procurement process for implementation of such lined storage structures may be standardised for easy adoption and implementation across the country. Financing of such initiatives can be done in convergence with MGNREGA schemes. • A large-scale initiative on de-siltation of all existing major and medium irrigation reservoirs may be initiated. Such de-siltation will increase the actual existing capacity of the reservoirs across the country. Before commencing desilting, environmental impact assessment studies may be carried out so that water turbidity and	WR-F1

Sl.no	Recommendations	Finding
	erosion of the reservoir banks are avoided. Further, the silt recovered from these bodies (after separation of sand) may be provided to farmers/WUAs in the nearby areas for improving fertility of their agricultural fields. Processing of desilted soil would provide a huge quantity of sand which can further be used for construction works. The inclusion of de-siltation component in the upcoming DRIP Phase 2 and Phase 3 projects may be explored. Similar large-scale de-siltation initiatives have been taken up by the Government of Maharashtra in the year 2017. • Alternatively, dredging of accumulated silt may also be attempted for very large dams. Extensive catchment area treatment should also be undertaken for all reservoirs to avoid silt deposition • A feasibility study to increase the existing height of the reservoirs of all existing major and medium irrigation projects in India may be taken up in a systematic manner. If feasible the height of the reservoirs may be increased based on recommendations by the technical panel. Through such initiatives, the storage capacity of reservoirs can be increased without incurring large investments. Similar attempts have been successful in Manipur where the state has increased the height of an existing dam by 1m to increase the storage capacity of the reservoir. • Since the focus should remain on small decentralised storage structures, in future we may have to measure the water storage capacity of dams plus other small storage structures on a regular basis. The storage capacity of Major and Medium irrigation projects is monitored by the CWC. However, a robust census of Minor Irrigation and other such small storage structures created across the country needs to be parallelly strengthened. The 6th Minor Irrigation Census along with first Census of Water Bodies is being conducted with Reference Year 2017-18 and scheduled to be published in FY 2020-21, may provide essential data in this aspect.	

Sl.no	Recommendations	Finding
	• O&M of large dams across the country should also be focused upon. Currently, majority of the dams do not have a separate operations and maintenance budget. Moreover, state WRDs don't have scheduled and pre-planned maintenance budget. A dedicated budget for operations and maintenance of the dams to address the existing O&M issues, is required. • Going forward, Integrated operations and monitoring system of dams may be introduced, Such systems can help optimize water storage capacity of dams on the same river and will help the dam operators maximize storage, especially during the monsoon season through integrated operations. • In addition to the above initiatives, using select groundwater storage aquifers for storage of water may also be explored. With increased knowledge on aquifers and improved recharge techniques, Mega-scale Artificial Recharge Schemes may be implemented after conducting detailed feasibility study for the same. Such schemes can create large underground storage in suitable geological areas, without acquiring land as well as with no threat of loss due to evaporation (as in surface water reservoirs).	
WR-R2	**Reduce spatial variance in surface water** • The GoI has been planning and undertaking multiple river interlinking projects to reduce the spatial variance in surface water. However, the on-ground implementation has been rather slow. The following aspects may be explored to implement these projects on a faster pace: o Prioritize intra-state river inter-linking projects as these may be quick wins due to less political interventions o River Interlinking projects may be further promoted, and their environmental sustainability may be publicised (through	WR-F2 WR-F34

Sl.no	Recommendations	Finding
	workshops, seminar or webinars) for better acceptability among the various stakeholders o Better coordination among states is required to implement such river interlinking projects as very often multiple states may be involved in a single inter-linking project. To empower a central agency, which often acts as a mediator in such disputes, either the Central Government (Ministry of Jal Shakti) may be empowered or a Central Regulatory Authority may be formed to act as a referee in such cases. However, for implementing this, such water treaties/interstate disputes, may have to be brought under the concurrent list. o Alternatively, for better coordination among the participating states, river basin authorities – may be created as special bodies with representatives from all participating States. Such authorities should be made responsible for implementing the water linking project under suitable guidance from the MoJS. The above recommendation should also help in better management of water sharing treaties and disputes among states. • In addition to river inter-linking projects, Lift Irrigation (LI) projects can also be promoted for reducing the spatial variance in surface water availability. For implementing this, technical and financial feasibility studies may be undertaken before implementing LI schemes. Alternative innovative financing options like PPPs (Hybrid Annuity Model) may be explored. Moreover, use of solar power as a source can also be promoted in convergence with the various GoI schemes in the renewable energy sector like the Jawaharlal Nehru National Solar Mission (JNNSM). Large LI projects are being constructed in certain states. Key projects are the Kaleshwaram LI project in Telangana and the Polavaram LI project in Andhra Pradesh.	
WR-R3	**Reduce unregulated extraction of groundwater**	WR-F3

Sl.no	Recommendations	Finding
	• The Groundwater (Sustainable Management) Bill, 2017 drafted by the MoJS, GoI has been a welcome step towards decentralised groundwater regulation enforcement and may assist in regulation of unregulated extraction of GW. States should be encouraged to adopt the salient features of the Bill, after suitable customization to suit local conditions, institutional, legal, governance as well as aquifer related differences. Decentralised monitoring and enforcement of GW related regulations are key to the success of GW acts. Public participation and awareness campaigns may be conducted in large scale, and participatory enforcement through WUAs and similar grassroot level organisations may also be explored. Latest NGT guidelines should also be accommodated to reduce unregulated extraction of GW. • In the long term, remote and real-time telemetry-based water sensors may be installed across states for accurate and updated data. Rain gauges may also be installed for accurate data on rainfall. Modelling and analysis of real-time GWL and rainfall data may be conducted to track extraction of GW. The state of Andhra Pradesh is attempting the same, with the help of piezometers located across the state. The APWRIMS portal provides updated information related to crucial aspects of GW. • Implement real-time telemetry-based meters for GWL measurement to monitor GW extraction through bore wells • Additional analysis using satellite data (such as NASA's Gravity Recovery and Climate Experiment) of groundwater level changes may also be undertaken at regular intervals to measure seasonal changes in groundwater levels. Such analysis shall help in understanding the multi-tier aquifers of the Indo-Gangetic plains.	
WR-R4	**Upgrade Groundwater level monitoring**	WR-F4

Sl.no	Recommendations	Finding
	• As highlighted in the above recommendation, in the long term, remote and real-time telemetry-based water sensors may be installed across states for accurate and updated data on GW level. The implementation of the same can be converged with the National Hydrology Project on a larger scale. The data can also be used to prioritise investments in GW recharge structures and other GW conservation initiatives. • As an alternative in the medium term, participatory GWL Monitoring may be undertaken. For implementing such initiatives, SHGs and volunteers may be involved who may be formally trained by CGWB or Stater Ground Water Board officials, to monitor GWL at GP level. Once the GWL is found out at the local level, the same may be shared with the State level GW authorities by phone or through an application on a regular basis. Utilisation of WUAs may also be done for this purpose. Similar initiatives are being undertaken in Karnataka where select SHGs and volunteers have been trained to record GWL at GP level based on nominal payment. The same is being shared by phone, postcard, etc.	
WR-R5	**Micro level information of depleted aquifers** National Aquifer Mapping programme (NAQUIM) is being implemented across the country which involves mapping of aquifers to some extent. Moreover, Atal Bhujal Yojana also has an aquifer mapping component. However, the same can be undertaken in further detail going forward. In addition to this, the data generated from the aquifer level mapping needs to be used for actionable insights generation. A few such probable initiatives are: • Water budgeting at GP level may be carried out by using micro level (at least GP) information. Such water budgeting document can be	WR-F5

Sl.no	Recommendations	Finding
	used to prepare a GP-wise water security plan, especially for those GPs which fall in the unsafe category. • GP level rainwater and GWL recording can be used to understand the extent of natural recharge of the aquifers and therefore plan for artificial GW recharge initiatives by prioritising investments • Attempts may be made to digitize GWL data and integration of data from all GWL recorders (under the NHP or NWIC) and use advanced mathematical techniques like artificial algorithms to check the quality of the data sets. Thereafter, the existing data may be used for analysis and planning of GW recharge initiatives. Collaborations and MoUs may be executed with various national level institutes like IITs, NITs, IISc and International institutes like Delft Institute (Netherlands) to undertake research on the GWL data collected, and formulation of recommendations based on the findings for implementation by the stakeholders.	
Demand Side- Irrigation		
WR-R6	**Reduction of IPC IPU Gap** • Standard guidelines and methodology should be developed for assessing the IPC and IPU of the various irrigation projects across India. This will enable to correctly ascertain the true potential of the irrigation systems and to promote more transparency in reporting by various organizations. Details related to the same are provided in the recommendations for AIBP scheme. • For monitoring IPU more effectively, remote sensing may be used for real-time data on cropping. A similar initiative has been taken up by the state of Manipur where remote sensing studies and aerial surveys are being undertaken to measure and quantify the IPU on	WR-F6

Sl.no	Recommendations	Finding
	scientific basis. North East Water Resources Information Base – a geoportal funded by World Bank has been created for this purpose. • Further, completion of distributary networks, field channels, lining of canals and adequate O&M of the existing canals need to be undertaken to reduce the IPC-IPU gap. The MoJS may plan for incentivising the states in the form of additional subsidy/central funds, based on reduction of IPC-IPU gap. However, standardised methodology (based on remote sensing) for measuring IPU needs to be developed and agreed prior to such initiatives.	
WR-R7	**Increase Irrigation Coverage for better crop productivity** • The existing Irrigation Census may be further strengthened by introducing community participation initiatives and technology to collect this data. WUAs may also be involved for getting more authentic data on actual irrigation coverage. Details related to the same are provided in the recommendations under Irrigation Census scheme. • Creation of additional small and decentralised storage structures under PMKSY/MGNREGA schemes will lead to more land area being brought under assured irrigation • Rainwater harvesting at village level may be further encouraged for increasing the coverage of irrigation. Convergence with the recently launched Jal Shakti Abhiyan (JSA) may be explored to	WR-F7

Sl.no	Recommendations	Finding
	create an intensive water conservation campaign built on citizen participation across the country. • Artificial GW recharge initiatives in select water scarce zones based on recommendations suggested earlier will also increase the access to assured irrigation • In addition, based on the recommendations suggested earlier, River Interlinking projects and Lift Irrigation projects will also increase irrigation coverage. • In areas where groundwater is in abundance and surface water availability is unreliable, farmers sometimes do not have money to invest in pumps to extract groundwater. Erratic electricity supply or high price of diesel further affects the usage of groundwater for agriculture in such regions. A suitable service delivery model may be explored in such areas where a mobile solar pump may be rented to farmers (at fixed hourly rates). Claro Energy has implemented a similar service delivery model in Bihar where a portable trolley-mounted solar pump is offered on a fixed hourly rent to small farmers within a local area.	
WR-R8	**Reduce dependency on GW for irrigation** Input subsidy to farmers in the form of free/subsidised power for irrigation and subsidy on bore wells may be removed to minimise over extraction of groundwater for irrigation. The following options may be explored, alternatively: • Regulating the supply of electricity supplied for groundwater pumping and limiting it to a few hours • Fixing ceilings for water or power used per hectare and thereafter providing cash incentives to farmers in the form of DBT corresponding to the quota allocated to the farmer based on his	WR-F11

Sl.no	Recommendations	Finding
	land ownership. The same can be converged with PM-KISAN scheme • Provide power subsidy in the form of DBT only to targeted farmers; for instance, subsidy may be provided to farmers practicing micro-irrigation or to farmers cultivating water efficient crops (in convergence with PM-KISAN scheme). • Measure the quantum of power and water for each connection; this may have an impact on the farmers psychology who in turn may reduce water abstraction and wastage	
WR-R9	**Increase Irrigation Efficiency** • Incentivize introduction of piped irrigation networks (PIN) for new irrigation projects or for all ongoing branch, distribution and minor canals should lead to increase in irrigation efficiency. However, detailed feasibility study (including cost benefit analysis covering social and environmental costs and benefits) may be undertaken before implementing PIN projects. Some facts on PIN are as follows: o Recent successful implementation of PIN projects in various states like Maharashtra, Odisha, Gujarat and Rajasthan o Countries like Israel have migrated from open water canals to piped supplies and drip irrigation; currently Israel has the world's highest crop yield/ m^3 of water consumed. Successful case studies in China showed 30% savings in water delivered (equivalent to 15% of the total irrigated area) and 25% in labour input using PIN in place of canal-based irrigation. o However, it may be noted that PIN is needed to be fitted with proper de-silting arrangements, including de-silting chambers and flushing arrangement, where irrigation water contains	WR-F8 WR-F9

Sl.no	Recommendations	Finding
	large quantity of sediments particularly in case the source of water is any of the Himalayan rivers. o Adequate provisions should be made for electricity connections through DISCOMS/solar power for operation of the pumps. Use of solar power as a source can also be promoted in convergence with the various GoI schemes in the renewable energy sector like the Jawaharlal Nehru National Solar Mission (JNNSM) o Further details related to PIN are mentioned in the recommendations for AIBP scheme. • Lining of old canals based on detailed condition assessment studies may also be taken up on a large scale to increase the irrigation efficiency. A detailed feasibility study including cost benefit analysis to determine impact of reduction of seepage on groundwater level, may be conducted before undertaking such projects. The same may be taken up in convergence with AIBP component (at least lining of the main canals); the funding modalities for the same needs to be finalized.	
WR-R10	**Crop Diversification** Crop diversification initiatives of the government may be further strengthened by adopting the following: • In the long term, alternative and less water intensive crops (like ragi, jowar, bajra) may be promoted over traditional water intensive crops like paddy and wheat. Nutritional security may be promoted among the population and thus crop diversification may be achieved through change in mindset and food habits. The same can	WR-F10

	be undertaken in convergence with existing schemes like Poshan Abhiyaan • Promotion and strengthening of E- platforms may be undertaken for wider awareness and acceptance among the farmer community. Specific IEC and Capacity building activities may be undertaken with WUAs to promote online agriculture trading platform like the e-NAM platform (GoI initiative). Increase in popularisation and adoption of such platforms will further bolster crop diversification as it will attract more buyers, farmers and agents and provide an assured market and price for a variety of crops through the portal. Similar initiative taken by the Government of Andhra Pradesh is the e-Rythu application. The initiative is designed to digitise agriculture marketplace by connecting buyers, farmers and agents in the agricultural value chain. This assures fair prices to the farmers for a large variety of crops and the application is easy to use and can be accessed from feature phones. • The Government can also promote crop diversification by introducing MSP for less water intensive crops and undertake actual procurement of such crops. • Additionally, strong market integration for offtake of agricultural produce and remunerative crop price must be ensured to promote MI adoption and avoid slip backs. Implementing agencies may sign MoUs with NGOs, private players and other similar marketing/food processing supply chains to promote such initiatives. • Crop diversification may also be promoted by adopting the concept of crop colonies as part of the regulated farming. Agriculture experts may be consulted to design and plan the specific crops to be grown in a particular state in a given area based on various factors like forecasted rainfall and water availability during the	

Sl.no	Recommendations	Finding
	season, soil conditions, demand of the produce, etc. The state of Telangana is planning to introduce this crop colony concept. • Alternatively, in addition to individual farmer-based beneficiary model, basin-centric approach for widespread implementation of MI initiatives with a specific area may be undertaken in a time bound manner. Karnataka's Ramthal MI project is one such example. • Additionally, by using water quota as a tool, crop planning, water budgeting and crop rotation policy may be implemented at WUA level. A specific water quantity may be allocated at WUA level and the individual crop planning responsibility (like cash crop rotation among farmers) may be left to the WUA for deciding on. Agriculture department may provide necessary capacity building and support to WUAs. Similar initiatives have been successful in Maharashtra on a small scale where WUAs are deciding who will take normal crop and who will take the crash crop during any given year. Crop rotation is being practiced to promote crop diversification among the members of the WUA.	
Demand Side- Industrial		
WR-R11	**Reduce Water consumption in Thermal Power Plants and other water intensive industries** • Thermal power plants are one of the major consumers of water in the industrial sector. It is necessary that India moves on to produce power from sources which have lesser water footprint. Diversifying to solar and wind power, will not only enable India to save on its precious water resources, but also reduce pollution and combat climate change. As per the Paris Accord on Climate Change, India has promised installation of 175 GW of renewable energy capacity by 2022. This includes 100 GW from solar power projects, 60 GW	WR-F12 WR-F13 WR-F14 WR-F15 WR-F16

Sl.no	Recommendations	Finding
	from wind power, 10 GW from bio-power and 5 GW from small hydro power projects[81] • To further promote water use efficiency among industries and optimise water consumption in the water sector, fixed water allocation (quotas) for each industrial sector may be explored. Tradable water use permits in the industrial sector may further improve water use efficiency.	
WR-R12	**Increase efficiency in water use and pricing in Industrial sector** • It has become extremely essential to promote water efficient processes across all industries, especially in the major water intensive industries such as, power, textile, iron & steel. These industrial sectors may be incentivised further to innovate and use water efficient processes, thereby reducing the pressure on water resources. In addition, appropriate tariff for the industrial consumers may be levied. Reuse of treated wastewater may also be promoted in the industrial sector; especially in regions of water scarcity. In Karnataka, the urban water supply authority is currently supplying treated wastewater to the industrial clusters (mining and sponge iron industries) in the water scarce areas.	WR-F12 WR-F13 WR-F14 WR-F15 WR-F16
Demand Side- Domestic		
WR-R13	**Increase efficiency in water use and pricing in Domestic sector** • It has become extremely essential to encourage water savings and thereby prevent wasteful consumption of water resources. Metering of water supply and appropriate tariff rates will encourage water conservation. Intermediate tariff (until meters are installed) may be set based on Built Up Area (BUA) of the property. The same may be collected as a part of Property Tax.	WR-F17 WR-F19 WR-F20 WR-F21

[81] Press Information issued by Ministry of New and Renewable Energy, GoI, December 2018

Sl.no	Recommendations	Finding
	However, ring fencing of water revenues collected by ULBs or Authorities should be made mandatory to ensure financial sustainability of the various water supply schemes. Moreover, ULBs may be mandated to have sub-budgets for specific components like water supply, distribution, sanitation, etc.	
WR-R14	**Enhance O&M and Financing of drinking water schemes** • To achieve O&M efficiency- O&M of common infrastructure of the water supply scheme may be handed over to a private or professional agency. However, inside ULB area, ULBs themselves need to take responsibility for O&M of distribution network and other assets. A dedicated water supply cell with dedicated manpower may be allocated for this purpose. • Water Audit for ULBs may be made mandatory. Such audit reports should also be put on the public domain. Similar initiatives have been implemented in Nagpur. The audit report includes key water supply related parameters like quantity of water withdrawal, water treated, water supplied, wastage and losses, cost recovery from users, etc., and is available in the public domain. Such data can be expected to motivate the people to put pressure on the authority to reduce the loss to make it more efficient. Additionally, collection efficiency may also increase due to such initiatives. • Extensive capacity building activities may be undertaken for ULB officials to enable them to undertake efficient O&M of assets • To enhance the financial sustainability of drinking water schemes, metering and tariff collection are extremely essential. The recommendations mentioned above may be implemented	WR-F17 WR-F19 WR-F21
WR-R15	**Water quality**	WR-F18

Sl.no	Recommendations	Finding
	• Water quality of drinking water supply projects may be maintained by proper O&M and monitoring. Additionally, water quality tests may be undertaken at regular intervals and as per CPHEEO guidelines to ensure adherence to drinking water quality standards • In addition, ETP for industries must be made mandatory and PCBs should monitor any pollution sources to maintain the water quality	
Wastewater		
WR-R16	**Wastewater reuse & pollution abatement measures** • State level action plan may be prepared to identify STP requirements. The mapping of the same should be done with the possible demand centers in the state (industrial clusters, agricultural zones, etc.). Projects in nearby demand centers and in water scarce areas may be taken up on priority. Financial feasibility of such projects will also be high due to possible revenue sources. • In line with NMCG, similar missions for creation of STPs in other states and for important rivers like Mahanadi, Godavari, Krishna, Kaveri, etc. may be undertaken. PPP (HAM model) similar to NMCG projects may be adopted for financing of such projects. • Wastewater treatment for rural and peri-urban areas may also be planned, going forward as JJM is being implemented which will bring household drinking water supply to rural areas. Modular and decentralized wastewater treatment plants may be explored for such rural and peri-urban areas • Reuse of wastewater in Agriculture and/or Industrial sector is currently being included as a component in the new NRCP projects. However, options for wastewater reuse in agriculture and industrial	WR-F18 WR-F22

Sl.no	Recommendations	Finding
	sector as a revenue generation mechanism may be explored for the previously commissioned projects under NRCP. This will also help boost the financial sustainability of those projects. The same may also be extended to the implemented NMCG projects, wherever possible. • For quicker adoption, areas where there is scarcity of water may be taken up on priority • Wastewater reuse policy should be framed by all state governments • Wastewater reuse roadmap may be prepared and extended to industrial and domestic sectors, gradually mandating reuse targets for industries as well as for large cities (starting with large commercial SEZs and housing complexes)	
WR-R17	**Formalise and increase use of recycled water for agriculture** • Further formalization and promotion of use of recycled water for agriculture may be undertaken in a large scale. Initially, water scarce areas may be the focus. Capacity building and IEC activities are required for farmers to educate them about the use of recycled wastewater and these should be undertaken.	WR-F23
Broad Sectoral outcomes		
WR-R18	**Improve Agriculture Water Use Efficiency** • To improve agriculture water use efficiency, micro-irrigation needs to be adopted at an even larger scale. Further details related to adoption and improvement of micro-irrigation are mentioned in the recommendations for PDMC scheme. • Broadly, micro-irrigation guidelines need to be crop specific and also tailored to the climatic or soil conditions. Such initiatives will	WR-F24

Sl.no	Recommendations	Finding
	allow the farmers to get better subsidy and also maintain better land productivity • Additionally, to increase micro-irrigation adoption, subsidised power is a major impediment. Therefore, blanket subsidy on power may be avoided.	
WR-R19	**Bridge increasing gap between demand and supply of water** Supply Side- Key interventions in the supply side are: • Improved Groundwater Management through community participation • Better regulatory system • Assured SW supply through LI, River interlinking and PDN projects • Reuse of treated wastewater in agricultural sector • GW recharge and water conservation promotion • River rejuvenation Demand Side- Key Interventions in the demand side are: • Improving water use efficiency in agriculture by strengthening micro-irrigation • Reducing conveyance losses in canals • Working on crop diversification • Implementing climate smart agriculture (CSA) and the climate smart water management practices. CSA aims to tackle three primary objectives- (1) Sustainably increasing agricultural productivity and incomes (2) Adapting and building resilience to climate change; and (3) Reducing and/or removing greenhouse gas emissions, where possible. Climate smart water management practices involve safeguarding of critical water resources for sustainable use through adaptive measures for effective water management, particularly in drought-prone regions. An integrated approach needs to be implemented in agricultural water management through adoption of innovative	WR-F8 WR-F12 WR-F20 WR-F24

Sl.no	Recommendations	Finding
	practices such as rainwater harvesting, micro-irrigation and resource conservation farming to increase water-use efficiency in agriculture.	
WR-R20	**Efficient groundwater management and technologies** • In addition to the earlier mentioned GW related initiatives, crowd sourcing GW related data may be attempted. For instance, it may be made mandatory by state GW authorities, to disclose GW related data when a user receives a NOC from the authority for extracting groundwater. The detailed level by level drilling data of soil strata should be shared with the authority. Such information regarding depth of individual strata will be beneficial to create a profile of the area. Moreover, information on GWL in the area can also be shared. Such information may be digitized and used judiciously for planning GW recharge related initiatives. However, in addition to GWL, monitoring of flow regime dynamics and GW quality shall also be taken up on regular basis.	WR-F3 WR-F11
WR-R21	**Water regulator** • Like the transformation in Telecom and Power sector has been achieved with a regulator in place, there should be a state level regulatory authority for water. The authority should monitor the progress of goals set in the state water policy and regulate the quantity of water for different category for users- agricultural, industrial and domestic. The regulator will also be an independent body which will be authorised to arbitrate on water related disputes. Such regulatory authority may also take up the mandate for streamlining and improving the data collected and maintained by various stakeholders. A careful attention should also be given to the organisation structure of the Authority, by drawing members from all all sectors of economy and water value chain, such as industrial users, domestic users, agricultural users, groundwater	WR-F25

Sl.no	Recommendations	Finding

	and surface water management authorities, legal and financial experts while constituting the Authority.
	• Various incentives may be provided by the GoI to the states to form an independent water regulator (similar to Maharashtra Water Resources Regulatory Authority. Specific measures may be:
	  ○ Providing more subsidy on certain schemes (e.g. micro-irrigation / PDMC) to states where independent regulatory authority has been formed. Such a move can initiate people's movement and create pressure on the state governments
	  ○ Another option could be to provide a one-time grant to the states whereby initiation fund may be provided for setting up an independent water regulatory authority in the state. Specific guidelines and suggested organisation structure may also be suggested by the Central government for adoption by the states.	

WR-R22	**Capacity building of organizations** • Renowned organizations working in the irrigation and agricultural sectors like Water and Land Management Institute (WALMI) and Punjab Agricultural University (PAU) may be empaneled for providing capacity building on latest technologies • The key topics which may be focused upon initially are Micro-irrigation, National Hydrology Project monitoring, Piped Distribution Network, reuse of treated wastewater and other such novel initiatives. In addition, certain special skillsets/capabilities may be developed among selected state officials in advanced areas related to climate modelling, hydrological modelling, etc.	WR-F26
WR-R23	**Scheme convergence**	WR-F27

Sl.no	Recommendations	Finding
	• The primary schemes with which attempts may be made to achieve convergence are MGNREGA, IWMP, SBM(G), MPLAD, MLALAD, DMDF • A cross-sectoral task force may be formed especially involving irrigation, agriculture, horticulture and rural development departments to facilitate scheme convergence	
WR-R24	**Staffing levels** • A thorough organisational and institutional study needs to be conducted to identify the gaps in staffing. Organisation restructuring, reskilling and job role review may be undertaken based on this comprehensive assessment. In case of inadequate staff strength, or poor ratio of field to office staff, recruitment or departmental transfer initiatives need to be undertaken	WR-F28
WR-R25	**Financing in the sector**	WR-F29

	To improve revenue collection in the irrigation sector, the following initiatives are suggested: • Mandatory formation of WUAs (or strengthening where it exists) • Stronger outreach, including training and capacity building of the WUAs may be focused upon • Strengthening of the Irrigation Act • Assured service levels to customers / beneficiaries • Online collection or local payment collection of irrigation fees through agents or WUAs • Linking of disbursal and approval of agricultural loans and other government support to payment of irrigation fees • In case of Micro-irrigation projects – PPP initiatives may be explored where capex is borne by Private sector. During O&M period, the irrigation service fee is collected through WUA. Such targeted programs may be carried out in water scarcity areas • Alternative financing mechanisms like Outcome financing and Impact financing may be explored for financing of water sector related projects. In these innovative financing mechanisms (mostly used to fund social sector projects), investors provide up-front capital to service providers, with the potential for a return if selected outcomes are achieved. Such innovative funding mechanisms have enabled successful achievement of outcomes across a variety of sectors like improved learning outcomes among primary school-aged girls in rural India, family reunification of children in out-of-home care in Australia, and sustained employment among vulnerable youth in Colombia, etc.	

Sl.no	Recommendations	Finding
WR-R26	**Improve Project Management** • Develop a national contractor management tool/ software- Since most large irrigation projects involve engagement of a host of contractors over a long period of time, an online contractor management tool should be developed by the Central government and source code should be shared to each of the states to avoid individual state investments in such tools. • Systematic progress tracking of contractors will help to identify critical paths and ensure timely actions and escalations are undertaken.	WR-F30
Overall nature and responsiveness of Water sector		
WR-R27	**Improve Planning and data management in the sector** Creation of reliable and dedicated data sources for the Water Resources sector focusing on supply as well as demand side (irrigation, industrial - consumption by sector, domestic and wastewater) is of utmost necessity. For this, the following may be adopted: • Since water is a state subject, data is collected and maintained by various state government agencies operating in the sector. Pooling and collection of existing data related to the water resources sector through state WRD (like APWRIMS). This should include both water supply and use related data. • In line with the National Hydrology Project which aims to improve Supply side data availability, demand side data may also be collected from the various responsible agencies by designing a similar scheme going forward. Moreover, when coverage of metering and monitoring infrastructure becomes more widespread, decentralized data collection from all demand centers	WR-F31

(irrigation, domestic and industrial) may be attempted. Involvement and support from various associations like WUAs, civil societies, industry associations, etc. may be sought for this.

Planning in the water resources sector may also be improved by adopting the following:

- A separate scheme may be undertaken dedicated to water resource planning at state level. Such exhaustive exercise is required to be conducted individually for all states. A comprehensive sector plan covering all facets of the sector- water supply and demand for irrigation, industrial and domestic sector, water use efficiency, etc. is required to be undertaken. A deeper and exhaustive study through a well-designed scheme will strengthen the state sector planning. The existing State Specific Action Plan which primarily focuses on climate change and water conservation initiatives, may be subsumed and merged with the proposed initiative. Such initiatives will also address data gaps pertaining to the sector

  Similar initiatives have been taken by the Government of Punjab which has recently engaged a leading private sector company to prepare a comprehensive water sector plan for the state. It should cover all aspects including improving water use efficiency, water supply, water demand, and measures to increase efficiency in agriculture, industrial and` domestic sectors.

- In Irrigation department at state level, three wings may be created based on the distinct skillsets required for the exhaustive list of activities conducted by the department. (1) Construction and Design Wing- The same to continue to focus on technical designs, asset creation and other technical activities; (2) Operations wing- The same may focus on O&M of existing assets, and other softer aspects like Community mobilization, and (3) Commercial Wing -

Sl.no	Recommendations	Finding
	focusing on commercial aspects like service fee collection, etc. These separate wings may operate under a common Engineer in Chief and Secretary. A fixed percentage of the capital expenses budget for the department should be allocated for O&M • Water entitlement for all category of users - domestic (bulk), industrial and irrigation may be fixed to promote water use efficiency. Regulatory authorities should be mandated to implement such initiatives. • In drinking water supply, for better planning, implementation and efficient O&M it is suggested that due to the inherent difference skillset required for undertaking these activities, bulk water production and transmission may be undertaken by a single entity (preferably Water Supply Authorities in case of Urban areas and ZPs in case of rural areas), whereas drinking water distribution related activities are conducted by a separate entity (preferably ULBs in case of Urban areas and GPs via VWSCs in case of rural areas).	
WR-R28	**Improve coordination between various agencies** • Design of irrigation sector related schemes and implementation of the same would require better cooperation between the Jal Shakti ministry, Agricultural Ministry and the Irrigation, Agriculture, Horticulture, Rural development and Groundwater authorities or departments at the state level. To promote this, task force or similar coordination mechanisms may be formalized both at State as well as District levels between the above-mentioned departments or agencies. The state of Gujarat has attempted such initiatives while implementing micro-irrigation programs. They have undertaken micro-irrigation programs in mission mode wherein they have created a task force and engaged experts from agriculture, water	WR-F32

Sl.no	Recommendations	Finding
	resources and rural development departments, to promote better coordination and planning. Alternatively, to improve the coordination especially between state groundwater departments/directorates and Irrigation department, a "Sustainability wing" may be created within the larger WRD to look after sustainability of groundwater resources. This wing should be filled up by domain specialists selected by the state groundwater departments/directorates/CGWB, as appropriate. Such an initiative would improve the coordination between the groundwater department and the irrigation department.	
WR-R29	**Promote conjunctive use of surface water and groundwater** • The departments at State levels are separate - GW being monitored and maintained by State GW authorities and surface water by WRD or Irrigation department in most cases. Therefore, for better coordination and planning on conjunctive use of SW and GW, the same task force as mentioned in the above recommendation may be used. • Alternatively, the Sustainability Wing as mentioned in the above recommendation may also be used to promote conjunctive use.	WR-F33

2 Scheme Level Analysis: Water resources

2.1 Introduction

Analysis of Centrally Sponsored Schemes to be covered under the Water Resources sector is presented here. For each CSS, the analysis presents a background of the scheme including historical context, physical and financial performances, performance evaluation using REESIE framework and cross-sectional themes, issues and challenges, recommendations and solutions mapped to the issues. A brief summary of those CSS for whose implementation has not started at the time of preparation of this report has also been included.

2.2 Individual Scheme Analysis

2.2.1 Accelerated Irrigation Benefits Program

Accelerated Irrigation Benefit Programme (AIBP) was launched by the central government in 1996-97 for providing Central Assistance to major/ medium irrigation projects to facilitate accelerated implementation of projects that were in advanced stage of completion or beyond the resource capacity of states with the objective of reducing the gap between Ultimate Irrigation Potential (UIP) and Irrigation Potential Created (IPC). Projects that were started in pre-5th and 5th plan period were prioritized under this scheme along with those projects which were catering to tribal and drought prone areas. Total 297 irrigation/ multi-purpose projects have been included under AIBP since its inception. 143 projects out of 297 have been completed, which have created an irrigation potential of 24 lakh ha under AIBP up to March 2014. Further, overall potential creation through all AIBP schemes up to March 2014 is 81 Lakh Ha.[82] AIBP became a part of PMKSY after its launch in 2015-16.

Under PMKSY-AIBP, 99 on-going major/medium irrigation projects were prioritized during 2016-17. These projects have an ultimate irrigation potential of 76.03 lakh ha. and up to March 2016, an irrigation potential of 41.39 lakh Ha was created through these

[82] AIBP-PMKSY website (http://pmksy-mowr.nic.in/aibp-mis/), Data shared by SPR wing (DoWR)

projects. The balance irrigation potential of 34.63 lakh Ha was targeted to be created under PMKSY-AIBP.

Further to expedite the completion of these projects, in 2016-17 a Long-Term Irrigation Fund (LTIF) was created under National Bank for Agriculture and Rural Development (NABARD) for providing funds to both Central and State Governments to meet the financial requirements for completion of the prioritized irrigation projects including CAD works. Initial corpus of LTIF was Rs. 20,000 Cr.[83]

2.2.1.1 Background

Irrigation is a state subject and the projects are implemented by the state governments from their own resources. Irrigation projects require huge capital investments and most of the projects suffer from fund crisis because the states have very limited funds, it was found that some of these projects were in an advanced stage of construction and if completed, they could benefit many farmers by bringing irrigation in their respective command areas.

In view of the above, the Central Government launched Accelerated Irrigation Benefits Programme in the year 1996-97 to provide Central Assistance to expedite the progress of ongoing major and medium irrigation projects.

The AIBP guidelines were amended from time to time for inclusion of more projects within its ambit including the projects of KBK (Koraput, Balangir and Kalahandi) districts of Odisha and from drought prone areas which were performing below national level. The Central Loan Assistant was also extended to Minor Surface Irrigation Projects of special category states: North-Eastern & Hilly states and KBK districts of Odisha. From October 2013 onwards, additional emphasis was placed on pari-passu implementation of command area development works for increasing utilization of created irrigation potential.

[83] National Water Development Agency website (http://nwda.gov.in/content/innerpage/pmksy-aibp.php)

Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)

PMKSY was launched in the year of 2015-16 with an aim to enhance physical access of water on farm and expand cultivable area under assured irrigation, improve water use efficiency at farm level, introduce sustainable water conservation practices, etc. There are four components of PMKSY; AIBP, Har Khet Ko Pani, Per Drop More Crop and Watershed Development. During 2016-17, 99 projects were identified from the 149 ongoing AIBP projects at that time, in consultation with States, which could be completed by December 2019 and their funding was approved by the Government of India through NABARD for Central Share and State Share both. Concurrent implementation of CAD&WM has been emphasized for realizing the benefits at field level and to reduce the gap between IPC and IPU.

The 99 priority AIBP projects on completion are expected to create total irrigation potential of 76 lakh ha, out of which 41.39 lakh ha has already been created as on March 2016 and the balance 35 lakh ha was to be addressed through the PMKSY-AIBP scheme.

As per the operational guidelines, the main objectives of PMKSY-AIBP are:

- Focus on faster completion of ongoing major and medium irrigation projects including National Projects which were beyond the resource capacity of the state and were in advanced stages of implementation
- Augment fund to the State Govt. for completion of the prioritized projects
- Create benefits of Irrigation Potential Created

The present pattern of funding for major and medium irrigation projects under PMKSY-AIBP is stated below:

Table 24: AIBP - Funding Pattern (Centre-State Split)[84]

#	Category	Funding Pattern	
		Centre	**State**
1	General category states	25%	75%
2	For North-eastern and Hilly States	90%	10%

[84] Scheme document shared by M/o of WR, RD & GR (July 2016),

#	Category	Funding Pattern	
3	Projects benefitting special areas, areas under Drought Prone Area Programme (DPAP), new projects (from 2013-14 onwards) under Desert Development Programme (DDP) (on pro-rate basis) and national projects	60%	40%

As on March 2016, the total balance cost of the PMKSY-AIBP projects is estimated to be around Rs. 73,348 Cr., out of which the balance Central Assistance admissible is Rs. 16,963 Cr. i.e. around 23% of the total cost.[91]

2.2.1.2 Performance

Physical Progress

As per data shared by PMKSY-AIBP, DoWR, RD&GR, as on March 2020, a total of 21 lakh ha (62% of the target) of additional irrigation potential has been created out of the target balance potential of 35 lakh ha. Thus, on a cumulative basis, currently out of the 76 lakh ha of envisaged IPC under these 99 projects, around 63 lakh ha (i.e. 82%) has already been created. 44 out of the total 99 projects (106 projects including 7 phases) have been completed till now, with others being envisaged to be completed by March 2023. Compared to previous records, the rate of completion and irrigation potential creation of these MMI projects under PMKSY-AIBP have been substantially enhanced.

Under PMKSY-AIBP, state-wise achievement of states against their targeted balance potential (balance potential as on March 2016) is illustrated in the figure below (note the states are arranged from left to right in terms of percentage achievement with the leftmost state having the highest achievement as percentage of its target).

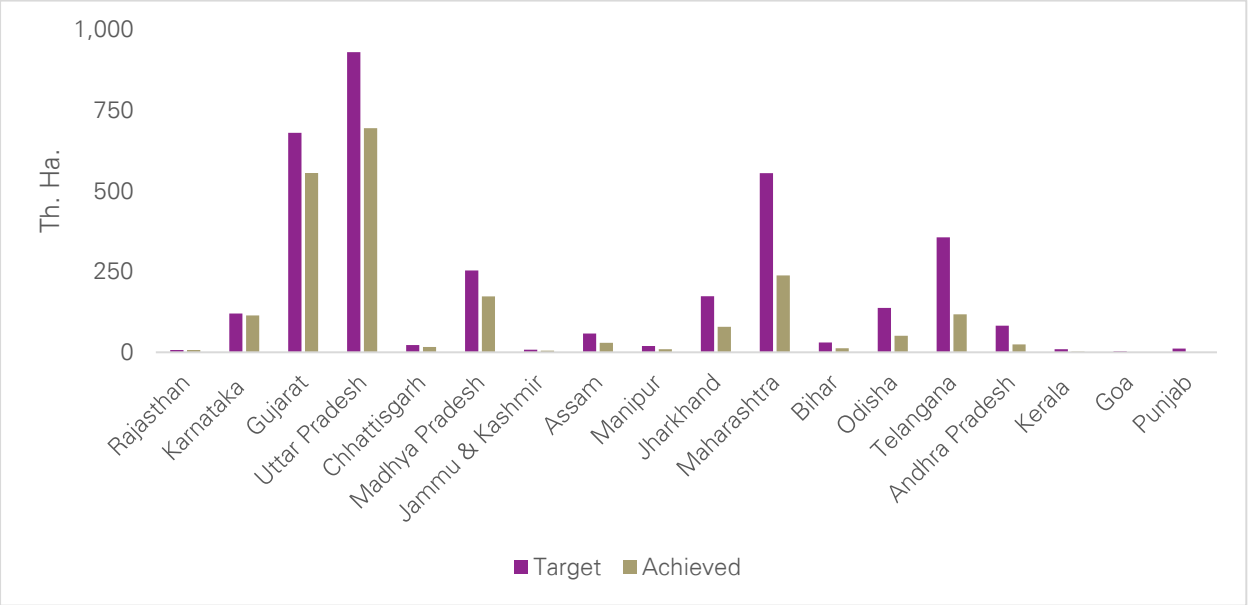


Figure 27: AIBP – physical progress during 2016-2020

As evident from the figure, Rajasthan has achieved its full target potential as on March 2020, followed by Karnataka (achieved 95% of target balance potential), Gujarat (achieved 82% of target balance potential), Uttar Pradesh (achieved 75% of target balance potential) and Chhattisgarh (achieved 74% of target balance potential). While some of the lagging states are Telangana (achieved 33% of target balance potential), Andhra Pradesh (achieved 29% of target balance potential), Kerala (achieved 21% of target balance potential)) and Goa (achieved 7% of target balance potential). The two projects under Punjab (viz. Kandi canal extension and Rehabilitation of 1st Patiala Feeder & Kotla branch have been declared as completed (with no further additional irrigation potential under PMKSY-AIBP). It may be noted that though some states like Gujarat and Uttar Pradesh with high target balance potential (greater than 1 lakh ha) have made substantial progress, yet other states (with high target balance potential) like Jharkhand, Maharashtra, Odisha and Telangana have failed to reach even 50% of their target balance potential.

Financial Progress

As per data shared by PMKSY-AIBP, DoWR, RD&GR, as on March 2020, a total of Rs. 43,633 Cr. has been incurred against the balance cost (as on March 2016) of Rs. 73,348 Cr. Thus, the overall

financial progress of 59% is commensurate with the overall physical progress of 62% during this period. State-wise performance in terms of physical progress compared to their financial progress is illustrated below (states are arranged in descending order with the topmost state with the highest margin between its physical and financial progress).

As evident in the figure below, states Karnataka, Rajasthan and Chhattisgarh have achieved considerable progress at lower expenses while states like Jammu & Kashmir, Telangana and Odisha have incurred higher expenses compared to their physical progress.

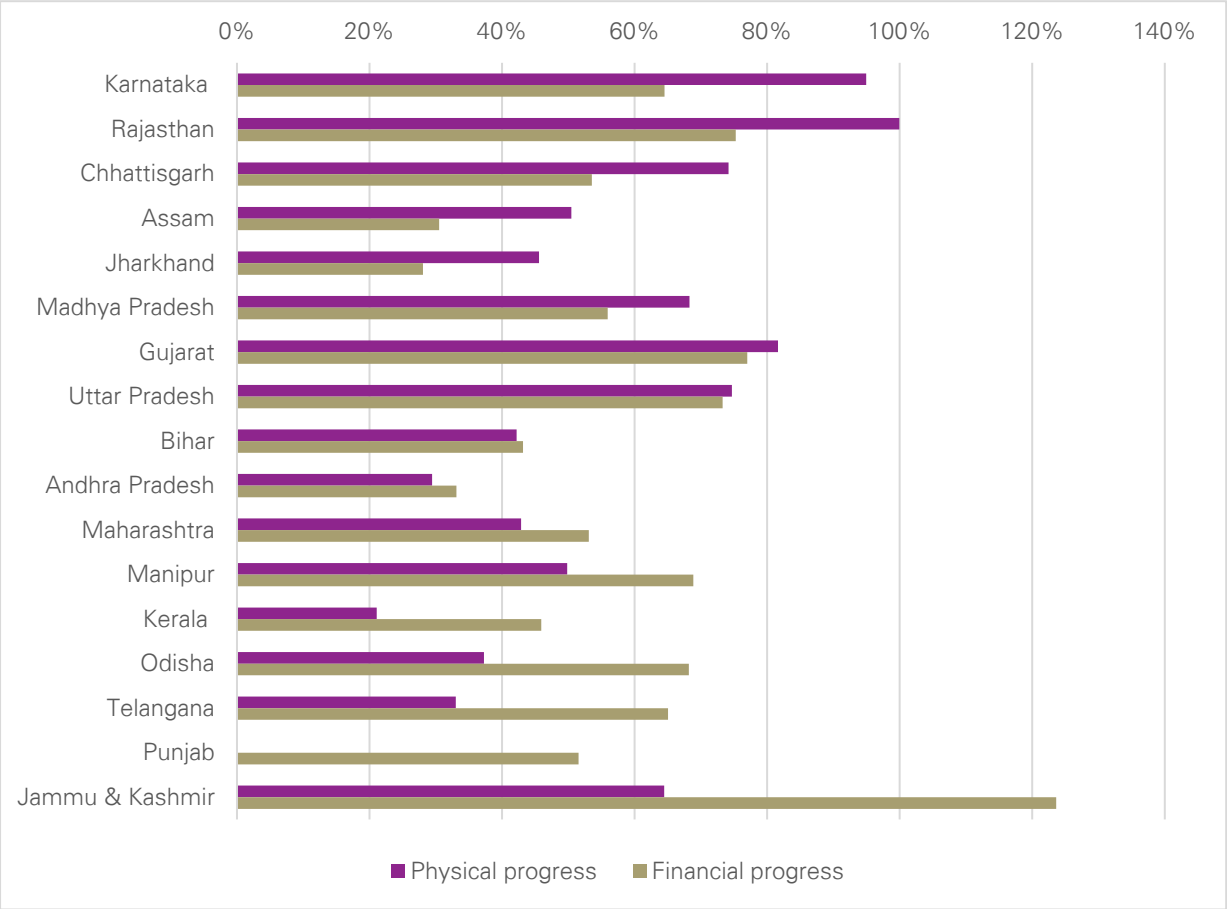


Figure 28: AIBP – comparison of physical and financial progress

Performance on REESI+E framework

Table 25: AIBP – performance evaluation using REESIE framework

Parameter	Findings from research

Relevance	**Secondary:**
	• The scheme's intended outcomes aim to address the following Sustainable Development Goals:
	  ○ SDG Goal 2 – hunger
	  ○ SDG Goal 6 – clean water and sanitation
	  ○ SDG Goal 10 – reduced inequalities
	• The scheme's objective of focusing on faster completion of ongoing MMI projects, funding of prioritized projects and creation of irrigation potential shall invariably address the following:
	  ○ Food security challenges – food grain production in 2016 stood at 255 MMT against estimated requirement of 291 MMT in 2025 and 450 MMT in 2050
	  ○ Inaccessibility to assured irrigation: in 2016, Ultimate Irrigation Potential (UIP) was 140 mha while Irrigation Potential Created (IPC) is 113 mha[85]. The 99 Priority AIBP projects on completion shall help in creating 76.03 lakh ha of irrigation potential
	  ○ Doubling of farmer's income by 2022 in line with the Central government target
	• In terms of PMKSY-AIBP scheme coverage, the eligibility criteria accord special consideration for states lagging in development, drought prone and tribal areas, states with lower irrigation development and districts identified under PM package for agrarian distress. However, out of the 18 states selected for PMKSY-AIBP, almost 86% of the total CA funding is accounted by only 6 states viz Gujarat (28%), Maharashtra (18%), Uttar Pradesh (9%), Jharkhand (8%), Karnataka (7%) and Madhya Pradesh (7%).

[85] Data shared by DoWR,RD&GR

Parameter	Findings from research
	• A number of recent studies (like IMMI-Tata policy paper 'Rethinking PMKSY, July 2016'), pointed that investments in Type I irrigation (i.e. large publicly funded irrigation projects) since 1990 resulted in 'little or no benefits' to Indian agriculture as utilization of assets failed to keep up with the assets creation. Farmers are found to prefer Type II irrigation (private wells/ tubewells and lift irrigation structures) owing to their cost effectiveness, quick completion and reliability. Several such studies advocated states to expand affordable and decentralized Type II irrigation on priority basis before investing in watershed treatment and surface water from tanks and canals. Again a study by IIM Ahmedabad in 2008 ('Study Gap between Irrigation Potential Created and Utilized in India') pointed out that though the government controlled and centralized MMI projects suffer from lower effectiveness due higher agency problem, yet they have much longer life compared due to minor-irrigation structures which have higher effectiveness (especially in the initial designed years) and shorter life-span. • A host of studies including Dr. Mihir Shah's article 'Water: Towards a Paradigm Shift in the Twelfth Plan' point to the importance of planning from 'reservoir to farm gate' and urgent need for development of command area development (CAD works).
	Primary: Discussions with the key stakeholders like Directors (Monitoring & Appraisal) CWC regional offices, Chief Engineers, Superintending Engineers and equivalents from State Government departments provided the following insights in relation to relevance: • In terms of scheme coverage, since only a handful of states account for majority of the CA funding, it was suggested by some stakeholders to revisit the selection criteria to ensure more equitable coverage across other states. It was suggested that a more accommodative stance may be adopted, where after a specified

Parameter	Findings from research
	time interval (say yearly, bi-yearly) new projects meeting the eligibility criteria may be allowed to be onboarded. • Both major and decentralized minor irrigation projects have equal potential in water resources exploitation and comparative merits and de-merits; comparison and substitution of one with the other may not be the right approach. Category of projects planned should depend on the site location (availability of command area), topography, quantum of water availability and other factors; while minor projects benefit from low gestation period and quick realization of benefits, major projects cater to larger population and other needs like drinking water, industrial water supply, hydel power generation, storages for essential use during drought years and also have better capital investment per ha ratio. According to many stakeholders, major projects are better planned and easier to monitor and also incur less resources (in terms of total maintenance cost over subsequent years). • Stakeholders in some states like Punjab, Andhra Pradesh and Karnataka pointed to the increasing demand for canal water in view of the dwindling groundwater level. • All the stakeholders unanimously validated the immense positive impact of the AIBP projects on the farming communities both in desert and drought prone states like Punjab and Maharashtra and water abundant states like Assam and Jharkhand.
	Inference: • The major and medium irrigation projects (including the AIBP projects) have immense potential in addressing the SDG goals and related national priorities; however, there is an imminent need to focus on some scheme components like command area development and maintenance to realize full potential of projects. In this aspect, the 99 Priority AIBP projects with provisions for pari-passu implementation of CAD works is a well-conceived scheme in

Parameter	Findings from research
	achieving the goals. However, as suggested by some stakeholders, scheme coverage may be made more accommodative by allowing onboarding of new projects meeting the eligibility criteria after specified periods of scheme launch. Thus, it may be concluded that the PMKSY-AIBP scheme is extremely relevant for achieving the SGD goals and the national priority.
Effectiveness	**Secondary:** **Scheme design** • Review mechanism: At national level, PMKSY Mission has been set up for overall coordination and outcome focused monitoring while Council is responsible for overall supervision and course correction and high level empowered committee (HLEC) responsible for policy guidance and midterm policy correction. • Institutional structure: Various studies (like ADB Study 2013) pointed out that with progressive shift towards service oriented approach from construction based approach and Participatory Irrigation Management, staffing pattern of Irrigation Departments needs to be broadened to include social mobilizers like social workers, agro-economists, anthropologists along with the engineers **Scheme implementation** • Out of the Ultimate Irrigation Potential (UIP) of 76 lakh ha of the 99 Priority AIBP projects, 41 lakh ha was created as on March 2016; while out of the balance 35 lakh ha, around 21 lakh ha (i.e. 62% of the balance) have been created during 2016-202091.Since its inception under PMKSY-AIBP in 2016-17, the pace of project completion and irrigation potential creation have significantly increased. Since 2016-17, annually, the AIBP works of 11 projects have been completed under PMKSY-AIBP against the average of 7 projects per year earlier. Similarly, annual rate of creation of irrigation potential now is 5.3 lakh hectares (ha) against the 4.5 lakh hectare

Parameter	Findings from research
	per annum earlier. This is facilitated by various innovative provisions introduced under the PMKSY-AIBP schemes like Fast Track Proforma Clearance for faster clearance of projects with escalated cost and Long Term Irrigation Fund (under NABARD) through which the government extended loan assistance for both centre and state shares at subsidized interest rate of 6%. As on date, the Central Government has already released Rs. 11,489 Cr. as Central Assistance and Rs. 22,710 Cr. as State Share through NABARD during 2016-20 for the 99 Priority AIBP projects.[85] However, inspite of this accelerated pace, the initial target of completion of all the 99 projects by December 2019 could not be met, which is now expected to be completed by 2023 only. Some of the teething problems still plaguing the project implementation are highlighted below: o Land acquisition: Delays in MMI due to land acquisition has been well documented in various past studies and literature. In accordance with the suggestion of the Public Accounts Committee (2012-13), the Ministry has invariably linked the release of funds in each financial year subject to state government's possession of adequate land for that particular financial year's work. However, land acquisition continues to scuttle many of the ongoing Priority Projects. Many of the delays may be attributed to externalities (outside the purview of the state implementing authorities) like the clearances required from other departments like, railways, roads and the environment departments. o Rehabilitation & Resettlement: Another significant contribution to delay in project implementation are stalling of projects (particularly those involving construction of reservoir structures) owing to protests related to R&R and demand for higher compensations. C&AG report on AIBP (Report No 22

Parameter	Findings from research
	of 2018) points to several deficiencies in terms of R&R like administrative laxities, incomplete coverage of all project affected people, lack of basic infrastructure and amenities, delays in release of funds which led to project delays.(note the C&AG report observations pertain to the period of study between 2008 and 2017 and hence some of the observations may not be relevant for the current PMKSY-AIBP schemes which were initiated only in 2016-17. Issues relevant for PMKSY-AIBP, observed during the primary study, are highlighted in the next row under 'Primary' observations). E.g. in case of Durgawati and Punpun projects in Bihar, it is reported that even though in possession of 96% and 86% of land for the respective projects, the state government released compensation for only 72% and 42% respectively[86]. This is also validated by the PMKSY-AIBP MIS dashboard where out of the 43 projects reported to be facing 'issues and constraints', land acquisition, R&R and legal/ court cases are reported to affect 26 of the projects (i.e. 60% of the 43 projects) while 4 of the remaining projects are facing issues owing to clearances from other departments. o Other issues: Issues like political or local interferences leading to deviation from optimal design (like change in location, size/length) hamper scheme implementation. • Negative factors affecting scheme benefits: o Operational losses: Conventional open canal systems are prone to severe water losses owing to percolation losses and poor conveyance capacity owing to inadequate maintenance, heavy siltation and weeding, the fallout of which is

[86] https://www.nationalheraldindia.comhttps://www.nationalheraldindia.com

Parameter	Findings from research

inadequate water availability at branch canals and tail-end regions. Also, the traditional water delivery systems in India (like warabandi, shejpali, satta, etc.) suffer from inherent weaknesses like discrepancies between forecast and actual delivery flows, inaccuracies in checking water flow, etc.

- A study by Rubicon Water India 'Global experience of automation of irrigation systems' states that the current conveyance efficiency is 40% and out of the 510 km^3 of water per annum for irrigation, only 204 km^3 translates into beneficial use. A report by IIM Calcutta (2008) "IPC-IPU Gap Analysis in West Bengal and the North-east" pointed how lack of maintenance, unlined channels and seepages are reported to cause 'more than 30% water loss'. Water loss[87] across different components in open conventional canals is summarized below:

Component	water loss %	cumulative loss %
Main canals	6%	6%
Branch canals	8%	14%
Distributaries	10%	24%
Water courses	20%	44%
Evaporation losses	15%	59%

Thus, various studies have suggested adoption of piped irrigation network (PIN) to contain the conveyance losses. CWC's 'Guidelines for Planning and Design of PIN', estimates overall efficiency for PDN is 70-80% compared to

[87] As per document shared by Jain Irrigation Systems Ltd

Parameter	Findings from research
	35-60% conveyance efficiency of Canal Distribution Network. • In order to address land acquisition, conveyance and other issues associated with open conventional canals, the Ministry has been promoting use of underground pipelines, wherever feasible. Detailed guidelines related to 'planning and design of piped irrigation network' have been released by the CWC on July 2017. As on date, 26 of the priority projects have planned/ implemented use of piped distribution network to the extent feasible, covering a total length of 64,137 km[88] and which helped to avoid land acquisition to the tune of 12.8 thousand ha and resulted in direct cost saving of Rs. 2,386 Cr. o Societal factors: Traditional irrigation methods (flood irrigation) and shift in cropping pattern towards water-intensive crops, particularly in the head reaches, (which is the fallout of skewed public procurement policies and MSP implementation, climatic pattern, market accessibility, food habits, climatic and soil conditions, etc.) have resulted in huge water demand and rampant pilferages in command areas. Farmers at reservoir rim and idle reaches/higher elevation to the canal lift water using submerged pumps, thus affecting the water availability and flow in the canals[89]. **Monitoring and evaluation** • A dedicated PMU and web portal with MIS has been established which tracks the various output indicators like status of completion of AIBP projects; however except for 'total irrigation potential created through PMKSY-AIBP' there are no provisions for tracking

[88] K Vohra and M L Franklin, "Reforms in the irrigation sector of India"

[89] Planning Commission, GOI (November 2010), Evaluation Study on Accelerated Irrigation Benefits Programme (AIBP)

Parameter	Findings from research
	the outcome indicators like '% of irrigation potential utilized (in lakh ha) through infrastructure created through PMKSY-AIBP, increase in crop yield attributable to increased irrigation from PMKSY-AIBP, increase in groundwater levels attributable to PMKSY-AIBP' as mentioned in the Output-Outcome Framework guidelines by Ministry of Finance, Govt. of India (it may be noted that the utilization of irrigation potential is tracked under CADWM-MIS in separate dashboard) • Scheme guidelines suggest submission of Independent Evaluation Report of AIBP and CADWM components by state govt (report to be submitted to CWC/ DoWR at end of each financial years) and minimum of two visits per year by the CWC officials. As per the guidelines, there is a provision of mandated budget for monitoring purposes like 3% of CA (estimated Rs. 940 Cr.) for concurrent evaluation, social audit (10% of projects in each state), third party monitoring, IEC, etc. As reported by the SPR wing, PMKSY-AIBP, DoWR, RD & GR, third party monitoring through PMU-WAPCOS is being conducted regularly for PMKSY-AIBP projects. • C&AG report on AIBP (Report No 22 of 2018) points out that according to 2013 guidelines, the State Level Monitoring Committees (SLMC) are to be formed immediately for MMI projects under AIBP for implementation of environmental safeguards; however only 4 of the 19 states formed SLMC. Since the C&AG observations pertains to the period 2008-2017, current status of SLMC formation needs to be validated. • Various past studies including the IIM Ahmedabad report in 2008 titled 'Studying Gap between Irrigation Potential Created and Utilized in India' have highlighted the discrepancies in assessment of IPC and IPU by various organizations. Currently most of the organizations calculate IPC by aggregating all areas at the outlets/ end of the watercourses that can be catered by the hydraulic structures.

Parameter	Findings from research
	However, the delivery capability of an irrigation system keeps on changing depending on various factors like design, wear and tear, source reliability and other factors, which are dynamic in nature.
	Primary: **Scheme design** • Institutional structure: Most of the evaluated states (barring some exceptions like Andhra Pradesh and Bihar) like Assam, Karnataka, Madhya Pradesh, Maharashtra and Manipur reported staff shortages at the field offices. This has significantly hampered survey work (as reported in Karnataka), execution of construction work (as reported in Assam and Maharashtra),water management and fees collection. Some of the reported issues contributing to staff shortages include no new recruitment for vacant positions left by retiring personnel, attachment of the engineers in land acquisition and R&R related issues and during water rotational periods, which collectively hamper the planning and construction works. Also, some of the project authorities in states like Maharashtra and Rajasthan pointed to inadequate resources like drivers and vehicles. **Scheme implementation** • Project implementation status and bottleneck: The most pressing problems contributing to delay in project implementation are listed (based on priority): o Land acquisition: Since most of the projects involve obtaining clearances from a number of departments like roads, railway, environment, land resources and others, considerable time is consumed in the process. Though the Ministry has adopted a policy of releasing funds in a year only when the state government is in possession of the required land; yet geological surprises encountered during implementation (say minor changes in canal alignments) or requirement to cater

Parameter	Findings from research
	to additional area (based on local demand) has resulted the need for additional land requirements. Often, though the quantum of land requirement may be small yet resistance of land holders and legal cases lead to delay in completing the hydraulic connectivity. o Rehabilitation and Resettlement: Some of the significant contributors to R&R issues are delay in administrative approvals (like getting clearances from respective land resources departments), non-involvement of the local stakeholders at the project inception stages and differences in relation to compensation amount. Owing to R&R issues, various proposals of increasing dam/ reservoir heights (and consequent IPC creation) in states like Bihar, Jharkhand, Uttar Pradesh and Manipur have been stalled. Delays due to land acquisition and R&R issues have been cited as the major factor hampering implementation of PMKSY-AIBP; some of the project authorities reporting such ongoing issues include Tadipudi LIS, Thotapally and Tarakaram Teerta Sagaram projects in Andhra Pradesh, Punpun barrage and Durgawati projects in Bihar, Upper Tunga project in Karnataka and Dhom Balkaawadi and Bembala projects in Maharashtra. Some of the common factors cited by stakeholders include revised higher compensation demands from some land-owners/ PAP on the basis of escalated price as per 'The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013', increased steps for soliciting approval as per the 2013 act, delay in disbursement of compensation to the PAP owing to administrative delays like vacancy in positions for related revenue/ land acquisition officials and inadequate provisions

Parameter	Findings from research
	for LA compensation in the initial proposal stage. During FGD in a tail reach village of Sri Rameswara project (Babujikoappa village, Belgaum district, Karnataka), the cultivators complained of not receiving any compensation for land acquired for canal construction. This finding is also validated by some of the stakeholders (mainly project implementing agencies) who confirmed how delay in payment of compensation by the state government is affecting the CAD field works owing to farmer protests. o Fund shortages: Though funding mechanisms have been streamlined under PMKSY-AIBP particularly in relation to release of CA and loan assistance to states from NABARD (LTIF), yet the following issues still persist in some states: ▪ Inability of the state governments to match central contribution. E.g. the projects authorities in Dhansiri major irrigation project in Assam reported stalling of project works during 2017-18 in want of approval from State Finance and pending MOA with NABARD[90] ▪ Delay in transfer of Central releases by states to implementing authorities. Instances of delay range from 1 months to 18 months in some projects. The delay in transfer of funds has significantly affected execution of works particularly contractor management. Also, as pointed by some of the stakeholders, though the Centre:State fund sharing split is higher for north-eastern and hilly states and special category states yet it is only 25:75 in general category states (which generally have

[90] Monitoring & Appraisal Directorate (March 2018), Monitoring Report of Dhansiri Major Irrigation Project Assam

Parameter	Findings from research
	higher irrigation potential than the above two category of states). Thus, the overall CA admissible was only 23% of the total balance cost of Rs. 73,348 Cr.[91] Thus, such a lower central grant leaves the Centre with little leverage to push the state governments to adopt various water sector reforms (like increasing maintenance budget, creation of water regulatory authority, wastewater reuse, etc.) o Contractor deficiencies like inability to simultaneously mobilize resource (particularly for critical paths), working capital management issues, delay in receipt of funds from project implementing authorities have significantly affected project implementation in some states like Andhra Pradesh, Assam, Punjab and Karnataka. o Other issues: ▪ lack of co-ordination among other departments like delay in Narmada Canal project in Rajasthan owing to laxity from state electricity DISCOM/ Jodhpur Vidyut Vitaran Nigam (JVVN) which has delayed the electrification works of all diggies in the command area. ▪ difficulty in resource mobilization (both machine and labour forces) in remote areas. E.g. Musurumulli project in Andhra Pradesh which covers a large chunk of remote tribal areas witnessed some delays owing to mobilization of machineries in such remote areas and labour shortages due to frequent outbreak of diseases in that tribal belt; same phenomenon has been witnessed in other projects (particularly north-eastern states).

Parameter	Findings from research
	▪ delay in procurement of sand for construction activities owing to delays in auction by state government has been reported by some of the projects in Maharashtra like Khadakpurna project ▪ environmental issues like floods have hampered project implementation in some states. E.g. various components (including motors and panel of the pumping stations) of the Narmada Canal project in Rajasthan suffered significant damages due to unexpected floods in 2015 and 2017; portion of the Borolia canal in Assam was breached by the villages at times of flood to divert water • Most of the states like Assam, Punjab, Maharashtra, Manipur and others, facing water availability issues in main canal and distributary canals attributed low conveyance efficiency of open canals as the main culprit for this IPC-IPU gap o The average open canal losses as estimates of states vary from 40% to 60% o A substantial portion of the water losses is contributed by operational losses like spillage during manual gate operation, high head losses owing to inaccurate operations of gates and co-ordination with peer gates, etc. Such inaccurate gate operation and water wastages were confirmed by the beneficiary cultivators in the command region of Sri Rameswara project in Karnataka. o Other significant contributors are high seepages and percolation losses, coupled with inadequate maintenance in some states. Notably, CWC's monitoring report for one of the projects in Assam pointed to the imminent need for maintaining the main canal for FSL condition from the state

Parameter	Findings from research
	fund (tasks like de-siltation/ cleaning of operative canals and greasing of regulators were suggested to maintain FSL) to ensure adequate water availability in the branch canals and distributaries. Again, in Champamati major irrigation project in Assam, during FGDs with cultivators, it was reported that de-siltation and cleaning of canals needed to be done in certain stretches by the cultivators themselves, in the backdrop of poor maintenance by irrigation officials due to lack of funds. Similarly, during FGD in tail region of Sri Rameswara project (Hulkund village, Belgaum district, Karnataka), the beneficiaries complained about huge weed growth and siltation in the canal which hindered normal water flow. Again, cultivators in another tail reach village of Sri Rameswara project (Babujikoappa village, Belgaum district, Karnataka) reported canal damages and high seepages in several places and associated water-logging (and damages to crops) in the surrounding areas. o Other issues are unauthorized water lifting or canal breaches by cultivators in upper and idle reaches. During FGD in the command area of Dhom Balkaawadi project (Wakhari village, Satara district, Maharashtra), the cultivators pointed how huge seepages in the network and unabated water withdrawal at the upper reaches delay and also reduce the water flow in the tail reaches (particularly during summer months when wells also dry up). o Above issues are further complicated by diversion of water for drinking, hydro-power and other industrial issues in multi-purpose projects. A case in point is the Champamati irrigation project in Assam, where the beneficiaries attributed diversion of water for hydro-electric power and maintenance issues for severe water shortages in the Rabi season. As per data

Parameter	Findings from research
	provided by the Champamati major irrigation authorities, total observed area under crop is only 13,262 ha against the envisaged 24,994 ha (i.e. only 53%), with observed area under crop during Rabi season recorded to be nil against the designed value of 8,816 ha, though the observed discharge of water was same as the designed value of 33.30 cumecs. Similarly, in Bawanthadi project (in Maharashtra), water shortage is reported in Rabi season owning to diversion for drinking water purposes and inter-state water sharing with Madhya Pradesh. **Monitoring and evaluation** • The stakeholders from all the evaluated states viz Andhra Pradesh, Assam, Jharkhand, Karnataka, Maharashtra, Manipur, Punjab and Rajasthan confirmed the positive impact of the AIBP projects on agricultural productivity, socio-economic conditions and overall groundwater level in the command area. But in most states, in absence of any survey done by the Irrigation departments in this aspect (as the outcome indicators come under the purview of other departments like agriculture and groundwater departments), exact estimates of quantum of benefits could not be ascertained. • Many of the states were observed to adopt different local methods for assessment of IPC and IPU figures. The awareness of any standard guidelines on the same among the implementing staff was found to be minimal. • Almost all the stakeholders (including respondents from both CWC regional offices and state departments) validated that officials from CWC pay adequate visits (more than two times/ year) to the project sites; however, considering the huge quantum of ongoing project works in some states and their remote location, visits are limited to critical project locations and/ or bottlenecks.

Parameter	Findings from research
	• Though all the stakeholders (project implementing authorities) are aware of the remote sensing technology (using satellites images through NRSC Hyderabad), yet none of the evaluated states are currently using them; reasons being low technical know-how, limited use owing to low imagery resolutions, high cost of procuring images from ISRO and low frequency of image capture (can be done quarterly/ yearly). However all the stakeholders asserted that some sort of remote sensing technologies (like drone survey, etc.) would greatly facilitate the monitoring of projects and identification of system deficiencies, which are often neglected owing to limited resources of the departments and huge spread of the command areas. In relation to remote sensing technologies, some recent initiatives have been undertaken at the national level by the Ministry. Cropped area mapping studies using remote sensing technologies are being initiated along with project monitoring through Bhaskaracharya Institute of Space Applications and Geo-informatics (BISAG) (note that the quality of assessment and monitoring studies has not been validated under this study). Also, a mobile application for geo-tagging project components has been developed along with a GIS-based web portal for monitoring progress.
	Inference: **Scheme design** • Institutional structure: In light of the staff shortages and increasing need for water management, a re-look at the current resource profile of irrigation departments and outsourcing of non-core works (as initiated in Andhra Pradesh) is warranted. **Scheme implementation** • Under PMKSY-AIBP, considerable progress has been achieved vis-a-vis previous years in terms of project completion and irrigation potential creation. Some noticeable steps taken by Ministry in

Parameter	Findings from research
	ensuring this includes faster clearance of escalated project costs through Fast track Proforma Clearance (FTPC), extension of financial support to states through NABARD (under Long Term Irrigation Fund) and extensive review mechanism set at the level of Secretary (WR,RD&GR), Hon'ble Minister (Jal Shakti) and PMKSY Council under Chairmanship of CEO, NITI Aayog. However, even at this accelerated pace under PMKSY-AIBP, the initial target of completion of 99 projects by December 2019 could not be achieved. Some of the teething problems like delays due to land acquisition, R&R, fund issues, contractor problems and lack of co-ordination among state departments still persist. While many of the problems may not be attributed solely to the project authorities, however considerable scope is there for executing the projects in 'mission mode', particularly those hindered due to administrative laxities. Thus, though the PMKSY-AIBP scheme is observed to be a well-conceived scheme in terms of planning (funding, institutional mechanisms and governance), yet some of the chronic execution issues (at state level) also experienced in earlier AIBP and MMI projects, still persist. • There is a significant scope to increase the conveyance efficiency of open canals systems in India through lining of canals, proper maintenance (de-silting, removal of weeds, etc.) which are often neglected for want of funds and through adoption of canal automation to mitigate water wastages associated with manual gate operations and management. • Recent promotion and adoption of underground piped distribution network by states are welcome steps in addressing some of the chronic issues like delays due to land acquisition and R&R, conveyance losses, unauthorized water withdrawals and escalated land acquisition costs.

Parameter	Findings from research
	Monitoring and evaluation • There is a scope for improvement in terms of monitoring and evaluation, particularly the imminent need for deployment of more resources in states with larger share of ongoing projects. Monitoring of outcome parameters (which are currently being not tracked by most of the implementing agencies) in addition to output parameters is necessary to get a holistic view of the project impact. Also, it is imperative to develop and follow standard guidelines for assessment of the output-outcome figures to avoid disparities in measurements across states. • Recent initiatives have been undertaken by the Ministry in relation to adoption of remote sensing technologies like crop assessment and project monitoring through BISAG. However, the extent of adoption of remote sensing technologies in overall project management and M&E was found to be in nascent stage in almost all the states barring some particular projects. Based on the above inferences, the performance of the scheme in terms of effectiveness is termed as 'average'.
Efficiency	**Secondary:** **Cost** • Total balance cost for the 99 Priority AIBP projects as on Apr'16 is Rs. 73,348 Cr., while total expenditure incurred during 2016-20 is Rs. 43,633 Cr.[91] • The Central Government has already released Rs. 11,489 Cr. as Central Assistance and Rs. 22,710 Cr. as State Share through NABARD during 2016-20 for the 99 Priority AIBP projects.91

[91] Data provided by DoWR,RD&GR

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<tr><th>Parameter</th><th>Findings from research</th></tr>
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Many of the 99 priority PMKSY-AIBP projects witnessed considerable cost-over runs, mainly due to delays due to LA and R&R issues, increased compensation costs under ‘Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement, Act, 2013’ and increase in scheduled rates. e.g. as reported in Khadakpurna project in Maharashtra, increase in land acquisition costs and schedule rates account for 44% and 45% of the total cost escalation estimate of Rs. 278 Cr. respectively.
As per data shared by the SPR wing, PMKSY-AIBP, DoWR, RD & GR, at the time of inclusion of the prioritized projects under PMKSY-AIBP, total cost of the projects was Rs. 1,39,529 Cr. while the latest cost as on date is Rs. 1,65,449 Cr. thus indicating a cost escalation of around 18.6%. Details of the 25 projects witnessing significant cost escalations (i.e. cost escalations exceeding 20% of estimated cost as per cabinet note at the time of inception under PMKSY) along with time escalations are illustrated in the table below[85].

<table>
<tr><th>Project Name</th><th>% cost escalation</th><th>Time escalation[92] (in years)</th></tr>
<tr><td>Thotapally (Andhra Pradesh)</td><td>32.05%</td><td>1.25 years</td></tr>
<tr><td>Borolia (Assam)</td><td>63.13%</td><td>1.25 years</td></tr>
<tr><td>Sardar Sarovar (Gujarat)</td><td>52.15%</td><td>2 years</td></tr>
<tr><td>Subarnarekha Multipurpose (Jharkhand)</td><td>124.68%</td><td>3.25 years</td></tr>
<tr><td>Upper Tunga (Karnataka)</td><td>98.88%</td><td>1.25 years</td></tr>
<tr><td>NLBC (Karnataka)</td><td>44.86%</td><td>1.25 years</td></tr>
<tr><td>Dongargaon (Maharashtra)</td><td>39.23%</td><td>Nil (completed)</td></tr>
<tr><td>Waghur (Maharashtra)</td><td>42.62%</td><td>1.5 years</td></tr>
<tr><td>Lower Wardha (Maharashtra)</td><td>52.45%</td><td>1 year</td></tr>
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[92] Note time escalations are calculated as differences between envisaged target date of completion viz Dec 2019 and current expected completion date

Parameter	Findings from research

Aruna (Maharashtra)	150.45%	2.25 years
Morna (Maharashtra)	20.26%	1 year
Lower Pedhi	38.16%	2.5 years
Nardave (Maharashtra)	208.12%	1.5 years
RET irrigation (Odisha)	76.98%	Nil (completed)
Telengiri (Odisha)	97.92%	Nil (completed)
Lower Indra KBK (Odisha)	33.54%	Nil (completed)
Subarnarekha (Odisha)	22.41%	2.25 years
Annadpur barrage (Odisha)	55.81%	2.5 years
Kanupur (Odisha)	36.98%	3.25 years
Kandi canal extension II (Punjab)	21.73%	Nil (completed)
Peddavagu – Neelwai (Telangana)	44.21%	1.25 years
Rajiv Bheema LIS (Telangana)	41.08%	1.25 years
J Chokha Rao LIS (Telangana)	44.38%	1.25 years
Arjun Sahayak (Uttar Pradesh)	74.70%	1.25 years
Madhya Ganga canal Ph-II	64.22%	1.25 years

- The C&AG report on AIBP (Report No 22 of 2018) pointed to inaccurate splitting of works, sub-standard execution of works and irregularities, deficiencies in award of work, deficiencies in work expenditure and undue benefits to the contractor. A sample illustration of the project-wise deficiencies (as stated in the Audit Report) is stated below:
    - Inaccurate splitting of works: Tillari and Dhom Balkaawadi projects in Maharashtra, Bansagar and Madhya Ganga canal projects in Uttar Pradesh and SRSP-II project in Telangana
    - Sub-standard execution of works: Durgawati project in Bihar, Sindh Project Phase II in Madhya Pradesh, Warna, Wand and Tarali projects in Maharashtra

It may be noted that since the C&AG report pertains to the period 2008 to 2017; hence some of the observations stated above may no longer be relevant for the PMKSY-AIBP projects.

Parameter	Findings from research
	Benefit • As stated earlier, since 2016-17, the 99 Priority AIBP projects contributed to an additional 21 lakh ha of IPC. Though the actual utilization of the potential created viz IPU needs to be ascertained; yet the benefits of the irrigation projects in terms of agricultural outputs and groundwater level have been well-documented in many evaluation reports. Also, many of the multi-purpose projects have significantly contributed to addressing drinking water needs, industrial water supply and hydel power generation in many areas. • In addition to these, these MMI projects are expected to provide large employment opportunities for both skilled and un-skilled labour in the project areas. As per MoWR sources, these 99 Priority AIBP projects are expected to generate 1700 lakh man-days, 850 lakh man-days and 425 lakh man-days of additional unskilled, semi-skilled and skilled employment respectively.
	Primary: **Cost** • Many of the projects have undergone significant cost overruns owing to delay in implementation, thus leading to additional financial burden on the state government. However, the issue of various execution deficiencies (like inaccurate splitting of works, sub-standard execution) as pointed by C&AG report, in reference to some of the projects during 2008 to 2017, have not been validated in this study. • The Central Government's policy of Fast Track Proforma Clearance (FTPC) policy of clearance/ TAC clearance/ Investment Clearance for projects with cost escalation has greatly benefitted many of the projects.

Parameter	Findings from research
	• Private sector investment: Across states, private sector investment remains tepid in this sector except in some cases of involvement in micro-irrigation structures, owing to lack of returns in this sector. In view of the financial burden on state exchequer, some states like Maharashtra are exploring options to involve private parties through innovative PPP models like Hybrid Annuity Model (HAM model has already been successfully implemented in financing road and sewage treatment infrastructure in India). **Benefit** • All the stakeholders validated the immense agricultural benefits resulting from the AIBP projects (particularly in barren/ drought prone/remote tribal areas) along with positive impact on groundwater level in the command area in places with open canal systems. • During Focus Group Discussions (FGD) among beneficiary farmers in the tail region of the Pushkara project (Jaggampeta village, East Godavari, Andhra Pradesh), it was confirmed that assured irrigation ensured cultivation of paddy, sugarcane and chilli, which would not have been possible/guaranteed earlier (before project implementation). Also, storage in nearby ponds ensures water access to cattle in dry season and also support to vegetable and other crops like black-gram. Growth in agricultural activities ensured sufficient employment in the villages all throughout the year. The beneficiaries also confirmed receiving adequate training through the year. Similarly, benefits in agricultural output were confirmed during FGD in villages in the head region of Champamati major irrigation project (Dakshin Karigaon, Kokrajhar, Assam) and tail region of Sri Rameswara project (Hulkund, Belgaum, Karnataka). The beneficiaries in the Sri Rameswara project confirmed increase in income from Rs. 6,000 – Rs. 10,000 per acre (earlier) to Rs. 70,000 – Rs. 80,000 per acre (post project implementation). Also, during

Parameter	Findings from research
	FGD (for CADWM scheme) in command area of Dhom Balkwaadi project (Wakhari village, Satara district, Maharashtra), the cultivators confirmed how assured irrigation from the dam ensured sufficient green fodder for the livestock which led to substantial growth in dairy farming in the village. During the household survey interviews with 255 cultivators in Andhra Pradesh (command areas of Musurumulli and Pushkara projects), Assam (Champamati major irrigation project), Karnataka (Sri Rameswara), Maharashtra (Dhom Balkaawadi and Tarali projects), Manipur (Dolaithabi barrage), Punjab (mod. of Kotla canal) and Rajasthan (Narmada Canal Project), 40% of the respondents confirmed increase in irrigated land, while 49% and 25% confirmed increase in crop yield and adoption of multi-cropping owing to assured water supply post completion of the canals. • Since, many of these projects are ongoing ones, the actual impact on groundwater level will take some time to get reflected; e.g. analysis of groundwater level in the command area of three of the projects in Andhra Pradesh viz Gundlakamma (Naguppalapadu and Maddipadu mandals in Prakasam districts), Musurumulli (Rampachodavaram and Devipatnam mandals in East Godavari districts) and Pushkara (Gandepalli and Jaggampeta mandals in Pushkara) revealed no significant trends during the period 2017-2020 (as per data reported in APWRIMS) However, noticeable growth in private tubewells/ bore wells as reported in some of the command areas indirectly validated the improvement in groundwater level. Also, during primary survey with 255 cultivators in Andhra Pradesh (command areas of Musurumulli and Pushkara projects), Assam (Champamati major irrigation project), Karnataka (Sri Rameswara), Maharashtra (Dhom Balkaawadi and Tarali projects), Manipur (Dolaithabi barrage), Punjab (mod. of Kotla canal) and Rajasthan (Narmada Canal Project), around 41% of

Parameter	Findings from research
	the respondents confirmed increase in groundwater due to AIBP projects; in some of the states like Andhra Pradesh (n=94), Karnataka (n=26) and Rajasthan (n=18), around 63%, 42% and 67% of the respondents confirmed increase in groundwater level respectively, after implementation of AIBP projects. In command areas of Musurumulli and Pushkara projects, recharge of groundwater through canal seepages has facilitated around 10%-20% of the cultivators to go for second crop through lifting of water using bore wells. • Moreover, many of the multi-purpose projects cater to drinking water needs (particularly in dry and summer seasons) and electricity generation in far-off remote places. During the household interviews, 46% of the 255 respondents confirmed usage of canal water for livestock while 36%, 28% and 15% of the respondents confirmed usage for domestic (washing/ cleaning), sanitation (bathing and handwashing) and drinking water purposes. • Notable examples: o In the desert and drought-prone areas of Jalore and Barmer districts in Rajasthan, the Narmada canal has benefitted 233 villages in terms of access to assured irrigation (2.46 lakh ha), 1,541 village and 3 towns in terms of drinking water supply[93]. Income from food production increased by 177% from Rs. 534 Cr. (base year 2013-14) to Rs. 1,480 cr[88]. The concurrent evaluation study by Department of Civil Engineering, MBM Engineering College, Jodhpur has stated the achievements and results under the project as 'overwhelming and encouraging'.

[93] Data shared by Office of the Chief Engineer Narmada Canal, Sanchore

Parameter	Findings from research
	○ In Assam, the Champamati major irrigation project has resulted in increase in irrigation intensity over net irrigated area (N.I.A.) from 18.88% in 2007-08 to 87.86% in 2012-13, change in cropping pattern in pre-Kharif season from early paddy to early paddy, mustard, potato and other vegetables[94]. ○ These projects also created huge employment opportunities in the command area (particularly significant in remote tribal areas). E.g. the Champamati major irrigation project in Assam generated around 26.76 lakh[95] of man-days of employment. The Subarnarekha Multipurpose Irrigation project is expected to create 112 lakh man days of work during 2020-21.[96] During household survey, 17% of the 132 respondents confirmed participation in the construction activities under AIBP, with the corresponding figure recorded is as high as 50% in Manipur (n=24). Noticeably, the construction activities benefitted the small and marginal farmers (land-holding less than 2 ha) more – 10% of the 192 small and marginal farmers confirmed involvement in AIBP construction activities compared to only 5% of 44 large farmers (land-holding more than 2 ha).
	Inference: • Many of the projects have witnessed considerable cost overrun owing mainly to delays, escalated land acquisition costs and schedule of rates and possible issues of execution deficiencies (like sub-standard works, inadequate splitting of works), thus undermining the envisaged benefits. Though some of the issues like

[94] NERIWALM, Tezpur (2014), Report on Concurrent Evaluation of Champamati Major Irrigation Project in BTC area in Assam

[95] As per reports provided by project authorities, Champamati Major Irrigation Project in BTC area in Assam

[96] As per reports provided by project authorities, Subarnarekha Multipurpose Irrigation Project, Jharkhand

Parameter	Findings from research
	delays due to R&R issues may not be directly under the purview of the implementing agencies, yet there is significant scope of improving the efficacy of execution by eliminating the administrative delays. The Central Government's policy of Fast Track Proforma Clearance (FTPC) is a welcome step in expediting the completion of the projects with escalated costs. Thus, it may be observed, that inspite of the time overruns and associated cost overruns, inception of the PMKSY-AIBP (since 2016-17) has significantly helped to rein in both the metrics vis-a-vis previous years. • The 99 AIBP projects have invariably led to increased agricultural outcomes while also catering to other needs like domestic and industrial water supply, electricity generation (with substantial benefits accruing to drought prone and tribal areas) and other allied livelihood activities like pisciculture, horticulture, etc. Construction activities in PMKSY-AIBP projects provided direct employment opportunities to a substantial local population particularly the small and marginal farmers. Thus, the performance of the scheme in terms of efficiency is termed as 'satisfactory'.
Sustainability	**Secondary:** Since many of the AIBP projects are either ongoing or recently completed, sustainability of the schemes has been studied based on both performance of similar projects and insights from the PMKSY-AIBP projects. Also, sustainability has been assessed from the standpoint of three key parameters: financial, social and environmental sustainability; some of the aspects/ insights developed will be overlapping with the CADWM scheme. • Financial factors: Various studies like the article "Reforms in the Irrigation Sector of India" by K. Vohra and M.L. Franklin, have pointed

Parameter	Findings from research
	to the capital intensive nature of irrigation projects along with their high maintenance expenditure. This is further complicated by the poor private participation in this sector owing to low investment returns along with extant social practices of low water rates which prevent recovery of not only the capital but also maintenance costs. CWC's report (2010) "Financial Aspects of Irrigation Projects in India" noted that the sub-optimal performance of many of the MMI projects may be attributed lack of proper maintenance and management, due to inadequate funding from State. It also noted that major portion of the available funds for maintenance and management of the system are incurred on establishment expenses. Similar views were also repeated by subsequent CWC reports like "Financial Aspects of Irrigation Projects in India (2015)". The CWC report (2015) further highlighted that the gross receipts from the MMI projects, on account of water charges and other economic activities, varied from 5% to 12% of capital expenditures during 1992-93 to 2013-14. This conundrum was also highlighted by Tushar Shah in IWMI paper "Past, Present and Future of Canal Irrigation in India", where he observed that in states where irrigation departments are expanding, with increasing salary costs and stagnant water tax collection, establishment cost will come to occupy a substantial portion of the working expenses pie which will leave little for repair and maintenance of systems. Thus, maintenance of the projects and thus realization of benefits over long term becomes challenging in light of poor financial commitment for the same by the government. The CWC report (2010) advocated levying water charges on the users to generate requisite finances for an effective operation, maintenance and management of the irrigation system. The erstwhile Planning Commission in the report 'Evaluation Study on AIBP, November 2010' noted that most of the farmers in

Parameter	Findings from research
	command areas of major irrigation projects in Assam, Karnataka and Uttar Pradesh do not pay any fees. However, the same report pointed that 50% of the farmers in major projects are willing to pay more in case of assured water supply. Along similar lines, in the article 'Water: Towards a Paradigm Shift in the Twelfth Plan, 2013', Dr. Mihir Shah proposed that there is a close link between service provided and fees collected – "wherever ISF gets regularly collected, irrigation staff shows greater accountability and responsiveness to farmers". The report opines that abolition of irrigation fees (or inadequate collection like 2% to 8% of dues) has broken the accountability link between irrigation officials and farmers. A similar hypothesis has been put forth by the IWMI working paper "Malik, R. P. S.; Prathapar, S. A.; Marwah, M. (2014), Revitalizing canal irrigation: towards improving cost recovery" which points that "the cost recovery is also influenced positively by the status of maintenance of irrigation infrastructure". These underscore the need for proper maintenance, particularly in the initial years, to ensure better farmer participation, fees recovery and sustainability of the projects. This hypothesis is also validated during primary household survey, where 61% of the 255 cultivators interviewed in seven states, confirmed that they are willing to pay 'additional fees' in case reliable water supply is ensured. **Case study: Main system irrigation management by Madhya Pradesh state government** From 2009-10, Madhya Pradesh government undertook host of initiatives to ensure improved management of existing schemes along with faster completion of ongoing projects and adoption of pipe based distribution system. During 2009-10 to 2015-16, the state succeeded in creating 2.06 mha of which around 64% was achieved through improved management of existing schemes and the remaining through construction of new schemes; average

Parameter	Findings from research
	utilization efficiency increased from 32% in 2009-10 to 85% in 2015-16. **Key initiatives:** • To bridge the gap between IPC and IPU, emphasis on pre-irrigation maintenance, rehabilitation of old irrigation projects and improved management using target setting and monitoring through conventional and web-based tools were adopted • Timely pre-emptive maintenance was given utmost priority to improve system performance o Pre-Rabi inspections were made mandatory for WRD staff to ensure FSL at main canal. This was complimented by additional delegation of authority to divisional offices to conduct small maintenance work during the month-long maintenance timeframe between mid-September to mid-October o The above initiatives were supported by adequate and timely budget support from the state government; annual expenditure per unit area increased from Rs. 112/ ha in 2009-10 to Rs. 820/ ha in 2015-16 o Also, participation of WUAs was ensured through delegation of civil works of less than Rs. 50 lakh each to 50 WUAs under Madhya Pradesh Water Sector Restructuring Project *(Reference: RS Julaniya et al., A Management Approach to Increase Irrigated Area and Production in Madhya Pradesh, India)* MP's irrigation management reform was also highlighted by Dr Tushar Shah (2016) in the article "Har Khet ko Pani?: Madhya

Parameter	Findings from research
	Pradesh's irrigation reform as a model", which highlighted the following success factors: • **Ensuring effective canal system operation:** it encompassed revision of obsolete irrigation schedules, strict enforcement of osarabandi and 'tail to head' irrigation schedule • **Expediting completion of last mile connectives:** competition of last-mile projects, rehabilitation of 4,000 minor irrigation schemes, lining of old earthen canals which led to a jump in area served from 0.37 mha to 0.76 mha in just 2 years • **Reduction of deferred maintenance:** additional financial resources provided to the departments to carry out de-siltation and fixation of canal breeches two months ahead of every irrigation season • **Setting up rigorous monitoring practices:** regular monitoring by higher management using ICT and video-conferences set up, water access at tail-end villages was fixed as one of the key performance metrics • **Revival of the irrigation bureaucracy:** irrigation bureaucracy was empowered and political interferences were curtailed • **Strengthening of the WUAs** All these concerted efforts resulted in increase in irrigated area from 2.53 mha in 2013-14 to 2.69 mha in 2014-15 and 2.81 mha in 2015-16 and increase in food grain production from 30.07 MT in 2013-14 to 34.09 MT in 2014-15 and 37 MT (expected) in 2015-16. • Societal Factors: In an IWMI paper "Past, Present and Future of Canal Irrigation in India", Tushar Shah attributed 'the gap between

Parameter	Findings from research
	the area designed to be served by gravity irrigation and area actually served after the irrigation system begins operation' to the repeated overlooking of the aspect of 'head-reach farmers irrigating water-intensive crops and the shrinking of the command area that actually gets served' during the design stage; it estimated that adoption of water-intensive crops in the head region leads to a shrinking of almost one-third to half of the designed command area. • Environmental Factors: Various reports have pointed how increase in groundwater level in the command areas of the canals led to proliferation of groundwater based private tubewells/bore wells. While such conjunctive use of surface and groundwater contributed to better yield, yet at the same it led to severe groundwater extraction in some areas along with shift towards water intensive crops like paddy (particularly in the head regions). In the paper titled "Past, Present and the Future of Canal Irrigation", Tushar Shah pointed that "proliferation of irrigation wells in many canal commands has turned what were irrigation canals into recharge canals". It may be noted that the above insights are drawn from literature available for MMI projects in India in general; the relevance of these insights with respect to PMKSY-AIBP projects is elaborated in the next row under 'Primary' observations.
	Primary: • Financial factors: Collection of irrigation fees or cess is found to be either inadequate or absent in most of the states barring some exceptions in Maharashtra and few other states. e.g. o in Punjab the practice of collection of irrigation fees (abiana) has been stopped few years back o inadequate collection reported in Assam (in Champamati irrigation project, canal maintenances are done by the cultivators only; hence they are reluctant to pay any additional

Parameter	Findings from research
	fees). An earlier report of CWC in May 2010 "Financial Aspects of Irrigation Projects in India" mentioned that the gross receipt on account of water charges levy in Assam amounts to only 0.1% to 1.8% of capital expenditure during 1990-91 to 2006-07. o in Andhra Pradesh, fees collection has not started in the ongoing projects owing to absences of required assessment mechanisms and operational WUAs (like Musurumulli, Pushkara LIS, Gundlakamma projects) o In Bihar, all the stakeholders interviewed confirmed low fees recovery in the range of 10-20%, which is however expected to increase once WUAs are delegated the authority to collect fees. Also, low fees payment by tail end farmers reported due to inadequate access to water. This is further exacerbated by political issues like waive-off of irrigation fees promised by certain political parties. The CWC (2010) report puts the water charges levy collection in Bihar at 2.5% to 18% of capital expenditure during 1990-91 to 2006-07. o Similarly, in Jharkhand, fees collection has not commenced as hydraulic connectivity or adequate water supply is yet to be established in many of the areas o In Sri Rameswara project in Karnataka, fees collection is reported to be waived off for the initial three years after which the WUAs will be responsible for collection o In Bariyarpur and Singpur projects in Madhya Pradesh, only 10% fees collection is reported owing to unavailability of adequate irrigation staff for collecting the same o In Maharashtra, a mixed response has been recorded – in some projects like Warna and Waghur regular fees collection has been reported, while it was reported to be almost nil in

Parameter	Findings from research
	other projects like Dhom Balkaawadi, Khadakpurna and Tillari mainly due to farmers' unwillingness to pay any fees. • During the household survey with 255 cultivators in Andhra Pradesh (command areas of Musurumulli and Pushkara projects), Assam (Champamati major irrigation project), Karnataka (Sri Rameswara), Maharashtra (Dhom Balkaawadi and Tarali projects), Manipur (Dolaithabi barrage), Punjab (mod. of Kotla canal) and Rajasthan (Narmada Canal Project), only 15% confirmed paying of water taxes with none in Manipur and Rajasthan confirming any payment. Some of the major contributing issues being political apathy, farmers' unwillingness, inadequate irrigation staff for fees collection, non-establishment of hydraulic connectivity/ adequate water supply in some of the ongoing projects. As highlighted by a number of studies, fees collection is expected to improve with increase in water access and service reliability. During the household survey interviews with 255 farmers in seven states of Andhra Pradesh, Assam, Karnataka, Manipur Maharashtra, Punjab and Rajasthan, around 41% confirmed increased access to water owing to AIBP; however sub-par performance was reported in some of the states like Assam (only 22% of 23 respondents), Punjab (only 18% of 17 respondents) and Manipur (only 20% of 46 respondents) where less than a quarter of the respondents confirmed increased water access due to AIBP. It is interesting to note here that around 60% of the 62 respondents, who reported increased access to water after AIBP, expressed willingness to pay additional fees if reliable water supply is ensured. • Societal factors: With increased access to assured irrigation and improved level of groundwater in the command area, many farmers (particularly in states like Andhra Pradesh, Punjab and Karnataka) have shifted to water intensive crops like paddy and sugarcane, though in many cases the canals are designed for dry crops. This

Parameter	Findings from research
	comes in the backdrop of subsidized electricity and subsidies for tubewells, bore wells and assured procurement for these crops in many of the states. Some examples of the projects where cultivators have shifted their cropping pattern after implementation of AIBP projects are stated below: o NLBC project (Karnataka): cultivators have shifted from sowing toor dal to paddy, vegetables and sunflower o Bhima and Karanja projects (Karnataka): though the systems are designed for semi-dry crops, the cultivators are shifting to paddy and sugarcane with assured water supply (particularly with almost perennial water supply in the upper reaches); market dynamics coupled with low labour requirements for sugarcane motivate the cultivators to adopt these two crops o Gundlakamma project (Andhra Pradesh): cultivators have started sowing water intensive crops like paddy and tobacco with assured water supply o Musurumulli and Pushkara projects (Andhra Pradesh): it is reported that though the systems were designed for dry crops, cultivators are going for paddy o Dhom Balkaawadi project (Maharashtra): with access to water in the drought-prone areas, cultivators have started sugarcane plantation, further fueled by the presence of sugar mills in near-by locations • During household survey interviews with 255 cultivators in Andhra Pradesh (command areas of Musurumulli and Pushkara projects), Assam (Champamati major irrigation project), Karnataka (Sri Rameswara), Maharashtra (Dhom Balkaawadi and Tarali projects), Manipur (Dolaithabi barrage), Punjab (mod. of Kotla canal) and

Parameter	Findings from research
	Rajasthan (Narmada Canal Project), 63% of the cultivators confirmed 'paddy' as the primary crop followed by grams, vegetables, bajra, wheat and maize. While paddy is the dominant primary crop in both the head and tail reaches of Musurumulli and Pushkara projects in Andhra Pradesh, tail reaches of Kotla branch canal in Punjab, Champamati irrigation project in Assam and Doliathabi barrage in Manipur, grams and bajra have been the dominant crops in both Tarali and Dhom Balkawadi projects which cater to drought prone areas in Maharashtra, while wheat and mustard were found to be popular in some of the water scarce western states like Narmada canal project in Rajasthan and Kolta branch canal in Punjab. • Environmental factors: With assured irrigation and increase in groundwater level in the command area, increase in private groundwater based tubewells, bore wells and open wells have been reported in command area of some of the projects like Karanja in Karnataka, Dhom Balkaawadi and Tarali irrigation projects in Maharashtra. Though, it is understood that such structures contribute to drinking water and irrigation purposes (particularly during dry seasons), yet over-extraction of groundwater in certain cases becomes a concern considering that some talukas in command areas of Karanja (viz Bhalki taluka in Bidar district), Dhom Balkaawadi (viz Phaltan taluka in Satara district) and Tarali (viz Khatav taluka in Satara district) fall under 'semi-critical' category as per Central Ground Water Board's 'Dynamic Ground Water Resources of India, 2017'.
	Inference: • The current irrigation fees collection is inadequate in most of the states and does not bode well for maintenance and long-term sustainability of the projects. The irrigation fees collection is expected to improve with increase in service reliability and greater involvement of the WUAs after completion of CADWM works.

Parameter	Findings from research
	However, at present, inadequate allocation by states for maintenance funding and overall low cost recovery (both rate and collection efficiency) as noticed in most projects, are major concerns for long-term sustainability of the PMKSY-AIBP projects • Various societal factors (like over-irrigation and shift towards water-intensive crops) and skewed government policies may negatively affect sustained realization of benefits, particularly in the tail reaches. Though, some of these water management aspects are envisaged to be addressed through the CADWM scheme, yet the current progress of the scheme (31% of physical target achieved as on June 2020) and poor success rate of previous CAD projects in many places raise serious concerns. Therefore, the performance of the scheme in terms of sustainability is termed as 'needs further improvement'.
Impact	**Secondary:** • The MMI projects (in general) has significantly improved the socio-economic condition of the farming communities (particularly in remote tribal areas); a considerable improvement in literacy rate and health standards in the command area has been reported by many studies. • Construction of new water reservoirs/ raising heights of the same involve considerable environmental and social costs considering submergence of vast tracks of land and R&R of large number of communities. Also, construction delays and cost over-runs incurred in most of these projects result into postponement of farmer incomes, increase in interest payments and affect service deliveries, thus reducing the net benefits. • 'Impact Assessment of AIBP on 10 Completed Projects Selected from Five Regions' by M/s Academy of Management Studies (2018) revealed substantial improvement in income and quality of life in

Parameter	Findings from research
	some of the projects viz. HK Doab, Upper Kolab Irrigation project, Priyadarshini Jurala project and Sindh Phase I. It may be noted that the above insights are drawn from literature available for MMI projects in India in general; the relevance of these insights with respect to PMKSY-AIBP projects is elaborated in the next row under 'Primary' observations.
	Primary: • All the stakeholders validated the large positive socio-economic impact on communities in command areas; considering many of these areas being in barren terrains, the communities were earlier dependent on subsistence farming but with assured irrigation, many of them have adopted multi-crop farming. • During FGD in the tail region of the Sri Rameswara project (Hulkund, Belgaum, Karnataka), the beneficiary cultivators confirmed increase in income from agricultural activities, access to better farm machineries, tractors, owning of private vehicles, inward migration of agricultural labourers from nearby villages and districts during cropping season as impact of the project. Similar benefits like increased access to reliable water supply (however, inadequate drinking water issues during summers were mentioned by some), considerable growth in agricultural output (substantial growth in sugarcane production) and activities (noticeable shift of workers from manual labour to farming activities), increase in overall income and education and decrease in outward migration were reported by beneficiary cultivators during FGD in the command area of Tarali irrigation project in Maharashtra (Katarkhatav village, Satara district). • During household survey interviews with 255 cultivators in Andhra Pradesh (command areas of Musurumulli and Pushkara projects), Assam (Champamati major irrigation project), Karnataka (Sri Rameswara), Maharashtra (Dhom Balkaawadi and Tarali projects), Manipur (Dolaithabi barrage), Punjab (mod. of Kotla canal) and

Parameter	Findings from research
	Rajasthan (Narmada Canal Project), 45% confirmed improvement in overall household income level post completion of AIBP works, while the corresponding cultivator percentages confirming increase in education level, employment opportunities, access to credit facilities and decrease in livelihood related migration are 48%, 44%, 34% and 23% respectively. Also, during FGDs in the command areas of Champamati, Sri Rameswara and Dhom Balkaawadi, the cultivators confirmed how increase in agricultural income facilitated the villagers in buying private two-wheelers, ensuring education of children and accessing better health facilities. Also, around 29% of the 255 cultivators confirmed decrease in incidences of water-borne diseases in the villages post completion of canal works.
	Inference: • The implementation of the PMKSY-AIBP projects have resulted in considerable improvement in socio-economic conditions of the communities (like increase in job opportunities, income, education and health standards and decrease in migration level) in the command area as reported during primary survey. However, in the absence of adequate impact studies of these 99 Priority AIBP projects (considering many of these are ongoing/recently completed projects), an accurate assessment of the impact of these schemes after accounting for the environmental and social costs cannot be done. Based on the reported socio-economic impacts of the PMKSY-AIBP projects at this stage, the performance of the scheme in terms of impact is termed as satisfactory.
Equity	**Secondary:** • 59 projects in 11 states (out of the 99 Priority AIBP projects) cater to the drought-prone areas
	Primary:

Parameter	Findings from research
	• The completion of AIBP projects in many drought prone and remote tribal areas facilitated in providing assured irrigation to the communities resulting in significant socio-economic benefits. • The projects have significantly benefitted the small and marginal farmers. E.g. 50% of the farmers catered by the Champamati major irrigation project in Assam have small land holding (1 to 2 ha) while 33% of them have marginal land holdings. • The issue of water inadequacy at tail ends (particularly during dry seasons) still continues to persist in many projects (mainly those with open conventional canals) in Assam, Andhra Pradesh, Karnataka, Punjab, Maharashtra, Uttar Pradesh and others as reported by various stakeholders. E.g. during FGD in command area of Dhom Balkaawadi (Wakhari village, Satara district, Maharashtra), the cultivators reported water scarcity in the dry months owing to high seepages and unabated water withdrawal (/ pilferages) at the head reaches. Similar observations in relation to water inadequacy at distant agricultural fields were reported during FGD in the command area of Champamati irrigation project (Assam). • A comparative analysis of 'increased access to water owing to implementation of AIBP' between head and tail reaches villages in Musurumulli project in Andhra Pradesh revealed a difference of 27% (while 91% of 23 farmers in head reaches confirmed increased water access, the same for tail region stands at 64% of 25 farmer). As reported during KIIs, the disparities between head and tail reaches are expected to decrease with completion of field channel works and establishment of WUAs. Recent initiatives like ERM (extension/ renovation/ modernisation) canals including adoption of piped distribution and canal automation network in some projects (NCP project in Rajasthan, NLBC in Karnataka) have helped to contain the issue of water inadequacy at tail ends to some extent. It is interesting to note at this stage though disparities in water access

Parameter	Findings from research
	was reported for head and tail reaches in Musurumulli projects, yet most of the farmers in both the reaches (95% of the head reach farmers and 100% of the tail reach farmers) confirmed cultivation of paddy, thus implying that choice of cropping pattern may also be dependent on market dynamics and cultural aspects apart from water availability. • The AIBP guidelines don't explicitly mention any provisions for earmarking funds for SC/ ST sub-plans. However, as reported during primary survey, some states like Karnataka (NLBC and Sri Rameswara projects) have undertaken several initiatives like installation of tubewells and bore wells under SC/ ST sub-plans.
	Inference: • The 99 Priority AIBP projects have successfully addressed the disparities between large and small/ marginal landowners, head and tail end farmers (to some extent) and have ensured extensive coverage in desert, drought prone and remote tribal areas in line with the National Water Policy. However, disparities in water access between head and tail reach villages were reported in some of the projects; such disparities are expected to decrease with gradual completion of field channels works and establishment of WUAs. Thus, the performance of the scheme in terms of equity is termed as satisfactory.

A summary analysis and performance of the scheme on the identified themes is presented below:

Table 26: AIBP – summary of performance evaluation using REESIE framework

Parameter	Performance
Relevance	
Effectiveness	

Parameter	Performance
Efficiency	●
Sustainability	●
Impact	●
Equity	●

REESI+E performance infographics legend

● Satisfactory ● Average ● Needs Improvement ● No information

Performance on cross-sectional themes

Table 27: AIBP – performance evaluation using cross-sectional themes

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
1.	Accountability & Transparency	Availability of Data Records and Reports in public domain • What data records are available for the scheme in public domain?	• The physical and financial progress of all the 99 projects are updated by the respective states in the national MIS dashboard • One of the scheme documents has also suggested to include PERT chart in the dashboard • C&AG audit of the AIBP schemes are also available in public domain
		Monitoring Mechanisms • Does a robust monitoring mechanism exist and at what level?	• Council headed by CEO (NITI Aayog), Secretary (DoWR, RD,A&C and Finance),Chief Secretaries (AP, MP, Maharashtra, Odisha and Telangana) has been formed for overall co-ordination and monitoring • A high level empowered committee comprising Ministers from finance,

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			MoA&FW, rural development departments, and Vice Chairman (NITI Aayog) review the progress and provide course-correction suggestions • Only upon approval by the Council, the Mission issued detailed operational guides for drawl of funds from NABARD • Regional offices of CWC monitor the physical progress in respective states (minimum two times in a year) • While releasing CA, PMKSY Mission shall consider third party monitoring reports
		Evaluation Mechanisms • What process / impact evaluation studies conducted in the last decade - frequency, quality, coverage, etc.	• The scheme guidelines mention mandatory Independent Evaluation of AIBP and CADWM component by state govt (report to be submitted to CWC/ DoWR at end of each financial year) • Social audit of works and efficacy of project to be carried out after completion of works in 10% projects in each state
		Financial Accountability • What funding mechanisms are being used?	• Apart from CA instalments release, states may avail funds at subsidized interest rates from NABARD (under Long Term Irrigation Fund scheme)

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			• The Ministry also introduced Fast Track Proforma Clearance for fast track clearances of projects with escalated revised cost
		Citizen Accountability • Are there functional grievance redressal mechanisms that successfully incorporate beneficiaries' and non-beneficiaries' concerns?	• Some of the projects involve creation of reservoir structures and thus involve R&R; the functional grievance redressal mechanisms in place at various states have not been yet studied at this stage of study
		Beneficiary involvement • What is the involvement of beneficiaries across the project lifecycle? Is the level of involvement adequate?	• The ambit of the AIBP project is limited to the creation of IPC; while last mile connectivity is implemented pari-passu through CADWM scheme. Thus, as per the scope, the direct involvement of beneficiaries is limited. • The government is itself responsible for maintenance of all the assets above the outlets in lieu of irrigation service fees.
		Community institutions • Are community institutions (e.g. WUAs) truly representative? Do they have adequate powers to take decisions?	• Formation and engagement of community institutions and WUAs come under the scope of the CADWM scheme.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
Summary Analysis: • The MIS dashboard is a positive step in monitoring of the 99 projects. The release of the C&AG reports further helps to bring transparency and accountability to the system. • Also, considering that many of the projects are ongoing/ recently completed, any impact evaluation study (other than the concurrent evaluation reports) encompassing socio-economic and environmental impacts on all the benefitted and affected stakeholders of the PMKSY-AIBP projects is yet to be undertaken. • The conduct of social audit in the command areas of the projects, was reported to be limited.			
2.	Direct/Indirect Employment Generation	Employment generation • What is the level of employment generation through schemes in the sector and overall sectoral contribution in National employment generation? • What is the improvement in income levels? • What is the women participation (%) in the Sector/Program?	• Currently, there is no aggregated record of actual man-days generated through these 99 projects in public domain, though one of the scheme documents has acknowledged employment generation as one of the envisaged benefits. • However, during the primary survey all the stakeholders confirmed creation of huge employment opportunities particularly in tribal areas owing to huge labour needed for the civil works. E.g. the Champamati major irrigation project in Assam generated around 26.76 lakh[97] of man-days of employment. The Subarnarekha Multipurpose Irrigation project is

[97] As per reports provided by project authorities, Champamati Major Irrigation Project in BTC area in Assam

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			expected to create 112 lakh man days of work during 2020-21.[98] • During household survey interviews with 255 cultivators in Andhra Pradesh (command areas of Musurumulli and Pushkara projects), Assam (Champamati major irrigation project), Karnataka (Sri Rameswara), Maharashtra (Dhom Balkaawadi and Tarali projects), Manipur (Dolaithabi barrage), Punjab (mod. of Kotla canal) and Rajasthan (Narmada Canal Project), around 44% and 34% of the respondents confirmed increases in employment opportunities and access to credit facilities respectively while around 23% confirmed decrease in livelihood related migration. During FGD in Hulkund village in Belgaum, Karnataka (command area of Sri Rameswara project), the farmers informed increase in income from Rs. 6,000/ acre (pre project) to as high as Rs. 70,000 – Rs. 80,000/ acre (post project). Increased income is reported to have resulted increase in private ownership of vehicles with number of

[98] As per reports provided by project authorities, Subarnarekha Multipurpose Irrigation Project, Jharkhand

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			tractors surging from 100 to 300 post implementation of AIBP. During cropping season, 20% of the labourers are reported to come from neighbouring districts to support cultivation work. • As also highlighted under the 'Efficiency' section in REESIE framework, around 17% of the 132 respondents during household survey confirmed participation in the construction activities under AIBP, with the corresponding figure recorded as high as 50% (n=24) in north-eastern states like Manipur. Noticeably, it was observed the construction activities benefitted the small and marginal farmers (land-holding less than 2 ha) more than the large farmers (with land-holding greater than 2 ha).
		Institutional barriers • Are there institutional barriers to employment generation (e.g. access to markets)?	• Institutional barriers like limited access to market, absence of other agro-processing industries and other infrastructural constraints like poor roads in the command areas of many projects have been reported which invariable led some of the cultivators to shift towards water-intensive crops

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			like paddy and sugarcane which have higher market demands.
Summary Analysis: • The 99 Priority AIBP projects, with their huge scope of labour intensive works, have invariably led to generation of huge man-days of employment (both direct like in construction activities and in-direct like in agriculture and allied activities) in all the command areas particularly in remote tribal hinterlands as confirmed during primary survey at various projects like the Champamati irrigation project in Assam, Subarnarekha multipurpose project in Jharkhand, Sri Rameswara project in Karnataka and others. However, currently, almost none of the project implementing authorities were observed to maintain any aggregate data record of the exact quantum of man-days of employment generated.			
3	Climate change & sustainability including adoption of climate-change resilient practices & diversifications	Climate resilience • Are there appropriate climate resilient policies for mitigation and/or adaptation (or included as part of scheme objectives and design)?	• The scheme guidelines don't have any explicit provisions for adoption of climate resilient practices. While in eligibility criteria for inclusion of ERM projects, criteria related to various water sector reforms like adoption of MI practices, PIM, initiation of CAD works were mentioned; however no specific guidelines related to climate resilient practices were noted.
		Climate impact • What are the main impacts of climate change on the sector and scheme beneficiaries?	• It may be noted that MMI projects, which involve creation of storage reservoirs, inherently support climate change resilent practices by acting as water abosrbers during periods of excess rainfall and using the excess water during periods of drought. However, in view of the drastic

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			changes in climatic patterns in recent years and considering the long life-span of MMI projects, it is imperative to incorporate additional climate resilient practices (say use of advanced rainfall and flood forecasting models, provisions for small-scale water harvesting structures, provisions for adequate diversions and intakes in areas prone to flash floods, etc.) at the design stage to avoid incidences of water inundation or water shortages at later stages as already observed in some command areas during the primary study. In this respect, inter-departmetal co-ordination may be explored at the design stage (like with the flood wing to incorporate aspects of recent developments in flood modelling). • Incidences of flood/ excess rainfall were reported to have severely affected some projects; some of the notable examples are summarized below: o Progress in Narmada canal (Rajasthan) was hampered by the floods in year 2017, when motors and panels of the pumping stations

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			were severely damaged and some canal breaches were reported. Subsequently, the existing syphone of the Lunui and Sukri rivers were extended. o Incidences of severe breaches of canal during monsoons were reported during FGDs at villages in command area of Champamati Major Irrigation Project in Assam, where extensive damages to agricultural lands and households were reported. In absence of any assistance from the government, the villagers reported to have formed a flood committee themselves which is entrusted to collect fees, mobilize resources and conduct canal repair works post-monsoon every year. • Lower storage capacities and erratic rainfall pattern are endemic concerns for irrigation and drainage (I&D) sector in India. Low water storage levels in dams, during droughts, severely affect water access in the tail end villages. This issue gets further exacerbated in projects, which have provisions for inter-state water sharing, like

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			Bawanthadi project in Maharashtra (which has water-sharing pact with Madhya Pradesh) and multi-purpose projects which need to cater to essential requirements like drinking water before catering to irrigation needs. In order to tackle the issues related to low dam storage capacities, convergence with other water resources sector schemes may be explored for enabling activities like de-siltatiion, allocating O&M budget for dam maintenances, etc. as already discussed in detail under the 'Sector Level Analysis' section. Also, as pointed by various research studies, to combat climate change induced water resources challenges, it is important to strengthen existing data collection networks and promote inter-disciplinary research centres.

Summary Analysis:

- The AIBP scheme guidelines don't have any explicit provisions for adoption of climate resilience practices. During primary survey, certain incidences of droughts and excess rainfall/ floods affecting the projects were reported.
- In view of the drastic changes in climatic patterns in recent years, it is imperative to incorporate the aspects of recent climate changes at the time of design to mitigate instances of inundation or shortages.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
4	Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population	Inclusion of vulnerable groups in scheme as well as sector • What are the interventions implemented for specific vulnerable groups?	• 59 projects in 11 states (out of the 99 Priority AIBP projects) cater to the drought-prone areas • The projects have significantly benefitted the small and marginal farmers. E.g. 50% of the farmers catered by the Champamati major irrigation project in Assam have small land holding (1 to 2 ha) while 33% of them have marginal land holdings. • The AIBP guidelines don't explicitly mention any provisions for earmarking funds for SC/ ST sub-plans. However, as reported during primary survey, some states like Karnataka (NLBC and Sri Rameswara projects) have undertaken several initiatives like installation of tubewells and bore wells under SC/ ST sub-plans.

Summary Analysis:

- The AIBP scheme guidelines don't have any explicit provisions for separate budget allocation under SC/ ST sub-plans. However, it may be noted that the completion of AIBP projects in many drought prone and remote tribal areas (with substantial presence of small and marginal farmers) facilitated in providing assured irrigation to the communities resulting in significant socio-economic benefits, as also confirmed during the HH survey and FGDs. Addition of separate provisions for earmarking funds for SC/ST sub-plans may be explored, as reported in Karnataka.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
5.	Use of IT/Technology in driving efficiency	Deployment of IT enabled mechanisms for monitoring of the Schemes • In case of a scheme to create physical assets, is geotagging and use of geotagged photographs being done? • How is technology being used for on-ground data collection?	• There are no explicit provisions in the guidelines for geo-tagging of assets. Yet, most of the states are geo-tagging the critical assets.
		Use of latest technology to improve efficiency and effectiveness of scheme implementation • What are the technologies being used in project implementation, service delivery? • Which states are using the latest technologies?	• Remote sensing technologies like satellite images (procured from NRSC – Hyderabad) for monitoring of projects have already been tried by the Ministry with limited success due to limited resolution of the images, high cost of procurement and limited frequencies owing to satellite positions, cloud cover. Recently the Ministry has undertaken new initiatives at national level like cropped area mapping studies (to assess IPU) using remote sensing technologies and project monitoring through Bhaskaracharya Institute of Space Applications and Geo-informatics (BISAG) (note that the quality of assessment and monitoring studies

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			has not been validated under this study). Also, a mobile application for geo-tagging project components has been developed along with a GIS-based web portal for monitoring the progress. • Monitoring of construction works using drones has been successfully demonstrated in some place like Polavaram project in Andhra Pradesh. Similarly, some projects in A.P. are using drone surveying for contour generation for preparing proposals for the CADWM projects. The Ministry has also undertaken a similar initiative (pilot study) of drone surveying in Bawanthadi irrigation project in Maharashtra. • Also, the project authorities in Narmada Canal project in Rajasthan has recently submitted proposal for crop assessment using satellite images
		Technology to address key challenges • What technologies are available to address key challenges facing the scheme? Are there	• In view of the land acquisition issues, high conveyance losses, increasing incidence of un-authorized water withdrawal, high maintenance losses, many states like Assam, Gujarat, Rajasthan and Maharashtra are

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		constraints in their adoption?	adopting underground piped distribution networks (for branch canals, distributaries, minors, sub-minors) in place of conventional open canals. • The Ministry has been promoting use of underground pipelines, wherever feasible. Detailed guidelines related to 'planning and design of piped irrigation network' have been released by the CWC on July 2017. As on date, 26 of the priority projects have planned/implemented use of piped distribution network to the extent feasible, covering a total length of 64,137 km[99] and which helped to avoid land acquisition to the tune of 12.8 thousand ha and resulted in direct cost saving of Rs. 2,386 Cr. • Other technologies like canal automation and SCADA, as already implemented successfully in NLBC project in Karnataka, may be adopted to contain the ineffeiciencies related to manual operations (like gate operations).

[99] K Vohra and M L Franklin, "Reforms in the irrigation sector of India"

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		Any best practices	• Countries like Israel has migrated from open water canals to piped supplies and drip irrigation; currently Israel has the world's highest crop yield/ m^3 of water consumed. Successful case studies in China showed 30% savings in water delivered (equivalent to 15% of the total irrigated area) and 25% in labour input using PIN in place of CDN • Among the 99 Priority AIBP projects, piped distribution network has already been implemented in Narmada Canal project in Rajasthan and Sardar Sarovar project in Gujarat and is under implementation in several projects in Maharashtra like Waghur.

Summary Analysis:

- Successful implementation of piped irrigation network in place of conventional open canals by some states marks a watershed in the history of canal irrigation in India and may significantly influence future policy decisions as irrigation departments move from construction based to utility-based approach. Piped network will greatly facilitate implementation of canal automation, volumetric supply and differential pricing and with low operations and maintenance costs, it will also reduce the huge burden on the state exchequer. Adoption of canal automation and SCADA is expeted to down on the wastages due to manual interventions. At present, overall adoption of such projects are obsesrved to be in nascent stages with implementation being initiated in a few projects in Gujarat (SSNNL), Rajasthan (NCP), Maharashtra (Waghur), Karnataka (NLBC), etc..
- Adoption of remote sensing techniques (like drone surveys) for monitoring purposes, as already being initiated by the Ministry and some states, becomes necessary in light of the

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
	huge spread of the command area and limited resources of the state departments. Overall, the extent of adoption of remote sensing technologies across states was observed to be in nascent stage.		
6.	Research & Development	What percentage of total allocation (Sector as well as Scheme specific) is directed towards R&D? How much of that percent is being utilized?	• The scheme guidelines have no separate provisions for fund allocation towards research and development.
		Institutes and departments dedicated for R&D	• It may be noted that the DoWR,RD&GR has a separate programme titled 'Research and Development Programme in Water Sector and Implementation of National Water Mission'[100]. Research activities are conducted primarily through 4 premier institutes viz Central Water and Power Research Station – Pune, Central Soil and Material Research Station – New Delhi, National Institute of Hydrology – Roorkee and Central Water Commission – Delhi. Also, various studies related to water use efficiency, post project performance evaluation and environmental impact assessment are taken up in co-ordination with IITs, Indian National Committees, regional WALMIs, etc. During primary survey,

[100] http://mowr.gov.in/schemes-projects-programmes/programmes/r-and-d-programme-water-sector

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			several state implementing agencies confirmed conducting studies for MMI projects through regional WALMIs like NERIWALM in Assam, WALMI Aurangabad; however the PMKSY projects being recent initiatives, no R&D studies have been initiated in relation to these.
		Private Sector participation in R & D	• Several notable initiatives have been taken up by private sector agencies like Jain Irrigation Systems Pvt Lt. in relation to piped distribution network and canal automation; some of the notable PMKSY projects are already being highlighted in above sections.
Summary Analysis: • Currently, the scheme does not have any separate provision for allocation of funds towards R&D. DoWR, RD & GR has a separate R&D programme for conducting studies through reputed institutes for overall irrigation sector. Since the PMKSY projects are recent initiatives, not much R&D studies have been conducted by the project authorities and detailed information regarding private sector participation (except in piped distribution network) are not available. In light of the same, the performance of the scheme against this parameter has been marked as 'no information'.			
7.	Unlocking Synergies with other Government Program	Convergence (Inter-Ministerial/Inter-Departmental/Financial/Human Resources/ Administrative/ Institutions/ Schemes	• Under PMKSY, the CADWM scheme is being implemented pari-passu with the 99 Priority AIBP projects. Thus, while the AIBP projects helps to create the irrigation potential, the CADWM ensures effective utilization of this

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		• What activities are undertaken to ensure convergence at community level? Are there any Action Plans prepared at State/District/Block level to ensure the same? • What are the challenges hindering effective convergence?	potential created by providing last mile connectivity. Incorporation of 'pari-passu' implementation of CAD projects in the AIBP guidelines (2013) itself is a significant progressive step over previous guidleines when they were implemented separately. • However, one of the major challenges includes delay in planning of execution of CADWM works as execution in a particular command area may start only when hydraulic connectivity to the outlets are established (since farmers are unwilling to part with their lands without being completely assured of water reaching the outlets).
		Potential areas for synergy • What are the areas for potential convergence / synergy across govt. programs?	• To ensure conjunctive use of surface and groundwater, for command areas catered by single season canals, provisions for setting up tanks/ groundwater based irrigation structures like bore wells, tubewells (in command areas where groundwater level is reported to be 'safe') may be explored through convergence with other government schemes and/or various agricultural schemes (like in Assam, where with Rural Infrastructure Development

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			Fund from NABARD, state agriculture department is facilitating installation of '1 lakh shallow tube well and '1,000 solar powered shallow tube wells' from 2016-17 to ensure assured irrigation during Rabi when there is scarcity of canal water). Other notable examples are the Narayanpur Left Bank Canal and Sri Rameswara projects in Karnataka, where the irrigation officials facilitate storage of water in numerous tanks in the command area for usage during off-seasons, which also indirectly contributes to increase in groundwater level. • Convergence with MGNREGA may be explored for the following type of works as permitted under MGNREGA Operational Guidelines 2013: o Irrigation canals including micro and minor irrigation o Masonry works in Lift Irrigation projects o One-time rehabilitation of minors, sub-minors and field channels, including repair of minor cracks, earth levelling,

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			repair of earthern embankments, bank raising, etc. However, it may be noted that regular O&M works are not permitted. During primary survey, most of the project authoriries could not ascertain the extent of convergence with MGNREGA for the PMKSY-AIBP projects, mostly due to non-maintenance of any such employment records.
Summary Analysis: • Currently, CADWM works are being executed pari-passu with the 99 Priority AIBP projects to establish last mile connectivities; however the physical progress achieved under CADWM structural interventions has been limited compared to that under AIBP owing to various issues; one of the issues being non-establishment of any hydraulic connectivity to outlets (owing to non-completion of minor canals under ongoing AIBP projects). • Conjunctive use of surface and groundwater in the command area may be promoted through convergence with groundwater related schemes and/or agricultural scheme (particularly in command areas with 'safe' groundwater level and inadequate surface water availability in certain seasons).			
8.	Reforms, Regulations	Adoption of models acts and reforms at governance, institutional and administrative level • What measures are being taken to ensure effective implementation and	• The National Water Framework Bill (2016) proposed differential pricing of water on volumetric basis and establishment of an independent Water Regulatory Authority for ensuring the same and determination of tariff. This is similar in lines with

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		compliance of adopted acts/rule/regulations? (like in areas of safety, accountability, transparency etc.)	National Water Policy (2012) which advocated for differential pricing and higher priority allocation for water use for ensuring food security and supporting livelihood for the poor. The 14th Finance Commission even incentivized the states to set up regulatory authorities to facilitate pricing and management – a grant in-aid of Rs. 5,000 Cr. to states were recommended for maintenance of irrigation assets with the grant release being subject to certain conditions met by the states like setting up of Water Regulatory Authority by 2011-12 and achievement of state specific recovery rates. Similarly, the Working Group on Major & Medium Irrigation and CAD for the XII Five Year Plan (2012-2017), suggested that the release of central assistances should be made subject to adoption of better management practices by states which includes maximization of collection of ISFs from users through WUAs and allowing the WUAs to retain at least 50% of ISF collected for maintenance of distribution system.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			• However, barring the exception of Maharashtra Water Resources Regulatory Authority and newly constituted Punjab Regulation and Development Authority (PWRDA), most of the states have adopted a lackadaisical approach towards setting up any WRA. Many of the states like Andhra Pradesh, Arunachal Pradesh Jharkhand and Jammu and Kashmir have enacted statutes for creation of water regulators but they are yet to be implemented. Similarly, Uttar Pradesh enacted a statute in 2008 while Kerala introduced a bill in 2012 to create water regulators; but none are functional yet. Recently, the Haryana state cabinet has decided to set up an authority for conservation, management and regulation of water resources in the state.

Summary Analysis:

- Though the National Water Policies and other successive government policies suggested differential pricing of water and establishment of independent water regulatory authority at state level, yet only a few states (like Maharashtra) have taken any concrete steps to facilitate the same. It is understood that differential water pricing forms an important step in ensuring sufficient revenue streams for attracting investors and enabling adequate O&M of the systems.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
9.	Impact on and role of private sector, community/ collectives/ cooperatives (e.g. Farmer cooperatives, FPOs, Water User Associations, etc.) and civil society in the scheme	Public-Private Partnership • How well have PPP functions in the Sector? What are the challenges faced?	• Private sector participation in irrigation and drainage sector (I&D) in India remains tepid till now. Some of the reasons being low cost recovery from water (water being perceived as a social good/ right rather than an economic commodity), land acquisition, R&R and other legal and administrative issues endemic in this sector, non-availability of alternative revenue streams. However, as adoption of piped distribution network gain traction, instances of private sector involvement in construction and O&M of the systems are expected to increase. At present, such involvements are mostly restricted to certain components of multi-purpose projects like hydel power generation and projects involving piped distribution network. A recent example being the Ramthal Integrated Drip Irrigation Project in Karnataka, which is a joint venture between Netafim India Pvt. Ltd. and Jain Irrigation, which is being developed under the Build, Own, Operate and Transfer (BOOT) Model and the private parties will be responsible for O&M of

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			the system for 5 years. Also, as part of the Karnataka government's Drip-to-Market Agro Corridor (DMAC), eight private agricultural firms signed MOUs with the government to procure the farm produce. • Few states like Andhra Pradesh and Maharashtra explored certain pilot PPP projects in the past; however the projects did not materialize due to want of adequate revenue streams for the private party (ADB 2013, "Exploring Public Private Partnership in the Irrigation and Drainage Sector in India").
		Any best practices	• There are numerous international case studies like West Delta and New Zealand where private parties have successfully invested in the I&D sector and recouped the costs (including capital costs) through water user charges. • Other notable examples are: Megech Seraba Irrigation and Drainage scheme, Ethiopia (management service contract) and Guerdane Irrigation Project, Morocco (design-build-operate for 30 year concessionaire period)

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
Summary Analysis: • Private sector participation in irrigation and drainage (I&D) has been lukewarm till now owing to various issues, two of the major issues being low cost recovery and delays due to land acquisition and R&R issues. • However, with gradual shift towards volumetric pricing and also increasing adoption of piped distribution network, the potential of private sector participation has greatly improved and options like EPC contract with built-in O&M clauses may be explored initially.			

In addition, to the above themes, other related themes for MMI projects under PMKSY like 'gender mainstreaming/ inclusiveness', 'stakeholder and beneficiary behavioural change' and 'Conjunctive use of water - surface versus groundwater usage optimizations' have been evaluated under the CADWM scheme; hence they have not been separately evaluated under this section and rated as 'not relevant' in the table below. Similarly, the 'water sharing treaties/ agreements & diplomacy' theme has been evaluated in detail under the 'Sector Level Analysis' section and hence not covered separately under PMKSY-AIBP while in absence of adequate information for the themes 'developlment, dissemination and adoption' and 'Research & Development', they have been marked as 'no information'.

A summary analysis and performance of the scheme on the identified themes is presented below:

Table 28: AIBP – summary of performance evaluation using cross-sectional themes

Parameter	Performance
Accountability & Transparency	●
Direct/Indirect Employment Generation	●
Gender mainstreaming/Inclusiveness	●

Parameter	Performance
Building resilience to climate change (including but not limited to developing water disaster preparedness) & ensuring sustainability	●
Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population	●
Use of IT/Technology in driving efficiency	●
Stakeholder and Beneficiary behavioural change	●
Development, dissemination & adoption	●
Research & Development	●
Water sharing treaties/agreements & diplomacy	●
Conjunctive use of water - surface versus groundwater usage optimizations	●
Unlocking Synergies with other Government Program	●
Reforms, Regulations	●
Impact on and role of private sector, community and civil society in the scheme	●

Cross-sectional themes performance infographics legend

● High ● Medium ● Low ● Not relevant ● No information

2.2.1.3 Issues and challenges

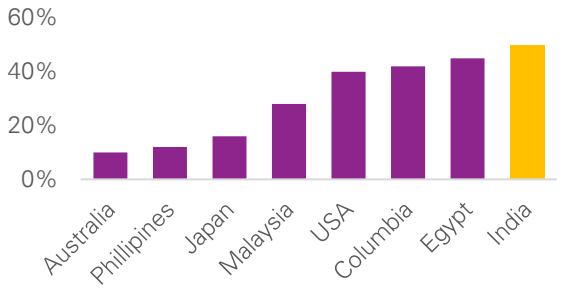
This sub-section describes the scheme issues and challenges and their mapping with the source of information viz. primary source, secondary source and household survey (if applicable).

Table 29: AIBP – issues and challenges

Sl.no	Area	Issues & Challenges	Secondary	KII	FGD/ HH
Scheme design					
AIBP-F1	**IPC assessment**	• A study by IIMs initiated by the MoWR noted that initial IPC, without further updates to account for lack of maintenance, change in cropping and			

Sl.no	Area	Issues & Challenges	Secondary	KII	FGD/ HH
		climatic patterns, may lead to miscalculation, lack of transparency and misguided policy decisions. • Also, the irrigation potential created under a large number of major and minor irrigation projects could have decreased over the years, owing to diversion of water for other purposes like drinking water, industrial use and other interceptions; but these are not reflected, thus leading to over-estimation of the IPC when aggregated at the national level. • During primary survey, it was observed currently none of the states have any reporting mechanisms for updating the IPC-IPU data over time. Also, some of the states were reported to adopt different conventions for assessment of IPC and IPU figures.			
AIBP-F2	**Fund transfer mechanism**	• The AIBP guidelines mandates the states to release the Central Assistance and the state's matching share to the project implementing authorities within 15 days of receipt of the Central releases. • However, delay in the range of 1 to 18 months was confirmed by the stakeholders during the primary survey in some states like Assam.			
Scheme implementation					

Sl.no	Area	Issues & Challenges	Secondary	KII	FGD/ HH
AIBP-F3	**Land acquisition and R&R issues**	• Under PMKSY-AIBP, the 99 Priority AIBP projects (106 projects including phases) were planned to be completed by December 2019. However as on March 2020, only 44 projects have been completed, while the balance is targeted to be completed over March 2020-23. • Land acquisition and R&R issues still continue to scuttle the progress of almost all the AIBP projects. • Many of the factors though may be attributed to externalities outside the control of the implementing authorities like revision in Land Acquisition and R&R acts, changes in design (say canal alignment) due to geological surprises. However, part of the delay may be attributed to various administrative deficiencies (shortage of revenue/land acquisition officials as reported in states like Karnataka) , lack of project stakeholder engagement and non-payment of compensation fees (as reported in Karnataka and Bihar).			
AIBP-F4	**Fund crunch**	• With the increase in land prices and escalation in projects costs (plagued by inordinate time delays), many states are witnessing limited fiscal space to accommodate the new construction projects. Though the Centre's loan arrangement from NABARD (Long Term			

Sl.no	Area	Issues & Challenges	Secondary	KII	FGD/ HH
		Irrigation Fund) has given much needed breathing fiscal space to many of the state governments like Maharashtra (currently implementing 258 MMI projects), North-eastern and other states; yet many of the states fail to arrange their respective state share and thereby unable to access the Central share in a timely manner.			
AIBP-F5	**Operational losses**	• India's average distribution losses (40% to 60%) in irrigation supply systems is quite high compared to other countries, which is further illustrated in the diagram below[101]:  • Conventional canal operates using delivery schedules by assessing the downstream water demand in advance (such as warabandi schedule in Punjab, Rajasthan and Uttar Pradesh, shejpali in Maharashtra and Gujarat, etc.). Such methods suffer from inevitable discrepancies between			

[101] United Nations, FAO

Sl.no	Area	Issues & Challenges	Secondary	KII	FGD/ HH
		forecast and actual delivery flow coupled with limited ability of system to react to actual demand, the fallout of which is water shortage or excess at the tail ends. Water wastage in such traditionally operated systems range between 5% to 10%[102]			
AIBP-F6	**Conveyance efficiency**	• Currently, many of the 99 Priority Projects involve construction of conventional open channels which are prone to huge seepage and evaporation losses, resulting into overall low conveyance efficiency, the fallout of which is inadequate water supply in the branch and distributary canals (particularly in the tail end areas). Seepages losses in irrigation canals contributes to around 98.37% of water conveyance loss[103].			
AIBP-F7	**Unauthorized water withdrawal**	• The conventional irrigation canal systems in India (including the AIBP projects) suffer rampant canal breaches/damages and unauthorized water withdrawal using submerged pumps by farmers at idle/ higher reaches of the canals. • This phenomenon severely hampers the regular canal water flow and availability;			

[102] Anil B Mandavia, C.E. MIS Sardar Sarovar Narmada Nigam Limited, Benchmark Studies on Modernization

[103] P.B. Jadhav and others (April 2014), IJIRSET, Conveyance Efficiency Improvement through Canal Lining and Yield Increment by Adopting Drift Irrigation in Command Area

Sl.no	Area	Issues & Challenges	Secondary	KII	FGD/ HH
		the fallout of which is inequitable water distribution, wasteful water usage practices, low accountability, shift towards water intensive crops, loss of state revenue along with promotion of social disharmony. • While many of the states like Gujarat, Rajasthan, Punjab and others have come up with strict legal provisions and stricter patrolling along canals, yet they have failed to mitigate water theft from canals.			
AIBP-F8	**Poor maintenance**	• Maintenance in most of the projects are being currently funded by the state government and considering the huge financial burden on state exchequer to fund construction cost, adequate fund allocation for maintenances may take a backseat. Inadequate maintenance and issues due to heavy siltation and weeding have already been reported during primary survey for some of the PMKSY-AIBP projects. • A World Bank study (2005) stated that the states need to expend 20 times more than their existing spends to minimise deferred maintenance of the MMI systems. 'Impact Assessment of AIBP on 10 Completed Projects Selected from Five Regions' by M/s Academy of Management Studies (2018) pointed out maintenance issues			

Sl.no	Area	Issues & Challenges	Secondary	KII	FGD/ HH
		(like leakages and deteriorating condition of the main canal, siltation and weeding) in 6 out of the 10 projects viz (Upper Kolab Irrigation Project, Jhuj Irrigation Project, Mahi Bajaj Sagar Project, Priyadarshini Jurala Project, Maskinala Medium Irrigation Project, Purna Medium Irrigation Project). • Thus, it may be noted that poor maintenance has been a chronic issue plaguing the MMI (including AIBP) projects in India. Also, maintenance of irrigation systems being under state government's ambit, the PMKSY-AIBP scheme, therefore, has no provision for addressing the same, which however endangers the long-term sustainability of these projects considering the poor performance across state governments.			
AIBP-F9	**Financial sustainability**	• Irrigation fees collection is found to be either inadequate or absent in most of states except for Maharashtra, Rajasthan (NCP – collection efficiency is around 70% to 80%), and a few other states. Some of the contributing factors are political unwillingness, inadequate services by the irrigation officials/ un-reliability of the irrigation systems. • Such low cost recoveries are detrimental in view of the long term maintenance and			

Sl.no	Area	Issues & Challenges	Secondary	KII	FGD/ HH
		sustainability of the projects and deterrent to any future investments by private sector.			
AIBP-F10	**Private sector participation**	• Though some states like Maharashtra, Andhra Pradesh have taken some steps in attracting private sector participation in irrigation and drainage sector (I&D), yet the overall participation across India remains tepid still now. Some of the reasons being low cost recovery from water (water being perceived as a social good/ right rather than an economic commodity), land acquisition, R&R and other legal and administrative issues endemic in this sector, and non-availability of alternative revenue streams.			
Monitoring and evaluation					
AIBP-F11	**Monitoring visits**	• AIBP scheme guidelines mandate minimum two site visits per year by CWC officials to the project sites in all states, which was also validated during the primary survey. • However, considering the large number of on-going projects (in states like Maharashtra, Assam and Manipur, Andhra Pradesh and Telangana) and huge span of the project area, two/three visits to the project sites may not be sufficient for the purpose, as also reported by some of the regional offices.			

Sl.no	Area	Issues & Challenges	Secondary	KII	FGD/ HH
		• In this aspect, the limited resources (manpower, vehicles) of the CWC regional offices often act as a barrier to adequate site visits particularly in states with remote locations and large number of projects.			
AIBP-F12	**MIS platform**	• The national MIS platform is a significant step forward towards data consolidation and reporting. But currently recorded parameters are limited only to the output indicators like status of completion of AIBP projects and some outcome indicators like 'irrigation potential created' but many of the outcome indicators (as mentioned in Ministry of Finance's Output-Outcome Framework) like '% of irrigation potential utilized (in lakh ha) through infrastructure created through PMKSY-AIBP, increase in crop yield attributable to increased irrigation from PMKSY-AIBP, increase in ground water levels attributable to PMKSY-AIBP' are not tracked on the same dashboard. • Also, there is lack of visibility among the implementing state agencies regarding the exact quantum of outcomes achieved from the projects (as some of the outcome indicators fall under purview of other departments like agriculture and Ground Water board).			

Sl.no	Area	Issues & Challenges	Secondary	KII	FGD/ HH
AIBP-F13	**Accountability and transparency**	• The scheme guidelines mandates allotment of 3% of CA (estimated Rs. 940 Cr.) for concurrent evaluation, social audit, third party monitoring, IEC, etc.; social audit of works and efficacy of project has to be carried out after completion of works in 10% of projects in each state • During primary survey, the following observations are made: ○ Social audit has not been carried out/ not initiated by the irrigation department as conducting such audits comes under the purview of land resources/ revenue department ○ In some cases, the stakeholders were not aware of any such audit provisions			

Issue relevance legend

	Supported		Partially supported		Not supported		Not applicable

A summary analysis of issues & challenges for the scheme is presented below:

Table 30: AIBP – summary of issues and challenges

Parameter	Performance
Institutional Mechanism and governance	●
Fund flow efficiency and utilization	●
Unavailability of resources (fund, manpower and others)	●
Monitoring and evaluation	●
Capacity building	●

Parameter	Performance
Operational efficiency	●

Performance infographics legend

● Satisfactory ● Average ● Needs Improvement

2.2.1.4 Recommendations and solutions

This sub-section describes the scheme recommendation and solutions from the perspective of scheme design, scheme implementation and monitoring & evaluation, along with their mapping with the issues and challenges described in the preceding sub-section.

Table 31: AIBP – recommendations and solutions

Sl.no	Recommendations	Finding
Scheme design		
AIBP-R1	**Standard guidelines for IPC assessment** • Standard guidelines should be developed by DoWR,RD&GR, in consultation with CWC and other research institutes, for assessing the IPC over the years to correctly ascertain the true potential of the irrigation systems (after discounting for natural wear and tear of the irrigation system, siltation of the reservoirs, diversion of water due to command area interceptions, overlapping with other minor irrigation systems in the same command area) and to promote more transparency in reporting by various organizations. Several such guidelines in relation to IPC measurement have already been prepared some IIMs in 2008, in consultation with MoWR. • The CWC should prepare standard guidelines for IPC-IPU assessment (in the line with similar guidelines like 'Guideline for Computing the Water Use Efficiency of the Irrigation Projects (February 2014)' and adequate dissemination of the prepared guidelines to all state project implementing agencies should to be	AIBP-F1

Sl.no	Recommendations	Finding
	ensured. Special statistical cells may be created under the state irrigation/ water resources department to compute the dynamic figures for IPC over specified time periods, which is to be monitored and assimilated by any designated statistical cell/ empowered committee at the national level. The computed data may be linked with the MIS dashboard to bring in greater transparency on the status of the irrigation projects. • The above recommendations will facilitate in executing the suggestions provided by the Standing Committee on Water Resources (2017-18) in its 21st Report where the Ministry was requested 'to reconcile the data with respect to IPC and IPU since the inception of projects state-wise, year-wise and project-wise'.	
AIBP-R2	**Change in guidelines for monitoring visits** • For monitoring of ongoing projects by CWC officials, a 'one-size-fits-all' approach viz minimum of 2 site visits may not suffice the purposes of visits, considering that the number and scope of ongoing projects, project locations and criticalities varies across states. In this aspect, the guidelines for site visits may be dynamically set for each of the projects based on: o project criticality (stage of completion, number of implementation bottlenecks reported in last 6 months, etc.) o project location (remoteness, terrain say hilly areas, etc.) • Based on the above guidelines, re-deployment of resources (mainly manpower) across CWC regional offices or hiring of third party agencies for the same purpose could be explored.	AIBP-F11
AIBP-R3	**Develop guidelines mandating states to explore feasibility of piped distribution networks in all branch and distributary networks for all new/ ongoing projects**	AIBP-F3 AIBP-F5 AIBP-F6 AIBP-F7

Sl.no	Recommendations	Finding
	• In view of the endemic issues of delays due to land acquisition and R&R in many of the ongoing AIBP projects coupled with poor conveyance efficiency of open canal systems, adoption of piped irrigation network (PIN) becomes imperative. • Particularly in light of the recent successful implementation of PIN projects in various states of India like Maharashtra, Odisha, Gujarat and Rajasthan (Narmada Canal project, one of the 99 AIBP projects has successfully implemented pressured irrigation network), **a re-look at exploring the feasibility of roll out of underground pressurized piped irrigation network in ongoing secondary and tertiary canal projects is warranted.** (including cost benefit analysis covering social and environmental costs and benefits). • Some benefits of the Piped Irrigation Network over open canal systems is demonstrated below: o Lesser land requirement - as per MoWR sources adoption of PIN assisted in avoiding land acquisition to the tune of 6,200 ha and 4,920 ha in Odisha and Maharashtra respectively leading to approximate cost saving of Rs. 1,500 Cr. o Avoidance of unauthorized water withdrawal o Higher conveyance efficiency- as per CWC's 'Guidelines for Planning and Design of Piped Irrigation Network', PIN has a conveyance efficiency of 70% to 80% compared to 35% to 60% efficiency of conventional canals o Lower cost – as per CWC estimates, cost of canal distribution network (CDN) is around 3.24 times that of PIN, as the high cost of land acquisition (particularly in view of recent escalation of land prices) and CD structures in CDN offset the cost of piping material in PIN by a large margin (while major components of canal	AIBP-F8

Sl.no	Recommendations	Finding
	cost are land acquisition & CD structures, that of PIN is cost of pipe material) • Countries like Israel has migrated from open water canals to piped supplies and drip irrigation; currently Israel has the world's highest crop yield/ m^3 of water consumed. Successful case studies in China showed 30% savings in water delivered (equivalent to 15% of the total irrigated area) and 25% in labour input using PIN in place of CDN • However, it may be noted that PIN needs to be fitted with proper de-silting arrangements where irrigation water contain large quantity of sediments particularly in the canals fed by Himalayan rivers. A notable example in this respect is Balh Valley Project in Himachal Pradesh where proper de-siltation arrangements have been put in place before water is conveyed to the Main Conveyance Line. Also, adequate provisions need to be put in place for electricity connections through DISCOMS/ solar power for operation of the pumps. Also, while checking feasibility of PIN projects, aspects like loss in groundwater recharges owing to elimantion of canal seepages, should be taken into account.	
AIBP-R4	**Introduce provisions for expanding command area using alternate systems like Lift Irrigation Schemes in new proposals** • Cultivators at higher elevation or rim of the storage reservoirs deploy lift irrigation using their own means (like Kachnari diversion scheme in Madhya Pradesh, Warna project in Maharashtra, etc.) to irrigate their fields. • There are numerous incidences where the project implementing agencies have to incorporate lift irrigation schemes by revising their initial proposals (e.g. introduction of Lift irrigation system in Narmada canal, inclusion four lift irrigation schemes to Lower Dudhna project in the latest proposal, one lift irrigation in Sangola branch canal project; talks are going on to include lift irrigation	AIBP-F7

Sl.no	Recommendations	Finding
	project on both side of the carrier canal in Punpun barrage project in Bihar) which led to unnecessary time delays and cost overruns. • In view of the same, it is **suggested that the implementing agencies critically explore the possibility of inclusion of lift irrigation proposals (particularly in project areas with high incidences of lifting) in the main irrigation system in their initial proposal. A national guideline in this aspect may be prepared by the Ministry to specify the eligibility criteria and other norms.** A 2010 Planning Commission study ("Evaluation Study on AIBP") also suggested to install/ legalize the lift irrigation schemes on main canal so as to increase the command area in lieu of service fees from the benefitting cultivators. Some of the notable examples where state governments undertook lift irrigation schemes in main irrigation system with considerable success are listed below: • Upper Krishna Basin in Maharashtra o Context: in 1976, Maharashtra was awarded 560 TMC by Bachhawat Award; however, by 1996 the state could only manage to 385 TMC of storage and associated canal networks. This led to proliferation of small-scale private lifting schemes along Krishna. o Key features: subsequently government legalized lifting of water and facilitated operational irrigation co-operative societies with capital cost subsidies and additional finances from national and co-operative banks to develop lift irrigation schemes (LIS). This is complimented by the irrigation department's initiative to construct a series of Kolhapur Type (KT) weirs across tributaries to act as storages for the LIS. Each LIS has to get an approval from irrigation department and state electricity board (for electricity connection).	

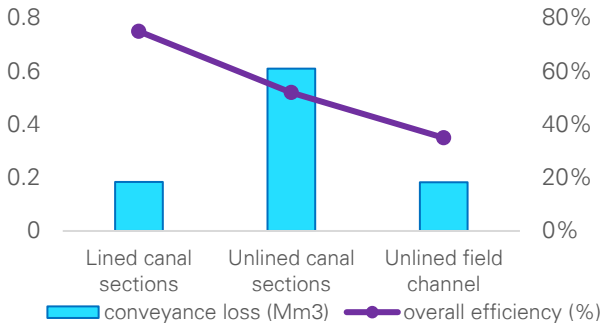
Sl.no	Recommendations	Finding
	○ Another similar example is the Radhanagari project in Kolhapur district where exceptional performance was recorded compared to surface irrigation systems; average irrigated area was 30,341 ha compared to design value of 26,560 ha and irrigation fees were collected to the tune of Rs. 179 lakh against O&M expenses of Rs. 79 lakh • Solar powered lift irrigation project, Hoshiarpur, Punjab ○ Key features: the project lifts water from Kandi canal to irrigate 1,641 acres (at higher elevation) across 14 villages and encapsulates innovative technologies like SCADA, solar powered pumps and micro-irrigation equipment ○ Project benefit cost ratio is around 3; it resulted incremental benefits to the cultivators to the tune of Rs. 180 Cr.[104] However, since the LIS demands a recurring expense on account of electricity costs, feasibility of long-term operations and maintenance of such projects needs to be thoroughly studied before inclusion. There are ample examples of such LIS like Hawaipur LIS, Assam which ultimately became defunct due to electricity cost issue despite huge investments.	
AIBP-R5	**Introduce provisions for lining of main canals** • Mandatory provisions may be included in the guidelines for lining of at least the main canals (on the side slopes and canal bed depending on the soil characteristics) under this scheme in places as feasible after cost benefit assessment. The funding modalities for the same needs to be chalked out by the Ministry.	AIBP-F6

[104] KPMG Analysis

Sl.no	Recommendations	Finding
	• As illustrated by numerous studies, canal lining not only minimizes the seepage losses but also help to retain the flow characteristics and shape of the canal. The overall irrigation efficiency is 65% to 75% in case of lined canals compared to 50% to 60% for unlined canals[105]. During primary survey, various stakeholders like irrigation officials from Assam (Dhansiri project), Andhra Pradesh (Musrumilli and Pushkara projects) and Bihar (Durgawati project) advocated for lining of canals to address seepage and tail end water unavailability issues. However, at the same time, it may be noted that the deacrese in seepages due to lining may also cut down on the amount of groundwater recharges in the surrounding areas (a research study by Anna University, Tamil Nadu, highlights that unlined canal assists in groundwater recharging 20% more than the lined canal[106]). Thus, a detailed feasibility study including cost benefit analysis to determine impact of reduction of seepage on groundwater level may be conducted before undertaking such projects. • Case study: Panchanadi minor irrigation project, Ratnagiri, Maharashtra[103] o Features: Project encapsulates earthen dam with masonry spillway with total storage capacity of 1.783 Mm^3, 1.33 km of lined and 0.67 km of unlined main canal o Findings: Conversion of unlined canal network sections into lined ones resulted in increase in conveyance efficiency up to 75% and in saving of 0.376 Mm^3 of water leading to scope of irrigating additional 43 ha.	

[105] ADB Scoping Study (2013), 'Exploring PPP in the Irrigation and Drainage Sector in India'

[106] Mirudhula K, Anna University (Sepetember 2014), Internationa Journal of Engineering Research and Technology, "Impact of lined/ unlined canal on groundwater recharge in the Lower Bhavani Basin"

Sl.no	Recommendations	Finding
	A brief comparison of the overall efficiency and conveyance losses across different sections of the canal is illustrated below.  	
AIBP-R6	**Change in funding norms/ eligibility criteria to facilitate more focus on ERM projects and release of additional grants for maintenance** • Various studies in the recent past has advocated for imminent need to invest more in maintenance and utilization of the existing irrigation assets rather than investing in new investment projects in the I&D sector. Scholars (like Ackerman 2011) and World Bank Study (Briscoe and Malik, 2006) state that most of the water storage projects in India (particularly in Peninsular India) has reached the limits of any economically viable additional water storage. An ADB study (Blackmore 2010) pointed to the low economic value addition by surface irrigation projects in Ganga basin because of existing high water table. Burton (2010) pointed that though construction of new irrigation schemes helped to expand irrigated area, yet much more benefits could be obtained through 'better management'. Past experiences in Madhya Pradya also confirm such findings as already highlighted in one of the case studies.	AIBP-F4

Sl.no	Recommendations	Finding
	• In view of these findings and existing low utilization/ below par utilization of many of the MMI projects (widening IPC-IPU gap), **it is proposed that government brings in a paradigm shift in its priority selection; more focus on Extension, Renovation and Modernization (ERM) and maintenance of existing projects is suggested.** Similar suggestions were put forth by the Working Group on Major & Medium Irrigation and CAD for the XII Five Year Plan (2012-2017), where it was recommended that 'liberalized central funding at enhanced rate' should be considered for central assistance in respect of CADWM and ERM projects. • Since its inception in 1996-97, around 42 ERM projects have been included under AIBP for which around Rs. 2845.27 Cr. have been released till December 2016[107]. A proactive approach in bringing more such projects under the scheme coverage by relaxing/ incentivizing the eligibility criteria for inclusion of ERM projects is necessary. • Change in funding forms for MMI projects is suggested with higher percentage of earmarked funds for O&M of headworks. • The ministry could also explore introducing a separate scheme for non-establishment component of maintenance expenditure for the MMI projects. Additional incentives may be provided to states that have adopted various water sector reforms like increase in state maintenance budget, setting up water resources regulatory authority, etc.	
AIBP-R7	**Bring in institutional changes to support recent developments and transition towards service oriented approach** • Capacity building: In line with recent developments in the sector like emergence of various remote sensing technologies, shift from	

[107] Lok Sabha reply by Water Resources Minister, Smt. Uma Bharti (https://economictimes.indiatimes.com)

<table>
<tr><th>Sl.no</th><th>Recommendations</th><th>Finding</th></tr>
<tr><td></td><td>
open canals to piped irrigation, etc. it becomes imperative to chalk out a national training plan for training state irrigation officials, backed by budgetary provisions.
• Change in staffing pattern: With paradigm shift towards water management, it becomes imperative to adopt a multi-disciplinary profile of the irrigation staff. An illustrative list is suggested below:

<table>
<tr><th>Staff discipline</th><th>Area</th><th>Task details</th></tr>
<tr><td>Engineer (civil, electrical, mechanical, IT, E&TC)</td><td>Irrigation and drainage system</td><td>• Civil construction
• Infrastructure O&M
• System automation
• Maintenance of water delivery</td></tr>
<tr><td>Agronomist</td><td>Agriculture economy</td><td>• Understanding economic and financial value of crops, water requirement and farm budget
• Determination of water tariff</td></tr>
<tr><td>Anthropologist/ sociologist</td><td>Socio-economy</td><td>• Community engagement
• IEC and capacity building</td></tr>
</table>

• Outsourcing of services: In view of the vast span of the MMI projects and limited resources of the irrigation department; outsourcing of maintenance activities to private organizations may be explored. As reported, such initiatives have already been adopted by the Andhra Pradesh government.
Also, outsourcing of other non-core seasonal works like monitoring of outlets, crop assessment, billing and revenue collection to private agencies/ retired personnel (on contract basis) may be explored.
</td><td></td></tr>
</table>

Sl.no	Recommendations	Finding
	• Inter-departmental co-ordination: Though the AIBP guidelines mandates pari-passu implementation of CADWM; yet works under CADWM has significantly lagged in many of the projects, in spite of the hydraulic activities being completed (particularly in states like Andhra Pradesh, Manipur, Punjab, Jharkhand and Uttar Pradesh). One of the reasons being lack of co-ordination among the implementing authorities of the two schemes (e.g. in Manipur there are two separate departments for water resources and CAD which puts administrative limits on the extent of co-operation). To mitigate such issues, standardized institutional guidelines for smooth co-operation of the two implementing agencies/ merging into a single implementing agency could be chalked out to bring more accountability.	
AIBP-R8	**Ensuring release of funds/ central grants by states to project implementing agencies within stipulated time** • To expedite the release of the central grants by the states, options like transfer of funds by the Centre directly to the project implementing agencies may be explored. Considering such modus operandi may be an interference in the federal power of the states, such mechanisms may be adopted for only those projects/ states which have witnessed significant delays in the past.	AIBP-F2
Scheme implementation		
AIBP-R9	**Create a task force for inter-departmental clearances and a separate R&R wing under Water Resources department** • To expedite the inter-departmental clearances for land acquisition (like clearances from roads, railways and environment), a separate inter-departmental task force could be created comprising Secretaries/ senior officials of the relevant departments who may meet regularly (say monthly) to expedite the approvals.	AIBP-F3

Sl.no	Recommendations	Finding
	• Currently, the irrigation officials have to make multiple visits to various divisions of the Land Resources department to sort out the R&R issues. This often leads to inordinate delays considering that Land Resources department officials being not dedicated to a particular sector have to address R&R issues pertaining to other sectors also. Thus, creation of a separate Rehabilitation and Resettlement wing is proposed under the Water Resources department for better co-ordination and expeditious clearances. E.g. in Polavaram project, a separate Relief and Rehabilitation Commissioner has been appointed by the Andhra Pradesh government. The AP government has also set up a separate wing called Commissioner of Rehabilitation and Resettlement under the Water Resources department to facilitate R&R of the MMI projects (including projects under 99 Priority AIBP projects like Musurumulli and Tharakarama Thirtha Sagaram Project.	
AIBP-R10	**Develop a national contractor management tool/ software** • Since most of the MMI projects involve engagement of a host of contractors over a long period of time, an online contractor management tool may be developed by the Central government and source code can be shared with each of the states to avoid individual state investments in such tools. • Systematic progress tracking of contractors will help to identify critical paths and ensure timely actions and escalations are done.	
AIBP-R11	**Implement SCADA/ telemetry techniques and canal automation** • Overall efficiency of manually operated canals is around 40%, which may be increased by at least 10% with some level of automation[102] • With progressive transition to Participatory Irrigation Management and shift from construction to service oriented approach, canal automation becomes inevitable. **DoWR, RD & GR, in association**	AIBP-F5 AIBP-F9

Sl.no	Recommendations	Finding
	with CWC and state governments, should conduct studies to identify MMI projects that could be taken up for canal automation either under current ERM projects (PMKSY-AIBP) or through any new schemes. Since, such initiatives entail less investments and no risks of delays due to land acquisition and R&R issues, this is expected to result in considerable benefits in a shorter period of time compared to new construction. • Some of the envisaged benefits of SCADA implementation and canal automation are: o Remote device monitoring and operations of components (particularly significant for projects in India with huge canal network and thousands of cross and head regulators) o Maintenance of water level at Full Supply Level (FSL) in every pool; alleviated the risk of water logging and salination at head reaches and scarcity at tail reaches o Volumetric water measurement and automated invoicing o Optimization of scheduling of water deliveries based on WUA's requirements and water availability in canal network • However, canal automation calls for a multi-pronged approach with close co-ordination between various engineering disciplines like Civil, Mechanical, Electrical, Electronics & Telecommunication and IT • While canal automation is still an evolving technology, it has already been implemented successfully in many parts of world including India, some of which are listed below: • Case Study 1: Narayanpur Left Bank Canal (NLBC), Karnataka (1 of the 99 Priority AIBP project) o Key features: SCADA based solar power operated 'Integrated Automated Gates' at all distributaries of NLBC and entire command network of Hunasgi Branch Canal; GIS based Irrigation Network Management Information System	

Sl.no	Recommendations	Finding
	(INMIS) for better crop yield and water management (dynamic planning of water demands and availability based on soil moisture, cropping pattern, soil health, weather conditions), 210 Information Kiosks for water allocation, information collection and dissemination to WUAs; wireless data connection network and control centres at Narayanpur (master) and 10 other remote monitoring stations o Status: 1st phase of the project has already been completed while 2nd phase is expected to be completed by December 2021 o Envisaged benefits: to increase system water use efficiency from 31.5% to designed 51%; supply water to 1.05 lakh ha of tail end farmers and mitigate water logging issues in 37,000 ha; reduce resources for canal operations and maintenance; improve responsiveness of the system; demand aggregation and volumetric water supply; dissemination of water allotment and invoice details to the farmers; GIS based information on soil health, soil moisture, crop pattern and weather conditions • Case Study 2: Ramthal Integrated Drip Irrigation Project, Karnataka o Key features: water lifted from Narayanpur reservoir and distributed to fields using HDPE/ PVC pipes; online self-cleaning automatic filters used to ensure clean water for drip systems; each field outlet is fitted with automated valves controlled by a wireless remote monitoring station – automated alerts through SMS are sent to farmers regarding on/ off schedules, crop alerts and other agronomical practices; entire systems like pressure regulation, opening and controlling of pumps are automated based on pre-defined and pre-set water	

Sl.no	Recommendations	Finding
	level in the system - all data are secured on cloud servers which thus allows remote monitoring ○ Envisaged benefits – the overall project efficiency is expected to be 90%[108] (water conveyance efficiency – 99% and field application efficiency – 95%), envisaged net income is Rs. 29,259/ acre while water productivity is expected to be 1.41 kg/ m^3 (which is much higher compared to 0.28 kg/ m^3 from comparable conventional canal system) • While 'one-size-fits-all' automation may not be the right approach and the extent of automation may vary project-wise, it is suggested to carry out renovation of the existing control structures, canal lining and sizing and CAD works before any sort of automation is adopted.	
AIBP-R12	**Attracting private investments in MMI projects** • Involvement of private parties in irrigation and drainage (I&D) sector may be explored to mitigate the current resource crunch (manpower, funds, technical knowhow) plaguing this sector. • In line with the recommendations of previous committees/ studies (like MoWR committee in 2003, ADB study in 2013), private party investments could initially be encouraged in management service contracts with gradual transition to BOT- annuity and other innovative PPP models like Hybrid Annuity model, which is further illustrated below: ○ Management service contract: the private concessionaire to maintain O&M of the infrastructure for specified years in accordance with prescribe service levels in lieu of specified	AIBP-9 AIBP-F10

[108] Document share by Jain Irrigation Systems Ltd. (one of the implementing contractors for this project)

Sl.no	Recommendations	Finding
	fees (to be shared between the government and the water users i. Case study – Megech Seraba Irrigation and Drainage scheme, Ethiopia ▪ Maintenance of the primary and secondary irrigation infrastructure in lieu of service fee paid by the government with farmers to share a part of the fees o EPC contract with built in O&M clause for 5-10 years: To attract private parties and ensure expeditious completion, EPC contracts with built-in O&M clauses for specified years (say 2 years for gravity canals and 5-10 years for LIS) may be explored. Such model is particularly relevant in the backdrop of recent demand for piped irrigation, canal automation and LIS projects. ii. The I&CAD department, Andhra Pradesh has proposed to build a 320 MW hydropower based project under BOT annuity based model with a provision for EPC contract with O&M contract for 15 years for the LIS component o BOT Annuity/ other PPP Models like Hybrid Annuity Model (HAM): HAM model has been successfully implemented in construction of road and sewage treatment plant projects in India. Under HAM the government invests 40%-60% of the initial construction cost (balance being borne by the private concessionaire) and pays the rest through annuity payments over 15-30 years. With increased options for other revenue streams (like sale of water to industries, drinking water to bulk consumers, hydro-power generation), such innovative models may be explored iii. Case study – Guerdane Irrigation Project, Morocco ▪ Design-Build-Operate based on a 30 year concession contract	

Sl.no	Recommendations	Finding
	▪ Government subsidy provided in form of 25% initial investment and soft loans to the tune of $25 million (total estimated cost was $105 million); balance was borne by the private contractor ▪ To minimize revenue risks, users need to pay an upfront subscription fees plus a variable component; revenue deficit due to water shortages (the project being in a drought prone area) to be shared between the parties with private concessionaire's loss capped to 15% while users need to partly bear the loss through increase in water charges ▪ Concessionaire agreement was signed in 2006 and 95% of the farmers subscribed by 2007 • Financial sustainability: There are numerous other international case studies like West Delta and New Zealand where private parties have successfully invested in the I&D sector and recouped the costs (including capital costs) through water user charges. • In the back drop of the poor fiscal position of many of the state governments and gradual shift from open canal to piped irrigation systems and adoption of canal automation, exploration of PPP models is suggested.	
Monitoring and evaluation		
AIBP-R13	**Tracking of outcome indicators on MIS platform** • For holistic view of the scheme implementation and impact, it is suggested to track all the outcome indicators suggested in the Ministry of Finance's Output-Outcome be tracked viz '% of irrigation potential utilized (in lakh ha) through infrastructure created through PMKSY-AIBP, increase in crop yield attributable to increased irrigation from PMKSY-AIBP, increase in groundwater levels attributable to PMKSY-AIBP' in addition to the already	AIBP-F12

Sl.no	Recommendations	Finding
	tracked indicator 'total additional irrigation potential created through PMKSY-AIBP'. • Considering that many of these indicators may be tracked/ needs to be tracked by other departments/ ministries/ schemes like PMKSY-HKKP, Groundwater board, Agriculture Ministry, a coordinated approach needs to be adopted for better visualization and tracking of the project impacts. E.g. irrigation potential utilized is currently tracked by the CADWM dashboard. Similarly, some of states maintain dashboards for groundwater level monitoring APWRIMs/ release monthly or quarterly groundwater level data. Thus, the feasibility of integration with the existing dashboards/ data records should be initiated on a priority basis. • Also, in line with the suggestions by the one of the scheme documents (July 2016), inclusion of detailed PERT chart for project management of the 99 projects is suggested.	
AIBP-R14	**Mandatory implementation of social audit provisions** • The states need to be encouraged (either by incentivization or penal provisions) to undertake mandatory implementation of social audit where 10% of the project works have been completed. A participatory approach involving the ground-level stakeholders and beneficiaries needs to be adopted; this becomes particularly relevant in view of the various execution deficiencies (like unnecessary splitting of works, sub-standard works, etc.) pointed by the C&AG report in reference to previous AIBP projects.	AIBP-F13
AIBP-R15	**Adoption of remote sensing technologies** • Considering the huge span and difficult terrains of project areas, adoption of remote sensing technologies for project monitoring (both for on-going and completed) projects is imperative. • **Survey of ongoing construction works and monitoring of projects (to detect canal breaches, unauthorized water withdrawals) using drones could be explored**. In this aspect the	AIBP-F13

Sl.no	Recommendations	Finding
	extensive use of drones during construction of Polavaram project (in Andhra Pradesh) is well documented. Recent MOU between Andhra Pradesh Drones Corporation Private Limited (APDC) and Andhra Pradesh Licensed Service Area (APLSA) may be leveraged to monitor the progress of ongoing seven AIBP projects in Andhra Pradesh, particularly for assessing the irrigation fees/revenue collections (based on land mapping) once the projects are completed. • With the progressive implementation of Participatory Irrigation Management, drone surveying could be a prominent tool in facilitating the Irrigation/ Revenue/ Agriculture departments in assessing the irrigation fees, revenue collection and crop planning. Recent initiatives by Water Resources Department of the Maharashtra Krishna Valley Development Corporation (MKDVC) in association with Terra Drone India helped in assessing the 4,200 sq. km[109] of agricultural land. In this aspect, even other alternative Remote Sensing and GIS technologies may be explored. A notable example is the recent proposal of mapping the Rabi season Land Use and Land Cover (LULC) in Narmada Canal (one of the 99 Priority AIBP projects) command area, Rajasthan, where satellite data procured from ISRO's NRSC Data Centre would be used[110]. Also, notable are the recent initiatives being undertaken at the national level by the Ministry like cropped area mapping studies (to assess IPU) using remote sensing technologies and project monitoring through Bhaskaracharya Institute of Space Applications and Geo-informatics (BISAG) (note that the quality of assessment and monitoring studies have not been validated under this study). Also, a mobile application for geo-tagging project components has	

[109] https://www.geospatialworld.net

[110] Document shared by A.C.E, Narmada Canal Project, Rajasthan

Sl.no	Recommendations	Finding
	been developed by the Ministry along with a GIS-based web portal for monitoring the progress.	

2.2.2 Har Khet Ko Pani

2.2.2.1 Command Area Development & Water Management

The CADWM programme component under Har Khet Ko Pani (PMKSY) involves creation of field channels, intermediate and link drains, reclamation of water-logged areas along with Participatory Irrigation Management. Its main objective is to reduce the yawning gap between Irrigation Potential Created (IPC) and Irrigation Potential Utilized (IPU) for the major and minor irrigation projects through more involvement of farmers.

Introduced in 1974 as 'Command Area Development Programme (CADP), the scheme was restructured a number of times and scope got extended with the new guidelines focussing more and more on involvement of the farmers for sustaining the scheme. Currently, the scheme is being implemented as a component of Har Khet Ko Pani with the main focus of developing pari-passu CAD works for 99 priority AIBP projects.

CAD works may be broadly categorized into the following two parts:

- Structural Interventions which involve survey, planning, design and execution of the following:
  - On-farm Development (OFD) works
  - Construction of field, intermediate and link drains
  - Correction of system deficiencies
  - Reclamation of water-logged areas
- Non-structural Interventions which involve strengthening of Participatory Irrigation Management (PIM) through activities like:
  - Providing one-time Functional Grant to the registered Water User's Association (WUAs)
  - Providing one-time Infrastructure Grant to the registered WUAs
  - Conducting trainings, demonstrations and adaptive trials in relation to water use efficiency and sustainable irrigation in participatory environment (trainings, demonstrations, etc shall be conducted by WALMIs/ IMTIs)

The institutional arrangement for CADWM programmes as suggested in the scheme guidelines is as follows:

- Implementation Support: All CAD works starting from planning, designing, tendering to execution are responsibility of the State Government. Since CAD works are implemented in pari-passu with AIBP, they shall be preferably executed by the same department
- Overall Monitoring and Co-ordination Support: Central Water Commission through its CAD cells in the Regional Office and Project Monitoring Organization at headquarters shall monitor and provide co-ordination support.
- Hand-holding Support: Empanelled Social Facilitators (like NGOs/ entities having substantial influence in village level reforms) shall provide hand-holding support for strengthening Participatory Irrigation Management. Activities of Social Facilitators shall be monitored by special institutes (experienced in social sciences) as engaged by MoWR.

Background

After independence, construction of a large number of irrigation projects were taken up to enhance agricultural production in the country. However, the increase in irrigation potential utilized fell far short of the increase in irrigation potential created. In 1972, the Irrigation Commission recommended development of command area to address this issue. In 1974, the Government introduced the Centrally Sponsored scheme of Command Area Development Programme (CADP) with an objective of increasing irrigation potential utilization and enhance food grain productions through efficient water management efforts. In 1996, scope of the programme was further extended to include farmer's participation and reclamation of water-logged areas. A review of the programme implementation during VIIIth and IXth Plan pointed to a number of other system constraints viz. system deficiency before the outlet leading to unreliability of outlet water supply, absence of link and intermediate drains to channelize the surplus water to the main drains, non-inclusion of minor irrigation projects in non-hilly areas, low priority of state governments in investing in training and hand-holding support to the farmers and non-revision of cost norms since VIIIth plan. Thus, during Xth plan, the programme was restructured to 'Command Area Development and Water Management Programme' and the scope was further expanded. However, the Working Group on Major & Medium Irrigation and Command Area Development for the XIIth Year Plan pointed to aggravating water logging problems. The target achievement in field drains was noticed to be one-tenth of that in field

channels (as on 2011 only 0.52 lakh ha was reclaimed out of the target of 0.79 lakh ha[111] waterlogged area). The Working Group also noted that a number of irrigation projects have failed to operate at their target level owing to fund shortage for O&M. Thus, a provision of Correction of System Deficiencies was added to the scope of CADWM programme to address such deficiencies above the outlet (on canal system of capacity up to 4.2 cusec). During the XIth Plan, the Ministry also introduced a model act for facilitating Participatory Irrigation Management. It was proposed to transfer responsibility for O&M to WUAs along with the authority of collecting Irrigation Service Fees (ISF) in their respective jurisdiction.

At the time of inception, CAD works for 60 major and medium irrigation projects with CCA of 150 lakh ha were taken up. As on December 2015, there were 145 active projects with CAD works covering 221.6 lakh ha[112] over 23 states and 2 UTs. Details of field constructions done during the XIth Plan and XIIth Plan under CADWM are given in the table below:

Table 32: CADWM – field construction details from 2008-09 to 2014-15

Year	Target	Achievement
	(in lakh ha)	(in lakh ha)
2008-09 to 2011-12	13.2	16.9
2012-13	3.5	3.6
2013-14	5.0	3.1
2014-15	5.0	0.3*

**as on December, 2014*

Data Source: Standing Committee on Water Resources (2016-17), Review of Accelerated Irrigation Benefit Programme (AIBP)

However, in spite of the above efforts, the issue of IPC-IPU gap cannot be fully resolved as highlighted in the figure below. According to a study, as on 2016, the IPC-IPU gap for 43 AIBP projects (out of the completed 143 projects) was around 7.87 lakh ha.

[111] MoWR (November 2011), Report of the Working Group on Major & Medium Irrigation and Command Area Development for the XII Five Year Plan (2012-2017)

[112] NITI Aayog (December 2015), Evaluation Study on Command Area Development & Water Management Programme

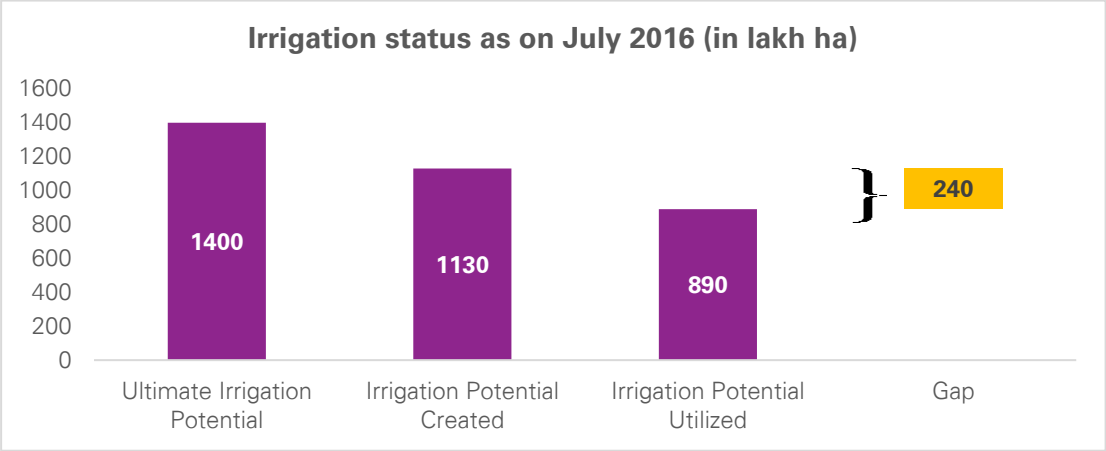


Figure 29: CADWM – India's irrigation status in 2016

This gap between creation and utilization may be attributed to lack of CAD works, poor maintenance of structures and canal networks, system deficiencies, poor planning, siltation in minor networks, change in cropping pattern, etc. Dr. Mihir Shah Report states "Our huge investments in irrigation have yielded much less than what they should have mainly because command area development (CAD) has been consistently neglected and divorced from building of irrigation capacities". Thus, the XIIth Plan stipulated pari-passu implementation of CAD works with AIBP projects to address the issue of IPC-IPU gap. Accordingly, the guidelines of AIBP were modified in October 2013.

In the beginning of FY 2016-17, CADWM works were ongoing in 152 projects targeting a CCA of about 70 Lakh ha. However, in July 2016, with the launch of 99 priority AIBP projects CAD works were made restricted to only these 99 priority projects from 2016-17 onwards. It was proposed to fund the scheme through budgetary support and loans from NABARD. (Note: for projects other than the 99 priority AIBP projects, it was proposed to fund the CADWM works through a new 'scheme of incentivization for bridging the IPC-IPU gap'). The implementation of 99 priority AIBP projects is envisaged to create an irrigation potential of 76.03 lakh ha.

As stated in MoWR's 'Guidelines for Central Assistance for Command Area Development Works in prioritized AIBP funded irrigation projects', aim of implementing the CAD works shall be to enhance food grain production to meet the needs of the rising population. The key objectives of the scheme are:

- Utilize Irrigation Potential Created (IPC) under the project soon after its completion
- Improve water use efficiency
- Increase agricultural productivity and production
- Bring sustainability in the irrigated agriculture in a participatory environment

New guidelines have emphasized on Participatory Irrigation Management; some of the suggestions are as follows:

- Along with grants and hand-holding support to WUAs, the provision of transfer of control and management of irrigation system to WUAs have been made necessary for treating the project as completed. The WUAs have also been empowered to collect ISFs as per State norms.
- WUAs shall be in place before commencement of the project works to ensure involvement of beneficiaries since inception of the project
- Inclusion of panchayat representatives in WUAs/ District Level Implementing Agency/ State Monitoring Committee

For improving water use efficiency, micro-irrigation infrastructure has been suggested as replacement for conventional OFD works like land-levelling. It has been mandated that micro-irrigation shall cover at-least 10% of total CCA of the project or a minimum of 40 ha (if CCA is less than 400 ha).

Performance

Under PMKSY-HKKP, works under CADWM are currently being implemented in 88 projects across 18 states in India viz. Andhra Pradesh, Assam, Bihar, Chhattisgarh, Goa, Gujarat, Jammu & Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Odisha, Punjab, Rajasthan, Telangana and Uttar Pradesh, with a target to utilize irrigation potential created in 45 lakh ha additional CCA at total estimated expenditure of Rs. 18,736 Cr. including CA of Rs. 8,300 Cr.

The cost sharing norms between the centre and state is stated below:

Table 33: CADWM – funding pattern (Centre – state split)

#	Activities Eligible for Funding	Funding Pattern	
		Centre	**State**
1	All activities of Structural Interventions	50	50
2	All activities of Non-structural Interventions excluding Functional Grant to WUAs (at the rate of Rs. 1,200/- per ha[113])	60	40
	All activities of Non-structural Interventions excluding Functional Grant to WUAs (for eight North Eastern states and three Himalayan states of Himachal Pradesh, Jammu & Kashmir and Uttarakhand)	75	25
3	Functional Grant to registered WUAs (10% by farmers)	50	50
4	Incremental establishment cost	50	50

Physical Progress:

Structural Interventions:

As per data shared by PMKSY-HKKP, DoWR,RD&GR, as on June 2020, out of the targeted CCA (through structural interventions) of 45 lakh ha, around 14 lakh ha (31%) CCA has been covered.

Out of the 45 lakh ha target CCA, five of the 18 states viz. Gujarat (with a target of 13 lakh ha), Madhya Pradesh (with a target of 6 lakh ha), Telangana, Uttar Pradesh and Maharashtra (each with a target of 5 lakh ha) account for 78% of the targeted CCA.

State-wise physical progress is illustrated in the figure below:

[113] Standing Committee on Water Resources (2016-17), Review of Accelerated Irrigation Benefits Programme (AIBP)

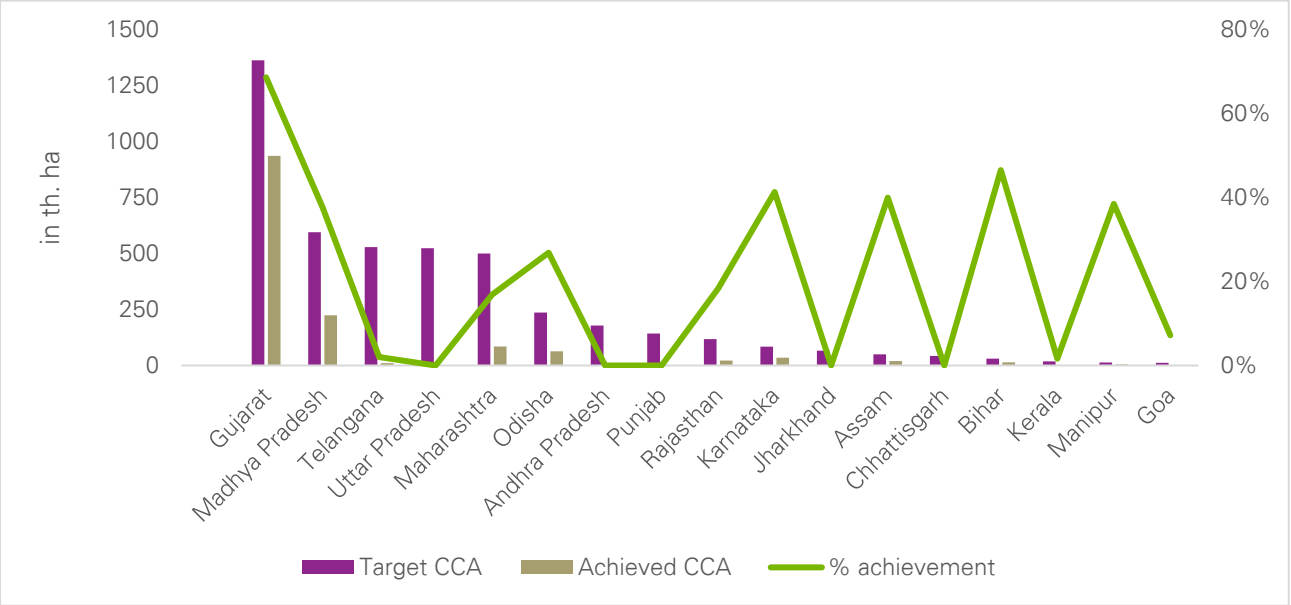


Figure 30: CADWM – physical progress as on June 2020 since 2016-17

It is critical to note, achievement in some of the states with higher targets like Telangana, Uttar Pradesh and Maharashtra is quite low at 2%, 0% and 17% respectively. In terms of overall achievement, Gujarat (69%), Jammu & Kashmir (61%), Bihar (47%), Karnataka (41%) and Assam (40%) are some of the leading performers; while states like Andhra Pradesh, Chhattisgarh, Punjab, Jharkhand and Uttar Pradesh are yet to achieve any progress. The causes for delay range from non-creation of IPC (under AIBP), non-availability of hydraulic connectivity, state budget constraint, delay in tendering and contractor issues.

Also, it may be noted that progress has been limited under some components of the structural interventions like micro-irrigation where, as per the MOM of 6th PIRC meeting (February 2020), only 0.08 lakh ha (i.e. 3%) of the targeted CCA of 2.6 lakh has been achieved.

Non-structural interventions:

Under non-structural interventions, as per data shared by PMKSY-HKKP wing, DoWR,RD&GR, as on October 2019, out of the 13,734 WUAs, around 6,981 (51%) has been created. However, progress in terms of transfer of infrastructural grants and handing over assets to the WUAs have been limited.

Financial Progress:

As per data shared by PMKSY-HKKP wing, DoWR, RD&GR, as on June 2020, out of the targeted expenditure of Rs. 18,736 Cr., around Rs. 5,064 (i.e. 27% of target) has been incurred. While out of the targeted CA of Rs. 8,301 Cr., the centre has released around Rs. 2,653 Cr. (i.e. 32% of target). Thus, the overall financial progress of 27% is commensurate with the overall physical progress (under structural interventions) of 31%.

A state-wise comparison of the physical and financial progresses is illustrated in the figure below:

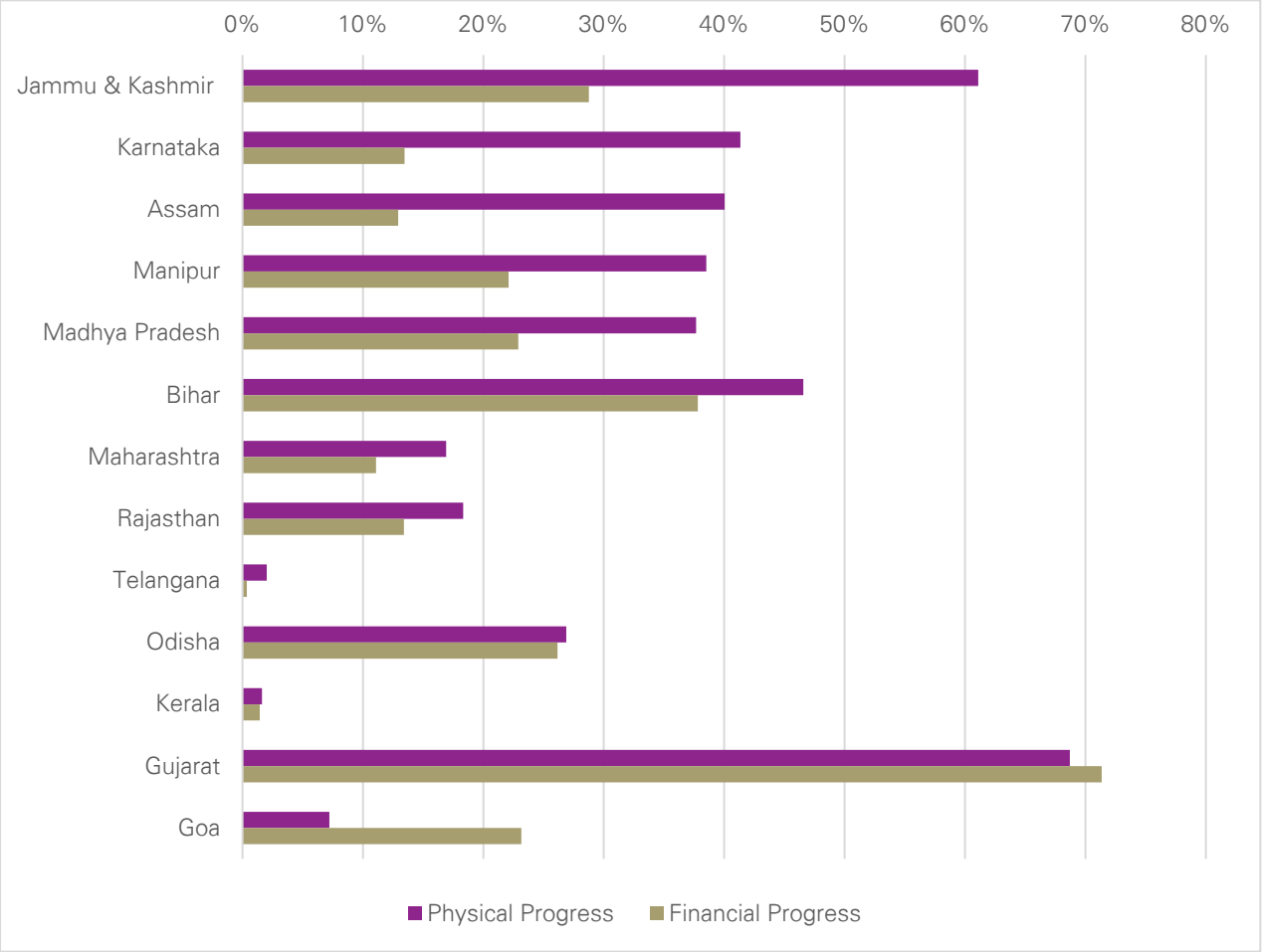


Figure 31: CADWM – comparison of physical and financial progresses

As evident from the above figure, states like Jammu & Kashmir, Karnataka and Assam has achieved higher physical progresses compared to the expenses incurred; while states like Goa have incurred higher expenses compared to their physical progresses.

Performance on REESI+E framework

Table 34: CADWM – performance evaluation using REESIE framework

Parameter	Findings from research

Relevance	**Secondary:**
	• The main objectives of the CADWM scheme under PMKSY-HKKP are:
	  ○ utilization of IPC soon after its creation
	  ○ improve water use efficiency
	  ○ increase in agriculture production and productivity
	  ○ ensure sustainability in the irrigated agriculture through Participatory Irrigation Management
	• Thus, the implementation of the scheme is envisaged to address the following sustainable development goals and national priorities:
	  ○ SDG Goal 2 – hunger
	  ○ SDG Goal 6 – clean water and sanitation
	  ○ SDG Goal 10 – reduced inequalities
	  ○ The national priority of doubling farmers' income by 2022
	• The successful implementation of the scheme would help to mitigate the issue of widening IPC-IPU gap in India: as per reported statistics (in 2012), out of the Ultimate Irrigation Potential (UIP) of 140 mha in India, around 113 mha of irrigation potential has already been created (IPC); however only 89 mha of this IPU can be utilized.
	• Some of the major causes contributing to this IPC-IPU gap, as pointed by various previous studies, are listed below:
	  ○ Non-completion and poor maintenance of distributary networks
	  ○ Inadequate maintenance of irrigation structures leading to high conveyance losses
	  ○ Poor-efficiency of on-farm applications including traditional methods of farming
	  ○ Crop pattern i.e. increasing shift to water-intensive crops

Parameter	Findings from research
	• The completion of CADWM works (to be implemented in pari-passu with 99 Priority AIBP projects) is expected to address some of these challenges by building last-mile connectivity, increasing field conveyance efficiency, proper water management and capacity building of cultivators. This is underlined by a host of studies including Dr. Mihir Shah's article 'Water: Towards a Paradigm Shift in the Twelfth Plan' which points to the importance of planning from 'reservoir to farm gate' and urgent need for development of command area development (CAD works).
	Primary: • Discussions with the key informants like Secretary (DoWR,RD&GR), Directors (Monitoring & Appraisal) CWC regional offices, Chief Engineers, Superintending Engineers and equivalents from State Government departments provided the following insights in relation to relevance: o The completion of CADWM works is extremely pertinent in establishing the last mile connectivity for major and medium irrigation projects o Lining of field channels, correction of system deficiencies and reclamation of water-logged areas hold the key to improving on-farm efficiency o Formation of WUAs and hand-holding the cultivators through specialized agencies are necessary steps to bring change in cropping pattern and restoring equity in water distribution o Adoption of micro-irrigation will assist in extending the command area coverage o As forward looking measures, several reforms similar in the lines of Incentivization Scheme for bridging Irrigation Gap (ISBIG) scheme were suggested to expand the scheme scope; some of which are listed below:

Parameter	Findings from research
	▪ Increased convergence with the extant micro-irrigation scheme of Ministry of Agriculture and Farmer's Welfare to facilitate procurement and installation of micro-irrigation equipment at farmer's end ▪ Provision enabling Installation of solar power system for micro-irrigation to cut down on the running expenses ▪ Provision for taking wastewater re-use projects on pilot basis ▪ Incorporation of conjunctive use of groundwater like components of groundwater development (dug wells/ tube wells/ farm ponds) to ensure assured water supply in lean monsoon periods ▪ Provision for implementation of canal automation system from the farm end and upward up to the distributaries or branch canals ▪ Provisions for strengthening capacities of existing WALMIs and establishment of WALMIs in states (where WALMIs are not existing)
	Inference: • The implementation of CADWM works pari-passu with the 99 AIBP Priority projects should definitely contribute to improvement of IPC-IPU gap for these projects. It should also help to facilitate gradual shift towards Participatory Irrigation Management. As forward looking measures, several of the additional intervention areas suggested under the ISBIG may be incorporated in the CADWM scheme. The CADWM scheme under PMKSY-HKKP is thus found to be quite relevant in containing the IPC-IPU gap and addressing the SDG goals and national priorities.

<table>
<tr><th>Parameter</th><th>Findings from research</th></tr>
<tr><td>Effectiveness</td><td>
Secondary:
Scheme design
• Institutional structure: Under the non-structural interventions, the CADWM guidelines suggest selection of social facilitators (from an empanelled list of suitable agencies/ institutes/ consultant) for each of the 99 projects for providing support to the WUAs, while the structural interventions are to be implemented by the respective CAD department of each state. A Project Implementation Review Committee shall review the implementation of both the interventions on zonal basis two times in a year.
Scheme implementation
• Physical Progress (structural interventions):
o As on June 2020, 14 lakh ha (31%) CCA was achieved against a target CCA of 45 lakh ha (structural interventions) under PMKSY-CADWM. Out of these, physical progress in 8 states (out of 18 selected states for implementation) viz. Andhra Pradesh, Chhattisgarh, Goa, Jharkhand, Kerala, Punjab, Telangana and Uttar Pradesh is almost nil or below 10%. As per the CADWM-MIS dashboard, accessed on 8th July 2020, physical progress for 55 out of 88 projects is between 0-10% of the targeted CCA.
o Though many of the contributing issues for poor performance vary across states, some of the common issues are summarized below. This is based on the 6th PIRC (February 2020) Progress Review Presentations MOM:
<table>
<tr><th>#</th><th>Contributing issues</th><th>No of states reporting issue</th><th>Examples</th></tr>
<tr><td>1.</td><td>Absence of hydraulic connectivity up to outlet</td><td>9</td><td>AP, Gujarat, Jharkhand, Kerala</td></tr>
</table>
</td></tr>
</table>

Parameter	Findings from research			
	2.	Delay in government/ administrative clearances	7	Assam, Goa, Jharkhand, Telangana, U.P.
	3.	State budget constraints	6	Assam, Manipur, Maharashtra, Kerala
	4.	Unwillingness of farmers	6	Goa, Gujarat, Karnataka, Kerala
	5.	Delays in tendering	6	A.P., Chhattisgarh, U.P.
	6.	Capacity related issues of Implementing Agencies	3	A.P., Maharashtra
	7.	Contractors/Supplier Issues	2	Chhattisgarh, Maharashtra

  - Some other issues highlighted by previous studies (not limited to projects under 99 Priority AIBP) include delay in transfer of central funds by the states to the implementing agencies, inadequate financial outlays, lack of priority of state governments for construction of field channels, the applicability of which for PMKSY projects is further evaluated in the next row under 'Primary' observations

- Progress of micro-irrigation component: With the intent of increasing water use efficiency, the guidelines mandate coverage of at least 10% of the CCA with micro-irrigation works. It is envisaged with adoption of MI structures (use of pumps, HDPE pipelines), components like land levelling and drainage works may be done away resulting in substantial cost reductions.

Parameter	Findings from research
	As per the 6th PIRC (February 2020) Progress Review Presentation, the progress in all states under micro-irrigation component is nil or almost nil (i.e. below 2% of target) except Assam (38.5% of target), J&K (50.25%), Maharashtra (9.24%) and Bihar (6.16%). The overall progress under micro-irrigation is only 3.1% of the total target. • Holistic implementation of CADWM scheme: In reference to previous CAD schemes, the Report of the Working Group on MMI and CADWM for the XII Five Year Plan (2012-2017) pointed to 'lack of holistic implementation of Programme' adding that 'programme is implemented by constructing only the field channels so much so that the construction of field channel only is construed as CADWM programme'. However, whether validity of such statement in relation to PMKSY-CADWM still holds is further tested in the next row under 'Primary' observations. • Physical Progress (non-structural interventions): o As on October 2019, 6,981 WUAs i.e. 51% of the targeted 13,734[115] WUAs have been created under the CADWM scheme. Though most of the states have made notable progresses in terms of creation of WUA compared to their physical progress, yet as per the MOM of 6th PIRC Presentation (February 2020), only 17% of the WUAs have been handed over infrastructural grants while only 34% of them have been handed over the assets. It may be noted that in Assam and Rajasthan, despite considerable progress in WUA creation, neither the infrastructural grants nor the handing over assets have taken place. o In the past, various organizations/ committee like DMEO NITI Aayog (2015) and the Working Group on Major & Medium Irrigation and CAD (2011) have pointed to the ineffectiveness of many of the WUAs, terming them as 'paper WUAs'. The same has been the echoed by the NITI Aayog CWMI Index

Parameter	Findings from research
	2019, which states that despite enactment of PIM laws by most of the states, the overall level of involvement has decreased. o Some of the other issues highlighted by various studies like DMEO NITI Aayog's 'Evaluation Study's 'Evaluation Study on CADWM' in 2015 include lack of capacity building initiatives for WUAs and non-involvement of farmers in the planning stage (note observations made in these past studies pertain to pre-PMKSY projects). **Case Study: Effective function of WUAs ensured through strategic community mobilization plan (Satak Tank, Khargone district, Madhya Pradesh)** Action for Social Advancement (ASA), an NGO, was appointed to facilitate capacity building of the WUAs for the Satak minor irrigation scheme in Khargone district. The key objective was to ensure effective functioning of the Satak WUAs and generate adequate funds for the canal restoration process through community collection drive. Some of the steps taken by ASA to ensure the same are summarized below: a. Community mobilization through awareness campaigns: • ASA held series of awareness campaigns using village wise quiz competitions, local folk media (Kalki-turra) and wall paintings. 36 community volunteers were trained as Jal Praharis, who also helped later in the water distribution process. Baseline surveys were conducted to understand the needs of the farmers and also agriculture support services were provided. b. Capacity building initiatives: • A training module was prepared by ASA – in the 1st phase emphasis was put on communicating the rights,

Parameter	Findings from research
	role and responsibilities of the WUA and its members while in the 2nd phase, attention was focussed on developing the institutional capacity of both the WUA and WRD through training programmes on water distribution management, gender sensitization and dispute resolution. Training were conducted on social audit. • Exposure visits were conducted to neighbouring states c. Community contribution collection drive: • To ensure a transparent collection process, a formalized instrument of agreement 'anshdaan anuband' was introduced between the WUA and the users. Contribution receipts were given to the payees and collected fund was deposited in the common bank account • To encourage more collection, letters of appreciation were issued to the payees and printed posters were pasted at the gram choupal d. Gender mainstreaming • WUA voting rights were extended to spouses of the existing WUA members through necessary amendment in the PIM act. • Extensive awareness campaigns were conducted to sensitize the villages about women participation and franchise rights • Self-help groups were set up to ensure women empowerment **Outcome:** • Community contribution by farmers touched 20% of the cost of physical works which exceed the 10% target set by the

Parameter	Findings from research
	authority (ICEF). Such contributions for canal restoration also helped to create a sense of ownership among farmers. • Increase in irrigation rotation frequencies resulted in 20-30% improvement in wheat production (in Balkhar village), increase in jobs for agricultural laborers with greater adoption of labour intensive commercial crops like cotton and chilli which greatly helped the landless labourers • Around 73% of spouses of landowners casted vote in the last reported WUA elections • Social audits were conducted in every 6 months *(Reference: Action for Social Advancement, "ICEF-M.P. WRD Project on Participatory Restoration and Management of Irrigation Systems by Water Users Associations in M.P.")* **Case Study: Ensuring involvement of WUAs through local leadership and assets handover, (Ozhar Water User Societies, Nashik, Maharashtra in command area of Waghad medium irrigation project)** Some of the key features are summarized below: • **Initial handholding by local leadership**: 3 WUAs set up by Samaj Parivartan Kendra with support from SOPPECOM in 1990s: Banganga, Mahatma Phule and Jay Yogeshwar. • **Asset handover**: One of the few earlier WUAs, where complete project has been handed over to the WUAs • **Provision for conjunctive water use:** Constructed water harvesting structures like check dams on the nullas and streams flowing nearby and stored unused quota of canal water which helped in recharging wells • To ensure conjunctive use of surface water and groundwater, water charges were imposed on the farmers for using well

Parameter	Findings from research
	water and a simple assessment mechanism for estimating well water level and charge was adopted All these concerted efforts resulted in substantial increase in irrigation efficiency, irrigated area and fees collection efficiency *(reference: IWMI TATA Water Policy Research, "Situational Analysis of WUAs in Maharashtra")* **Case Study: Enhancing community involvement to ensure effective functioning of the WUAs (Chappi Tank, Rajgarh)** In order to address the deteriorating maintenances and acute water shortages in the Chappi medium irrigation scheme, the MP-WRD appointed an NGO Bhartiya Agro Industries Foundation (BAIF) to operationalize the PIM. Implementation strategies adopted by BAIF are summarized below: **Community mobilization process**: To gain credibility among the community, initially BAIF assisted the community with livestock development and other food security related government programs. **Setting up a transparent mechanism for fund collection**: To lend more legitimacy and acceptance of the collection drive, irrigation officials were roped in the collection process. Community contribution were directly transferred to the account of the executive engineer and receipts were provided to the payees. A separate sub-committee viz Nirman Samiti was set up to channelize all the funds and supervise the physical work. **Setting up a water distribution system**: WUA took decision to give priority to tail ends villages and release 2 rotations of water. An equitable water distribution system was worked out by the WUA to ensure optimum water utilization and reduce community conflicts.

Parameter	Findings from research
	Outcome • Increase in irrigated area and agricultural productivity was reported – farmers have shifted from crops like maize, jowar and local cotton to other diversified crops like gram, coriander, mustard and soya bean. • Effective functioning of the WUAs imparted a sense of ownership among farmers and faster resolution of grievances. • Community sensitization about water conservation and management led to reduction in water loss to 5-10% from 40% • Some tail end villages were reported to get access to canal water for the first time *(Reference: Action for Social Advancement, "ICEF-M.P. WRD Project on Participatory Restoration and Management of Irrigation Systems by Water Users Associations in M.P.")* **Monitoring and evaluation** • IPC-IPU assessment: Various studies including an IIM Ahmedabad Study initiated by the MoWR (Samar K Dutta et al., 2008) pointed that both IPC and IPU are dynamic figures dependant on a number of factors like resource reliability, wear and tear of the infrastructure, cropping pattern, etc.; thus simply aggregating the same without normalization (e.g. without allowing for discounting factors) is methodologically not sound. The study recommends a number of steps like reconciliation of IPC and IPU data by standing committees starting from district level, inter-departmental co-ordination for data collection and re-defining the concepts of IPC and IPU. This was again echoed by a NITI Aayog Study (in 2015), asserting the imminent need for 'more reliable and accurate' system for

Parameter	Findings from research

	assessment of IPC-IPU with active co-ordination of statistical organization in each state.
	• The Output Outcome Framework prepared by the Ministry of Finance has suggested the following outcome indicators:
	  o Utilization of irrigation potential in an additional culturable command area
	  o Command area covered for PIM through WUA formation
	  o Additional irrigation potential created
	• However, the CADWM-MIS tracker currently does not record any figure for 'additional irrigation potential created'; the tracker currently provides figures in respect of physical progress (in terms of CCA covered), financial progress and other non-structural interventions.
	• The CADWM MIS dashboard has been a significant step in ensuring accountability and data transparency. Though the updates in relation to structural interventions are observed to be regular, yet some deficiencies in update of non-structural interventions have been noted which are further detailed out in the issues section.
	• Under the CAD implementation support and review process, the guideline has suggested the following:
	  o Periodic review of the structural components by the regional CWC cells
	  o Under non-structural interventions, social facilitators shall submit monthly progress report to the social agencies/ institute and PIRC
	  o PIRC to review both the structural and non-structural interventions on a yearly basis.

	Primary: **Scheme design** • Though the CAD guidelines suggested 'continuous support' of the Social Facilitators, yet during primary survey the following deficiencies were observed:

Parameter	Findings from research
	○ In almost all states (viz Assam, Bihar, Karnataka, Madhya Pradesh, Maharashtra barring some exceptions like Lower Panzara and Dhom Balkaawadi projects, Manipur and Rajasthan), the involvement of social facilitators under CADWM scheme was reported to be either limited or non-existent owing to want of funds. Majority of the informants across the states were found to be not much familiar with the provision and concept of 'social facilitator'. However, some of the states like Assam, Bihar, Karnataka and Madhya Pradesh confirmed periodic training of cultivators at regional WALMIs/ agricultural institutes. Among the four afore-mentioned states, Karnataka was observed to be most effective in conducting regular training through irrigation officials, WALMI and Krishi Vigyan Kendra (KVKs) in relation to functionality of WUAs, maintenance of water courses and micro-irrigation structures (though inadequacy of training reported in some projects like Upper Tunga); while in Madhya Pradesh the WUA chairmen were reported to undergo training at regional WALMIs after election while exposure visits are arranged for farmers to other states like Maharashtra and Gujarat (it may be noted here that though conduct of WUA chairmen training was confirmed by the beneficiaries yet conduct of exposure visits for farmers has not been validated by them). However, baring these exceptions, in most of the other states trainings were observed to be sporadic, non-institutional and limited to only agricultural aspects like cropping pattern, seeds selection, thus underlying the imminent need for a structured institutional training programmes mandated in the CADWM guidelines. It is to be noted that in the 4th PIRC meeting (February 2019) all states have been suggested to involve the empanelled

Parameter	Findings from research
	NGOs under MoWR's National Water Mission. The delay in onboarding of agencies/ NGOs as 'social facilitators' has been attributed to the following causes: ▪ in many of the projects, either WUA formation has not commenced or been recently undertaken; hence social facilitators have not been appointed ▪ registered WUAs are not functional/ effective handover of assets have not taken place ▪ non-receipt of central funds for conducting trainings (as reported in Champamati and Dhansiri projects in Assam), inadequate grants (as reported in Durgawati project in Bihar and Upper Tunga project in Karnataka) ▪ non-availability of any local competent agency/ NGO **Scheme implementation** • Structural interventions: In line with the issues highlighted by the 6th PIRC meeting MOM, some of the major issues pointed by the informants during primary survey are summarized below (without any order of priority): o Delay in IPC creation: Though the AIBP guidelines mandate pari-passu implementation of CADWM provisions, yet various constraints (like land acquisition, R&R issues, etc.) delayed the completion of some of the main/ branch/ distributaries canals and without any hydraulic connectivity to the outlets, the CAD officials were either unable to plan/ conduct the survey for field courses (as in Andhra Pradesh) or cultivators were un-willing to part with their lands (as in Assam, Manipur and Karnataka) without visibility of any realizable benefits o State budget constraints: In many states like Assam and Manipur, states failed to match their share for central releases; however the same has been resolved last year through loans from NABARD (under LTIF).

Parameter	Findings from research
	○ Small window for execution of works: Owing to standing crops during cropping season or field preparation during pre-harvesting months, the actual working period available for execution of works is limited to only 3-4 months in a year as pointed by informants in many states like Bihar, Maharashtra and Manipur. Thus, simultaneous mobilization of resources by contractors (considering the huge span of command area), timely release of funds by the government become critical in execution of the field works. ○ Delay in transfer of central grants (in Assam) and transfer of grants by state government to implementing agencies (in Assam, in Bihar owing to technical issues related to Comprehensive Financial Management System and in Rajasthan) to the tune of 2-3 months to 12-18 months resulted in delay in mobilizing contractors/ resources during the limited execution period (which is of 3-4 months duration in a year owing to standing crops in cultivator's field) • Progress under micro-irrigation (MI) target has been remarkably low almost across all the states. The reason being un-willingness of the farmers to adopt such techniques, the causes of which are stated below: ○ Lack of awareness among cultivators regarding micro-irrigation (as reported in Bihar, Maharashtra, Madya Pradesh and Rajasthan). During focus group discussions (FGD), cultivators in command area of Champamati irrigation project (Khargaon village, Kokrajhar district, Assam) confirmed not a single training being conducted by government in relation to micro-irrigation techniques; cultivators expressed reluctance to adopt drips and sprinkler without proper trainings. ○ MI is not conducive to water-intensive crops like paddy and its usage is restricted to mostly horticulture crops and

Parameter	Findings from research
	vegetables. With access to assured irrigation, the cultivators, particularly those in the head region, are shifting to either water-intensive crops (in states like Karnataka and Rajasthan) or already cultivating paddy and/ sugarcane (as in Assam, Bihar, Rajasthan and Punjab) and are unwilling to change their cropping patterns. Also, in states like Assam and Uttar Pradesh, with low land-holdings and adequate water supply (unlike some western states), cultivators are reluctant to shift from their traditional crop (like paddy) and adopt expensive water-efficient technologies. During household survey interviews with 225 cultivators in five states of Assam, Karnataka, Maharashtra, Rajasthan and Manipur, top three reasons cited by the farmers for cultivating water-intensive crops like paddy, cotton, sugarcane, wheat and soya are 'demand in more' (selected by 40% of the respondents), 'this is a traditional practice' (selected by 27%) and 'there is no scarcity of water' (selected by 23%). Thus, without adequate economic incentives and awareness trainings, farmers may be reluctant to shift away from their traditional practices and adopt water-efficient practices in water abundant regions particularly when such crops like paddy are in higher demand. It may be noted here that in NITI Aayog's Working Group Report (2018) "Demand and Supply Projections Towards 2033: Crops, Livestock, Fisheries and Agricultural Inputs", it was pointed that 94% of the total coverage under micro-irrigation is accounted by only 9 states viz Andhra Pradesh, Chhattisgarh, Gujarat, Haryana, Karnataka, Maharashtra, Madhya Pradesh, Rajasthan and Tamil Nadu, which notably are some of the states facing high water scarcity. These was also validated during household interviews with 255 cultivators in Andhra Pradesh

Parameter	Findings from research

(Musurumulli and Pushkara projects), Assam (Champamati major irrigation project), Karnataka (Sri Rameswara), Maharashtra (Dhom Balkaawadi and Tarali projects), Manipur (Dolaithabi barrage), Punjab (mod. of Kotla canal) and Rajasthan (Narmada Canal Project) under AIBP scheme, where it was observed that MI adoption was much higher in some of the aforementioned 9 states compared to water abundant states – MI adoption rates in Andhra Pradesh (40% of 94 respondents), Karnataka (12% of 26 respondents), Rajasthan (67% of 18 respondents) was much higher compared to water abundant states like Assam (9% of 23 respondents) and Manipur (0% of 46 respondents). Such patterns were also observed during the household interviews in head and tail reaches of some of the projects in Andhra Pradesh and Karnataka; adoption of MI was found to be indirectly related to water abundance as highlighted in the table below:

	% cultivators reporting increase in water access after AIBP	% cultivators using any MI equipment
Musurumulli project (Andhra Pradesh)		
Head reaches	91% (n=23)	22% (n=23)
Tail reaches	64% (n=25)	40% (n=25)
Sri Rameswara project (Karnataka)		
Head reaches	40% (n=13)	0% (n=13)
Tail reaches	38% (n=13)	23% (n=13)

The above insights imply that though willingness of farmers to adopt such techniques may be lower in areas with traditional cropping practices and having adequate access to water, yet it may be easily promoted in areas suffering from

Parameter	Findings from research
	water shortages (like tail/ idle reaches) which have shown a higher adoption rate for such water-efficient techniques. E.g. in Bansagar project in Madhya Pradesh, MI adoption is being encouraged in areas at higher elevation or outside direct canal reaches. o Fragmented land and advanced stage of project led the irrigation officials to scrap the MI proposal; since adoption of MI structures at such advanced stages would led to significant cost escalations (as reported in Sri Rameswara LIS, Bhima and Karanja projects in Karnataka) thus exceeding the prescribed cost norms under the scheme guidelines o Creation of MI structures encapsulates construction of small diggies/ sumps/ tanks which occupy land; thus, cultivators with small land holding are unwilling to adopt such techniques o Unless the cultivators procure drips and sprinklers (via government assistance/ under subsidies provided by the extant Per Drop More Crop scheme of MoA&FW), the sumps/ pumps remain un-utilized which further de-motivates them o Cultivators are un-willing to commit the initial capex cost and the recurring cost (for electricity, etc.) (as reported in Bihar, Madhya Pradesh and Maharashtra) o Non-availability of canal water in other seasons (say summer and Rabi) dissuades the farmer to adopt such expensive mechanisms (as reported in Bihar and Madhya Pradesh). E.g. in Durgawati project in Bihar, it was reported that farmers are unwilling to adopt any water-efficient technologies during Kharif season when adequate rain and canal water are available; again in the absence of any water sources during Rabi season and with no prospect for cultivation, farmers are apprehensive of investing in any new farming technologies. Thus, it was suggested that access to alternate water sources

Parameter	Findings from research
	in off/ dry/ Rabi seasons may persuade the farmers to explore adoption of such technologies. o In places with sandy and loamy soil, there are instances of MI structures getting choked, which further dissuaded the cultivators (as reported in Gang canal in Rajasthan) o Lack of awareness among the irrigation officials regarding micro-irrigation techniques, which is further complicated by staff shortage at field offices thus leading to low priority to execution of such components o Non-receipt of funds under such component (as reported in Assam) • The convergence with other schemes like MGNREGA was found to be minimal. Almost all states attributed the low convergence with MGNREGA to the extant 40:60 material-labour shares in MGNREGA which precludes taking up CADWM works as CAD works require around 70-80% material component. Also, it is reported that CADWM works require skilled manpower which are generally provided by the contractors engaged, which thus obviates the need to seek services under MGNREGA which generally offers services of un-skilled labourers. • Except micro-irrigation component, more or less holistic implementation of all components of structural interventions have been observed, with some scope for improvement in some of the components like 'reclamation of water-logged areas." Type of activities undertaken (along with percentages of cultivators confirming the same in their fields) as reported during primary survey with 225 cultivators in Assam, Karnataka, Manipur, Maharashtra and Rajasthan are stated below: o Construction of field channels – 40% o Construction of intermediate and link drains – 33%

Parameter	Findings from research
	○ Reclamation of water-logged areas/ drainage – 16% (note a relatively lower progress percentage may be attributed to the fact that water-logging being not significant in some projects, this component has not been kept in the proposals submitted by the states as they don't face any such issues). However, there is a scope of further improving the implementation of the water-logging initiatives and revisiting the proposals (where this component has not been initially considered), considering that during the household interviews with 225 cultivators in five states, around 40% of the respondents still complained about water-logging issues in their fields.Land levelling and shaping – 15% ○ Re-alignment of field boundaries/ consolidation of holdings – 6%. Among the evaluated states, Karnataka reported substantial progress under this component with a number of initiatives being undertaken in relation to reclamation of land facing surface and sub-surface damages. ○ Correction of system deficiencies – 7% (lower percentage may be attributed to the recent establishment of hydraulic connections) • Non-structural interventions: Though WUA formation and handing over assets are still going on in many of the projects, yet even in projects where substantial number of WUAs have been registered, actual functioning of the WUAs are noted to be limited barring some exceptions in the states like Karnataka, Maharashtra and Madhya Pradesh (notably, in these later two states, many of the projects have successful history of functional WUAs prior to inception of PMKSY schemes). This is in line with the apprehensions expressed by many of the previous studies regarding non-functional or 'paper WUAs'. Some of the contributing issues are listed below:

Parameter	Findings from research
	○ Owing to non-completion of CAD works, WUA's involvement remained mostly mutant (as reported in Borolia and Champamati projects in Assam) ○ Poor competency level of cultivators coupled with lack of training have rendered most of the WUA non-effective. This is further complicated by lack of any other financial incentives along with lack of motivation in areas with adequate access to canal water (as reported in Bhima and Karanja projects in Karnataka) ○ Non-delegation of any financial powers (say collection of fees) to the WUAs (as reported in Durgawati project Bihar). At present, the onus of fees collection still lies with the irrigation/ revenue officials in most of the evaluated projects (viz irrigation officials in Dhansiri project in Assam, Durgawati project in Bihar, Bariyarpur and Singpur projects in Madhya Pradesh, Bawanthadi project in Maharashtra, revenue officials in Bhima and Karanja projects in Karnataka, etc.). ○ Non-transfer of infrastructure and/ or functional grants (as reported in Durgawati project in Bihar) ○ Lack of local leadership (as reported in Tarali and Dhom Balkaawadi projects in Maharashtra); often competent local organizations are disinterested to participate owing to low financial returns. It may be noted that during KIIs, various stakeholders stressed the importance of local level leadership for ensuring success of the WUAs. Such observations are also validated by secondary findings – notable examples are the prominent role taken by Bapu Upadhye and Bharat Khawale and their NGO 'Samaj Pragati Kendra' along with senior researchers of SOPPEKOM in setting up Ozhar WUAs in Nashik; initiatives taken by Aga Khan Rural Support Program and Development Support Centre to catalyse WUAs in Gujarat

Parameter	Findings from research
	(Tushar Shah, IWMI, "Past, Present and the Future of Canal Irrigation in India"). o Non-willingness of cultivators to take over the maintenance of the assets (as reported in Manipur) o Non-willing of cultivators to take ownership of the assets owing to unreliability of water supply at the outlets (as reported in Maharashtra). Also, during household interviews with 225 cultivators in Assam (Champamati major irrigation project), Karnataka (Sri Rameswara irrigation project), Manipur (Dolaithabi barrage), Maharashtra (Dhom Balkaawadi project) and Rajasthan (Gang canal), around 56% of the cultivators confirmed non-availability of adequate water at the supply outlets throughout the year (barring Sri Rameswara project where the figure is 2%, other projects recorded more than 65%) o Other issues include lack of involvement of the agriculture department. E.g. in some states like Maharashtra, the agricultural department was reported to be unaware of even presence of WUAs in some of the projects. Significant scope lies in involving the WUAs in other agriculture schemes, ensuring timely receipt of fertilizers, seeds and subsidy for farm machineries. • During household interviews with 225 cultivators in Assam (Champamati major irrigation project), Karnataka (Sri Rameswara irrigation project), Manipur (Dolaithabi barrage), Maharashtra (Dhom Balkaawadi project) and Rajasthan (Gang canal), only 25% respondents confirmed existence of WUAs in the command areas This is particularly concerning considering that as per CADWM MIS dashboard, some of the above-mentioned projects reported existence of a substantial number of WUAs – 25 WUAs in

Parameter	Findings from research
	Champamati (Assam), 19 in Sri Rameswara (Karnataka), 54[114] in Dhom Balkaawadi (Maharashtra) and 36 in Gang canal (mod of Gang Canal); • Some of the states (like Bihar, Karnataka and Madhya Pradesh) confirmed regular trainings of cultivators, yet the awareness of 'social facilitator' as a concept was found to be extremely poor among all the state implementing agencies. Though some projects like Dhom Balkaawadi in Maharashtra confirmed presence of specialized agencies like Suprabha Pratishtan, Pune and G.P. Gahanekar, Pune, yet the fact that none of the sampled cultivators in the command area confirmed receiving any training, raise question on the actual performance of the social facilitators. Also, states like Assam cited non-receipt of adequate funds (as on date) for conducting trainings. During household interviews with 225 cultivators in Assam (Champamati major irrigation project), Karnataka (Sri Rameswara irrigation project), Manipur (Dolaithabi barrage), Maharashtra (Dhom Balkaawadi project) and Rajasthan (Gang canal), only 10% of the respondents confirmed attending any trainings in last three years with Karnataka alone contributing to 70% of the total trainings held. Topics of the training included mainly water management, crop management and maintenance of irrigation systems. It is concerning to note that majority of the trainings were conducted by the irrigation officials themselves, with only a few being undertaken by specialized agencies/ WALMIs/ regional agricultural institutes. Also, around 48% of the trainees reported receiving training more than 2 years ago and around 70% of the trainees confirmed attending less than 2 trainings in last 3 years. This points to the imminent need to have a structured institutional setup for conducting trainings to ensure both quality and periodicity of the trainings.

[114] As reported by state project authorities

Parameter	Findings from research
	• Barring some exceptions (like Durgawati project in Bihar), almost all informants across states pointed to staff crunch as the major contributor to delay in execution (since no land acquisition is done under this scheme, one-to-one relationship with the cultivators need to be established to get consent for construction of water courses in their field), deficiency in water management (particularly in tail ends) and poor billing and collection efficiencies. During KIIs, staff shortages were reported in the following projects by the implementing departments: o Dhansiri (Assam): shortage of field staff o WALMI (Bihar): current strength is only 20% of that of the sanctioned staff o Bhima, Karanja, Upper Tunga (Karnataka): shortage of staff reported to affect land reclamation survey works, co-ordination with water user co-operatives o Bansagar (Madhya Pradesh): current strength is only 25% of that of the sanctioned staff, staff shortage affecting patrolling o Tarali and Dhom Balkaawadi (Maharashtra): staff shortages hampering water management and revenue assessment and fees collection, current strength reported to be only 25% of that of the sanctioned staff in Tarali o Upper Penganga (Maharashtra): current strength is only 20% of that of the sanctioned staff o Nandur Madhmeshwar (Maharashtra): current strength is only 40% of that of the sanctioned staff o Lower Panzara: staff shortages affecting measurement of water discharges, revenue collection and billing o Thoubal and Dolaithabi: staff shortages affecting execution of CADWM works

Parameter	Findings from research
	○ Gang canal (Rajasthan); vacancy reported for all assistant and junior engineer posts; shortage of drivers and vehicles also reported • Though all the informants confirmed that completion of CADWM works resulted in greater access to canal water particularly in tail end areas, however the true potential benefits of the scheme get somewhat offset by poor irrigation practices like flood irrigation and shift toward water-intensive crops in the head reaches of the canals, details for a few of the projects are summarized below: ○ Shift towards water intensive crops like sugarcane and paddy in the upper reaches of the projects like (Bhima, Karanja and Upper Tunga projects in Karnataka) though most of these projects are being designed for semi-dry crops ○ Diversion of water for drinking water purposes in Upper Tunga project in Karnataka ○ Shortages due to water sharing with other states, e.g. water from Karanja project in Karnataka is shared with Maharashtra and Andhra Pradesh, ○ Obstruction of water flow by head reaches farmers as reported in Bariyarpur and Singpur projects in Madhya Pradesh ○ System deficiencies and inadequate maintenance as reported in Dhansiri project in Assam **Monitoring and evaluation** • During interactions with informants, it is understood currently there is no defined/ standard guidelines for tracking of IPU. Stakeholders calculate physical progress based on coverage of field channels/ structural interventions, which is then aggregated at project levels.
	Inference: **Scheme design**

Parameter	Findings from research
	• Many of the states have made considerable progress in terms of WUA creation, however there is an unmet need for proper hand-holding of the WUAs. Particularly notable is the absence of any dedicated social facilitator in most of the states (reasons being lack of awareness, want of funds, etc.) **Scheme implementation** • The scheme has made considerable progress in spite of various delays (not directly attributable to the implementing agencies) like non-establishment of hydraulic connectivity to outlets, delay in release of state grants and contractor issues. However, at the current progress rate (with achievement of only 31% of structural interventions target as on June 2020), the desired CCA coverage would take several years to be achieved. There is a scope to expedite the execution rate by addressing the administrative issues through timely transfer of funds to implementing agencies and deployment of adequate staff and resources. • Also, it may be noted that progress under components like micro-irrigation has been extremely poor across all states even after 3-4 years of scheme inception. • Apart from the MI component and 'reclamation of water logged areas' components, more or less a holistic implementation of other structural interventions has been observed. • There is a considerable scope for improvement in the non-structural interventions like ensuring proper functioning of the WUAs through proper delegation of powers and capacity building initiatives, which are critical for the success and sustainability of the scheme. **Monitoring and evaluation** • As advocated by various past studies, correct assessment of IPC and IPU forms an integral part of measuring the impact of the scheme. Simply, aggregation of physical coverage under field works may not

Parameter	Findings from research
	truly reflect the actual IPC and IPU figures which are dependent on various factors like resource availability, wear and tear of the structures, maintenance, cropping pattern, climatic conditions, etc. • Online update of both physical and financial progresses in the MIS dashboard is a significant positive step by the Ministry in ensuring accountability and transparency. However there is a significant scope to improve the MIS further through tracking of all the outcome indicators mentioned in the Output-Outcome Framework and also ensuring regular update of the implementation progresses (particularly non-structural interventions). Thus, the performance of the scheme in terms of effectiveness is termed as 'average'.
Efficiency	**Secondary:** **Cost** • The total targeted expenditure for CADWM works in 45.08 lakh ha CCA is Rs. 18,736 Cr. out of which Rs. 5,064 Cr. (27%) has been incurred as on June 2020. Of this the targeted CA is Rs. 8,301 Cr. out of which Rs. 2,653 Cr. (32%) has been disbursed as on June 2020[115]. • As per cost norms in the CADWM guidelines, the total cost for structural components is capped at Rs. 35,000 per ha., while that for non-structural interventions is Rs. 5,000 per ha. Also, for calculation of CA, the guideline has set the ceiling cost for lined channel as Rs. 25,050 per ha. • In context of lowering costs and better contractor management, the 1st PIRC meeting (2017) suggested to go for large contract packages (with prior consultation with cultivators) to avoid issues related to execution limitations of WUAs like attracting large contractors in

[115] Date shared by PMKSY-HKKP, DoWR,RD&GR

Parameter	Findings from research
	WUA's elected bodies, slow progress in case of small packages, lack of competitive pricing and absence of mechanization and inferior quality to that offered by large contractors. **Benefit** • The benefits of the implementation of CAD works have been well-documented by various past studies, some of which are: o Improvement in field conveyance efficiency due to construction and lining of water courses ensured access to water at tail ends of the command area (particularly during the drought seasons) o Establishment of WUAs and water regulation has led to better water management among the cultivators o Around 10% to 15% improvement in utilization of irrigation potential owing to CAD works o All the above have ultimately contributed to increase in agricultural productivity and subsequent income level of the famers
	Primary: **Cost** • Inadequate cost norms: the current cost norms (Rs. 25,050 for construction of lined field channels, laying of underground pipelines, etc. and Rs. 35,000/ ha overall for structural interventions) specified in the CADWM guidelines were termed inadequate by the key stakeholders in Assam, Bihar, Maharashtra, Manipur and Karnataka in light of the escalation of market rates in the last 3-4 years and higher schedule of rates in some states compared to others. One of the fallouts of this constrained budget has been restriction of lining/ concretization of field channels to limited portions of water courses (say 30% of the total length), which becomes particularly concerning in the wake of limited durability of 'kutcha' field channels. Informants

Parameter	Findings from research
	in states like Bihar, Madhya Pradesh, Maharashtra and Manipur pointed to the high propensity of 'kutcha' channels of getting easily damaged owing to movement of tractors and heavy machineries or flattened by the cultivators during dry seasons or easily dilapidated due to poor maintenance. However, in some projects in Madhya Pradesh and Rajasthan (particularly older ones), where old water courses are already existing, substantial portion of the water courses have been concretized and both the stakeholders and beneficiaries from these command areas also vouched for the high durability of such 'pucca' channels. • In the context of adoption of cost reduction initiatives, use of cheaper alternatives plastic pipes in place of lined field channels was termed unadvisable by some of the stakeholders considering the low durability of such alternatives. • The informants across states expressed mixed opinions regarding award of projects to large contractors (through clusters) in place of small contractors. Clustering a number of small projects into a large one and awarding to one large contractor are expected to result in lower costs (achieved through economics of scale and higher mechanization) and greater negotiation power for dealing with the recalcitrant land owners (cultivators). However, blanket adoption of such an approach suffers from the following pitfalls: o The large contractors generally outsource their scope of work to a number of small contractors who have low accountability; sometimes these small contractors do not have adequate capacities to execute the works o Local small contractors have closer relations with the cultivators and are thus more accountable; also in cases of recalcitrant cultivators (unwilling to part with their land), local

Parameter	Findings from research
	contractors leverage their personal relationships to resolve the same **Benefit** • The positive impact to farmers owing to construction of 'pucca' water channels like improvement in water efficiency, extension in command reach has been validated by all the key stakeholders. Particularly noticeable is that in some areas of Assam, Madhya Pradesh, Maharashtra and Rajasthan, the cultivators themselves have come forward for construction of water courses after seeing the benefits in adjacent command areas. • Some of the reported benefits by the informants are listed below: o Durgawati project in Bihar and Upper Tunga Project in Karnataka: horticulture crops and vegetables sown along with traditional crops like paddy and wheat, increase in groundwater level resulting greater access to drinking water through tube wells, increase in livestock feeding o Bhima and Karanja projects in Karnataka: increase in crop yields by 35% to 40%, tail end farmers sowing crops for 2 seasons (initially it used to be single season), growth in agricultural jobs o Tarali and Dhom Balkaawadi projects in Maharashtra: considerable increase in IPU, shift from sustenance crops to commercial crops, increase in agricultural jobs coupled with decrease in migration, increase in dairy activities due to availability of green fodder o Nandur Madhmeshwar project in Maharashtra: shift from rain-fed crops like jowar, bajra and cotton to cash crops like sugarcane along with vegetable and other horticulture crops, CAD works obviated the requirement for lifting of canal water (and hence the associated electricity/ diesel cost), increase in

Parameter	Findings from research
	groundwater level ensured well recharging and adequate drinking water provisions • During household interviews with 225 cultivators in Assam (Champamati major irrigation project), Karnataka (Sri Rameswara irrigation project), Manipur (Dolaithabi barrage), Maharashtra (Dhom Balkaawadi project) and Rajasthan (Gang canal), around 45% of the cultivators confirmed increase in irrigated area, while 60% confirmed increase in crop yield while 14% validated increase in water efficiency post completion of CADWM works. Also, around 45% of the respondents confirmed increase in groundwater level (with around 78% and 47% respondents in water scarce states like Karnataka and Rajasthan respectively confirming such increase).
	Inference: • Revision of the existing cost norms as suggested by many states need to be further explored in view of the cost escalations in the last 3-4 years and higher schedule of rates in some of the states. • As expected and documented by the primary and secondary research, the implementation of CADWM works have immensely benefited most of the cultivators in terms of agricultural benefits and other livelihood opportunities. Thus, the performance of the scheme in terms of efficiency is termed as 'satisfactory'.
Sustainability	**Secondary:** • As per the CADWM guidelines, all the assets created below outlets are not accounted as government assets (the assets are created on cultivators' land) and thus the routine maintenance of such assets shall be the onus of the cultivators/ WUAs; for which the WUAs may collect fees from the individual collectors. Central/ state government grants for such purposes are not desired. • Various studies have pointed out to the existing low fees collection efficiencies in most of the states. As highlighted in the article by Dr

Parameter	Findings from research
	Mihir Shah (2013), "Water: Towards a Paradigm Shift in the Twelfth Plan" the current Irrigation Service Fee (ISF) collection is as low as 2-8% of the dues. Regarding fees collection, the IWMI working paper "Malik, R. P. S.; Prathapar, S. A.; Marwah, M. (2014), Revitalizing canal irrigation: towards improving cost recovery, Colombo, Sri Lanka: International Water Management Institute (IWMI)" put forward and validated the following hypothesis: "cost recovery is likely to be much higher in areas where WUAs manage the affairs of water allocations, setting of water tariffs, collection of bills and maintenance of local supply infrastructure in comparison to those projects/areas where these roles are being performed by other institutions such as Irrigation Departments". **Case Study: Capacity building and handholding by specialized agencies resulting in high cost recovery (Paliganj Viratni Krishak Samiti, Bihar)** Key features: • **Handholding in initial stages**: Continuous dialogues with cultivators in the command area of Paliganj distributary and subsequent hand-holding in the initial few months by specialized organizations like WALMI, supported by USAID team, led to the formation of Paliganj Distributary Famers Committee and Village Level Committees • **Delegation of power**: Decisions regarding water distribution, agricultural activities (like choice of crops) and collection of fees delegated to the committees • **Increase in recovery:** The above two features resulted in substantial improvement in canal condition, conveyance efficiency, water availability at canal ends while collection efficiency improved to 30%- 50%. This is further helped

Parameter	Findings from research
	by the PIM act in Bihar which allows sharing 70% of the collected fees with the WUAs. In case of additional monetary requirements, farmers pay through additional payment or labour contribution ("*Shramadan*"). **Case Study: Ensuring proper maintenance through non-monetary contributions (Khairani WUA—Jopadong Pagladia No. 2 Group Bund Dong Committee, Baksa, Assam)** Key features: • The WUA's working rules have no provision for monetary collection of water taxes. All the taxes are collected in the form of labour and activities undertaken by WUA. Participation and contribution of labour for WUA's activities are mandatory for each member failing which stiff monetary penalties ('kuruk') are imposed. Also, fines are imposed in case of withdrawal more water compared to the allotted one. The penalty fees form an important source for conducting repair and maintenance organization. Also, the WUA, which was initially working a voluntary organization of farmers, got officially registered to avail the government grants which compliments the penalty fees in financing R&M works. *(reference: Vasant P. Gandhi et al., November 2019, Institutional Structure, Participation, and Devolution in Water Institutions of Eastern India)* **Case Study: Fess collection based on time-based assessment (Ozhar Water User Societies, Nashik, Maharashtra (command area of Waghad medium irrigation project)** Key feature:

Parameter	Findings from research
	• Instead of internal assessment of water charges based on area and crop, time based charging was adopted as a better metric of the actual volume of water consumed. Individual cultivators are charged based on the time duration of water receipt. This mechanism simplified the assessment of water charges and ensured greater transparency to the farmers. *(reference: Subhas Paranjape et al., SOPPECOM, "The Ozhar Water User Societies: Impact of Society Formation)* • As per the MOM of 1st PIRC meeting (2017), rampant variations in crop pattern, contrary to that envisaged at planning stage, undermines the equitable distribution of water. Proposed awareness programmes, empowerment of WUAs and control of water at government outlets are mitigating measures in this respect.
	Primary: • Financial factors: Adequate maintenance of the water courses along with minor distributaries in the absence of government grants is the biggest challenge to the upkeep of the assets created under this scheme, considering the current trend of fees collection. o Collection of irrigation fees (/ cess) by states is found to be either inadequate or absent in most of states except a few – Maharashtra, Rajasthan (NCP – collection efficiency is around 70% to 80%),and few other states. The poor cost of recovery may be broadly attributed to the following factors: ▪ Unwillingness to pay owing to non-reliability of water supply ▪ Lack of motivation to pay due to absence of any sharing mechanism for the collected fees with the WUAs as reported in Assam (however some states like Bihar, Maharashtra and Karnataka have put in

Parameter	Findings from research
	place mechanisms where a substantial portion of the collected fees are shared with the WUAs) ▪ Poor economic position of the small and marginal cultivators ▪ Absence of dedicated irrigation staff for fees collection o Some of stakeholders (in Assam, Andhra Pradesh, Manipur, Maharashtra and Karnataka) however opined that with establishment of sufficient hydraulic connectivity to outlets and establishment of WUAs (of which the farmers themselves shall be members), the fees collection/ willingness of farmers to bear at least the O&M costs may increase. However, in many of the existing (/old) projects or projects in advanced stages i.e. projects where hydraulic connectivity to the field has already been established, collection of O&M fees may become a challenge without sufficient legal provisions and capacity building/ awareness of the cultivators. For. e.g. in states like Assam, Manipur and Uttar Pradesh with adequate rainfall/ access to water sources, the paddy cultivators have been practicing flood irrigation for decades; convincing the cultivators to resort to volumetric supply and fees payment is expected to be challenging without adequate legal provisions/ capacity building programmes and involvement of the WUAs. This is corroborated by the IWMI working paper "Malik, R. P. S.; Prathapar, S. A.; Marwah, M. 2014. Revitalizing canal irrigation: towards improving cost recovery. Colombo, Sri Lanka: International Water Management Institute (IWMI)" which validated the following hypothesis: "The collection of water charges is likely to be greater in projects/regions which are dependent exclusively on availability of canal water in comparison to areas where

Parameter	Findings from research
	farmers have access to both surface water and groundwater". Such a trend was also observed (though it would be premature to draw any conclusion at this stage considering the limitation of the survey to five states) during primary survey with 225 cultivators in five states viz Assam, Karnataka, Manipur, Maharashtra and Rajasthan, where it was found that fees payment is quite high (60%) in Rajasthan (n=43) where the cultivators are primarily dependant on canal water for irrigation (77% dependent on canal water, 9% on rain water and only 2% on groundwater) compared to Karnataka (n=55) where fees payment is quite low (5%) and cultivators are almost equally dependent on canal water (40%) and groundwater (36%). Similarly, Assam (n=31) with low fees payment (26%) has equal dependence on canal water (48%) and rain water (45%). ○ During household interviews with 225 cultivators in Assam (Champamati major irrigation project), Karnataka (Sri Rameswara irrigation project), Manipur (Dolaithabi barrage), Maharashtra (Dhom Balkaawadi project) and Rajasthan (Gang canal), only 26% confirmed any payment of fees/ water taxes with the figure as low as 5% in Karnataka (n=55). Another interesting observation is the significant difference in propensity to pay fees between the head and tail end cultivators – e.g. while only 24% of the tail reach cultivators (n=17) in Gang canal (Rajasthan) confirmed fees payment, the same figure stands at 85% for head reach cultivators (n=17. Such disparity in payments between tail and head reaches farmers have also been highlighted during interactions with stakeholders in other projects like Upper Tunga in Karnataka, where it was reported that tail reaches farmers are unwilling to pay water owing to unreliable water supply. This is in line

Parameter	Findings from research
	with the findings put forth by various studies that water fees payment is directly related to water service availability; areas which have better water access and where irrigation staff show better accountability, generally recorded higher fees collection. It may be noted here that the IWMI working paper (2014) has also put forth another hypothesis that "the cost recovery is also influenced positively by the status of maintenance of irrigation infrastructure". This is also validated during the primary survey where around 60% of the 225 respondents confirmed that they are willing to pay fees (/ additional fees) provided reliable water supply is assured. o Also, with proper capacity building programmes, increasing involvement of the WUAs, completion of the structural intervention works and gradual trickling of the benefits (achieved through better access to water and higher conveyance efficiency) to the individual cultivators, the sense of ownership among them is expected to increase, as also highlighted in various projects like Sri Rameswara LIS in Karnataka, Waghad, Nashik (non-AIBP project) in Maharashtra where initial reluctance of the farmers gradually gave way to co-operation as the benefits started being realized. • Social factors: With increased access to assured irrigation (under AIBP) many cultivators in the upper reaches of the canal in some states (like Andhra Pradesh, Karnataka) have been shifting to water-intensive crops like paddy and sugarcane. With many of these irrigation systems being designed for dry or semi-dry crops like maize, chilli, etc, water availability at the branch canals and minors particularly in the tail ends may pose to be a serious challenge. This is also validated during primary household interviews conducted in five states in Assam, Karnataka, Manipur, Maharashtra and Rajasthan, where around 71% of the 73 beneficiary cultivators

Parameter	Findings from research
	responded that they are planning to shift towards crops like paddy and sugarcane with increase in assured water supply. • Other factors: As highlighted in the above section under 'Efficiency', the current cap on cost norms have restricted lining/ concretization to certain sections of the water courses, which exposes the un-lined/ 'kuccha' part to various climatic vagaries – many of the stakeholders (from Bihar, Maharashtra and Manipur) confirmed the vulnerability of the 'kuchha' channels during rainy season run-off or during droughts when cultivators demolish these temporary redundant structures. However, places where lining of substantial portion of water courses has been done, the stakeholder (both the implementing agencies and WUAs) vouched for the high durability of the 'pucca' structures.
	Inference: • Proper maintenance and up-keep of the assets (like field channels) in absence of any government grant may pose to be a challenge in the future. However with gradual involvement of the WUAs and increasing realization of the benefits of the scheme, a sense of ownership is expected to prevail among the cultivators. • Increase in ownership and adoption of transparent fees assessment is expected to result in increasing cost recovery. However, collection of fees may still be a challenge in water abundant states like Assam, Manipur and Uttar Pradesh, where adequate access to other water sources are available. • Social factors (in spite of efforts to implement better water management practices through CADWM) like poor irrigation practices and increasing shift towards water-intensive crops like wheat, sugarcane (propelled by skewed government policies, market dynamics, infrastructure gaps, food habits, etc.) may lead to higher incidences of water unavailability at tail ends. With fading of the benefits, it would be a challenge to keep the farmers motivated to maintain and upkeep the field channels and other assets.

Parameter	Findings from research
	• The durability of the 'kutcha' channels is undermined by their vulnerabilities during rainy season run-offs and droughts. Thus, the performance of the scheme in terms of sustainability is termed as 'average'.
Impact	**Secondary:** • Improvement in agricultural outputs has resulted in significant improvement in socio-economic conditions of the farming communities including literacy rate, health and sanitation conditions.
	Primary: • The increase in socio-economic conditions of the farming communities have also been validated by all the informants. However, many pointed to the further scope for improvement in terms of awareness generation among farmers in terms of crop planning and capacity building in relation to water management and maintenance of irrigation structures. • During household interviews with 225 cultivators in Assam (Champamati major irrigation project), Karnataka (Sri Rameswara irrigation project), Manipur (Dolaithabi barrage), Maharashtra (Dhom Balkaawadi project) and Rajasthan (Gang canal), percentages of cultivators confirming various benefits owing to implementation of CAD activities are listed below: o increase in household income – 45% o increase in education – 49% o increase in overall health conditions – 41% o new employment opportunities in the village – 43% o decrease in migration to other places for livelihood options – 24%
	Inference: • Implementation of CADWM works has increased the socio-economic conditions of the farming communities in the command areas in

Parameter	Findings from research
	terms of overall household income, education, health standards and employment opportunities. Thus, the performance of the scheme in terms of impact is termed as satisfactory.
Equity	**Secondary:** • CADWM works are being implemented pari-passu in the command area of the 99 Priority AIBP projects, out which 59 projects in 11 states cater to the drought-prone areas. • One of the main objectives of the CADWM scheme has been equitable distribution of water (among cultivators across head and tail reaches) through proper water management • A recent survey by Vidarbha Irrigation Development Corporation (January 2019) at command area of Gosikhurd National Project (one of the 99 AIBP projects) in Maharashtra mentioned that in spite of the appreciable increase in command area and crop yield, the disparities between the head and tail end farmers in terms of apportion of the benefits still remain. The validity of such statement in relation to PMKSY-CADWM projects is tested below under 'Primary' observations.
	Primary: • The completion of AIBP projects and CADWM works in many drought prone and remote tribal areas facilitated in providing assured irrigation to the communities resulting in significant socio-economic benefits. • The projects have significantly benefitted the small and marginal farmers. E.g. 50% of the farmers catered by the Champamati major irrigation project in Assam have small land holding (1 to 2 ha) while 33% of them have marginal land holdings. • During KIIs, the stakeholder also confirmed that significant benefits accrued to the tail end farmers owing to the CADWM scheme. During primary survey among 55 cultivators in Karnataka (Sri Rameswara

<table>
<tr><th>Parameter</th><th>Findings from research</th></tr>
<tr><td></td><td>irrigation project), no major disparities were noted between the head and tail reaches cultivators in terms of water availability at the supply outlets.
Also, as demonstrated below for Sri Rameswara project (Karnataka), no significant differences have been observed in terms of benefit accrual to head and tail end cultivators:
N = 23 (head reach) and 32 (tail reach), Sri Rameswara project (district: Belgaum, Karnataka)
<table>
<tr><th></th><th>Head</th><th>Tail</th></tr>
<tr><td>Increase in water efficiency</td><td>22%</td><td>22%</td></tr>
<tr><td>Increase in crop yield</td><td>87%</td><td>81%</td></tr>
<tr><td>Increase in irrigated land</td><td>78%</td><td>78%</td></tr>
<tr><td>Increase in crop intensity</td><td>43%</td><td>41%</td></tr>
</table>

However, during focus group discussions with cultivators in command area of Dhom Balkaawadi project (Wakhari village, Satara district, Maharashtra), delay in receipt of water along with its inadequacy in tail reach villages (particularly in summer months when wells also dry up) is reported; unabated withdrawal of water in upper reaches and seepages in dams and canals were attributed to causing such shortages.
</td></tr>
<tr><td></td><td>Inference:

The implementation of CADWM works in the command areas of PMKSY-AIBP projects have significantly improved the access to assured irrigation to many small and marginal cultivators (particularly in desert and drought prone areas). Also, significant benefits accrued to the tail end cultivators in terms of water availability and agricultural benefits, barring some exceptions as reported.

Thus, the performance of the scheme in terms of equity is termed as satisfactory.</td></tr>
</table>

Table 35: CADWM – summary of performance evaluation using REESIE framework

Parameter	Performance
Relevance	🟢
Effectiveness	🟡
Efficiency	🟢
Sustainability	🟡
Impact	🟢
Equity	🟢

REESI+E performance infographics legend

🟢 Satisfactory 🟡 Average 🔴 Needs Improvement ⚪ No information

Performance on cross-sectional themes

Table 36: CADWM – performance evaluation using cross-sectional themes

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
1.	Accountability & Transparency	Availability of Data Records and Reports in public domain • What data records are available for the scheme in public domain?	• The physical and financial progress of both the structural and non-structural interventions for each project are updated by the respective states in the national MIS dashboard. However, some discrepancies were observed in terms of MIS updates for non-structural interventions which have been highlighted in detail

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			in a later section "Issues and Challenges". • The PIRC conducts half-yearly review of the projects, details of which are released publicly.
		Monitoring Mechanisms • Does a robust monitoring mechanism exist and at what level?	• For structural interventions, the regional CWC offices monitor the progress, while at the national level it is monitored and reviewed by the PIRC half-yearly. • For the non-structural interventions, an agency empanelled by the MoJS shall monitor the performance of the Social Facilitator, while at the national level it is monitored and reviewed by the PIRC half-yearly. However, during primary survey, existence of 'social facilitators' was found to be limited. Also, no such evaluation mechanism by empanelled agencies was observed to be operative.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		Evaluation Mechanisms • What process / impact evaluation studies conducted in the last decade - frequency, quality, coverage, etc.	• PIRC conducts half-yearly review of the progresses. • The states need to submit concurrent evaluation report by a 3rd party agency; however the quality and independence of such evaluations have not been validated in this study. • Currently, there is a provision under Impact Assessment Studies for evaluation of AIBP (and CADWM) projects; however no such study has been initiated for these 99 priority projects till date
		Financial Accountability • What funding mechanisms are being used?	• The cost norms along with the Centre – State cost sharing ratio has been specified in the scheme guidelines. • The CA is capped at Rs. 35,000/ ha for structural interventions and Rs. 5,000/ ha for the non-structural norms.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			• Various states however raised questions regarding the adequacy of the cost norms (as on date) which were set in 2016-17 and not revised hence after.
		Beneficiary involvement • What is the involvement of beneficiaries across the project lifecycle? Is the level of involvement adequate?	• The non-structural component of the scheme entails provisions for creations of WUAs and their proper hand-holding along with organizing trials/ demonstrations through local WALMIs. • The structures are built on the cultivator's land and in subsequent stages the structures are handed over to the cultivators for O&M; thus, involvement of the cultivators at the project planning stage is a critical determinant of the success and sustainability of the scheme. • A considerable progress has been achieved in creation of WUAs,

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			however most of the WUAs are yet to be functional; issues for the same have been discussed in detail under 'Effectiveness' in the above section.
		Community institutions • Are community institutions (e.g. WUAs) truly representative? Do they have adequate powers to take decisions?	• Almost all the states have enacted PIM laws for empowering the WUAs, with the extent of delegation of power varying from states to states. • Delegation of actual power like financial power to collect fees was found to be lacking in some states, as discussed in detail under 'Effectiveness' in the above section. • Also, as discussed in detail under the 'gender mainstreaming' theme, the involvement of women in WUAs and their decision making power in WUA activities

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			were observed to be limited.
Summary Analysis: • The national MIS dashboard is effective in tracking the overall physical and financial progress of the scheme; however some deficiencies like non-regular update, inconsistencies with other databases in relation to non-structural interventions are observed. It may be noted that release of MOMs of half-yearly progress review by PIRC is a significant step towards increasing accountability and transparency. • Though the scheme guidelines entail a robust monitoring mechanism, yet actual implementation of the same, particularly the non-structural interventions, is observed to be inadequate. • A considerable number of WUAs have been registered under the CADWM provision; however the many of them were reported to be non-functional as on date owing to non-delegation of adequate authority to WUAs, inadequate financial resources and lack of technical competency of the members. Also, decision making authority of women on WUA activities was noted to be limited.			
2.	Direct/Indirect Employment Generation	Employment generation • What is the level of employment generation through schemes in the sector and overall sectoral contribution in National employment generation? • What is the improvement in income levels?	• The scheme guidelines do not explicitly provide any estimate for employment generation target. However, one the provisions highlighted the need for convergence with PMKSY (watershed) and MGNREGA, wherever feasible, for activities involving earth works like construction of unlined channels,

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			intermediate and link drains, etc. • During primary survey, it was observed that the implementation of the scheme has resulted in substantial increase in agricultural productivity, increase in income of the farmers, creation of agricultural jobs and decrease in migration; details of which are elaborated under 'Impact' in previous section.
		Institutional barriers • Are there institutional barriers to employment generation (e.g. access to markets)?	• Limited access to market mechanism and absence of other-agro processing industries in the command areas (as reported in some states like Karnataka) are some of the factors leading to shift towards water-intensive crops like paddy by many of the cultivators with increased access to assured irrigation.
Summary Analysis:			

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
• Implementation of the CAD works has significantly benefitted the cultivators in the command area in terms of creation of employment opportunities and decreasing the migration rate, as confirmed during primary survey. • Institutional barriers like absence of local agro-based industries and market for different crops along with poor infrastructure like roads have negatively impacted crop planning and water management in some command areas.			
3.	Climate change & sustainability including adoption of climate-change resilient practices & diversifications	Climate resilience • Are there appropriate climate resilient policies for mitigation and/or adaptation (or included as part of scheme objectives and design)?	• The scheme has no specific guideline for adopting climate resilient practices. However, it is understood that increase in participatory irrigation management and awareness generation through specialized agencies would lead to adoption of sustainable water management practices and cropping pattern.
		Sustainable practices • Is there an effective waste management/end-of-life system in place for resources used in the sector/schemes?	• Currently, the CADWM scheme has no specific provision for waste management. However, it may be noted in a similar recent CSS scheme viz. ISBIG, provisions for wastewater reuse and solar power based micro-

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			irrigation system has been introduced.
		Awareness and capacity building • Are there any training sessions held regularly for reducing pollution, adopting green practices, using local materials etc.?	• As noted earlier, in overall conduct of training and capacity building initiatives, the scheme performance has been poor. • During household interviews with 225 cultivators in Assam, Karnataka, Manipur, Maharashtra and Rajasthan, only 10% of the respondents confirmed attending any trainings in last three years with Karnataka alone contributing to 70% of the total trainings held. Topics of the training included mainly water management, crop management and maintenance of irrigation systems.. Also, it is concerning to note that around 48% of the trainees reported receiving training more

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			than 2 years ago and around 70% of the trainees confirmed attending less than 2 trainings in last 3 years.
		Climate impact • What are the main impacts of climate change on the sector and scheme beneficiaries?	• As reported by many states, the existing prescribed norms limit the extent to which lining of field channels may be done. It may become a serious issue in terms of climate change and unsustainability, as unlined or 'kutcha' portion of water courses are vulnerable to incidences of excess water run-off (as reported during monsoons in Bihar) and also deteriorate quickly after 2-3 seasons of drying and wetting of the fields.
Summary Analysis: • There are no specific provisions in the scheme guidelines in relation to adoption of climate resilient practices. However, some of the scheme provisions in relation to participatory irrigation management, once properly implemented, would contribute to sustainable water management practices.			

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
• Provisions related to wastewater reuse may be incorporated in line with provisions in similar CSS schemes like ISBIG. • Considering that 'kutcha' portion of the water courses are more susceptible to climate change, revisiting the prescribed cost norms is warranted to ensure maximum lining of the field channels.			
4.	Gender mainstreaming	Inclusiveness in scheme design/ planning • Is there a specific mention of gender equality and equity considerations in the scheme guidelines/objectives, i.e. has the scheme been designed keeping gender considerations in mind?	• There is no specified guideline in the scheme for ensuring gender equality. • However, some states have enacted provisions for ensuring increased participation of women in the WUAs. E.g. MMISFA (Maharashtra) mandates quota of 3 women members in the management committees. In Bihar, also the general policy of appointing at least 1 woman in each WUA is followed. Similarly in Karnataka, in some projects, reservation of two seats for women in each WUA has been adopted. The M.P. government has introduced a provision of

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			electing/ nominating at least 1 woman member in the WUA. • However, even in WUAs with women members, the extent of women participation was reported to be limited. During household survey interviews in seven states (under AIBP scheme), in places with WUAs, only 35% of the 46 cultivators confirmed presence of any women members in the WUAs. Also, in most cases, women members' participation was reported to be limited to only attending meetings while a small percentage also participated in trainings. Such findings are also lent credence by various research articles like a primary study in WUAs in Assam and Bihar by Varsha Khander et al.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			(2020)[116] which also observed that barring some few instances of joint-decision making, most of the decisions are taken by men only though in Bihar, presence of women membership was found to be substantial (because of mandatory provisions). The study attributed the following factors as the major deterrents to women participation: the participants in meetings are mainly men and women lack knowledge about water management issues, cultures issues and family tradition prevent women from attending and participating such issues, women more engaged in household tasks. During KII with stakeholders in

[116] Varsha Khander et al. (2020), "Gender Perspective in Water Management: The Involvement of Women in Participatory Water Institutions of Eastern India"

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			Assam, low women membership in WUAs was attributed to gender gap in property rights – since WUA memberships and water rights are allocated to land-holders, women without any formal property rights are thus excluded from such organizations. An IWMI study (2012)[117] in Tamil Nadu found the following factors to be mainly responsible for 'fencing' of women in WUA governance: gender discrimination in land ownership limits women membership in the WUAs, male domination in activities of WUA alienate women's participation, lack of land-ownership by women restricts their membership while inclusion of non-

[117] K.Gulam Dasthagir (2012) "Fencing Women in Water User Associations"

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			cultivating women land-owners leads to only nominal participation of women. • As part of project planning and implementation, the National Water Policy (2012) has urged that "unique needs and aspirations of the Scheduled caste and Scheduled Tribes, women and other weaker sections of the society should be given due consideration". The draft National Policy for Women (2016) also advocated that "unique needs and aspirations of the Scheduled caste and Scheduled Tribes, women and other weaker sections of the society should be given due consideration". However, the PMKSY-CADWM scheme guidelines do not have any gender specific provisions as part of the

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			participatory irrigation management approach.
		Any best practices	Case study 1: Chhattisgarh Irrigation Development Project[118] Some of the key features of the project is mentioned below: • Institutional structure: membership of WUA on household basis so that both men and women (irrespective of who is the land title owner) can participate; WUA management committee to have at least two women member, 33% women membership mandated in all sub-committees and each WUA to have a gender sub-committee • Capacity building: 50% of training slots for WUAs reserved for women; women were also given

[118] Asian Development Bank, Gender Mainstreaming Case Study: Chhattisgarh Irrigation Development Project

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			training on other livelihood options • Others: women to receive equal pay as men Case study 2: Dhom Balkaawadi Project in Maharashtra (one of the 99 Priority AIBP projects)[119] Some of the key features of the project are: • Institutional structure: 33% of total seats of directors of WUAs are reserved for women • Capacity building: Five trainings are conducted before and after formation of each WUA to increase awareness and promote more livelihood opportunities for women Case Study 3: Satak Tank Minor Irrigation Scheme, Madhya Pradesh As detailed in the 'REESIE' section, in Satak, the appointed NGO, Action for

[119] Data shared by relevant state implementing agencies

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			Social Advancement (ASA), adopted the following steps to ensure women participation: • Franchise rights: Voting rights for WUA elections were also extended to the spouses of the landholders and the WUA members, through appropriate amendment in the PIM Act. This was followed by extensive awareness campaigns to sensitize the villagers regarding roles of women and their rights • Women empowerment: Enabling participation in WUA was also supplemented by facilitating the women volunteers to establish self-help groups
Summary Analysis: • There are no specific gender specific provisions in the scheme guidelines. However, some projects have taken individual steps to ensure participation of women and promotion of livelihood opportunities. • Though many of the states like M.P and Bihar introduced provisions for electing women in the WUAs, yet their participation in WUA governance remain mostly nominal without any			

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
	significant decision making power, as reported during primary survey and by several studies.		
5.	Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population	Inclusion of vulnerable groups in scheme as well as sector • What are the interventions implemented for specific vulnerable groups?	• CADWM works are being implemented pari-passu in the command area of the 99 Priority AIBP projects, out which many of the projects cater to tribal hinterlands • The scheme guidelines do not have specific provisions for TSP/ SCSP. However, in some projects in Karnataka like NLBC and Sri Rameswara, the state project authorities have earmarked certain portion of funds for TSP/ SCSP for providing bore wells / tubewells to SC/ ST population in the command area to facilitate conjunctive use of groundwater.
Summary Analysis: • The scheme guidelines do not have specific provisions for TSP/ SCSP. However, some states like Karnataka have taken initiatives to earmark certain portion of funds for TSP/SCSP. Such provisions may be incorporated in the scheme guidelines to further			

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
	strengthen the social equity aspects; though it is understood that most of the PMKSY-AIBP and CADWM projects cater to the tribal belts and drought prone areas.		
6.	Use of IT/Technology in driving efficiency	Deployment of IT enabled mechanisms for monitoring of the Schemes • In case of a scheme to create physical assets, is geotagging and use of geotagged photographs being done? • How is technology being used for on-ground data collection?	• The CAD guidelines suggest inclusion of geo-tagging of outlets in the DPR. • Geo-tagging of outlets and update in MIS would not only facilitate the irrigation department in monitoring of the outlets, but also assist the agriculture department in crop-planning. • State like Maharashtra have developed apps like Prabha for updating dam levels and E-Jal Sewa for updating billing details. Particularly noticeable is an app developed by the Nanded Irrigation Circle (Maharashtra) where irrigation rotation schedules are updated.
		Technology to address key challenges • What technologies are available to address key challenges facing the scheme? Are there constraints in their adoption?	• Considering the limited resources (manpower, vehicles, etc) of the CAD departments and the huge span of the

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			command areas, the use of remote sensing technologies to monitor the physical progress becomes imperative. Use of satellite images (current utility is limited due to low resolution, high cost of procurement and low frequency of image availability) and 3D images using drones may be explored, particularly in relation to monitoring of field channels progress, identification of system deficiencies and water-logged areas. • The recent initiative taken by the Ministry to map crop assessment and project monitoring through BISAG is noteworthy.
		Any best practices	• Use of drones has been successfully demonstrated at various parts in in India like monitoring of construction works in

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			Polavaram project in Andhra Pradesh, generation of contour at the surveying stage for the 99 Priority AIBP projects in Andhra Pradesh. While the project authorities of Narmada Canal Project in Rajasthan have proposed use of satellite images for assessing the crop-production in the command area. Recently, a pilot study has been conducted by the Ministry in command area of Bawanthadi project for drone surveying.

Summary Analysis:

- Use of apps/ technological interventions for real-time data upload and dissemination has been initiated by some states. However, there is considerable scope in identifying more such technologies and replicating across similar projects.
- Adoption of geo-tagging of assets by many of the states has facilitated in smother monitoring of the assets and crop planning.
- In view of the huge spread of the command area and limited resources of the irrigation/ CAD departments, it is imperative to adopt remote sensing technologies like drone/ satellite images to monitor the projects and assess the crop pattern. Recently, the Ministry has

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
	initiated some steps in this regard. Overall, the extent of adoption of remote sensing technologies across states was observed to be in nascent stage.		
7.	Development, dissemination & adoption of innovative practices, technology & know-how	Fund allocation towards promotion of innovation • What percent of total allocation is directed towards development, dissemination and adoption of innovative practices and technology? How much of it is utilized?	• There is no separate fund allocation for promotion of innovative practices. However, certain provisions under non-structural interventions like 'trainings, demonstrations and adaptive trials with respect to water use efficiency, increased productivity and sustainable irrigation' promote such practices. Also, the half-yearly PIRC meetings highlight some of the innovative practices adopted by some states in terms of micro-irrigation, conjunctive water use and lining of water courses.
		Contribution of improved practices in increasing outcomes • What is the impact of innovative technologies and practices on scheme and sectoral outcomes?	• Adoption of pressured piped distribution networks instead of open field channels has resulted in avoiding land acquisition issues,

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			conveyance losses, reduction in operations and maintenance cost. • Successful case studies in China showed 30% savings in water delivered (equivalent to 15% of the total irrigated area) and 25% in labour input using PIN in place of CDN
		Any best practices	• Piped distribution has successfully been implemented in command areas of a number of projects in India like Sardar Sarovar project in Gujarat and Narmada canal project in Rajasthan (both are part of the 99 Priority AIBP projects). • Another successful demonstration of piped distribution network in a non-PMKSY project is Integrated Drip Irrigation project in Ramthal, Karnataka, where water is being conveyed to the individual fields using

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			HDPE/ PVC pipe. Every field outlet is being fitted with an automatic valve operated through a wirelessly controlled RTU (remote terminal unit) to regulate the water flow. The automated system monitors and controls through a series of field sensors and the data is stored in a central server which allows flexible control and data access to multiple users like project engineers, field technicians, and farmers. The farmers are apprised beforehand of on-off schedules, crop alerts and other agronomical services through automated SMS alerts. This integrated project has recorded as high as 90% overall efficiency with water conveyance efficiency at 99% and

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			field application efficiency up to 95%[120].
Summary Analysis: • Though there is no separate fund allocation for dissemination of innovative practices, yet certain provisions under non-structural interventions and half-yearly PIRC review meetings ensure sharing of innovative practices among states mainly in relation to adequate norms for water course linings, adoption of MI practices, conjunctive use of groundwater, etc. • Successful adoption of piped distribution networks in various parts of India like Gujarat, Maharashtra, Rajasthan and Karnataka has led to similar proposals from project authorities of ongoing projects in Assam, Maharashtra and Manipur. However, feasibility of such projects (in the wake of huge initial capex, recurring electricity costs, acceptability among cultivators) needs to be studied more; generally new lift irrigation schemes may be encouraged to adopt such mechanisms (as successfully demonstrated in Ramthal in Karnataka). • Currently, adoption of various innovative technologies like piped distribution network and conjunctive use of groundwater was found to be sporadic across certain states. It is however expected to be successfully replicated across other states, once considerable progress in the scheme implementation is attained.			
8.	Stakeholder and Beneficiary behavioural change	Fund Allocation • What percent of total allocation is directed towards Awareness generation or sensitization? What is the utilization rate? and How much impact has it been able to generate in terms of behaviour change?	• Under the non-structural interventions, there are components for trainings, demonstration, and adaptive trials (including on micro-irrigation, water use efficiency, increased productivity and

[120] Source: Jain Irrigation Systems Ltd., "Resource to Root: Integrated Irrigation Solution"

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			sustainable irrigation) to be conducted through regional WALMIs or agricultural training institutes. The scheme guidelines also mandate construction of mico-irrigation (MI) facilities in 10% CCA. • As mentioned in earlier sections, the adoption of MI facilities was found to be limited – around 3% of the target was achieved. Similarly adoption of suitable cropping pattern and efficient water practices was reported to be limited.
		Mechanisms to promote and ensure behaviour change • What activities are undertaken at District/Block level to promote adoption of good practices?	• Trial and demonstrations are held in the command area by the regional agriculture institutes in many of the states like Karnataka, Madhya Pradesh to promote efficient on-farm water management.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			• The scheme guidelines also manadate engagement of 'social facilitators' / specialized agencies for conducting trainings and hand-holding the WUA members. However the implementation of the same was observed to be limited.
		Challenges faced • What are the major challenges? Are there any areas which needs more attention in terms of bringing behaviour change?	• Societal factors like cultural and food habits, skewed government policies (like free electricity, distorted MSP setting and procurement policy), institutional barriers (like barrier to market access, lack of agro-processing industries), climatic patterns has led many cultivators to shift towards water intensive crops like paddy. • In terms of adoption of MI facilities, the key issues reported were extant traditional flood irrigation

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			practices which are conducive to water intensive crops like paddy and are further facilitated by adequate water availability during Kharif seasons, low awareness among farmers regarding such technologies, unwillingness to incur any capex and opex for the MI equipment (like drips and sprinklers)
		Cropping pattern • What are the key constraints in crop planning based on local water availability with a view to reduce water intensive crops?	• Increased access to surface water (owing to completion of canals) has promoted many farmers even in drought prone areas to shift towards water intensive crops, further supplemented by proliferation of groundwater based structures like tubewells and bore wells (which are supported by the increase in groundwater level in the command area). Such a tendency is also validated during

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			household interviews in five states of Assam, Karnataka, Maharashtra, Manipur and Rajasthan, where 71% of the 73 cultivators confirmed that given increased access to water, they would like to switch to water-intensive crops like paddy and sugarcane.
Summary Analysis: • There is a huge scope for further intensifying the IEC activities, awareness among the farmers through proper implementation of the non-structural components as mandated in the guidelines. • Currently, the performance of the scheme has been found poor in relation to awareness generation and trainings conducted to bring in any noticeable stakeholder and behavioural change. With increased access to assured irrigation, cultivators in many areas have shifted to water-intensive crops like paddy and sugarcane which is further complicated by skewed government policies, societal factors and others. Also, in absence of adequate trainings and other issues, the adoption of micro-irrigation facilities was also found to be limited.			
9.	Conjunctive use of water - surface versus groundwater usage optimizations	What are the main challenges to conjunctive use of ground and surface water?	• The existing scheme guidelines have no provisions for promoting conjunctive use of groundwater. However, the 4th PIRC and subsequent PIRCs encouraged states to adopt conjunctive use of

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			groundwater. However, in absence of any definite guidelines and fund allocation for the same, adoption of such practices has been minimal. • It may be noted here that the recently conceived CSS scheme ISBIG has included certain provisions for implementation of groundwater management activities (through bore wells and tubewells) to ensure assured water supply in lean monsoon periods.
		Any best practice	• In some projects in Karnataka like NLBC and Sri Rameswara, the state implementing authorities have provided bore wells and tubewells under SC/ST sub-plan to facilitate conjunctive use of groundwater. • In Assam, solar powered shallow tubewells have been provided to the

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			farmers using the MI fund, to ensure adequate water access during dry Rabi seasons. • As highlighted earlier in Ozhar case study (non-PMKSY), the WUAs have evolved a mechanism where certain water charges are imposed on the farmers for using well water and a simple assessment mechanism for estimating well water level and charge has been developed. Such practices help to mitigate the issue of over-extraction of groundwater and at the same time ensure conjunctive use of surface and groundwater.
Summary Analysis: • The existing scheme guidelines have no provisions for promoting conjunctive use of groundwater; however conjuctive use of groundwater has been promoted during PIRC			

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
review meetings. In absence of any specified guideline and fund allocation for the same, adoption of such practices was reported to be limited barring some exceptions like Assam.			
10.	Unlocking Synergies with other Government Program	Convergence (Inter-Ministerial/Inter-Departmental/Financial/Human Resources/ Administrative/ Institutions/ Schemes • What activities are undertaken to ensure convergence at community level? Are there any Action Plans prepared at State/District/Block level to ensure the same? • What are the challenges hindering effective convergence?	• CADWM under PMKSY is implemented pari-passu with the 99 Priority AIBP projects • CADWM guidelines mandate implementation of micro-irrigation structures (like laying of pipelines, creation of sumps/ tanks, etc.) at 10% of the CCA; convergence with extant PMKSY-PDMC is suggested for procurement of the MI equipment like drips and sprinklers • Guidelines suggest convergence with PMKSY (WDC) and MGNREGA works for activities involving earth works like construction of unlined field works, land levelling works, creation of surface drainage, etc. However, the convergence with other schemes like

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			MGNREGA was found to be minimal. Almost all states attributed the low convergence with MGNREGA to the extant 40:60 material-labour share convention in MGNREGA which precludes taking up CADWM works as CAD works require around 70-80% material component. Also, it is reported that CADWM works require skilled labour while MGNREGA generally offers services of un-skilled labourers.
		Potential areas for synergy • What are the areas for potential convergence / synergy across govt. programs?	• Conjunctive use of surface and groundwater need to be explored for installation of groundwater based minor irrigation structures like tube wells, bore wells in command areas catered by projects designed for single season use (notably, the

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			Groundwater Irrigation scheme under PMKSY-HKKP caters to only areas not catered by surface water schemes). Some states like Assam has reported utilization of portion of MI fund to facilitate installation of solar powered shallow tube wells, thus ensuring water availability during dry Rabi season.
		Any Best Practices	**Case Study: Effective convergence with MNREGS (Dhar district, Madhya Pradesh)** In 2008, the MP Panchayat and Rural Development department formulated two schemes for facilitating development and management of irrigation infrastructure using MNREGS funds. Some of the key features of the implementation strategy is highlighted below: **Enabling policies:** MNREGS funds used for canal

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			rehabilitation and construction of field channels under Sahastradhara scheme. **Joint planning:** Joint walk-throughs conducted with farmers by NVDA to prepare detailed estimates of minor canal repairs followed by submission of technical sanction plan by Executive Engineer to the Panchayat. **Faster fund disbursal:** Funds were directly transferred to the WUA's account by the Jilla Panchayat (thus bypassing the Gram Panchayat) **Hand-holding by specialized agencies:** NVDA together with the appointed NGO Development Support Centre (DSC) provided technical support to the WUAs in relation to technical planning and estimation, MNREGS labour orientation, training of supervisors (/ mate), preparation of job cards, bookkeeping and accounting. Exposure visits for WUA members were

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			arranged by DCS to successful projects in Madhya Pradesh, Gujarat and Maharashtra. 20 local youths were trained as Kolaba Sahayaks/ mate of MNREGS works. IEC and awareness campaigns involving graphic and visual shows were arranged to sensitize the villagers. **Implementation by WUAs:** The WUAs got the opportunity to carry out the R&M under the MNREGS assisted canal repairing works themselves, thus obviating the need for appointment of departmental/ private contractors. **Outcome** • 147 km of canal network repaired and 93 km of earther field channels created in Maan and Jobat projects. New field channels facilitated water access to tail end users in Kukshi block. • Direct transfer of MNREGS funds to WUAs

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			instilled a sense of ownership and accountability among the members. • 6,500 ha of additional area was brought under irrigation. Irrigated area in Maan and Jobat projects increased from 7000 ha and 5000 ha in 2007-08 to 11,400 ha and 7,700 ha in 2009-10 respectively. • The farmers reported increase in net income by Rs. 10,000/ ha. Majority of the farmers were able to irrigate more than 50% of their land and sow two crops in a season by adoption of new crops like wheat, cotton, chilly, pulses, etc. • Substantial increase in groundwater reported in areas where field channels have been constructed. *(Reference: Tapan Patel et. al. (2010), "Best Practices on MNREGS Assisted Canal Rehabilitation under Participatory Irrigation*

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			Management in Dhar, Madhya Pradesh). .
Summary Analysis: • Though convergence with various schemes like PDMC, WDC and MGNREGA is suggested, but actual convergence has been observed to be limited till now; some of the causes are as follows: low acceptability of the MI structures by the farmers (particularly in light of the increasing shift towards water-intensive crops like paddy which are conducive to flood irrigation and abundant water availability during Kharif season) while the 40:60 material - labour ratio mandated for MGNREGA works limit the mobilization of resources for CADWM which demands material intensive services, etc.			
11.	Reforms, Regulations	Adoption of models acts and reforms at governance, institutional and administrative level • What measures are being taken to ensure effective implementation and compliance of adopted acts/rule/regulations? (like in areas of safety, accountability, transparency etc.)	• In line with the suggestions of National Water Policy 2002, 20 out of 25 states (except Haryana, Meghalaya, Uttarakhand, Tripura and Puducherry) have instituted some framework with respect to PIM (as per NITI Aayog CWMI 2019). A brief comparison of the important provisions in the PIM acts across various states is summarized below: o Capacity building: Detailed provisions for capacity building of

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			WUA members and government field staffs are absent in most of the states except for Gujarat, Jharkhand, Karnataka, Kerala, Maharashtra and Uttar Pradesh (on payment basis) and Goa. o Gender mainstreaming: Only 5 states viz A.P., Jharkhand, Maharashtra, M.P. and Chhattisgarh have provisions for certain reservation of women in WUAs. During primary survey, it was observed that in some projects in states like Bihar and Karnataka, certain women reservation conventions are followed. o Social inclusion: apart from Chhattisgarh and West Bengal, none of the states' PIM acts

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			have any special provisions for SC/ ST. o Water management: Provisions for measuring devices and monitoring are stated in acts for states like Gujarat, Maharashtra, Goa and Uttar Pradesh. o In states like Goa, Uttar Pradesh, Maharashtra and Bihar, there are provisions for conjunctive use of groundwater • However, during primary survey in the command areas of some of the PMKSY-CADWM projects, it was observed that many of the WUAs are non-functional; detailed reasons for the same are being highlighted in the REESIE section. In the NITI Aayog CWMI 2019, it is reported that during FY 16 to FY 18, overall states have 'not shown

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			any significant progress on the existing low WUA participation in O&M and irrigation facilities'; while no states reported WUA participation greater than 50%, the figures are abysmally low for north-eastern and Himalayan states. The NITI Aayog report attributed this poor participation rate to low technical competency and poor financial resources of the WUAs. • As reported during the primary survey in some states, the WUAs are further financially crippled by the lack of any provision in state PIM act to retain fees collected. This is highlighted in the NITI Aayog CWMI 2019, where it was observed that '18 of the 25 reporting states and UT' do not share any

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			percentage of the Irrigation Service collection. Only 4 non-Himalayan states viz. Andhra Pradesh, Bihar, Gujarat and Rajasthan allow WUAs to retain 50% or more share. It may be noted here that the National Water Policy (2012) proposed giving statutory powers to WUAs 'to collect and retain a portion of water charges, manage the volumetric quantum of water allotted to them and maintain the distribution system in their jurisdiction'.
Summary Analysis: • Most of the states have instituted some mechanisms to ensure involvement of WUA; however during the primary research, it was observed that many of the WUAs are non-functional. • Though National Water Policy (2012) suggested statutory powers to WUAs to collect and retain portion of the water taxes, yet most states, barring some exceptions, are yet to implement the same provision. Currently, most of the states PIM Acts have no provisions for allowing the WUAs to retain 50% or more of the water fess collected.			
12.	Impact on and role of private	Public-Private Partnership	• Though some states like Maharashtra, Andhra

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
	sector, community/ collectives/ cooperatives (e.g. Farmer cooperatives, FPOs, Water User Associations, etc.) and civil society in the scheme	• How well have PPP functions in the Sector? What are the challenges faced?	Pradesh have taken some steps in attracting private sector participation in irrigation and drainage sector (I&D) particularly in building the large assets, yet the overall participation across India remains tepid till now. • Some of the reasons being low cost recovery from water (water being perceived as a social good/ right rather than an economic commodity), land acquisition, R&R and other legal and administrative issues endemic in this sector, non-availability of alternative revenue streams. • However, with adoption of piped distribution network gaining traction, there is a potential for engaging private contractors for both construction and O&M of these networks through

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			some cost and revenue sharing models.
		Any best practices	International Case Studies • Megech Seraba Irrigation and Drainage scheme, Ethiopia : maintenance of the primary and secondary irrigation infrastructure by a private entity in lieu of service fee paid by the government with farmers to share a part of the fees • Also, a number of irrigation command areas in China have engaged private contractors for maintenance and service of the field distribution networks. • In terms of private sector participation to reduce the market barriers for agri-produces, the Ramthal Integrated Drip Irrigation Project in Karanataka is a notable project, where the state government signed MoUs with eight private agricultural firms

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			for procuring farm produces from this project command area.
		FPOs/SHGs/Cooperative's Participation • How many private sector, community/collectives/cooperatives and civil society have availed the benefits under any Scheme?	• Under non-structural interventions of the scheme, trials and demonstrations are provided by the WALMIs/ regional agriculture universities to the WUAs. The scheme guidelines also mandate appointment of 'social facilitators' for each project to hand-hold the WUAs. However, as mentioned in previous sections, barring some exceptions (in Maharshtra and Karnataka where in some cases specialized agencies and/ or irrigation department conducted regular trainings for WUA members), the performance of the scheme has been sub-par in terms of non-structural interventions.
Summary Analysis:			

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			• The extent of private participation in overall irrigation and drainage sector in India has been lukewarm until now, but with increasing adoption of piped distribution networks and shift towards service oriented from construction oriented approach, there is an emerging possibility of increased participation of private parties in construction, maintenance and servicing of these networks, with substantial scope for employment generation. • Under the non-structural interventions, various trainings are arranged for the WUAs including promotion of livelihood opportunities among women (like Dhom Balkaawadi Project in Maharashtra). However, in view of the sub-par performance of the scheme in terms of non-structural interventions in many of the projects, the extent of involvement of the WUAs was reported to be limited.

It may be noted that CST theme 'Research & Development' has not been evaluated separately for CADWM scheme, as no separate funding for R&D is allocated under the scheme and in terms of institutional mechanisms for R&D, it is common with that of PMKSY-AIBP scheme. Hence the same rating as that of PMKSY-AIBP has been given to PMKSY-CADWM for this theme. Also, the theme 'water sharing treaties/ agreements & diplomacy' is not relevant for this scheme and hence this theme has not been evaluated.

A summary analysis and performance of the scheme on the identified themes is presented below:

Table 37: CADWM – summary of performance evaluation using cross-sectional themes

Parameter	Performance
Accountability & Transparency	🟡
Direct/Indirect Employment Generation	🟢
Gender mainstreaming/ Inclusiveness	🟡
Building resilience to climate change (including but not limited to developing water disaster preparedness) & ensuring sustainability	🟡
Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population	🟡
Use of IT/Technology in driving efficiency	🟡

Parameter	Performance
Stakeholder and Beneficiary behavioural change	🔴
Development, dissemination & adoption	🟡
Research & Development	⚫
Water sharing treaties/agreements & diplomacy	⚫
Conjunctive use of water - surface versus groundwater usage optimizations	🟡
Unlocking Synergies with other Government Program	🔴
Reforms, Regulations	🟡
Impact on and role of private sector, community and civil society in the scheme	🟡

Cross-sectional themes performance infographics legend

🟢 High 🟡 Medium 🔴 Low ⚫ Not relevant ⚪ No information

Issues and challenges

This sub-section describes the scheme issues and challenges and their mapping with the source of information viz. primary source, secondary source and household survey (if applicable).

Table 38: CADWM – issues and challenges

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
Scheme design					
CADWM-F1	**IPU assessment**	• One of the major objectives of the CADWM scheme is to reduce the IPC-IPU gap. Thus, one of the outcome indicators of this scheme, as suggested by the Ministry of Finance's Output Outcome framework is 'utilization of irrigation potential in an additional culturable land'. Currently the MIS tracker			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
		records the physical progress in terms of coverage under structural interventions as IPU. • However, currently there is no standard guidelines for calculation of IPU, resulting in significant disparities between studies conducted by various organizations. E.g. the report by IIM Calcutta in 2008 "IPC-IPU Analysis in West Bengal and the North-east" pointed that 'none of the states satisfied the team about actual process of reporting the IPU'. • In 2007, a similar study conducted by IIM Ahmedabad under the guidance of MoWR for the purpose of assessment IPC-IPU gap, also pointed that both IPC and IPU are dynamic figures dependant on a number of factors like resource reliability, wear and tear of the infrastructure, cropping pattern, etc.; thus simply aggregating the same without further updates (/ without accounting for the discounting factors) is not methodologically sound. The same has been echoed by various other			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
		studies in the last decade like NITI Aayog study (in 2015).			
CADWM -F2	**Cost norms**	• The cost norms for calculation of CA set in 2016-17 has not been revised thereafter, resulting in differences with the existing market rates • It has also been reported inadequate for some states particularly those which have moved to a higher schedule of rates like Assam and Manipur. • This may compromise the extent of lining of water courses (for want of additional funds from the state for the same) thus contributing to inefficiency in conveyance, the fallout of which is abandonment of the water courses by farmers during periods of drought. Also unlined channels have higher chances of getting damaged during period of alternate drying and wetting of the fields further aggravated by the movement of heavy equipment by the cultivators.			
Scheme implementation					
CADWM -F3	**Institutional structure**	• Under the non-structural interventions, the CADWM guidelines has identified the Social Facilitators as the main organization			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
		responsible for providing 'continuous support' to the WUAs. In line with the intent of PIM, these Social Facilitators are envisaged to play a vital role to ensure involvement of the cultivators in the initial phase and gradual handling over the assets. • However, during primary survey, the awareness among the implementing agencies regarding 'social facilitators' was found to be very low. Though some states have engaged the regional WALMIs or agricultural institutes to conduct trainings/ demonstration for the farmers; yet the concept of 'providing continuous support by a social facilitator' has not been implemented in letter and spirit of the guidelines; even many of the implementing agencies were found to be unaware of such provisions.			
CADWM -F4	**Inter-departmental co-ordination**	• Inter-departmental co-ordination among water resources, CAD and agriculture officials forms an important pillar for the success of the scheme. While close co-ordination is needed among the water resources and CAD			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
		departments for ensuring adequate water availability at the outlets, correct requisition of demands from WUA and successful operation of the warabandi schedule while engagement with the agriculture department becomes vital in ensuring crop planning, estimating demand for water, hand-holding the cultivators, etc. • The following deficiencies in relation to co-ordination was observed: o In some states like Uttar Pradesh, inadequate co-ordination between water resources and CAD departments (in terms of staff deployment, identification of scope) were stated o In states like Manipur, CAD and water resources have been bifurcated into separate department resulting in administrative hurdles and staff shortages o One of the causes attributed to the poor performance of micro-irrigation schemes is non-utilization of the sumps/ tanks (created under MI component			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
		in CADWM) due to non-availability of drips and sprinklers from the agriculture department, thus leading to lesser motivation for this component among the cultivators. This is also complicated by the lack of awareness among farmers regarding micro-irrigation as reported in states like Bihar, Madhya Pradesh and Maharashtra.			
CADWM -F5	**Staff shortage**	• Almost all the informants across evaluated states, barring exceptions like Bihar, confirmed severe staff shortages under the CAD department. The high number of vacancies across different posts has hampered the survey, execution, monitoring and water taxes assessment and collection in many of projects (like Dhansiri in Assam, Durgawati in Bihar, Bhima and Karanja in Karnataka, Baryiarpur and Singpur in Madhya Pradesh, Tarali, Dhom Balkaawadi, Upper Penganga, Lower Panzara and Nandur Madhmeshwar in Maharashtra, Thoubal and Dolaithabi			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
		in Manipur). Details of staff shortages issues reported in Maharashtra as reported by the project authorities are summarized below (it may be noted that the authenticity of the figures has not been validated as part of this study): o In Tarali project, only 25% of the sanctioned field strength reported o Similarly for Upper Penganga project, present strength was reported to be hardly 20% of the sanctioned strength o In Nandur Madhmeshwar project, the figure reported stands at 40% o In Dhom Balkaawadi project, a significant portion of the staff remain engaged in the irrigation rotational schedules for around 120 days in a year Similarly, in Champamati project in Assam, it was reported that engagement of irrigation staff in non-departmental government works (like assistance with update of NRC in Assam) hampered monitoring of projects particularly timely update of MIS			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
		• This becomes particularly concerning considering that field level construction and water management under CADWM entail continuous engagement with the beneficiaries across the whole command area which demands higher staff presence			
CADWM -F6	**Scheme convergence**	• Though the CAD guidelines and several PIRC meetings have mentioned the need for convergence with other schemes, yet the current status of convergence is not satisfactory. While the progress under micro-irrigation component has been only 3.1% of the total target, none of the informants confirmed utilizing material and labour resources under MGNREGA. Some of the causes for the same is highlighted below: o Convergence with extant PDMC scheme (under MoA&FW): the cultivators showed lack of interest in adopting micro-irrigation structures owing to their unwillingness to shift from traditional crops like paddy, requirement of additional land			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
		occupying structures like sumps/ tanks for using MI equipment like drips/ sprinklers, choking of some of the MI equipment in sandy and loamy soil and additional capex and recurrent expenses (like electricity costs) requirement. This is further complicated by lack of co-ordination with horticulture/ agriculture resulting into delay in obtaining subsidy for the MI equipment and lack of awareness among farmers regarding MI equipment. o Convergence with MGNREGA: None of the informants across sampled states confirmed taking either material and labour support under MGNREGA. The reasons cited is the mandatory 40:60 ratio of material and labour component under MGNREGA prevents using the services under CADWM as this is more material intensive scheme (with ratios of material to labour).			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
CADWM -F7	**Fund transfer**	• In view of the limited working period available for execution of field works (3-4 months in many states) owing to standing crops and field preparation during pre-harvesting period, the need for proper resource planning (both financial, manpower and other material resources) becomes critical. • However, implementing agencies in some states pointed to delay in receipt of funds: delay in receipt of both Centre and State share in Assam, stalling in transfer of grants from state treasuries due to technical issues in Comprehensive Financial Management System in Bihar and delay in transfer of grants by state departments in Rajasthan were reported. Such delays are understood to have hampered the contractor mobilization process before start of field work and setting up of WUAs. • This phenomenon has also been pointed by past studies like NITI Aayog (2015) which stated that modus operandi of transfer of CA grants to state finance department (state common pool) is not			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
		conducive to timely release of funds to the implementing agencies.			
CADWM -F8	**Maintenance issue**	• Adequate maintenance of the water courses, WUAs and other assets is the main determinant of the success of the scheme in long run. As per the guidelines, since the assets are created on the individual cultivator's field, the onus of maintenance and up-keep of the same falls on the cultivators and the WUAs. The guidelines mandate gradual hand-holding of the WUAs and transfer of the management and maintenance of all the assets (below outlets) to the WUAs. • However, at a national level, the NITI Aayog CWMI 2019 points to the low level of participation (around 24% only of irrigated command areas) of the WUAs in the O&M and the irrigation facilities; particularly concerning is the poor performance of some of the bigger states like Bihar (3%), Gujarat (35%) and U.P. (2%). • In the backdrop of the existing trend of poor collection of water fees, generating enough cash for smooth operation of the WUAs may turn out			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
		to be challenging in the future. Also, as per the NITI Aayog's CWMI 2019, 18 of the 25 reporting states and UTs do not share any portion of the irrigation fees collected with the WUAs for O&M. Only 4 non-Himalayan states viz Andhra Pradesh, Bihar, Gujarat and Rajasthan allow the WUAs to retain 50% or more of the fees collected. Thus, defunct WUAs and low fees collection are major concerns in ensuring proper maintenance of the water courses. • Though it is understood that interest earned from the infrastructure/ functional grants may be utilized to fund the operations and repair and maintenance works, yet as per the 6th PIRC MOM, only 17% of the registered 8,332 WUAs have been handed over the infrastructure grant.			
CADWM -F9	**Private participation**	• Though some states like Maharashtra, Andhra Pradesh have taken some steps in attracting private sector participation in irrigation and drainage sector (I&D) particularly in building of large			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
		assets, yet the overall participation across India remains tepid till now. • Some of the reasons being low cost recovery from water (water being perceived as a social good/ right rather than an economic commodity), land acquisition, R&R and other legal and administrative issues endemic in this sector, non-availability of alternative revenue streams.			
Monitoring and evaluation					
CADWM-F10	**Non-structural intervention evaluation criteria**	• The CAD guidelines mandate engagement of one Social Facilitator for each of the projects and the monitoring of the performance of the Social Facilitator by some specialized agency/ institute/ consultant engaged by the MoWR. • However during primary survey, it was found the level of awareness about 'social facilitators' is almost nil among all states (barring some exceptions like Lower Panzara project in Maharashtra). Some of the project implementing authorities have engaged the local WALMIs/ agricultural institutes for training and demonstration to the farmers, but the mechanism of engagement of			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
		social facilitators for continuous hand-holding and submission of evaluation reports was found to be totally absent.			
CADWM-F11	**MIS update**	• The CADWM MIS dashboard has been a significant step in ensuring accountability and data transparency. Though the updates in relation to structural interventions are observed to be regular, yet some deficiencies in update of non-structural interventions have been noted (dashboard accessed on 9th July 2020), some of which are listed below: o Data inconsistencies: ▪ Under Dhansiri Irrigation Project in Assam, though the 'number of WUA created' has been stated as 44, yet the 'total number of farms' has been stated as 1. o Incomplete data update: ▪ Under Durgawati project in Bihar, though the 'number of WUA created' is stated as 14, yet no corresponding figure has been updated for 'CCA covered' and 'total number of farms'			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
		○ Inconsistencies among different databases ▪ Under Sardar Sarovar project in Gujarat, as per MOM of 6th PIRC meeting (February 2020), the nos. of WUA created is stated as 3,624; while the corresponding figure in MIS dashboard (as on July 2020) reads as 2,140 ▪ Similarly as per MOM of 6th PIRC meeting (February 2020), the nos. of WUA created in Jharkhand is 48; while the same head under MIS dashboard is found to be blank. ▪ Again, the number of WUAs created in Manipur reads as 34 in 6th PIRC MOM and 2 in MIS dashboard (1 for Thoubal and Dolaithabi project each). ▪ Similarly, as per data shared by project authorities of Dhom Balkaawadi project in Maharashtra, 54 WUAs have been formed out of the targeted 85 WUAs			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH/ FGD
		while infrastructural grants have been handed over to 30 of the WUAs during 2018-20. But as per MIS dashboard (as accessed on 8th June 2020), only 1 out of the targeted 85 WUAs have been created and infrastructural grants have been handed to over none. • Deficiencies in data upload in MIS and inconsistencies in data reporting across various databases severely undermine the transparency and accountability with negative implications on policy design. • Also, one of the outcome indicators viz. 'additional irrigation potential created' as mandated in the Output Outcome framework by Ministry of Finance, is not being tracked in the dashboard.			

Issue relevance legend

	Supported		Partially supported		Not supported		Not applicable

A summary analysis of issues & challenges for the scheme is presented below:

Table 39: CADWM – summary of issues and challenges

Parameter	Performance
Institutional Mechanism and governance	🟡
Fund flow efficiency and utilization	🟢
Unavailability of resources (fund, manpower and others)	🟡
Monitoring and evaluation	🟡
Capacity building	🟡
Operational efficiency	🟢

Performance infographics legend

🟢 Satisfactory 🟡 Average 🔴 Needs Improvement

Recommendations and solutions

This sub-section describes the scheme recommendation and solutions from the perspective of scheme design, scheme implementation and monitoring & evaluation, along with their mapping with the issues and challenges described in the preceding sub-section.

Table 40: CADWM – recommendations and solutions

Sl.no	Recommendations	Finding
Scheme design		
CADWM-R1	**Develop standard guidelines for IPU assessment** • Standard guidelines need to be developed by DoWR,RD&GR, in consultation with CWC and other research institutes, for assessing the IPU for each project to correctly ascertain the actual impact of the scheme in terms of utilization of the irrigation potential and to promote transparency in reporting by various organizations. Several such guidelines in relation to IPC-IPU measurement have been prepared by some IIMs in 2008, in consultation with MoWR. A similar type of guideline was also released by CWC in 2014 for estimating water use efficiency of irrigation systems - 'Guideline for Computing the Water Use Efficiency of the Irrigation Projects'.	CADWM-F1

Sl.no	Recommendations	Finding
	• IPU being a dynamic figure which substantially depends on the existing cropping pattern, climatic conditions, etc., it is suggested to create special statistical cells under the state irrigation/ water resources department to compute the dynamic figures for IPU over specified time periods, which should be monitored and assimilated at national level by any designated statistical cell/ empowered committee. • As an interim measure, remote sensing technologies like satellite image mapping (as already initiated by Ministry in co-ordination with BISAG) for crop assessment may be explored. Another noticeable example is the Narmada Canal Project, Rajasthan, where the project authorities are leveraging satellites ordered through ISRO's NRSC Data Centre (NDC) – UOPS Portal to carry out mapping of the Rabi season Land Use and Land Cover (LUCL) in the command area. It is suggested to link such crop assessment data with the 'CCA covered through CADWM interventions' in the MIS dashboard to bring more transparency in assessing the scheme outcomes.	
CADWM -R2	**Prioritize implementation of non-structural components** • As per the Fourteenth Report to Lok Sabha by Standing Committee on Water Resources (2016-17), it is mandatory to have the WUAs in position before project components are taken up so as to ensure participation of the beneficiaries in the planning stage. Also, as highlighted by many past studies like DMEO NITI Aayog (2015), there are many instances where project implementation of various components starts without the formation of WUAs. • Also, mere formation of WUAs without proper capacity building/ awareness programmes by Social Facilitators may not help in the cause of their active involvement and later sustainability of the projects. Thus, taking the cultivators to confidence before scheme implementation forms a major step in initial acceptance of the	CADWM -F10

Sl.no	Recommendations	Finding
	scheme. This is reflected in various projects like Waghad in Nashik, Maharashtra and Paliganj project in Bihar (non-AIBP projects), Sri Rameswara LIS in Karnataka where handholding by specialized training institutes and gradual realization of benefits helped to overcome the initial resistance of the farmers. Also, in case of ongoing projects with inadequate hydraulic connectivity to outlets, release of infrastructure grants to the WUAs (for setting up establishments, etc) at the project onset would help to secure the confidence of cultivators. • Thus, the release of 2nd CA instalment (or some portion thereof) for structural interventions (in a particular project) may be linked subject to the completion of the following steps by states: o Online registration of the WUAs o Appointment of social facilitator for the project (notification/ proofs for the same to be submitted at the time of application for 2nd instalment and uploaded in MIS dashboard) o A minimum number of trainings (to be specified) to be conducted by the social facilitators (conduct of trainings to be validated by the WUA chairman and submitted by state at the time of application for 2nd instalment) o Transfer of the CA grant under the one-time infrastructural component (which should be immediately released by the Centre at the project onset) to the WUAs (such a lump sum amount at project onset would help to garner more involvement from the cultivators and also interest generated on the same shall help to ensure R&M of the assets in the subsequent years)	

Sl.no	Recommendations	Finding
CADWM -R3	**Ensure release of funds/ central grants by states within stipulated time** • To expedite the release of the central grants by the states, options like transfer of funds by the Centre directly to the project implementing agencies may be explored in case of states (like Assam) where such significant delays are reported in consequent years. Adequate safeguards to mitigate any attendant risks or in case of dilution of the statutory powers of the states may be instituted.	CADWM -F7
CADWM -R4	**Prepare detailed guidelines for convergence with other schemes** • To address the poor convergence with the MGNREGA, the DoWR may consult with the Ministry of Rural Development to pro-actively identify the type of works under CADWM that may be conducted under the MGNREGA scheme, especially to overcome restrictions around 40:60 material to labour component ratio as required under MGNREGA. Accordingly, a set of guidelines with list of permitted activities under CADWM can be developed and passed on to the implementing agencies for implementation. • Similarly to ensure holistic development of WUAs, co-ordination with MoA&FW is suggested so as to introduce provisions under extant agricultural schemes which would enable the WUAs to draw benefits under various fertilizer/ seed distribution and agricultural mechanization schemes. At present, the extent of involving WUAs in other agricultural schemes was found to be limited (even in some states awareness of thel agricultural officers about the local WUAs was observed to be limited); hence a guideline in this aspect from MoA&FW to involve registered WUAs for agricultural schemes would be helpful.	CADWM -F6
CADWM -R5	**Prepare detailed guidelines for conjunctive use of surface and groundwater**	CADWM -F6

Sl.no	Recommendations	Finding
	• The need for conjunctive use of surface and groundwater has been highlighted by various previous studies. Even the 4th PIRC meeting (February 2019) suggested that inclusion of conjunctive use of groundwater, along with other small surface storage structures may be considered as part of micro-irrigation of infrastructure. This becomes particularly pertinent considering that many of the projects are being designed for single season crops; thus cultivators dependant solely on canal water (with no provision for water supply and hence agriculture in dry or Rabi seasons) may not be motivated enough to make investments in MI structures for single cropping season. In such cases, availability of water through bore wells/ tubewells/ tanks/ water storages would help to ensure round-the-year (/ 2-3 seasons) water availability and incentivize the cultivators to adopt MI (the cause for the groundwater based structures is further bolstered by the increase in groundwater level in areas associated with canal water seepages). One notable example is the ongoing Waghur Lift Irrigation Scheme in Maharashtra, where decentralized storages have been created for every 5 ha of the command area (the cultivators can access these storage tanks using pumps; solar panels have been installed to cut down the electricity costs) which is expected to substantially increase the CCA and ensure sustainable water supply. Similarly, solar powered shallow tube wells are currently being installed in the command area of projects in Assam, under the support of agriculture department, to ensure water availability during Rabi and summer season. Also, during Focus Group Discussion (FGD) with cultivators in the command area of Champamati major irrigation project (Amguri village, Chirang, Assam), the cultivators stressed the imminent need for installation of bore wells to ensure cultivation during the Rabi season. Similar requests were raised	

Sl.no	Recommendations	Finding
	during FGD in the command area of Dhom Balkaawadi project (Wakhari village, Satara district, Maharashtra), where the cultivators asserted the need for filling up tanks, particularly in the tail reaches, to reduce the dependency on rain water. • The absence of any specific guidelines for conjuctive water use and poor progress under micro-irrigation component (only 3.1% of the target) have brought to fore the imminent need of detailing the guidelines for successful implementation of such component like installation of bore wells/ tubewells in areas with 'safe' groundwater levels and creation of small tanks (as required) which can be undertaken using the fund earmarked under micro-irrigation component. The Ministry should clearly specify the activities to be counted under conjunctive use of groundwater and the relevant cost norms.	
CADWM-R6	**Explore scheme rationalization by merging the micro-irrigation component with OI component of PDMC scheme** • In view of the continuing poor progress under the micro-irrigation component, transfer of this component to the Other Interventions component of the extant Per Drop more Crop scheme (under MoA&FW) may be explored. • In consultation with the MoA&FW, provisions may be added under the OI component of Per Drop More Crop (PDMC) scheme for mandatory coverage of 10% of the command area (or more in case of lift irrigation schemes) of the 99 AIBP projects along with flexibilities to compensate the shortfall in coverage in one command area through higher target coverage in another command area (in the same state). • This would enable the beneficiaries to directly apply for the subsidies for drips/ sprinklers to the MoA&FW. • Transfer of the micro-irrigation component to OI component under PDMC scheme is also expected to increase the acceptance of MI	CADWM-F6

Sl.no	Recommendations	Finding
	techniques among the cultivators with the hand-holding and awareness sessions already being conducted by the agriculture/ horticulture department in this aspect. At present, low awareness among the cultivators regarding MI techniques was found to be a stumbling block for adopting such techniques – this can be addressed using the 5% 'Admin Expenses' earmarked under PDMC schemes and also can be supported by the awareness trainings organized by the various MI manufacturers.	
CADWM -R7	**Incentivize states for adopting piped distribution network, wherever feasible** • In view of the increasing shift towards volumetric water supply and differential pricing and reluctance of farmers in some areas to part with their land (particularly in light of the fragmented land-holding pattern in many states and recent escalation in land prices), use of piped distribution network, wherever feasible, can be explored. • The success of piped distribution network has already been demonstrated across several projects in India like Sardar Sarovar in Gujarat, Narmada Canal Project in Rajasthan and currently being implemented in Waghur command area in Maharashtra. Some of the benefits of piped irrigation network include less requirement of land, low conveyance loss, higher durability and lower O&M cost, thus assisting in avoiding the impending issue of high maintenance burden to be borne by the WUAs. Also, such networks with provisions for water regulation and measurement would greatly enable the shift towards volumetric supply and differential pricing. • For all new proposals, the state governments may be incentivized to adopt pressurized piped irrigation distribution network (wherever feasible). The Ministry should pro-actively develop a list of the ongoing projects where implementation of such distribution	CADWM -F8

Sl.no	Recommendations	Finding
	facility is feasible. While checking feasibility, the associated recurring costs (like electricity costs, which may be mitigated to some extent using solar panels), success/ acceptability of past projects by cultivators in near-by/ similar districts should be taken into account.	
Scheme implementation		
CADWM -R8	**Revise cost norms based on current market and schedule of rates** • In view of the budget constraints in many states, the ministry should explore the possibility of revising the cost norms to be at par with the prevailing market rates and increases in schedule of rates in some states. Provisions for annual increment by indexing the labour and material components with relevant inflation indices may be explored.	CADWM -F2
CADWM -R9	**Attract private investments in distribution network and service delivery** • Involvement of private parties in irrigation and drainage (I&D) sector may be explored to mitigate the current resource crunch particularly proper maintenance of assets and service delivery to the beneficiaries. • In line with the recommendations of previous committees/ studies (like MoWR committee in 2003, ADB study in 2013), private party investments may initially be encouraged in management service contracts with gradual transition to BOT- annuity and other innovative PPP models like Hybrid Annuity model, which is further illustrated below. • In view of the shift towards piped irrigation and volumetric water supply, EPC contracts with built in O&M clauses/ management service contracts may be explored for better service delivery to beneficiaries and sustenance of the benefits. The private party would be responsible for laying of the entire distribution network, O&M and service delivery in lieu of specified fees (fees to be	CADWM -F9

Sl.no	Recommendations	Finding
	regulated by the government; subsidy may be provided in the initial stages to attract more players) paid by the beneficiaries. • In relation to such modus operandi (where O&M and service of distribution network has been outsourced to individual managers) in some irrigation projects in China, a study by Tushar Shah et al. (July 2004), "Irrigation Institutions in a Dynamic Economy: What is China Doing Differently from India" stated the following: o contracting to individual managers (instead of collective management by WUAs) was found to be more popular among the cultivators o water use per ha reduced in systems maintained by private managers • Case Study: o Megech Seraba Irrigation and Drainage scheme, Ethiopia ▪ Maintenance of the primary and secondary irrigation infrastructure in lieu of service fee paid by the government where farmers contribute a part of the fees • In the backdrop of the poor fiscal position of many of the state governments and gradual shift from open canal to piped irrigation systems and adoption of canal automation, exploration of PPP models is surely called for.	
Monitoring and evaluation		
CADWM -R10	**Prepare guidelines to ensure regular update of MIS** • Despite suggestions from PIRC to states (as noted in MOMs of 4th PIRC February 2019 and 5th PIRC July 2019) for regular update of MIS portal, discrepancies (in terms of update, inconsistencies among data, mismatch across databases) in case of non-structural interventions still persist. This undermines the transparency and accountability of the data dissemination process. To mitigate the issue, following steps are recommended:	CADWM -F11

Sl.no	Recommendations	Finding
	○ Linking of subsequent CA instalments releases to the physical and financial progress as reflected on the dashboard ○ The Ministry in association with the NIC should chalk out a training plan for all the state-level responsible for MIS updates ○ The CWC regional office should share monthly reports of data upload status, highlighting areas of deficiencies, to the Ministry and state governments.	
CADWM -R11	**Prepare detailed guidelines for engagement and monitoring of social facilitator** • The ministry should prepare detailed guidelines for engagement of the social facilitators and their monitoring KPIs to avoid non-standardization and dilution of engagement mechanisms across states. The current guidelines fall short of detailing out any measurable KPIs for evaluation of the social facilitators. Also, with no detailed provisions for engagement of the social facilitators, the implementation of the same has been found poor invariably across all states. Though the ministry has provided some suggestions from time to time like involvement of NGOs empanelled under the National Water Mission and others, yet without any detailed provisions for implementation of the same has led to laxity in implementation. • It is suggested that the Ministry clearly defines the following in respect to social facilitators and ensure strict implementation: ○ Define eligibility criteria for selection of social facilitators (like defining minimum experience in relevant fields, experience in water management, etc.). In this aspect, the states may choose from the already empanelled NGOs under National Water Mission at national level or competent local NGOs operating in the	CADWM -F10

Sl.no	Recommendations	Finding
	respective state in the same sector for a specified period of time (as in Maharashtra). The Ministry may also explore creating a common national pool of empanelled NGOs/ specialized agencies across relevant schemes for irrigation water management, watershed development, drinking water supply, etc. o Prepare details of the KPI for evaluation of their performance (indicative list: success in opening of separate bank accounts for WUAs, performance in mobilization of community contribution for O&M, campaigns and awareness drives conducted in relation to water management and maintenance of water courses, number of inter-departmental meetings held involving irrigation, agriculture departments and WUAs, etc.). As mandated in the existing scheme guidelines, the Ministry needs to appoint the social science agency/ institute/ consultant to review the performance of the social facilitators o Mandatory submission of monthly progress report by social facilitators to social agencies/ consultant and PIRC (in line with the provisions already set out in the existing CADWM guidelines) Similar guidelines covering some of the above aspects have already been developed by Department of Drinking Water and Sanitation in respect to engagement of Implementation Support Agencies (ISAs) for implementation of Jal Jeevan Mission (implementation of piped drinking water connections to each rural household).	
CADWM -R12	**Explore use of remote sensing techniques for monitoring and IPU assessment**	CADWM -F5

Sl.no	Recommendations	Finding
	• Considering the limited resources (manpower, vehicles, etc as already) of the CAD departments and the huge span of the command areas, the use of remote sensing technologies to monitor the physical progress becomes imperative. Use of satellite images and 3D images using drones may be explored, particularly in relation to monitoring of field channels progress, identification of system deficiencies and water-logged areas and crop assessment. • Use of drones has been successfully demonstrated at various parts in in India like monitoring of construction works in Polavaram project in Andhra Pradesh, generation of contour at the surveying stage for the respective 99 Priority AIBP projects in Andhra Pradesh. Other notable examples include extensive use of drone in agricultural insurance and assessment sector – agencies like Skymet are already leveraging drones to provide agricultural survey services to insurance companies and various state governments like Gujarat, Madhya Pradesh, Maharashtra and Rajasthan. In another recent successful example, the Maharashtra Krishna Valley Development Corporation (MKDVC) in association with Terra Drones mapped 4200 sq.km of agricultural land. Also once drone survey is conducted for a specific project and a database of the orthomossaic image, area, crop and other details for a particular village is created, next time the survey may be updated using just a mobile app and capturing geo-time stamped photo of the crop. (Source Reference: *Pravin Kohle and T N Munde, "Use of Drone for Efficient Water Management – A Case Study").* • Along with drones, many states are also leveraging satellite imaging for crop assessment. One such notable example is the Narmada Canal Project in Rajasthan (one of the PMKSY-AIBP projects) who are procuring satellite data using ISRO's NRSC Data	

Sl.no	Recommendations	Finding
	Centre (NDC) – UOPS portal for mapping of the Rabi season Land Use and Land Cover (LULC). Similarly, Vassar Labs helped the state government of Andhra Pradesh in developing agro-climatic zone mapping to optimize the cropping pattern along crop moisture, crop pest advisories and crop acreage estimation. Noteworthy examples in other sectors include Crop Cutting Experiments (CCE) conducted under Pradhan Mantri Fasal Bima Yojana by government of India in some states like Haryana, Karnataka, Madhya Pradesh and Maharashtra where multidate satellite remote sensing data was used to map particular crop area with ground truthing support. NRSC-ISRO also developed an Android app 'Bhuvan crop yield' for collecting CCE data with geographic location and field photographs. Such platforms may be leveraged for IPU assessment and data generated may be linked with the CADWM MIS dashboard, side by side with the 'CCA covered by field works' so as to reflect both the output and outcome of the scheme in the same portal. • It may be noted here that the Ministry has already initiated crop assessment studies using satellite images, in co-ordination with Bhaskaracharya Institute for Space Applications and Geoinformatics (BISAG) and drone pilot surveys in Bawanthadi project in Maharashtra. Once such assessment is completed, update of data in the MIS is suggested so as to bring more transparency regarding IPC-IPU gap data for the PMKSY-AIBP projects. It may be noted here that in the 21st Report of Standing Committee on Water Resources (2017-18) on 'Review of Accelerated Irrigation Benefits Programme', the committee urged the Ministry to reconcile the IPC and IPU data 'state-wise, year-wise and project-wise and maintain them at one place so as to have a holistic picture of the progress, actual gap between Irrigation Potential targeted, created and utilized'.	

Sl.no	Recommendations	Finding
CADWM -R13	**Outsourcing of non-core works to third party agencies** • In view of the limited resources in most of the CAD departments (as mentioned in detail in Sl. No. CADWM-F5 under 'Issues and Challenges' section), outsourcing of non-core/ non-technical seasonal works like water management below outlets, revenue assessment, billing and collection of water taxes to third party agencies/ part time contracts to retired personnel (considering retired departmental personnel may be well-acquainted with the department and local set-ups) may be explored. This becomes particularly pertinent in projects designed for single season/ 3-4 months' water supply (say only Rabi season). In such cases periodic contracts to third parties are expected to bring in greater efficiency.	CADWM -F5

2.2.2.2 Repair, Renovation & Restoration of Water Bodies

Repair, Renovation and Restoration (RRR) of water bodies, a sub-component of the programme 'Har Khet Ko Pane', was conceived during the XIth Plan to check the irrigation potential lost every year owing to non-use and/ or sub-optimal use of existing water bodies and irrigation tanks/ water storage systems. The scheme aims at increasing storage capacities of existing water bodies through comprehensive improvement and restoration. The scheme also encompasses rejuvenating traditional water storage systems like Jal Mandir in Gujarat, Khatri and Khul in Himachal Pradesh, Katas and Bandhas in Odisha and Madhya Pradesh, Dongs in Assam, Eri and Ooranis in Tamil Nadu, etc. As per the scheme guidelines, the scheme shall emphasize on development of catchment, de-siltation of tanks and command area development. The RRR of water bodies has been set a target of creation of irrigation potential and utilization of 1.5 lakh ha/ year during 2015-16 to 2019-20. In order to sustain the benefits accrued, the scheme also envisages building capacities of local communities and financially empowering the local water user groups to maintain the water bodies.

As stated in the scheme guidelines, RRR shall be accorded high priority in drought-prone areas. The scheme envisages developing an inventory of water bodies in villages and geo-map them to ensure that all the water bodies are put to maximum storage. This shall facilitate in meeting water demand for drinking, irrigation and other purposes during the off-rainy season along with recharge of groundwater. Additionally, during the monsoons they may act as a natural sink for storage of excess water thus mitigating surface run-off and incidence of flood.

Background

In India, traditionally water bodies like tanks, ponds and lakes have always played a significant role in conserving water to meet various needs of the communities particularly in monsoon dependant areas. In addition to sustaining agriculture, some of the water bodies also have significant religious influence. While the small water bodies/ tanks locally known as 'bundhis' are community owned, the large ones with command areas between 20 to 2,000 hectares are constructed by government bodies. As per the 3rd Minor Irrigation Census 2000-2001, 5.56 lakh tanks and storages act as minor irrigation sources with an estimated irrigation potential of 6.27 million ha. However, around 15% of these tanks become dysfunctional owing to inadequate

maintenance, encroachments, diversion of land, etc. thus leading to loss of irrigation potential to the tune of 1 million ha.

In order to restrict this reduction in irrigation potential, the GoI launched a pilot scheme of 'Repair, Restoration and Renovation of water bodies directly linked to agriculture' in January 2005 to be implemented during the remaining of Xth Plan with a total budget outlay of Rs. 300 Cr. (75% as Central Assistance and 25% by State Government). The scheme was sanctioned in 26 districts of 15 states covering 1,098 water bodies with an estimated additional irrigation potential 0.78 lakh ha[121] (thus roughly translating into budget outlay of Rs. 3,845/ ha of additional irrigation potential). Till 2008, 1085 of the water bodies were completed while the remaining 13 were dropped by the respective state governments. However, the total target irrigation potential of 0.78 lakh ha[122] was achieved by the scheme.

Table 41: RRR - budget outlays and target during Xth to XIIth Plan

#		Xth Plan	XIth Plan		XIIth Plan
			External Assistance	Domestic Budgetary Support	
1	**Budget**				
a	Outlay (in Rs. Cr.)	300	3,700	1,309	10,000
b	Centre: State split	75:25	NA	NA	90:10 (seven north eastern states and three hilly states) 60:40 (project benefitting special areas) 25:75 (non-special category)[109]
2	**Target**				

[121] http://pmksy-mowr.nic.in/rrr.html

[122] India Water Portal (2019), Background Note on Repair, Renovation and Restoration (RRR) of Water Bodies

#			Xth Plan	XIth Plan		XIIth Plan
a	No of water bodies		1,098	10,887	3,341	9,000 (rural) 1,000 (urban)
b	Irrigation potential (in lakh ha)		0.78	8.25	3.09	6.24
3	Budget/ additional potential*	1 (a) Cr.	300	3700	1309	10000
		2 (b) L Ha	0.78	8.25	3.09	6.24
		1 (a) x 100 / 2(b) Rs./Ha	38462	44848	42362	160256

**Data shared by Ministry of Water Resources, Rural Development and Ganga Rejuvenation*

In view of the success of the pilot scheme, the Ministry of Water Resources launched a State Sector scheme of Repair, Renovation and Restoration of water bodies with two components viz. one with external assistance and another with domestic budgetary support, during the XIth Plan. During the XIIth plan, the external and domestic components were merged into one and an additional Rs. 10,000 Cr. was allotted to the scheme. It may be noted that the Working Group of Minor Irrigation and Watershed Management recommended an outlay of Rs. 30,000 Cr. during the XIIth Plan; however, due to financial constraints, the budget outlay was restricted to Rs. 10,000 Cr. A comparison of budget outlays and targets for the RRR of water bodies during Xth to XIIth Plans is illustrated in the above table. As can be noted from the table, the budget allotted per additional ha of irrigation potential created substantially increased from Xth Plan to XIIth plan, thus pointing to government's priority for this scheme.

In 2013 the Adviser, Planning Commission has pointed to the need for achieving convergence with other schemes like IWMP, CAD & Ground Water Management while selecting water bodies

for RRR.[123] With the launch of PMKSY in 2015-16, the RRR of water bodies scheme got subsumed under Har Khet Ko Pani (HKKP) component along with two other schemes viz. CAD&WM and Surface Minor Irrigation to achieve more convergence. Under PMSKY, HKKP has been set a target of creation of additional irrigation potential of 21 lakh ha, out of which RRR of water bodies shall account for 1.50 lakh ha.

Performance

Currently 2,219 water bodies with a target irrigation potential of 1.88 lakh ha and target storage revival of 997.18 MCM are being implemented in 12 states across India. Of these a total of 1,395 water bodies (i.e. 63% of target) have been completed and irrigation potential of 0.99 lakh ha (i.e. 53% of target) and storage capacity of 504.85 MCM (i.e. 51% of target) has been restored as on March 2020.[124] State-wise details of the target and achievement (as on March 2019) are demonstrated in the figures below.

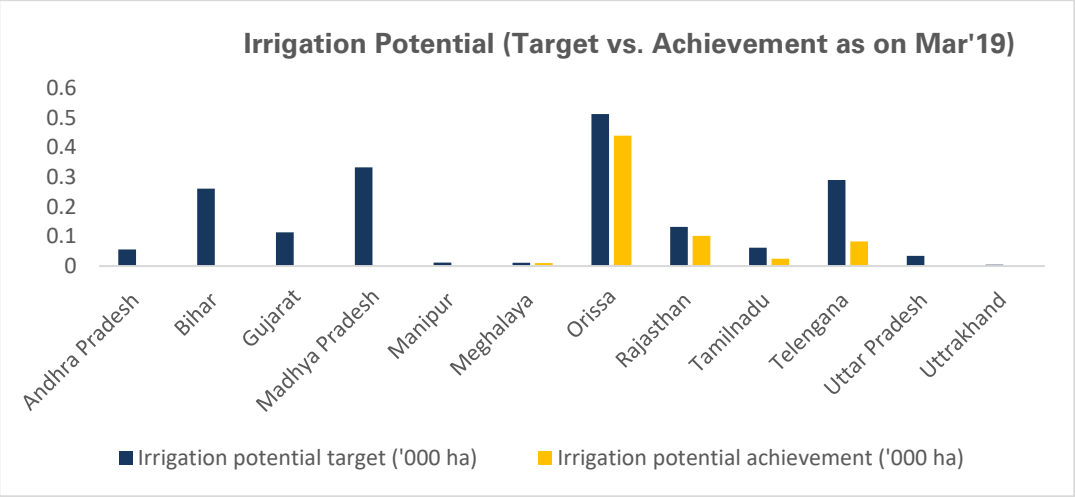


Figure 32: RRR – physical progress (irrigation potential)

[123] Cabinet note on Economic Affairs (September 2013), Approval for continuation of Repair, Renovation and Restoration of Water Bodies (RRR) in XII plan

[124] Data shared by SPR wing, Ministry of Jal Shakti

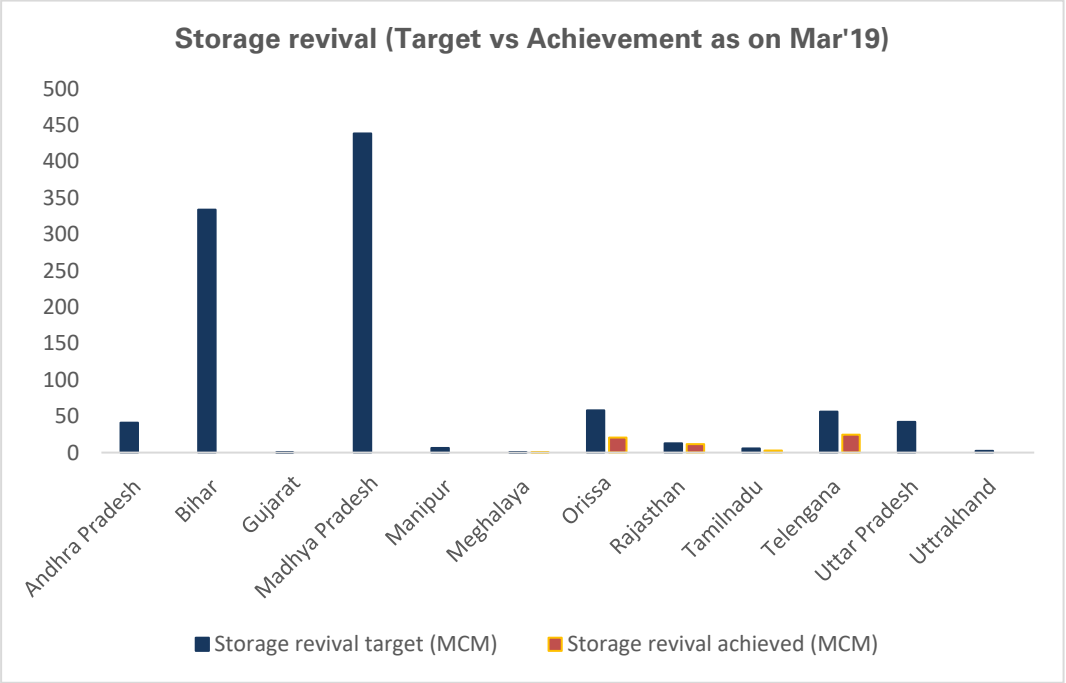


Figure 33: RRR – physical progress (storage revival)

From the above two figures it may be noted that among states with projects sanctioned prior to 2017-18, 3 states viz. Madhya Pradesh, Meghalaya and Rajasthan have achieved considerable progress (i.e. over 75%). None of the states for which projects were sanctioned last year (2018-19) viz. Andhra Pradesh, Bihar, Odisha and Tamil Nadu have made much progress. It may be noted that the scheme guidelines specify "*the works shall be completed within 2 financial years excluding the year of inclusion of water bodies under RRR*". However, 791 water bodies still to be completed stretches back to 2014-15 and 2015-16.

As on March 2020, around Rs. 925 Cr. has been incurred on works related to 2,219 water bodies with a total estimated cost of Rs. 1,911 Cr. The corresponding Central Allocation (as on March 2020) of Rs. 433.8 Cr. against the planned Rs. 1,120 Cr. has been released. Detailed state-wise figures are listed in the table below.

Table 42: RRR – financial progress (as on March, 2020)

#	State	Estimated Cost (in Rs. Cr.)	Expenditure (in Rs. Cr.)	Central Share (in Rs. Cr.)	CA released (till Mar'20) (in Rs. Cr.)
1	Andhra Pradesh	66.7660	0.0000	40.0596	2.7000
2	Bihar	161.9055	21.7002	89.4592	18.0750
3	Gujarat	102.9080	8.0467	61.7448	8.8125
4	Madhya Pradesh	183.2421	149.6600	93.0100	37.7000
5	Manipur	65.4420	16.9171	58.9000	34.6296
6	Meghalaya	11.4320	8.9922	10.2900	5.1830
7	Odisha	449.0250	326.1064	267.9360	110.6460
8	Rajasthan	187.8196	127.4535	86.7357	62.1840
9	Tamil Nadu	127.0620	70.2176	76.0865	32.9986
10	Telangana	459.1827	150.2400	272.0240	104.5593
11	Uttar Pradesh	83.4073	44.4131	52.9888	16.4087
12	Uttarakhand	12.4900	1.4077	11.2400	0.0000
13	**Total**	**1910.6822**	**925.1546**	**1120.4745**	**433.8967**

As expected, the states which incurred higher expenditure are ones which made higher physical progress. However, higher expenditure incurred may also be due to cost overruns owing to various reasons like delay in implementation, higher procurement cost, faulty design, etc. Thus, to get a better idea whether expenditure incurred was commensurate with the physical progress, expenditure incurred (as % of total estimated cost) is compared with percentage of physical progress (taken as average of percentages of achievement in irrigation potential and storage revival) as on March 2019. As evident from the figure below, states like Madhya Pradesh, Meghalaya, Rajasthan, Telangana and Uttarakhand have performed well from the perspective of cost effectiveness. From an all-India perspective, 50% of both irrigation potential and storage revival targets have been achieved while incurring only 38% of the total estimated cost.

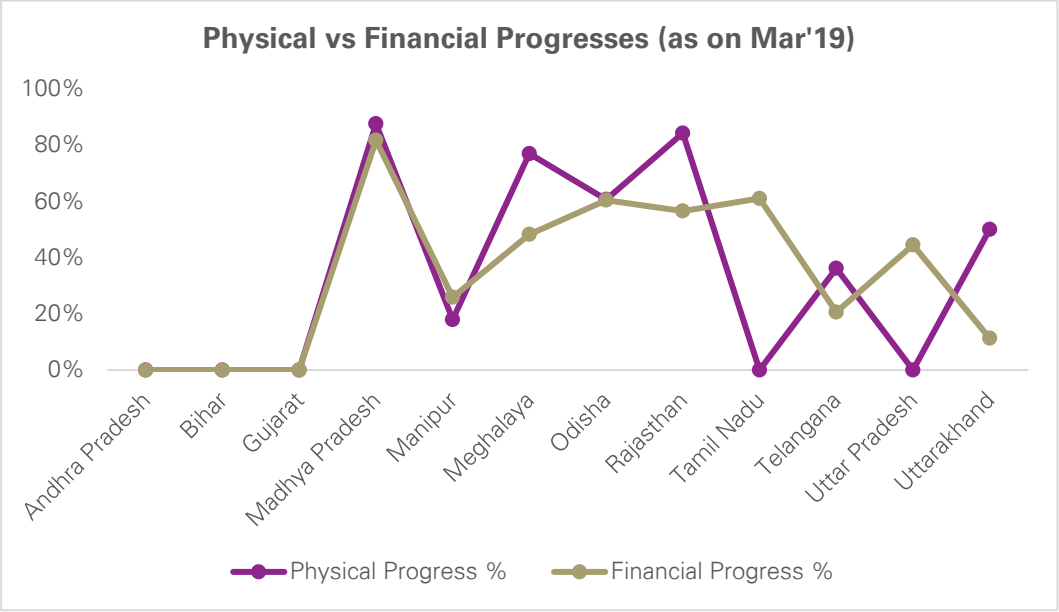


Figure 34: RRR – comparison of physical and financial progress

However, in spite of the physical and financial progresses, it is worth noting the comment by the Standing Committee on Water Resources in its Twentieth Report of Demands for Grants (2018-19) in relation to fund utilization: "It is further seen that in all the Central Schemes and Centrally Sponsored Schemes, the utilization of funds has been lower as compared to Revised Estimate during 2017-18." Also, the 'Note for Cabinet Committee on Economic Affairs (2013) - Approval for Continuation of Repair, Renovation and Restoration (RRR) of Water Bodies in XIIth Plan' further stated that "*there is general reluctance on the part of the States to seek external assistance for RRR of water bodies… the reluctance of the states need to be ascertained*"

Performance on REESI+E framework

Table 43: RRR – performance evaluation using REESIE framework

Parameter	Findings from research
Relevance	**Secondary:** • The system of water tanks has traditionally been critical for meeting the irrigation demands and overall management of water resources in India. Apart from aiding in sustaining agricultural and

<table>
<tr><th>Parameter</th><th>Findings from research</th></tr>
<tr><td></td><td>domestic water requirements, they also hold ecological, cultural and religious significance.
• However, the 5th Minor Irrigation Census report estimates a decline in surface flow minor irrigation scheme from 6,01,000 in 2006-07 to 5,92,000 in 2013-14. These schemes irrigate 4.89 million ha of land across 661 districts in the country Tanks/ ponds constitute largest share (41%) in these surface flow minor irrigation schemes.
• This recent deterioration of community-based tanks/ surface water bodies is largely attributed to reasons like continued ignorance of maintenance, siltation, urbanization, indiscriminate dumping on tank beds and encroachment of surface water system.[125] This has resulted in shift from community-based tanks to groundwater-oriented water resources system, leading to increased pressure on the latter.
• Out of 6881 groundwater assessment units across 17 states and UTs in the country, 1186 have been declared as 'overexploited' i.e. extraction beyond the safe yield.[126]
• The tenth report of the standing committee on water resources highlights the increasing incidence of urban floods owing to encroachment of water bodies.[127]
• The scheme objectives align with the following SDGs:
<table>
<tr><th>SDG Target</th><th>Scheme objectives</th></tr>
<tr><td>SDG 2.1: By 2030 end hunger and ensure access by all people, in</td><td>Enhancing irrigation potential through comprehensive</td></tr>
</table>
</td></tr>
</table>

[125] Background Note on Repair, Renovation and Restoration of Water Bodies (https://hindi.indiawaterportal.org/node/53526)

[126] Ministry of Jal Shakti reply to Lok Sabha on Depleting Ground Water on July 18, 2019 (http://www.indiaenvironmentportal.org.in/files/file/depleting%20groundwater.pdf)

[127] 'Repair, Renovation and Restoration of Water Bodies- Encroachment on Water Bodies and Steps Required to Remove the Encroachment and Restore the Water Bodies", tenth report of standing committee on water resources', Standing Committee on water resources, tenth report.

Parameter	Findings from research	
	particular the poor and people in vulnerable situations including infants, to safe, nutritious and sufficient food all year round	improvement and restoration of water bodies
	SDG 6.1: *By 2030, achieve universal and equitable access to safe and affordable drinking water for all.*	Increasing availability of drinking water through restoration of water bodies
	SDG 6.5: *By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate.*	Community participation and self-supporting system for sustainable management of water bodies
	SDG 6.6: *By 2030, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.*	Comprehensive improvement and restoration of water bodies.
	Primary: • The Key Informant Interviews with national, state and district level stakeholder across eight states: Andhra Pradesh, Bihar, Madhya Pradesh, Manipur, Meghalaya, Rajasthan, Tamil Nadu and Telangana	

Parameter	Findings from research
	highlight the reducing storage capacity of traditional water systems due to lack of maintenance and the importance of RRR for continued provision of water for irrigation and domestic needs. • In the drought prone areas of Rajasthan and rain-shadow regions of Andhra Pradesh, tanks are primary source for domestic and agricultural water needs. • Tanks have been traditionally serving as lifeline for the state of Telangana due to its geographical positioning, topography and rainfall pattern. Considering its significance for employment generation, agriculture and poverty reduction; RRR works are pertinent for the state. • While 19 tanks have already been taken under RRR in Betul district, Madhya Pradesh; there are 50 more tanks in the district which are more than 15 years old and require immediate inclusion under RRR to arrest further damage. • In hilly areas like Manipur and Meghalaya, tanks act as natural sinks for storage of excess water during rainy season, thereby reducing runoff and incidences of flooding. These states are prone to flash floods, which makes the infrastructure highly vulnerable, requiring frequent operations and maintenance. • Farmers in Tamil Nadu primarily depend on north-east monsoon for cultivation, which brings erratic, unpredictable and usually deficit rainfall. State highlights rehabilitation of minor irrigation tank as an absolute necessity to improve water use efficiency, particularly in drought prone regions. • Expedited scheme implementation is critical to ensure sustainable irrigation, particularly in groundwater overexploited regions. o Agriculture is the primary source of livelihood in Patna district of Bihar. The Son canal system serves the water needs of a limited area while most of the regions are dependent on rainfed agriculture. Hence, enhancement of storage capacity

Parameter	Findings from research
	in traditional water bodies like Ahar Pynes and its optimum management becomes important to continue cropping after Kharif season and reduce dependence on groundwater-based agriculture. o Out of 313 blocks in Madhya Pradesh, 105 are in grey/ black zone due to overexploitation of groundwater[128]. o In Vellore district, Tamil Nadu, 29% of the total 5,92,018 ha area is under cultivation: 52% rainfed and 48% irrigated. Out of 20 blocks; 14 are estimated as overexploited, 3 as critical while one is under semi-critical category with regards to groundwater.[129] Likewise, in drought-prone Virudhunagar district, though the cultivation is primarily dependent on north-east monsoon; water scarcity due to scanty rainfall and indiscriminate abstraction of groundwater, necessitates improvement of existing tank storage capacity to reduce agricultural susceptibility. • KIIs suggest scale up and further acceleration of RRR across all states. However, in Meghalaya the scope for expansion under RRR is limited as most of the water bodies are less than 5 ha in size and hence do not fulfil the scheme eligibility criteria. Therefore, the state is planning alternate 'Multipurpose Reservoir Project' with an objective to meet the irrigation needs, promote pisciculture and recreational activities; without any size constraint.
	Inference: • RRR scheme is appropriate to increase the storage capacity of existing surface water structures, thereby meet the agricultural and domestic water needs, particularly in drought prone and rainfed

[128] Agriculture Department, Government of Madhya Pradesh

[129] Data shared by district agriculture department, Vellore, Tamil Nadu

Parameter	Findings from research
	regions. It also serves to reduce dependence on groundwater and mitigate impacts of extreme climate events like droughts and floods. Based on relevance, the scheme may be categorised as 'satisfactory'.

Effectiveness	**Secondary:**
	• Scheme performance[130]
	  ○ Xth Plan:
	  ▪ Funding pattern: 75:25 (centre: state)
	  ▪ Water bodies completed:1085 out of 1098 (13 dropped off)
	  ▪ Grant released: Rs. 197.30 Cr.
	  ▪ Potential restored: 0.78 lakh ha
	  ○ XIth Plan:
	  ▪ With domestic assistance:
	  • Funding pattern
	  ○ Special category states: 90:10 (centre: state)
	  ○ General states: 25: 75 (centre: state)
	  • Physical and financial progress:
	  ○ Water bodies completed: 2501 out of 3341
	  ○ Funds utilised: Rs. 820.043 Cr.
	  ○ Potential restored: 1.24 lakh ha.
	  ▪ With external assistance:
	  • Funding pattern: 75% of the loan taken by the Government of India from World Bank and passed on to concerned states on back to back basis and is to be re-paid by the

[130] Presentation on RRR by Ministry of Water Resources, River Development and Ganga Rejuvenation

Parameter	Findings from research
	State. The balance 25% of the cost of the project as loan is taken as liability by Government of India and passed on to the states as 100% grant for the projects. o RRR under PMKSY: ▪ Funding pattern: • Special category states: 90:10 (centre: state) • General states: 25: 75 (centre: state) ▪ As on March, 2020: • Water bodies completed: 1350 out of 2219 (61%). • CA released: Rs. 433.89 Cr. against planned Rs. 1120.47 Cr. (39%). • Expenditure incurred: Rs. 925.15 Cr. against estimated 1910.68 (48%). • Potential restored: 0.99 lakh ha out of 1.88 lakh ha. (53%) • Independent evaluation of completed pilot scheme by Water & Land Management and Training and Research Institute (WALAMTARI), Hyderabad; National Remote Sensing Centre (NRSC), Hyderabad; Water Technology Centre (WTC), Bhubaneshwar; Centre for Water Resources Development and Management (CWRDM), Kerala confirms multiple positive outcomes of RRR like enhanced storage capacity and increased utilisation of water for irrigation.[131] • Other outcomes include expansion of area under irrigation, improvement in agricultural productivity, command area development, improvement in socio-economic conditions of

[131] Background Note on Repair Renovation and Restoration (RRR) of water bodies.

Parameter	Findings from research
	community, sustainable system for water body management through community participation and capacity building of WUAs and government agencies. • Though the scheme guidelines mandate completion within 2 years except the year of inception, 791 water bodies still to be restored/completed stretch back to 2014-15 and 2015-16.[132] • Positive factors impacting scheme performance: o **Convergence with other complementary schemes:** Implementation of RRR in Chittoor, Andhra Pradesh in a chain of tanks via training of 1383 CBOs and 610 WUAs in convergence with other complementary schemes likes "Neeru Pragati" and MGNREGA resulted in an increase in irrigation potential by 5,023 ha.[133] o **Community participation:** "Mission Kakatiya" was launched by the Government of Telangana in 2014 with an objective to enhance development of minor irrigation structures and promote community-based irrigation management. By March 2018, it was successful in restoration of 22,500 tanks, leading to outcomes like increased water storage capacity and enhanced on-farm moisture retention.[134] Through active community involvement in planning and motivating farmers to deposit silt in agricultural field; the project resulted in reduction of gap ayacut by 63%, agricultural diversification, reduced use of chemical fertilisers, enhanced on-farm water retention, improved soil

[132] Data received from Ministry of Water Resources, River Development and Ganga Rejuvenation

[133] Selected best practices in water management, August 2017, prepared by NITI Aayog with the support of Teri University

[134] Composite Water Management Index by NITI Aayog, August 2019 (https://niti.gov.in/sites/default/files/2019-08/CWMI-2.0-latest.pdf)

Parameter	Findings from research
	nutritive value and water accessibility to small and medium farmers. Additionally, it also led to development of fisheries and livestock, increase in groundwater levels and income augmentation of farmers.[135] ○ **Involvement of CSR/community and usage of mobile app for monitoring:** 'Gaalmukt Dharan Gaalyukt Shivar Yojana'[136] (silt free water reservoirs and silt applied farms) is an initiative by Maharashtra Government towards making it water secure and boosting agricultural income through activities like community-based tank desiltation under RRR and WDC, along with awareness generation for efficient water utilisation. While the state government provided fuel subsidy; machine rent cost was contributed by community/ pooled through CSR/ NGO funds. Desiltation resulted in increased water storage capacity in the tank, which lead to drought resilience, improved incomes and reduced water scarcity. At the same time, farmers could use the silt for free as organic manure, which improved soil quality, productivity and regional hydrology. • Negative factors that reduce scheme performance: ○ **Encroachment:** Standing Committee on Water Resources (2015-16) points out encroachment of water bodies as a major challenge, resulting in depletion of surface and groundwater resources. Encroachment has been further found to cause adverse impacts like flash floods (as in

[135] Selected best practices in Water Management, prepared by NITI Aayog with the support of Teri University, August 2017.

[136] Soil and water conservation Department, Government of Maharashtra 'Jalyukt Shivar Abhiyan'(http://cgwb.gov.in/Bhujal-manthan/bm3-file3.pdf)

Parameter	Findings from research
	Maharashtra & Uttarakhand) and drainage congestion leading to urban floods/ inundation. o **Budget constraints:** Commensurate CA could not be released for RRR projects in 2017-18 due to budget constraints.[137] • Institutional arrangement: at water body level - DPR preparation and monitoring is done by WUA/ local community; at the district level - proposal scrutiny and monitoring is done by DLIA at district and SLNA at the state level; proposal approval is done by STAC, SLSC and monitoring is undertaken by CWC (field office); at the centre: approval and monitoring is the responsibility of M/o JS and CWC. • As per CWMI 2019, most of the states don't maintain individual project level data and only maintain cluster/ state level data. • Scheme guidelines specify engagement of community members and capacity building objectives; but no indicators are tracked in this regard.
	Primary: • Scheme performance: o Out of eight states assessed under primary study, five have performed well under PMKSY-RRR: Madhya Pradesh, Meghalaya, Rajasthan, Tamil Nadu and Telangana. However, projects are yet to be completed in Andhra Pradesh, Bihar and Manipur. o Completion of RRR projects in Bhilwara district, Rajasthan have extended irrigation to the tail-end, unlike earlier years. The irrigation command area has increased from 40% to 65-

[137] Standing committee on Water Resources (2017-18), Sixteenth Lok Sabha, Ministry of Water Resources, River Development and Ganga Rejuvenation, Demands for Grants (2018-19) (http://164.100.47.193/lsscommittee/Water%20Resources/16_Water_Resources_20.pdf)

Parameter	Findings from research
	75%. Furthermore, 4 out of 9 dams have stored water even after completion of 3 watering under Rabi season. For instance: Shakargarh dam has 50% water stored even after 3 irrigation cycles as headworks taken up under the project prevent leakages. Based on HH survey, 54% respondents validate increase in surface water storage after completion of RRR works in Rajasthan. o Groundwater dependence is continued in parts of Andhra Pradesh and Bihar to meet irrigation and domestic needs, leading to depleting water table. With enhancement in living standards of people, groundwater utilisation has increased in Bihar. On the other hand, in Manipur and Meghalaya groundwater abstraction has not begun yet due to low demand and lack of technical knowledge. o Out of 65 works sanctioned under RRR in Vellore district, Tamil Nadu, 64 have been completed while 1 had to be dropped off due to overlap with an existing scheme. Though these projects particularly target critical blocks of the district and are expected to positively impact on-farm water availability and agriculture; its effectiveness is yet to be ascertained as these projects were completed in 2019, which was a drought year. o In Meghalaya 8 out of 9 projects have been completed under RRR while 1 was dropped off because the actual cost of physical work exceeded the estimated cost. o In Madhya Pradesh, 125 projects were sanctioned under PMKSY-RRR and all of these have been completed. In the last five years, RRR along with schemes like PDMC has aided in increased irrigation potential from 50% to 64%, reduced

Parameter	Findings from research
	power consumption towards irrigation and aided in groundwater recharge in critical blocks. o As per district authorities in Betul district, Madhya Pradesh; completion of 19 works under RRR have led to reduction in evaporation and transmission losses by 20%. Additionally, lining of canal has also reduced its susceptibility to damages. However, KII with Chairman, WUA indicates that lining works are incomplete and have not been sanctioned despite sending proposals. In Damoh district, Madhya Pradesh completion of RRR works has increased the irrigation potential utilisation by 2-8 times. o Out of 575 water bodies included under RRR in Telangana with an estimated cost of Rs. 459.7 Cr., 371 have been completed at an expenditure of Rs. 163.07 Cr. Works are under progress in 173 water bodies while they have not started yet in 27 due to delays in administrative/ tendering process. Most of these water bodies are included in drought prone and Naxal affected areas. State, district and village level stakeholders unanimously agree on the effectiveness of RRR in agricultural diversification and groundwater recharge. Though these tanks have been designed to serve crop-water needs during Kharif season, some of these were able to sustain water for Rabi season too. • Based on HH survey, it may be inferred that RRR is successful increasing groundwater level, irrigated land, crop yield, crop intensity and land productivity in Rajasthan and Madhya Pradesh. • In states like Andhra Pradesh, Bihar, Rajasthan, Tamil Nadu and Telangana, priority is given to special category areas, which includes drought prone/ tribal/ flood prone and/or under desert

development programme, due to higher central share in comparison to other parts of the state.

- Positive factors impacting scheme performance:
    - **Convergence with other complementary schemes and interdepartmental coordination:**
        - 'Mission Kakatiya' in Telangana complements RRR scheme, such that 575 tanks included under RRR are not included under Mission Kakatiya. However, Mission Kakatiya has much greater scope than RRR with 40,000 tanks included in the former.
        - In Patna district, Bihar, RRR scheme is complemented by 'Jal Jeevan Hariyali Abhiyan', a state sponsored scheme, which has aided in coordination between Water Resources Department, Minor Irrigation Department and Panchayati Raj Department of the state; resulting in quick action on issues like encroachment. As a result, RRR works were completed in record time of 3 months in Bihar. This has generated a system of tapping rainfall, resulting in 60-70% of water requirement being met by surface water bodies. Additionally, in critical blocks, there has been a significant increase in groundwater table in the last two years. The state has also developed an online documentation system to avoid any duplication of activities.
    - **Community participation:** State Irrigation Department, Telangana highlights that despite having exactly same components as RRR, 'Mission Kakatiya' is a greater success due to active involvement of the community. Likewise, RRR projects in West Garo Hills, Meghalaya are a success owing to aware and active community. In contrast, village level stakeholders in Patna district, Bihar stress that non-

Parameter	Findings from research
	involvement of local community during DPR preparation has led to technical issues in scheme design, which limits it from realizing its true potential. ○ **Participatory planning:** Participatory planning is done in Bhilwara district, Rajasthan after the water is available through RRR. People of the command area and WUAs get together on the notified date and take decision on prioritising water distribution, considering the water available. • Negative factors that reduce scheme performance: ○ **Waste discharge by municipalities:** Works in Nagdi canal, Bhilwara district, Rajasthan got delayed as it passes through the middle of a town and is prone to encroachment and waste discharge by municipalities. However, the state has taken it up and plans to complete work by September end. ○ **Encroachment:** Whilst Ministry of WR, RD and GR in its response to Standing Committee of Water Resources (2017-18) stated "water bodies are considered under RRR programme after State Government gives certificate that they are encroachment free"; as per the current scheme guidelines such certificate is issued during the release of second instalment. Hence encroachment continues to be a major issue delaying project implementation across Andhra Pradesh, Bihar, Madhya Pradesh, Manipur and Meghalaya. In Manipur, encroachment by fishing society resulted in a 4-year delay. Likewise, in Bihar, 11 projects are still on hold because of the encroachment issue. In parts of Betul district, Madhya Pradesh; farmers have encroached canal area for agricultural and domestic purposes.

Parameter	Findings from research
	However, in rural Rajasthan, 'Nadi' and 'Talab' are given special treatment. Since these are very small water bodies and hold cultural and religious significance, state claims there are no issues of encroachment/ discharge of waste. ○ **Cumbersome administrative procedures and delays in budget provisioning:** Central share was released timely in Madhya Pradesh, Meghalaya, Rajasthan and Telangana while delayed fund allocation was observed in Andhra Pradesh, Bihar, Madhya Pradesh, Manipur and Tamil Nadu due to cumbersome administrative process; which deters scheme performance. For instance: Second instalment for 125 water bodies sanctioned under RRR in Madhya Pradesh was requested by the state in 2016 but the completion of administrative procedures, including submission of non-encroachment certificate and audit of the expenditure incurred took until February 2017. However, scheme guidelines had been revised by then and central: state share changed from 90:10 to 60:40 for special category areas. Since state had already completed works in 119 water bodies by then, central share was released for 6 remaining projects only while state had to bear 100% cost for the rest. Similarly, while first instalment of central assistance (Rs. 512.79 and Rs. 409.56) was received by Tamil Nadu in March 2016; the state has not received second instalment till date. In this regard, centre has informed the state that expenditure incurred cannot be reimbursed. For tanks included under Phase III in the state, release of second instalment got delayed by 11 months (i.e., proposal sent on March, 2019 but CA released on February, 2020)

Parameter	Findings from research
	○ **Preference of private irrigation system over community-based irrigation:** CWC regional officials in Telangana highlight preference of farmers to dig wells near their command area due to provision of free electricity in the state. Likewise, in Madhya Pradesh, electricity is easily available and there is a shift towards micro-irrigation. Hence, farmers prefer private irrigation despite higher cost. ○ **Non linkage with Micro-irrigation:** Efficient utilization of irrigation potential created under RRR is limited by non-linkage of RRR to micro-irrigation.[138] In Bhilwara district, Rajasthan, 10% of command area is mandatorily under micro-irrigation through drip/sprinkler under state specific restoration scheme funded by World Bank and JICA. However, RRR doesn't have any similar provisions to improve water use efficiency. ○ **Lack of coordination between agriculture and irrigation department during scheme implementation:** The participation of agriculture department under RRR is limited to conducting SLSC meetings and calculation of B-C ratio. Agriculture and Horticulture department, Madhya Pradesh point out non-involvement of agriculture department during scheme implementation to limit realization of holistic outcomes. ○ **Limiting scheme design:** ▪ States like Andhra Pradesh, Manipur, Meghalaya, Rajasthan and Telangana face difficulty in undertaking more relevant projects under RRR due to cost capping at Rs. 2.5 lakh/ha. Particularly for hilly areas like Manipur and Meghalaya, water bodies

[138] Agriculture and Horticulture department, Madhya Pradesh

	are small and sites are often inaccessible through roads. This increases the expenditure under transportation/ labour but proposals with higher estimates get rejected by the centre. ▪ Though scheme guidelines mandate completion of work in two years (excluding the year of inclusion), states in hilly areas often need to seek extension since working period is limited to 4-5 months only due to rains. State level stakeholders in Madhya Pradesh also highlight the difficultly in completing scheme on time as the effective working period is limited to 3 months between April to June i.e. post-irrigation period. ▪ Detailed hydrological information mandatorily needed during DPR preparation is seen as a hindrance as it is often unavailable/ difficult to obtain for small water bodies in Andhra Pradesh. ▪ Several levels of approvals are needed before scheme sanctioning: State Level Nodal Agency (SLNA) followed by Technical Advisory Committee (TAC) and State Level Sanctioning Committee (SLSC). This often leads to delays in states like Meghalaya and Rajasthan. ▪ The criterion for inclusion of water bodies with minimum water spread area of 5 ha in rural areas and 2-10 ha in urban areas is seen as a major challenge by state and district level stakeholders in Meghalaya and Telangana. Smaller size of most water bodies limits Meghalaya from including water bodies in regions of water scarcity where RRR works are of utmost importance.

	▪ The constitution and roles of District Level Implementation Agency (DLIA) is not clear in the scheme guidelines. However, it is headed by District Magistrate and formed in all states except Meghalaya. Stakeholders in Rajasthan pointed out the challenges faced while convincing DLIA towards inclusion of water bodies in DIP, often leading to delays. It has also been highlighted that RRR is a continuous process and it is difficult for the states to propose all works to be included in the next 5 years under DIP. ▪ Owing to torrential rains in Meghalaya, upstream lands often get submerged after implementation of RRR. Since there is no mechanism for compensation under the scheme guidelines, local communities are reluctant towards RRR works. ▪ The storage capacity of Arvad dam, Bhilwara district, Rajasthan has been estimated to reduce from 47.79 MCM to 12.26 MCM due to establishment of Rampura Agucha mines in 1984. Since 29 villages are dependent upon the dam for fulfilling their agricultural and domestic needs; restoration works have been proposed under multiple schemes including RRR, NABARD and RWSLIT. However, they have been rejected each time on grounds of hydrological dependability criteria. District estimates that even at less than 50% dependability, the dam sustains agricultural yield worth 7.5 Cr. each year. They further emphasize the dire need to restore the tank, considering the water scarcity in the region, which is so severe that army has to be called in each time there is water in the tank.

Parameter	Findings from research
	▪ CWC Regional office is involved during techno-economical appraisal of DPR, monitoring and forwarding financial proposal to Ministry of Jal Shakti. However, presence of only one regional office for all north eastern states poses a challenge, considering difficulties involved in travel, thereby delaying scheme implementation as pointed out by stakeholders in Manipur. ▪ CWC officials in Telangana highlight that unlike medium and major projects, specific guidelines on DPR preparation are not available for RRR projects. • Monitoring is done at three levels across all states: by Panchayats/WUAs, state government and CWC field office. States face no challenge in this regard. • As per HH survey, an increase in surface water storage was confirmed by 31% farmers while 27% indicated an increase in engagement in agricultural activities as a result of RRR works. Though 57% farmers farmer are dependent on surface water for irrigation after completion of RRR, 29% continue to be dependent on groundwater (n= 172).
	Inference: • Both secondary literature and KIIs across national, state and district level emphasize the effectiveness of RRR in meeting its objective. This is further validated by HH survey, indicating an increase in irrigated land, crop yield, crop intensity, land productivity, drinking water availability and groundwater storage after completion of RRR. However, most of the general category states are unable to take relevant projects under RRR due to fund constraints and much higher proportion of state share. • While community participation and convergence with complimentary schemes positively impacts scheme effectiveness; it is deterred by

Parameter	Findings from research
	factors like delayed/ inadequate fund release, encroachments, waste discharge by municipalities, cumbersome administrative process, farmer's preference for private irrigation and lack of interdepartmental coordination. Hence, the scheme effectiveness has been categorised as 'average'.
Efficiency	**Secondary:** • Proposals sent under RRR need to specify Benefit-Cost ratio of 1:1 for special category states and more than 1 for non-special category states. • Guidelines mandate convergence with Integrated Watershed Management Program (IWMP) through selection of water bodies with overlapping catchment area. However, there are no details on the implementation structure.
	Primary • The Benefit-Cost (B-C) ratio, which is mandatorily included in DPR considers only irrigation potential created, based on inputs received from agriculture department. It does not take other benefits from the scheme like provisioning of drinking water through PHED, groundwater recharge and socio-economic benefits into account. However, improved availability of drinking water after RRR has been highlighted by 37% respondents during HH survey in Rajasthan. o Non-inclusions in B-C ratio makes it difficult for districts like Jaisalmer to take water bodies under RRR because no irrigation potential is created but revival of water bodies is of

	tremendous importance, particularly for domestic purposes and groundwater recharge. o In Rajasthan, the revenue generation after RRR activities is more substantial through domestic and industrial water supply than irrigation. For instance: In Bhilwara district, Rajasthan, Fisheries Department generates a revenue of Rs. 30-40 lakh per tank per annum. Likewise, in Andhra Pradesh, the constraint of B-C ratio >1 makes it difficult for the state to undertake small waterbodies under RRR due to creation of limited irrigation potential. However, the state points out the significance of including these water bodies under RRR owing to several other purposes being fulfilled by these water bodies like groundwater recharge, which are included under scheme objectives too. • Whilst scheme guidelines mention prioritisation of ODF towns/ villages and areas covered under Saansad Adarsh Gram Yojana; this parameter is not considered by the states during site selection. • Strict convergence with IWMP is considered by all states except Meghalaya and Madhya Pradesh, where RRR projects have been completed but watershed component has not been implemented yet since these projects were initiated before 2015. In Rajasthan, this restriction limits the scope of work under RRR as no work has been undertaken under IWMP since 2015-16. For instance: In Sirohi district, Rajasthan, a project had to be pulled back at the state level despite high significance because the water body exists in middle of a forest, where implementation of IWMP is not possible. • After provisioning of assured irrigation under RRR, farmers in Madhya Pradesh have shifted from monsoon dependent soybean to water intensive paddy, considering 5-7 times higher productivity in

Parameter	Findings from research
	the latter. HH survey further confirms that majority of farmers continue to grow water intensive crops like paddy since it is profitable and has higher demand. However, it has been pointed out during KIIs that after 2-3 cropping seasons of continuous water availability, farmers become aware and start using water more judiciously. • Though dependency on flood irrigation continues after completion of RRR works, controlled irrigation though direct outlets has replaced uncontrolled irrigation in parts of Madhya Pradesh. State agriculture department further highlights growing awareness amongst farmers and shift towards water efficient agriculture like micro-irrigation, particularly in medium irrigation schemes. • As per HH survey, an increase in incidences of waterlogging as a result of RRR works has been indicated by 47% respondents in Rajasthan (n= 113) and 16% in Madhya Pradesh (n=59).
	Inference: • The scheme efficiency is impacted by selection criterion of mandatory IWMP implementation and prevalence of traditional practices like flood irrigation to grow water intensive crops like paddy. • Many proposed water bodies are unable to fulfil the B-C ratio > 1 criterion because the calculations are largely based on creation of irrigation potential. The numerous other functions fulfilled by the water bodies, particularly in desert prone areas are not considered while determining the B-C ratio. • Whilst HH survey indicates an increase in surface water storage as a result of RRR works; it also indicates an increase in waterlogging incidences. Hence, under efficiency, the scheme may be rated as 'average'.
Sustainability	**Secondary:**

Parameter	Findings from research

	• Scheme guidelines mention WUAs to earn revenues by charging its members, but no detailed provisions/ mechanism for financial sustainability are stated.
	• As per 5th Minor Irrigation census, surface flow schemes have highest percentage of temporarily not in use (9.4%) and permanently not in use (2.9%) water bodies.
	  o The primary reasons behind temporary non-usage of surface water scheme includes 'less discharge of water' (32.9%), 'storage not filled up fully' (23.2%) and 'channel break down' (9.2%).
	  o Permanent non-usage of surface water schemes is attributed to 'dried up' (35.1%) and 'destroyed beyond repair' (5.1%) water bodies.
	• The increasing incidences of drying up of water bodies may be attributed to an increase in average annual temperature (0.48 degrees) and decline in average rainfall (26mm) between 1970 and 2016.[139]
	• Factors like rapid urbanisation, encroachment and discharge of sewage/ waste into the drains are also detrimental to scheme sustainability.

	Primary: • Rainfall is regarded as critical to scheme sustainability across, Andhra Pradesh, Bihar, Manipur, Madhya Pradesh and Rajasthan. • Repercussions of climate change have been observed across all states. For instance: In Madhya Pradesh, there has been an increase

[139] The Economic Survey (2017-18)

	in periods of dry spells, which requires supplementary irrigation even during monsoon period while in Manipur. • No provision for O&M poses a major threat to scheme across all states, particularly in hilly areas, where siltation is a continuous phenomenon. Though water is a state subject; Andhra Pradesh, Manipur, Meghalaya, Rajasthan and Telangana have pointed to non-availability of adequate funds under O&M as the major reason for having to include these water bodies under RRR at the first place. • Though the scheme guidelines mention WUAs to charge for its services and build up corpus for maintenance and management of water bodies; there are no details on its implementation structure. o The KIIs in Rajasthan highlight WUAs to be functioning well near perennial water source in Rajasthan. However, they are working as per the state specified guidelines: 50% of the collected revenue is returned to WUAs for undertaking their works. Revenue directly generated through irrigation under RRR schemes is low due to water bodies being small in scale. State specific provisions on the functioning of WUAs are as per Rajasthan Farmers Participation Act, 2018. In practice, WUA is unable to charge for livelihood generating services like fisheries due to lack of interdepartmental coordination. o In Bhilwara district, Rajasthan, WUAs could not be created for 3 tanks as they are 250-300 year old structures and it is difficult to obtain revenue map of the command area. o While O&M works are undertaken by Madhya Pradesh state government, tax is recovered from the farmers based on number of watering per season. However, farmers are reluctant to contribute and there are large pending dues in this regard. WUA is incentivized at Rs. 120/ha by the state government but this is regarded as inadequate for annual maintenance works by both district irrigation authorities and

Parameter	Findings from research
	WUAs. The chairman of WUA, Madhya Pradesh further highlights that the area is inhabited by marginal farmers who are not capable for undertaking O&M works on their own. o In Meghalaya, WUAs are formed for all completed projects under RRR. Though they are involved in water distribution and management; they lack in financial capability towards O&M and instead contribute via labour for minor maintenance works while major works continue to be funded by the state government. o In Tamil Nadu, WUAs are formed but currently non-active since their 5-year tenure is over and the state is unable to conduct elections due to Covid situation. • HH survey in Rajasthan and Madhya Pradesh indicates only 17% respondents are aware of the presence of registered WUA in the command area (n= 172).
	Inference: • Scheme sustainability is dependent on climatic factors: rainfall and temperature, which directly affects discharge in the water bodies. • Scheme design ensures presence of WUAs for operations and maintenance of water bodies refurbished under RRR works. However, the secondary data, KIIs and HH survey indicates that WUAs are non-existent/ exist at conceptual level only, with no details on its framework, management and financial sustainability. Therefore, under sustainability, RRR may be categorised as 'average'.
Impact	**Secondary:** • The anticipated impact of the scheme includes increase in employment, improvement in socio-economic conditions like increase in health levels, literacy level, women empowerment, social harmony and decrease in distress migration.

Parameter	Findings from research
	• Community based tank management in Karnataka led to increase in income by Rs. 8,015/ year for an average land holding of 0.75 ha. Improvement and increase in irrigation coverage led to intensification and diversification of irrigated agriculture, generating additional farm employment of 8,050 persons per year. This has helped in poverty alleviation for 17% of the population. Additionally, irrigated area and water volume increased by 20% and 44% respectively. Though there was some rise in groundwater levels, groundwater abstraction also increased by 42%.[140]
	Primary: • Out of 8 states assessed, RRR works under PMKSY has been completed in Rajasthan, Bihar, Madhya Pradesh, Meghalaya, Tamil Nadu and Telangana. Though the guidelines mention post implementation evaluation and impact assessment studies to be done by MoWR/CWC, no such studies have been done under HKKP-RRR. KIIs across all states confirm creation of irrigation potential, generation of employment, reduction in power consumption and enhanced agricultural productivity as a result of RRR. • The district irrigation officials of Betul district, Madhya Pradesh confirm increase in food grain production by 1.5 times as a result of improved irrigation through RRR and other schemes. Furthermore, it has also led to income augmentation, agricultural diversification, improvement in education and overall socioeconomic development of the community. The KII with Chairman, WUA further validates this. • In Deora Gram Panchayat, Patna district, Bihar, restoration of Ahar-Pyne system has not only reduced soil erosion; but also replaced

[140] Background note on Repair Renovation and Restoration (RRR) of Water Bodies

Parameter	Findings from research
	groundwater dependence of the farmers, leading to increase in groundwater level from 35 ft to 15 ft below ground. • The HH survey further validates an increase in groundwater level, income, education and employment, as a result of RRR works.
	Inference: • Though the guidelines mention post implementation evaluation and impact assessment studies to be done by MoWR/CWC, no such studies have been done under HKKP-RRR. • The secondary data indicates multiple positive impacts of the scheme, including increase in income, generation of employment, women empowerment and increase in groundwater table. • The KIIs and HH data further validates this change. Hence, under impact, the scheme may be categorised as satisfactory.
Equity	**Secondary:** • Scheme guidelines propose higher percentage of Central Grant for north-eastern, hilly states, KBK states, tribal and flood prone areas. Project proposals are required to provide details of SC/ST people benefitted. • Independent studies by WALAMATRI, Water Technology Centre for Eastern Region confirmed increased water utilization and benefits to farmers & SC/ST families. • Cabinet note recommends not to affect the rights of the existing users/ communities during repair, renovation and restoration stage.
	Primary: • KIIs across all states indicate equitable distribution of water resources under RRR. • In parts of Sirohi district, Rajasthan, influential beneficiaries in the head region of the tank have monopoly over water usage during scarcity. However, in other areas like Bhilwara, 60-70% beneficiaries in the command area belong to SC/ST/OBC communities and there

Parameter	Findings from research
	are no concerns relating to equity. Few issues which arise are resolved by WUAs. • Instances of SC, ST and other weaker sections of the society not getting equal access to water were earlier prevalent in Bihar. However, with handing over of water bodies to Gram Panchayats, such problems have been completely resolved. In Madhya Pradesh, KII with chairman, WUA, Betul district validates equitable access to water after completion of RRR works. • With the introduction of Rajasthan Farmer Participation in Management of Irrigation Systems Act, 2018, women participation in WUA needs to be ensured at 50%. However, this is yet to be implemented on ground. Absence of women in WUAs was further highlighted by 97% respondents during HH survey across Rajasthan and Madhya Pradesh (n= 30).
	Inference: • The scheme has provisions favouring equity like higher central grant for north-eastern, hilly and flood prone states. • Most of the states further confirm equitable distribution of resources post scheme implementation. However, there have been occasional instances of few influential individuals having monopoly in water scarce region of Rajasthan. • There are no provisions favouring gender equity in scheme guidelines. The HH data and KIIs indicates absence of women in WUAs. Considering all these factors, the scheme may be categorised as 'average' under equity.

A summary analysis and performance of the scheme on the identified themes is presented below:

Table 44: RRR - summary of performance evaluation using REESIE framework

Parameter	Performance
Relevance	🟢
Effectiveness	🟡
Efficiency	🟡
Sustainability	🟡
Impact	🟢
Equity	🟡

REESI+E performance infographics legend

🟢 Satisfactory 🟡 Average 🔴 Needs Improvement ⚪ No information

Performance on cross-sectional themes

Table 45: RRR - performance evaluation using cross-sectional themes

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
1.	Accountability & Transparency	Monitoring Mechanisms Citizen Accountability	• Scheme parameters like number of water bodies created/ restored, CCA covered, MCM storage restored and financial progress are tracked on PMKSY-RRR dashboard, which in available in public domain. • Institutional arrangement - DPR preparation and monitoring is done by WUA/ local community; proposal scrutiny and monitoring is done by DLIA at district and SLNA at state level; proposal approval is done by STAC, SLSC and monitoring is undertaken by CWC (field office), at the

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			centre level: approval and monitoring is the responsibility of M/o JS and CWC. • Only irrigation potential and storage revival parameters are tracked on MIS portal while the scheme has several other outcomes, corresponding to its objectives, like groundwater recharge. • As per CWMI 2019, most of the states don't maintain individual project level data and only maintain cluster/ state level data. • There is no mechanism to ensure financial sustainability of WUAs.
Summary Analysis: The is a gap in output-outcome parameters currently being tracked under RRR. Though institutional structure has a provision to ensure citizen accountability through WUAs, there is no mechanism to ensure its institutional and financial sustainability.			
2.	Direct/Indirect Employment Generation	Employment generation	• Generation of direct and indirect employment under RRR can be attributed to the following outcomes: Increase in agri-allied employment: Increase in agricultural productivity, groundwater level, soil moisture, drought proofing, additional irrigation potential, increase in agriculture/ horticulture/ pisciculture production and

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			productivity, removal of weed growth and promotion of tourism. • To ensure financial sustainability, other commercial activities like selling of silt as organic manure and tourism activities may be promoted. • Community based tank management in Karnataka has helped in generating additional farm employment of Rs. 8,050 per person per year.[141] • The KIIs across all states further confirm generation of employment as a result of scheme implementation.
Summary Analysis: The primary and secondary data indicates generation of direct and indirect employment as a result of scheme implementation.			
3.	Gender mainstreaming	Inclusiveness in scheme design/planning	• There are no provisions favouring gender mainstreaming in the scheme guideline document. • The KIIs indicate non-involvement of women in WUAs across all states. The household survey further validates absence of women in WUAs in Rajasthan and Madhya Pradesh. However, in hilly states (e.g. Meghalaya, Uttarakhand),

[141] Background note on Repair Renovation and Restoration (RRR) of Water Bodies.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			women are actively involved in agriculture and allied activities.
Summary Analysis: A gap in scheme design, considering inclusiveness can be seen, which limits gender mainstreaming.			
4.	Climate change & sustainability including adoption of climate-change resilient practices & diversification	Climate resilience Climate impact	• Creation of additional storage through RRR aids in building resilience against extreme climate events like droughts and floods. • However, erratic rainfall pattern (excess rainfall, less than normal rainfall, abrupt interval) poses a major risk to scheme sustainability, which is unaddressed under current scheme guidelines. It directly affects discharge which leads to temporary/permanent non-usage of water bodies. • Repercussions of climate change have been observed across all states. For instance: In Madhya Pradesh, there has been an increase in periods of dry spells, which requires supplementary irrigation even during monsoon period.
Summary Analysis: Though climate change factor is critical to scheme sustainability, it is unaddressed under the current scheme guidelines. RRR also aids in building climate resilience to some extent by creating additional storage.			
5.	Use of IT/Technology	Deployment of IT enabled mechanisms for	• In Maharashtra, project progress under 'Gaalmukt Dharan Gaalyukt Shivar Yojana', was monitored using mobile app.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
	in driving efficiency	monitoring of the Schemes Use of latest technology to improve efficiency and effectiveness of scheme implementation	• Usage of GIS has aided in effective scheme implementation in states like Telangana and Manipur. For instance: Manipur is utilising GIS technology, which has aided in mitigating overlap with similar schemes. • While geotagging of photograph is done in Rajasthan, gap with regards to usage of latest technologies like Remote Sensing and GIS has been observed in the state. Likewise, usage of GIS is yet to be initiated in multiple states like Meghalaya.
Summary Analysis: Use of latest technology is pertinent for efficient scheme implementation. However, under RRR its current utilisation is limited to few states only.			
6.	Research & Development	Fund Allocation, challenges in undertaking R&D efforts, any Best Practices	• No specific funds are earmarked for R&D as per the scheme guidelines. • Previous research has shown lining material to significantly affect storage, water losses and benefit-cost ratio. For instance: lining with LDPE agrifilm reduced seepage losses by 94.7%, lining with 200 GSM UV resistant polyethylene film commonly known as Silpaulin was found to hinder storage and percolation losses.[142]

[142] Smuel and Mathew, 2008, Rejuvenation of Water Bodies by Adopting Rainwater Harvesting and Groundwater Recharging Practices in Catchment Area-A Case Study (https://www.researchgate.net/publication/229045738_Rejuvenation_of_Water_Bodies_by_Adopting_Rainwater_Harvesting_and_Groundwater_Recharging_Practices_in_Catchment_Area-A_Case_Study)

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			• More research on localised low-cost technologies for lining could aid in enhancing scheme effectiveness by increasing benefit-cost ratio. • Research institutes like IITs/ IISc, Indian Council for Agricultural research, National Academy of Agricultural Research Management and state agriculture universities could be involved in such studies.
Summary Analysis: Though no funds are earmarked for R&D under the scheme, research on localised low-cost technologies for canal lining under RRR through involvement of national and regional research organisations could aid increasing scheme effectiveness.			
7.	Stakeholder and Beneficiary behavioural change	Fund Allocation Mechanisms to promote and ensure behaviour change Challenges faced	• The scheme envisages capacity building of implementing agencies such as Ministry of Water Resources, River Development & Ganga Rejuvenation (MoWR, RD & GR) and its attached and subordinate offices, State Governments, District Implementing agencies, Water Users' Associations (WUAs) and Panchayats. Accordingly, a capacity building programme aimed at sensitization of stakeholders, identification and selection of water bodies, monitoring and evaluation is to be prepared and included in the DPRs.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			However, there are no indicators to track the same. • Poor maintenance of water bodies often leads to siltation and encroachment issues. Primary research found that encroachment is a major issue across Andhra Pradesh, Bihar, Manipur and Meghalaya. RRR works got delayed by 4 years due to encroachment by fishing society in Manipur. • Though few states like Telangana and Madhya Pradesh conduct capacity building and awareness generation activities, KIIs and HH survey indicates the scheme has not been able to bring significant behavioural change amongst beneficiaries as the farmers continue to be primarily dependent on groundwater for irrigation, while majority of farmers continue to cultivate water intensive crops like Paddy.
Summary Analysis: The primary and secondary data indicates the scheme has been unable to bring stakeholder and beneficiary behavioural change.			
8.	Conjunctive use of water	Challenges and awareness	• Though scheme objectives include conjunctive use of surface and groundwater, no indicators are tracked in this regard.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			• KIIs highlight provision of RRR has reduced dependence on groundwater in most states. However, HH survey in Rajasthan and Madhya Pradesh indicates 29% farmers continue to be dependent on groundwater for irrigation even after completion of RRR works. • Parts of Rajasthan adopt conjunctive water use planning at WUA level through participatory planning and water budgeting.
Summary Analysis: Though conjunctive use of water resources in an objective under RRR, no indicators are tracked in this regard. However, water budgeting is done at WUA level in parts of Rajasthan.			
9.	Unlocking Synergies with other Government Program	Convergence (Inter-Ministerial/Inter-Departmental/Financial/Human Resource/Administrative/Institutional/ Schemes	• As per RRR guidelines, proposals of only those water bodies in which the catchment area treatment works have already started or are proposed to start shall be included under the scheme. This is considered across all states except Madhya Pradesh, Meghalaya and Tamil Nadu where RRR works initiated before 2015. • States like Rajasthan see IWMP criterion as a factor limiting scheme implementation. • Some of the scheme objectives overlap with other state sponsored schemes like pond restoration works undertaken by

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			Urban & Rural development departments, AMRUT and JNNURM. • The scheme guideline highlights preference to be given to water bodies in villages or towns covered under 'Saansad Aadarsh Gram Yojana' or those that are declared as ODF. However, KIIs indicate that this criterion is not considered while project prioritisation. • Lack of coordination between agriculture, irrigation and fishery department was observed in Rajasthan, which reduces scheme efficiency. • Limited coordination between agriculture and irrigation department during scheme implementation limits realization of holistic benefits.
Summary Analysis: While the scheme design adequately addresses convergence across departments, states see this as a challenge limiting scheme implementation. Lack of coordination between agriculture, irrigation and fishery department further minimises scheme effectiveness.			
10.	Impact on and role of private sector, community/ collectives/ cooperatives (e.g. Farmer	What is the percentage of private investment in the clusters/programs run by the government?	• The scheme guidelines point out that NGOs could play a role in implementation, planning and execution of the scheme, subject to state government's decision.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
	cooperatives, FPOs, Water User Associations, etc.) and civil society in the scheme	How many private sector, community/collectives/cooperatives and civil society have availed the benefits under any Scheme?	However, as per KIIs, no such activities are being carried out. • The onus of scheme operations and maintenance lies with the WUAs but there is no defined mechanism to ensure the same. • Though WUAs are active in parts of Rajasthan, there is a reluctance to start off unless they see water continuously for few seasons. • Alternate model case study: Maharashtra's 'Gaalmukt Dharan Gaalyukt Shivar Yojana' is an initiative by Maharashtra Government towards making it water secure and boost agricultural income through community-based tank desiltation. While the state government provided fuel subsidy, machine rent cost was contributed by community/ pooled through CSR. Farmers could use the silt for free as organic manure, which improved soil quality, productivity and regional hydrology. Desiltation resulted in increased water storage capacity in the tank, which lead to drought resilience, improved incomes and reduction in water scarcity.
Summary Analysis:			

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			Secondary data indicates success stories with respect to involvement of community/ collectives. KIIs highlight while limited involvement of community in operations and maintenance through WUAs.

In addition to the above themes, no information was found for 'Development, dissemination & adoption', 'Research & Development' and 'Reform, Regulation' while 'Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population' and 'Water sharing treaties/agreements & diplomacy' are not relevant for the scheme.

A summary analysis and performance of the scheme on the identified themes is presented below:

Table 46: RRR - summary of performance evaluation using cross-sectional themes

Parameter	Performance
Accountability & Transparency	🟡
Direct/Indirect Employment Generation	🟢
Gender mainstreaming/Inclusiveness	🟡
Building resilience to climate change (including but not limited to developing water disaster preparedness) & ensuring sustainability	🔴
Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population	⚫
Use of IT/Technology in driving efficiency	🟡
Stakeholder and Beneficiary behavioural change	🟡
Development, dissemination & adoption	⚪
Research & Development	⚪
Water sharing treaties/agreements & diplomacy	⚫
Conjunctive use of water - surface versus groundwater usage optimizations	🟡
Unlocking Synergies with other Government Program	🔴

Parameter	Performance
Reforms, Regulations	●
Impact on and role of private sector, community and civil society in the scheme	●

Cross-sectional themes performance infographics legend

● High ● Medium ● Low ● Not relevant ● No information

Issues and challenges

This sub-section describes the scheme issues and challenges and their mapping with the source of information viz. primary source, secondary source and household survey (if applicable).

Table 47: RRR – issues and challenges

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
RRR - F1	Site selection under RRR	• The scattered nature of site selection under PMKSY has been highlighted by agriculture department in Madhya Pradesh, which limits realization of scheme outcomes.			
RRR-F2	Limiting scheme guidelines	• **Central-State funding:** ○ 'Note for Cabinet Committee on Economic Affairs (2013) - Approval for Continuation of Repair, Renovation and Restoration (RRR) of Water Bodies in XIIth Plan' highlights reluctance amongst states to seek assistance under RRR. ○ The KIIs across Andhra Pradesh, Rajasthan, Madhya Pradesh and Telangana			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		indicate much higher state share in comparison to the centre share i.e. 25 (Central): 75 (state) in general category states as primary reason behind this reluctance. ○ As a result, site selection under RRR is primarily based on proportion of central funds being received and irrigation deprived regions in general category states remain excluded. • **Size restriction** ○ The scheme guidelines restrict inclusion of water bodies with minimum water spread area of 5 ha in rural areas while 2-10 ha in urban areas. This has been pointed out as major limitation by states like Meghalaya and Telangana. Particularly in Meghalaya, most of the water bodies are less than 5 ha in size and need RRR works not only to enhance access to assured irrigation, but also to arrest impacts of flash floods.			
RRR-F2	Increasing dependency on groundwater	• A noticeable shift has been observed among farmers from community-based tank system to individual			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		beneficiary-oriented groundwater-based structures due to free/easy access to electricity, quick creation and year around water supply. • As per 5th Minor Irrigation Census, the ratio between IPU to IPC for surface water schemes has reduced (0.71) while that for groundwater has increased (0.8). • KIIs validate preference of farmers for groundwater-based structures in Andhra Pradesh, Bihar and Telangana during unavailability of surface water resources. With enhancement in living standards of people, groundwater abstraction rates have increased, leading to depletion of water table in parts of Bihar. • Household survey across Madhya Pradesh and Rajasthan further highlights continued dependence of 29 % farmers on groundwater, even after provisioning of surface water through RRR (n= 172).			
RRR-F4	Scheme sustainability: Climatic uncertainties	• Erratic rainfall pattern poses a major risk to scheme sustainability, which is unaddressed under current scheme guidelines. The frequency and intensity of rainfall is predicted to further shift on account of climate change.			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		• Rainfall is regarded as critical to scheme sustainability across all 8 states: Andhra Pradesh, Bihar, Madhya Pradesh, Manipur, Meghalaya, Rajasthan, Tamil Nadu and Telangana. The 5th MI census further finds low discharge in water bodies due to deficit rainfall and droughts as a major reason behind permanent non-usage of water bodies.			
RRR-F5	Social risk: Encroachment and affecting rights of existing users	• Standing committee on Water Resources, 2015-16 highlights encroachment as a major constraint to scheme implementation. It has been found to further contribute to adverse impacts like flash floods. • As per current guidelines, states are required to submit certificate indicating absence of encroachment before the release of second instalment. As a result, encroachment by fishing society resulted in delay in scheme implementation by 4 years in Manipur while in Bihar, 11 schemes are on hold due to encroachment. • Farmers in Meghalaya often oppose RRR works as it disrupts their system of transportation. Moreover, unlike major irrigation schemes, there is no			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		mechanism for compensation under RRR. Though the cabinet note recommends not to affect the rights of existing users during scheme implementation, there is no mechanism to ensure the same.			
RRR F6	Poor Water Use Efficiency	• One of the objectives of RRR is introduction of sustainable water conservation practices. However, states usually carry out conventional irrigation practices like flood irrigation after water is provisioned under RRR. • States like Bihar, which are dependent on agriculture as primary source for livelihood opt for traditional water intensive crops like paddy even in water scarce areas. • Household data depicts majority of farmers continue to grow water intensive crop like Paddy due to greater profit and higher demand after completion of RRR works. An increase in incidences of waterlogging has also been highlighted by 47% and 16% respondents in Rajasthan (n= 59) and Madhya Pradesh (n= 113) respectively.			
RRR-F7	Delays in fund release and	• Delayed/inadequate fund release was observed in Andhra Pradesh, Manipur, Madhya Pradesh, and Tamil			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
	cost capping criterion	Nadu, thereby significantly slowing the scheme progress. • For instance: While first instalment of central assistance was received by Tamil Nadu in March 2016; the state has not received second instalment till date. In this regard, centre has informed the state that expenditure incurred cannot be reimbursed. Similarly, for tanks included under Phase III, release of second instalment got delayed by 11 months. • States like Andhra Pradesh, Manipur, Meghalaya and Rajasthan face difficulty in undertaking more relevant projects under RRR due to cost capping at Rs. 2.5 lakh/hectare.			
RRR-F8	Cumbersome administrative processes	• DPR preparation is a cumbersome exercise requiring hydrological data, benefit-cost ratio and several levels of approvals, including appraisal from CWC regional office. • Project sanctioning has taken as long as 4-5 years in Rajasthan. Relevant projects have been rejected multiple times due to non-fulfilment of hydrological dependability criteria. • Due to delays in release of second instalment for administrative reasons and changes in scheme guidelines			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		midway, Madhya Pradesh had to bear 100% cost of 119 works under RRR. • Considering the hilly terrain and difficulties involved in travel, a single CWC regional office catering to all north-eastern states is inadequate.			
RRR-F9	Non- Inclusions in Benefit-Cost ratio	• Revenue generation from domestic and industrial water supply after completion of RRR projects is much higher compared to irrigation. However, the current checklist for B-C ratio, included in DPR, takes only irrigation potential into account, despite the scheme having multiple other benefits like groundwater recharge and provisioning of drinking water. Since the B-C ratio does not fully account for all the benefits that flow from the scheme, it limits taking up projects under RRR (e.g. Andhra Pradesh, Rajasthan, Telangana). • Districts like Jaisalmer are unable to implement RRR because creation of irrigation potential is not possible in such areas, though revival of water bodies is of tremendous importance, particularly for drinking water and groundwater recharge.			
RRR-F10	Lack of funds for O&M	• States like Andhra Pradesh, Manipur, Meghalaya, Madhya Pradesh and			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		Rajasthan have pointed to non-availability of O&M funds as the major reason for having to restore waterbodies under RRR in the first place. Further, current scheme guidelines do not include provision of designated fund allocation for O&M.			
RRR-F11	Involvement of WUAs and financial sustainability	• The onus of O&M is on WUAs but there is no defined mechanism to ensure the same. • Though WUAs are active in parts of Rajasthan, there is a reluctance to start off unless they see water continuously for few seasons. At most of the places, their involvement is limited and need based. • Revenue generated through irrigation under RRR schemes is insufficient for O&M low due to them being at small scale. • Based on HH survey, presence of WUA in the command area was confirmed by mere 17% of the respondents (n= 172). While 41% of the beneficiaries are currently paying to access water from restored bodies, 86% of those are willing to continue to pay to access water.			
RRR-F12	Convergence with IWMP	• The mandate for inclusion of only those water bodies which have been treated/ are proposed to be treated			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		under Integrated Watershed Management Program, poses a hurdle in taking relevant projects in Andhra Pradesh and Rajasthan. • At several instances, projects were sent back (e.g. Rajasthan) owing to non-fulfilment of this criterion. The state claims it to be an unnecessary constraint reducing the scope of the scheme as no projects have been taken in parts of Rajasthan under IWMP since 2015-16.			
RRR-F13	Project Implementation structure and limited working period	• The constitution and role of District level Implementation Agency is not described in the scheme guidelines. Its current role is limited to including work under DIP in Rajasthan. • Limited working period, particularly in hilly states like Manipur and Meghalaya, prevents completion of project in two years (excluding the year of inclusion), as mandated by the scheme guidelines.			
RRR-F14	Need for project inclusion under DIP	• Approval under RRR requires project to be included in the District Irrigation Plan (DIP). However, DIP is prepared for a 5-year period while restoration of waterbodies under RRR is a continuous process. Therefore, it is			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		not feasible for states to anticipate and include all works under DIP. • Furthermore, there is no provision to include emergency maintenance works (say, from droughts/floods) under RRR.			
RRR-F15	Database maintenance and monitoring	• There is a lack of transparent database on the status of water bodies and zones/ areas with critical water bodies. • Only irrigation potential and storage revival parameters are tracked on MIS portal while the scheme has several other outcomes, corresponding to its objectives like groundwater recharge.			
RRR-F16	Output-Outcome Framework	• Output-outcome framework mentions no separate outcome for each objective. Additionally, outcome targets like IPU, additional IPC and WUA formation are not tracked at RRR scheme level. • Though guidelines mention evaluation and impact assessment of the schemes to be done by independent agencies identified by CWC/ MoWR; no activities have been carried out by the centre in this regard.			

Issue relevance legend

	Supported		Partially supported		Not supported		Not applicable

A summary analysis of issues & challenges for the scheme is presented below:

Table 48: RRR – summary of issues and challenges

Parameter	Performance
Institutional Mechanism and governance	🟡
Fund flow efficiency and utilization	🔴
Unavailability of resource persons	🟢
Capacity building	🟡
Monitoring and evaluation	🔴
Encroachment of surface water bodies	🔴

Performance infographics legend

🟢 Satisfactory 🟡 Average 🔴 Needs Improvement

Recommendations and solutions

This sub-section describes the scheme recommendation and solutions from the perspective of scheme design, scheme implementation and monitoring & evaluation, along with their mapping with the issues and challenges described in the preceding sub-section.

Table 49: RRR – recommendations and solutions

Sl.no	Recommendation	Finding
Scheme design		
RRR - R1	**Phase-wise site selection** • Considering the scattered nature of scheme implementation under RRR; area-wise phased planning, with due consideration to existing schemes in the catchment area is suggested for it to realize maximum benefits.	RRR-F1

Sl.no	Recommendation	Finding
	• Project prioritisation within the scheme should be defined such that, most irrigation deprived districts are targeted first. Furthermore, within these districts, waterbodies in catchments with rainfed farm holdings could be the primary focus. • Since the scheme has a close alignment with HKKP-SMI, scheme rationalization has been proposed to enhance physical access to water on farm, improve sustainability and accountability (detailed description in Section 2.2.2.3, SMI – R1).	
RRR-R2	**Revising scheme guidelines** • To address the reluctance amongst states to seek funds under RRR, centre state ratio (25:75) needs to be reconsidered. • Size restriction of including water bodies with minimum water spread area of 5 ha in rural areas needs to be removed, particularly for hilly areas, where most of the water bodies are smaller in size (e.g. Meghalaya). • It is suggested to increase the capping of Rs. 2.5 lakh/hectare to Rs. 5 lakh/hectare to ensure inclusion of smaller water bodies. • The constitution and role of DLIA needs to be defined in the scheme guidelines. It could serve as a medium to ensure interdepartmental convergence rather than different departments working in isolation.	RRR-F2, RRR-F7, RRR-F13
RRR-R3	**Conjunctive water resources management: Participatory planning** • Post scheme implementation, conjunctive use for surface and groundwater resources may be ensured through participatory planning by the WUAs and Gram Panchayats.	RRR-F3

Sl.no	Recommendation	Finding
	• In groundwater vulnerable/critical blocks, change in operational policy to retaining storage /forgoing cultivation could be considered, based on local hydrogeology and aquifer characteristics to revive water table • **Case study: Technical strategies to operate minor and medium irrigation schemes towards improving groundwater systems:** Water balance and economic feasibility modelling was carried out in 185.23 km^2 aquifer in Vavuniya, Sri Lanka. It found that forgoing cultivation under minor and medium irrigation schemes by 25-35% would replenish 45-65% loss of water tables in 80-90% of the catchment area in the consecutive season. An additional reduction in boundary permeability by 40-50% lead to reduced transmissivity and recovery of 60-70% loss in water table in nearly 95% of area under consideration. Economic analysis indicated gain in water table to reduce cost of energy, thereby increasing economic cultivation per unit irrigation water.[143]. • Based on community consensus, water available each season may be prioritised for drinking, irrigation, other livelihood generating activities like fisheries and industrial use through water budgeting exercise.	
RRR-R4	**Building climate resilient irrigation** • Power subsidies that favour indiscriminate abstraction of water resources need to be reduced/removed. These may be	RRR-F4

[143] Sivakumar, 2013; Conjunctive Use of Surface and Groundwater to Improve Food Productivity in Vavuniya District in the Dry Zone Area (https://www.researchgate.net/publication/247773415_Conjunctive_Use_of_Surface_and_Groundwater_to_Improve_Food_Productivity_in_Vavuniya_District_in_the_Dry_Zone_Area)

Sl.no	Recommendation	Finding
	replaced by direct benefit transfer, as initiated by Telangana and Odisha. • Towards achieving the objective of groundwater recharge and increased availability of drinking water along with building climate resilience; scope of work under RRR may be enhanced further to include percolation tank and waterbodies used for drinking water/ other community purposes. • Water bodies may be connected to adjacent canal system so that excess flood waters may be stored in these canals when water demand for irrigation is comparatively less. This would reduce the incidences of flooding while additional water stored may be gainfully utilized for irrigation and other allied purpose during dry season.	
RRR-R5	**Ascertaining extent of encroachment and ensuring its removal before commencement of RRR** • As recommended by Standing Committee in its tenth report (16th Lok Sabha), survey of water bodies to assess their size, condition and status of encroachment needs to be carried out. • To ensure there is no encroachment, domestic/industrial discharge in proposed water bodies, a certificate may be issued by the Gram Panchayat before inclusion of water bodies under RRR instead of waiting till the release of second instalment. It may also be checked through active involvement of stakeholders at grassroot level since planning stage.	RRR-F5
RRR-R6	**Mandating micro-irrigation to improve water use efficiency** • Towards realisation of the scheme objective: introduction of sustainable water conservation, water efficient irrigation techniques like micro-irrigation should be mandatory in 10-20% of irrigation potential created through RRR.	RRR-F6

Sl.no	Recommendation	Finding
	• This is critical not only to improve water-use efficiency, but also to reduce expense on fertilizers and enhance agricultural productivity.	
RRR-R7	**Revising phased process of DPR approval** • Given the volume and spatial spread of RRR works, preparing tank-wise DPR is time consuming and particularly challenging for areas where working season is limited. If the repair is not attended on time, the damage and thereby cost increases and agriculture gets affected. • An estimate duly explaining the necessity of RRR works in respective water bodies, as had served the purpose in RRR Phase-II could be considered to speed up the process. Since these are not new works, the whole process of study stipulated for DPR preparation and phased approval might not be necessary.	RRR-F8
Scheme implementation		
RRR-R8	**Revision in B-C ratio checklist** • Given that the scheme objectives are not limited to creation of irrigation potential; other factors like provisioning of drinking water, groundwater recharge, livelihood generation activities like pisciculture and other direct-indirect benefits of the scheme should also be considered while calculating B-C ratio. The checklist for calculation needs to be revised accordingly.	RRR-F9
RRR-R9	**Mechanism for O&M by WUAs** • WUAs and local people should be involved in the project since inception, to inculcate feeling of ownership within the community. Their understanding of local topographical condition needs to be appreciated and considered during project planning.	RRR-F10, RRR-F11

Sl.no	Recommendation	Finding
	• Use of water body by the villagers for economic benefits through activities like fisheries may be encouraged. Assured income generation may motivate the villagers to protect the water bodies, which may ultimately contribute to water security in the region. • Revenue generation mechanism for WUAs should be defined in detail. For instance: A proportion of revenue generated through activities like fisheries, drinking water provision, agriculture undertaken in restored water bodies may be utilised to generate funds for O&M. • Provision of handholding support to WUAs in the initial 5-year period through active involvement of CSR/NGOs/public sector would help in strengthening them further. • Regular maintenance of the scheme could also be ensured through collective efforts and 'shramdan'. • Social monitoring of water bodies involving Local Bodies/ Water User Associations should be encouraged at village level.	
RRR-R10	**Removing condition of strict convergence with IWMP** • Though strict convergence with IWMP was created with the intention to ensure source sustainability, it is restricting states (e.g. Rajasthan) from including deserving projects under RRR. Guidelines may be revised to remove such a constraint.	RRR-F12
RRR-R11	**Exempting pre-listing of RRR works in DIP** • Listing of the RRR proposals in DIP as a pre-requisite for approval under PMKSY needs to be reconsidered as unlike new projects, RRR works may arise as per necessity due to damages from natural calamities and need early attention to arrest further damage. In such a scenario, inclusion of works	RRR-F14

Sl.no	Recommendation	Finding
	in a 5-year plan as specified in DIP or anticipating needs for RRR works may not be practical. • Considering the damages that occur to tanks every year, priorities may change, and the DIP may need modifications from time to time. Accordingly, this condition of 'pre-listing to be included in DIP' may be reviewed and exempted for effectively addressing the RRR scheme objectives.	
Monitoring and evaluation		
RRR-R12	**Linking GIS imagery on India-WRIS to HKKP-RRR MIS** • To assess and compare the condition of restored water bodies over the years after completion, GIS imagery obtained on India-WRIS may be linked to RRR dashboard. GIS based imageries at different time periods/ month may be used to assess and compare the condition of restored water bodies over the years after project completion.	RRR-F15
RRR-F13	**Need for additional CWC regional office for north-eastern states** • There is a need to have additional CWC branch office in north eastern region, considering the difficult terrain and having a single regional office for all north eastern states being inadequate. • Since CWC branch office plays critical role in techno-economical appraisal of DPR and sending financial proposals to Ministry of Jal Shakti, this would speed up the scheme implementation and ensure effective monitoring.	RRR-F8
RRR-R14	**Tracking outcome parameters on RRR dashboard** • There is a need to evolve format and procedures to carry out post project evaluation. The output- outcome framework and objective based outcomes should be tracked at RRR scheme level.	RRR-F16

Sl.no	Recommendation	Finding
	• Apart from currently tracked irrigation potential created and storage revived; additional indicators (mainly outcome based) corresponding to scheme objectives like groundwater level, agricultural productivity, capacity building, water use efficiency, revenue generated through allied activities like fisheries, domestic and industrial water supply obtained could also be tracked to understand holistic benefits accruing from the scheme. The parameters currently tracked by other departments in few states (e.g. groundwater recharge is monitored by regional groundwater board/ state groundwater board) may be directly integrated to the existing dashboard.	

2.2.2.3 Surface Minor Irrigation

Surface Minor Irrigation (SMI) was initiated in 1999-2000 as a part of AIBP package to cover projects with irrigation potential less than 2000 ha in Special Category states. The scheme was later extended to areas under DPAP, tribal, desert prone, flood prone, naxal afflicted and Koraput, Bolangir and Kalahandi (KBK) districts of Odisha. With the launch of PMKSY in 2015-16, SMI got subsumed under the Har Khet Ko Pani programme. The programme covers individual schemes with CCA more than or equal to 20 ha. (10 ha for Special Category states) or a cluster of Minor Irrigation schemes within a radius of 5 km covering CCA of 50 ha. (20 ha for Special Category states) or more.

Background

The water-stressed situation has been found to create gaps in irrigation coverage, resulting in a difference of 20% (23 million ha) between IPC and IPU. This, in addition to water loss throughout irrigation value chain, critically impacts food production. Since XIIth Plan, 6213 SMI projects were taken up; out of which 3386 were completed (i.e. 54%) till March 2020. A total CA of Rs. 7299 Cr. has been released since XIIth Plan, which includes CA release of Rs. 665 Cr. during 2017-

18.[144] Also, the budget estimate (BE) for SMI and RRR in 2017-18 and 2018-19 was Rs. 450 Cr. and Rs. 300 Cr. respectively. However, it was increased in the revised estimate (RE) because there were many ongoing pending proposals under SMI/RRR for which the CA could not be released because of budget constraint. Hence, the RE for SMI and RRR in 2017-18 and 2018-19 was Rs. 745 Cr. and Rs. 750 Cr. respectively. To promote timely completion, the guidelines mandated freezing of the estimated cost at the time of project inclusion and completion of project in two years from the start of disbursal of CA (excluding the first year of release).

The institutional arrangement is as follows:

Table 50: SMI – institutional arrangement

Level 1	Level 2	Level 3
Scheme level	**State level**	**Central level**
• **DPR preparation in consultation with PRI and implementing state department**	• Techno-economic feasibility to be approved by State Technical Advisory Committee (STAC) (having representatives from both CWC and CGWB) • SLSC to sanction after STAC approval • Final proposal to be sent to MoWR jointly by state and regional/ field offices of CWC	• Programme to be monitored by MoWR through Central Water Commission

Stated Objectives of the Scheme

The scheme aims to achieve the objectives of PMKSY i.e. enhanced physical access of water on farm, expanded cultivable area under assured irrigation, improvement of farm water-use

[144] MoWR (2017 – 18), Annual Report 2017 - 18

efficiency and introduction of sustainable water conservation practices, through surface minor irrigation.

Funding details of the Scheme-Budget Amount-Centre-State split

The funding pattern of the scheme is listed in the table below:

Table 51: SMI – funding pattern (Centre-state split)

#	Category	Funding Pattern	
		Centre	**State**
1	Seven North-Eastern states including Sikkim and, three Hilly states (Himachal Pradesh, Jammu and Kashmir and Uttarakhand)	90	10
2	Project benefitting special areas i.e., undivided Koraput, Bolangir and Kalahandi (KBK) districts of Odisha, Bundelkhand region of UP and MP, Marathwada and Vidharbha region of Maharashtra, Naxal affected areas, DPAP areas, Tribal areas, Flood prone area, Desert Development Programme (DDP) areas	60	40

The scheme guidelines not only include favourable funding pattern for Special category states but has also incorporated several other provisions to ensure inclusiveness. The guidelines mandate consultation with Panchayat Raj Institutions at the time of proposal submission.

Broad list of Projects and Beneficiary States

A total of 5,801 SMI schemes across 16 states are ongoing. Out of these, 2804 (i.e. 48%), schemes have already been completed. Details of beneficiary states is presented in the table below.

Table 52: SMI - beneficiary states with targets

States	Targeted Schemes	Targeted Irrigation Potential	Estimated cost	Targeted Central Share
	Nos.	(in '000 ha)	(in Rs. Cr.)	(in Rs. Cr.)
Arunachal Pradesh	919	42	716	645
Assam	1,010	423	4,975	4,478
Bihar	176	76	352	274
Chhattisgarh	147	51	722	433
Himachal Pradesh	154	26	499	449
Jammu and Kashmir	417	112	1,278	1,150
Jharkhand	82	9	75	56
Karnataka	465	39	595	456
Madhya Pradesh	276	111	1,817	1,192
Manipur	102	13	170	153
Meghalaya	260	41	703	632
Mizoram	36	2	42	38
Nagaland	704	29	520	468
Sikkim	381	12	115	104
Tripura	21	4	47	43
Uttarakhand	651	42	521	469
Total	**5,801**	**1,033**	**13,148**	**11,040**

Performance

Physical progress

Under the SMI – HKKP (PMKSY) scheme, 5838 SMI schemes with total irrigation potential of 10.5 lakh ha. have been taken up. Till March 2020, 3386 schemes have been completed and an

estimated irrigation potential of 6.77 lakh ha i.e. 64% of the targeted potential has been created. State-wise progress, as on March 2019 is further highlighted in the figure below:

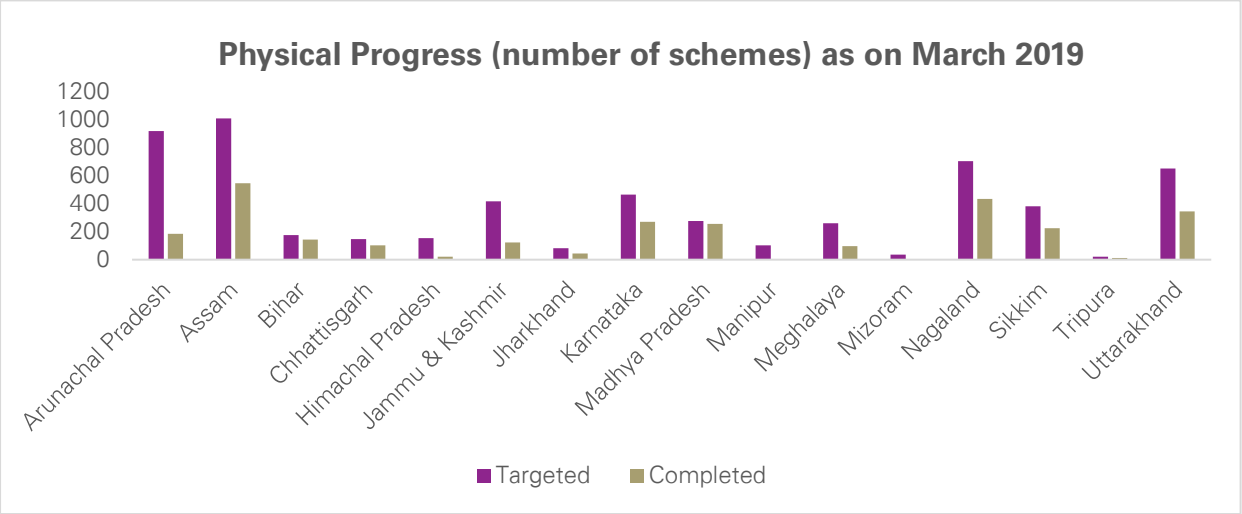


Figure 35 SMI-State-wise physical progress (number of schemes) as on March 2019.

As can be noted from Figure 35, among the general category states, Bihar, Chhattisgarh and Karnataka while among the North-eastern and hilly states, Nagaland, Sikkim and Uttarakhand have made considerable progress. It is interesting to note that in many states, particularly in Chhattisgarh, Jammu and Kashmir, Karnataka, Nagaland, Sikkim and Uttarakhand, percentage achievement of target additional irrigation potential is much greater than that of target schemes completed (Figure 36).

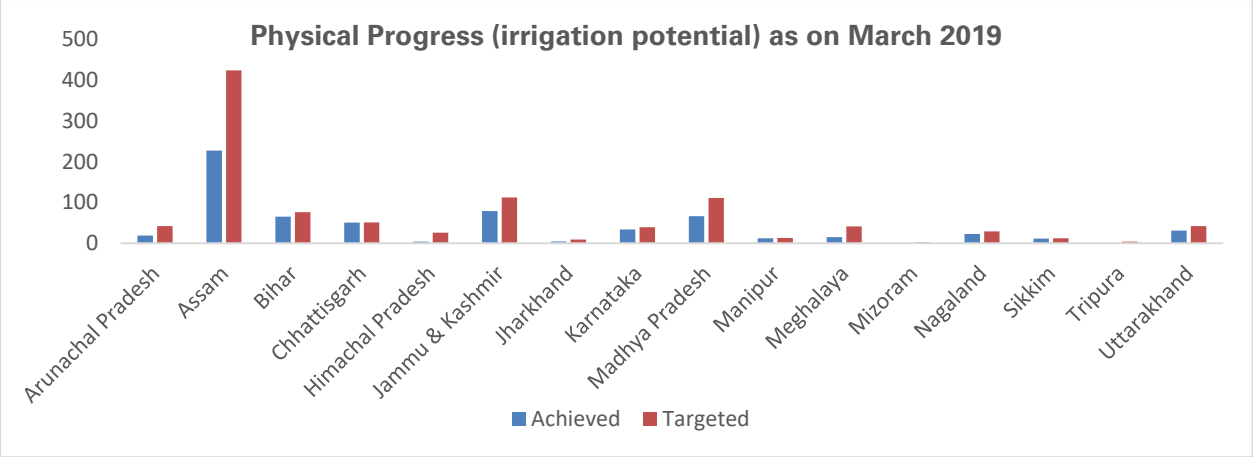


Figure 36: SMI-Physical Progress (irrigation potential) as on March 2019

This may be due to underestimation of the target irrigation potential or prioritisation of SMI schemes with larger CCA by states.

Financial Progress

The expected targeted expenditure is Rs. 13,449 Cr., with central share of Rs. 11,310 Cr. Till March 2020, an expenditure of Rs. 9236 Cr. has been incurred, which is 69% of the total targeted expenditure. Total CA of Rs. 7299 Cr. has already been released till March 2020. The state-wise financial progress, till March2019 is further highlighted in Figure 37.

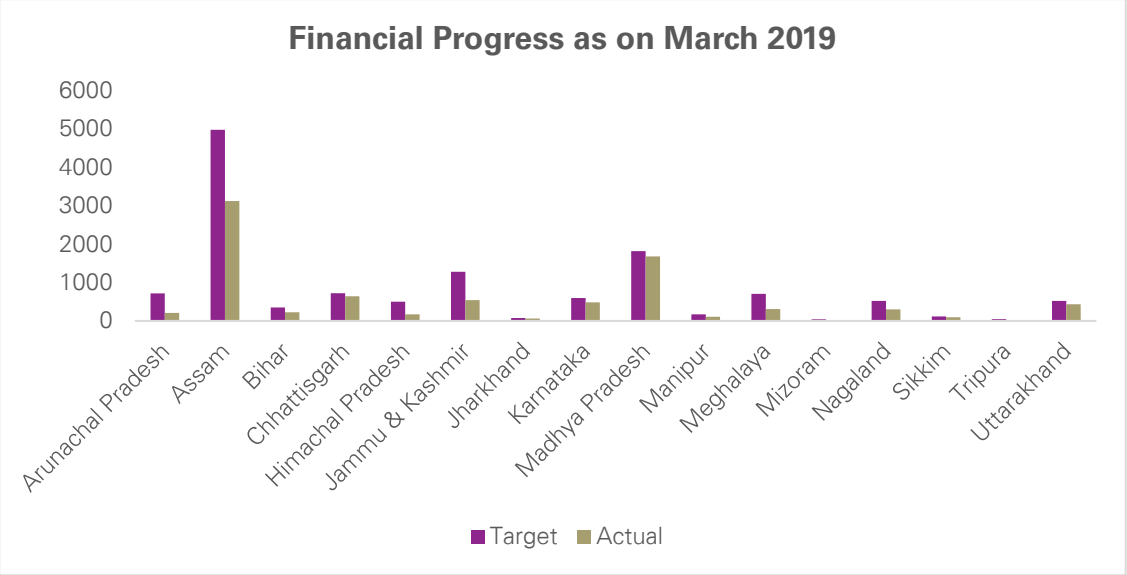


Figure 37: Financial Progress (Target versus actual) as on March 2019

It can be concluded that the physical progress of 62% of targeted irrigation potential is in commensurate with the actual expenditure incurred. A state-wise comparison of physical and financial progress reveals efficiency of the states. This is further illustrated using the figure below.

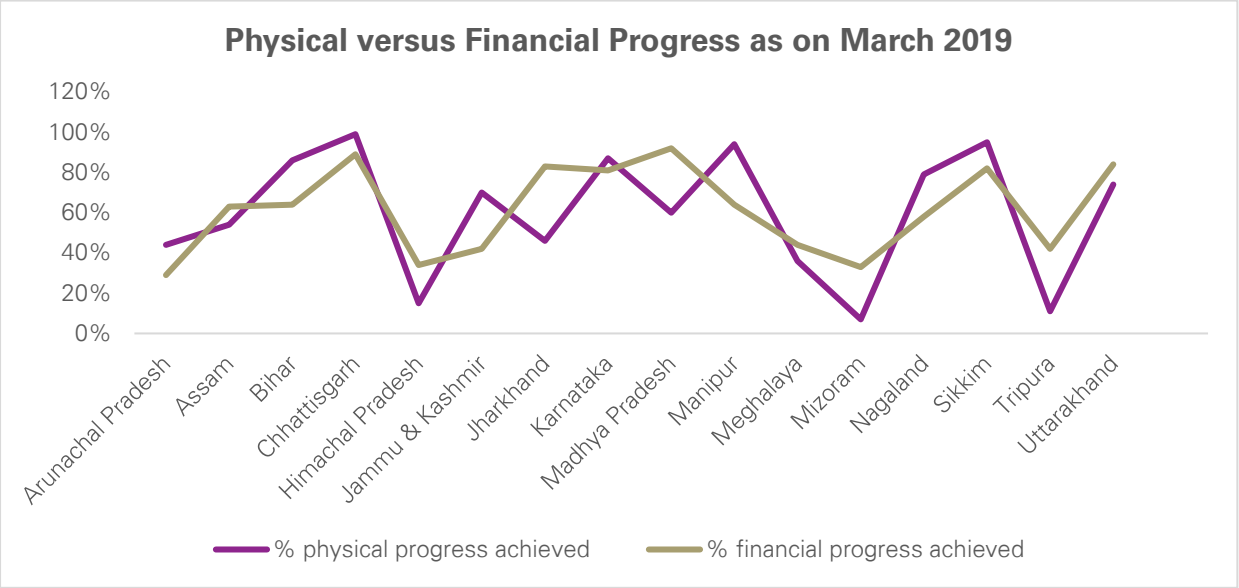


Figure 38 SMI-state-wise comparison of physical versus financial progress.

Clearly, many of the states like Arunachal Pradesh, Bihar, Chhattisgarh, Jammu and Kashmir, Karnataka, Manipur, Nagaland and Sikkim (i.e. 50% out of 16 states) have performed well with regards to cost effectiveness.

Performance on REESI+E framework

Table 53: SMI - performance evaluation using REESIE framework

Parameter	Findings from research
Relevance	**Secondary:** • Gaps in irrigation coverage due to water stressed situation and huge water loss throughout the irrigation value chain impacts food production. • While the number of groundwater schemes in the country have increased from 19.75 million to 20.52 million; surface water schemes have reduced from 1.24 million to 1.19 million between 2006-07 to 2013-14.[145] Furthermore, the ratio between IPU to IPC for surface

[145] 5th Minor Irrigation Census Report (Pg. xvi)

Parameter	Findings from research
	water schemes has reduced (0.71) while that for groundwater has increased (0.8).[146] • Only in a relatively small proportion of cases have water resources been developed in the irrigation deprived regions, which leaves significant scope for development of irrigation potential and augmentation of groundwater through recharge in these areas.[147] • Most of the minor irrigation schemes (96.7%) are under private ownership i.e. owned and maintained by individual/ group of individuals.[148] • The scheme objective of 'Expanding cultivable area under assured irrigation' contribute towards SDG 2.1: *By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations.*
	Primary: • The CWC highlights, most of the accessible and economical sites for major irrigation projects have been exhausted in the country, leaving limited possibility for construction of major projects. Since SMI is designed to utilise local water resources to irrigate nearby fields; there are fewer land acquisition issues and adverse environmental impacts compared to major irrigation projects. Hence, SMI is becoming more important, not only for hilly regions, but also for the plain areas. • Primary study across all states emphasizes the relevance of SMI towards provision of assured irrigation. o In hilly states like Assam, Meghalaya, Manipur, Himachal Pradesh, Jammu & Kashmir and Uttarakhand, it is not possible

[146] 5th Minor Irrigation Census Report (Pg. xvii)

[147] IWMI-TATA Policy Paper: Har Khet Ko Pani: Rethinking Pradhan Mantri Krishi Sinchai Yojana (PMSY), June 2016

[148] 5th Census of Minor Irrigation scheme report (Pg 12)

	to construct major and medium dams/canal system due to topographical constraints and scattered command area. o Out of 1.40 Cr. hectares in Karnataka, irrigable area is around 70 lakh hectares, and the minor irrigation department has a mandate of bringing 10 lakh hectares under irrigation. Though works undertaken by the minor irrigation department are small in nature, they provide big relief and have very low gestation period i.e. irrigation benefits start flowing almost immediately. o The scheme is also relevant to check the dependence on groundwater in states like Himachal Pradesh, Karnataka and Madhya Pradesh. o SMI serves as lifeline for irrigation network in the UT of J&K, particularly in context of Kashmir division, where the existence of major/ medium/ groundwater-based schemes is negligible. Out of 861 schemes approved under DIP, merely 170 could be taken up by the division. Hence, huge potential for development of SMI is yet to be tapped. o In Uttarakhand, 11 out of 13 districts are in hilly areas and 60-70% of irrigation is through SMI. While 70% of the total area is irrigated, merely 15% of the hilly area comes under irrigated category; leaving huge scope for development of irrigation through SMI in these areas. The scheme is critical not only for provision of assured irrigation but also for generation of local employment and reducing migration. • All states except Madhya Pradesh demand further scaling up of the scheme. While state irrigation department in Madhya Pradesh claims there is no scope for expansion as sites for minor irrigation projects have already exhausted; district irrigation and agriculture department highlight the significant importance of these projects and demand further expansion and acceleration of SMI.

Parameter	Findings from research
	Inference: • The relevance of SMI is attributed to its quick construction, lower losses / high water-use efficiency, lower environmental impacts, easy management and more involvement of local stakeholders. However, the scheme is limited to public water bodies only while most of the minor irrigation structures in India are privately owned. • Considering the reducing number of surface water schemes and increasing pressure on groundwater resources, there is a need to prioritise SMI. Therefore, the scheme may be rated as 'satisfactory' under relevance.
Effectiveness	**Secondary:** • The envisaged output, outcome and impacts of the scheme are not clear from the scheme guidelines document. However, the 5th Minor Irrigation census report covers some information on the type, ownership, culturable command area (CCA), season wise irrigation potential created (IPC) and irrigation potential utilised (IPU) from SMI. • Underutilization of Minor Irrigation schemes has been observed due to reasons like mechanical breakdown, less discharge of water and non-availability of power supply.[149] • The SMI structures have low water losses (i.e. high irrigation efficiency) as unlike major irrigation projects, these do not involve long conveyance and distribution system. • The percentage of open channels used for conveying water to field has reduced from 65% during 4th Minor Irrigation census to 53% as per 5th Minor Irrigation census, with a corresponding increase in the share of piped irrigation, drips and sprinklers. However, despite high evaporation and seepage losses in open channels, viz. 42.6% in open

[149] Report on 5th MI Census (Page 43)

	unlined channels while 10.4% in open lined channels[150]; they remain primary mechanism for water distribution. • Previous 3rd party evaluation report on the Minor Irrigation schemes in Jammu and Kashmir (2014-15) stated that the approved technical norms, design and quality standards were observed at the site. However, it recommended regular supervision of works during execution to improve the overall quality. Proper tendering procedure was followed while awarding work to the contractor and the implementation process was transparent. It further mentioned about close involvement of local stakeholders, users as well as NGOs. However, formation of WUAs for maintenance of the completed asset, was under progress at that time. • Previous evaluation study on minor irrigation projects (2013-14/2014-15) in Nagaland did not find any issues regarding land acquisition, litigation, community protest etc. It found delay in project progress due to inadequate and delayed fund release. • 5th census of Minor Irrigation schemes shows a decline in the dependence on surface irrigation schemes while a corresponding increase in groundwater usage for irrigation. • **Farmer participation: Case study from South India**: Evaluation of minor irrigation in Kozhikode district, Kerala found level of farmers participation as a key indicator of scheme performance. Most of the farmers (83-100%) were found to discuss problems in cultivation and ways to improve productivity. Further, marketing of the produce was done through farmers association, which motivated them to be more involved in the scheme.[151] • Provision of wastewater reuse for SMI is not addressed in the current scheme design. • State Irrigation/Water Resources Department and regional offices of CWC are responsible for periodic monitoring of the schemes on sample basis (at least 20% of the Minor Irrigation schemes) and

Parameter	Findings from research
	performance of the schemes are to be assessed against the pre-determined targets set by MoWR.
	Primary: • Target for creation of irrigation potential are set by the implementing department of the state government, with the support from revenue department. For instance: In Himachal Pradesh, targets are set by the Department of Jal Shakti (erstwhile Department of Irrigation and Public Health) based on their experience and fund availability while in Uttarakhand, they are set by the Minor Irrigation department, based on the inputs from PRIs. • All states confirm three levels of monitoring under the scheme: by state implementing agency (Minor Irrigation/Water Resources Department), CWC regional office and independent third-party monitoring. However, no third-party independent evaluation has been undertaken for completed Minor Irrigation schemes in any state. o Most of the projects are in construction phase in Himachal Pradesh and concurrent evaluation studies are being done by NIT, Hamirpur to check the quality of construction. o In Uttarakhand, state minor irrigation department and independent district level task force is involved in monitoring. Targets achieved are reported to the statistics department.

[150] 5th MI Census Report (Pg. xviii)

[151] Evaluation of minor irrigation schemes using performance indicators: case studies from south India (https://link.springer.com/content/pdf/10.1007/s40899-016-0074-3.pdf)

	Concurrent evaluation studies during implementation are carried out by WAPCOS. • The effectiveness of SMI has been emphasized by all states. However, works under PMKSY-SMI have not been initiated in Jharkhand and Karnataka. o Out of 1010 schemes sanctioned for Assam, 595 have been completed. The target for creation of irrigation potential was 53,724 ha and 11,529 ha for 2018-19 and 2019-20 respectively, against which 52,255 ha and 13,000 ha was achieved. o In Madhya Pradesh, no projects have been proposed in the last 5 years. Against 276 schemes proposed before 2015 (68 in 2012-13, 89 in 2012-13, 111 in 2013-14 and 8 in 2014-15), 18 had to be dropped due to opposition by the community/ non feasibility of site. Finally, 258 schemes were included under PMKSY, out of which 257 have been completed while 1 is ongoing. The state has been successful in creating irrigation potential of 67,957 ha against the target of 79,163 ha. o In Himachal Pradesh, 8 out of 115 sanctioned projects have been completed under SMI. Remaining are expected to be completed by March 2020-21. Though 2 SMI projects have been completed in Solan district around March 2020, their effectiveness is yet to be ascertained as they could not be utilised due to lockdown imposed in the state. However, the district anticipates a change in cropping pattern from traditional to cash crops and up to 1.5% increase in production, based on previous experience. o In Uttarakhand, 651 schemes, with target irrigation potential of 42,755 ha were sanctioned in 2013-14 and later included under PMKSY. Till June 2020, the state has been successful in creating irrigation potential of 35,948 ha at the expense of 459 Cr. However, 60 projects had to be dropped off due to reasons like drying of source and overlap with other ongoing schemes.

	Further, 422 projects have been included in DIP and proposed under PMKSY, which are expected to be sanctioned this year. o Out of 175 projects ongoing in J&K, 50 have been completed, 14 had to be dropped off and 57 are scheduled to complete this year. o In Meghalaya, SMI projects were proposed under AIBP in 2012-13 and 2013-14 while 44 projects were sanctioned under PMKSY in 2015-16 and 68 in 2018-19. • The effectiveness of the scheme in meeting the objectives of HKKP has been highlighted by most states: o Before the introduction of SMI, temporary bunds had to be created by farmers each year as they used to get washed away during floods. However, now farmers in parts of Assam and Manipur are getting assured irrigation. o Irrigation reliability has improved in Kamrup district, Assam due to SMI. However, in Baska district, SMI structures are unable to fulfil the irrigation needs during Rabi season. Farmers largely rely on rainfall since there is no mechanism for water storage. There is a difference in opinion regarding effectiveness of SMI amongst district irrigation and agriculture department. While the former regard SMI to be effective in providing assured irrigation; the latter point out its inability in meeting irrigation water needs during peak season. FGD with farmers in this area validates limited utility of Tihunadi FIS constructed under SMI. Despite high water scarcity in the region, farmers grow water intensive crops like paddy. o In Bihar, minor irrigation is primarily being undertaken through state sponsored schemes. PMKSY-SMI has been implemented only in drought prone and flood affected areas and has resulted in provision of assured irrigation and groundwater recharge.

	○ In Manipur, SMI has resulted in enhancement of agricultural productivity and income of farmers. However, there has not been much impact on the groundwater levels as the water table is already high in the state. Given an increase in drought like situation over the past few years, the scheme has aided in providing resilience to climate change and access to water during droughts. ○ Most SMI projects in Himachal Pradesh are under implementation phase. Though the exact outcomes of the scheme are not known yet, the state anticipates immense positive effects like reduction in IPC-IPU gap and upliftment in economic status of farmers based on its experience with similar projects under NABARD. ○ SMI has been effective in enhancing agricultural productivity, reducing soil erosion, augmenting income, generating employment and increasing groundwater levels in Madhya Pradesh. While state irrigation authorities infer their utility is limited due to its limited scale; district level stakeholders highlight their immense significance in providing assured irrigation. Participants in FGD at Rajgarh district, Madhya Pradesh highlight limited effectiveness of SMI: while it has reduced dependence on groundwater, its utility is limited by damages/ leakages in the canal. This has further increased incidences of water logging in the village, which leads to decline in soil structure and crop losses. ○ In Uttarakhand, implementation of SMI has resulted in increased agricultural productivity, reduction in soil erosion and local employment generation. Due to small and scattered farm holdings, farmers are engaged in subsistence agriculture in Chamoli district. In contrast, transition from traditional crops to cash crops like vegetables can be seen after completion of

	SMI in Nainital district. In plain areas of the state, the scheme has also led to reduced dependence on groundwater. For instance: In parts of Udham Singh Nagar district, the groundwater levels have increased by 2-3 meters after implementation of SMI and groundwater irrigation. o HH survey across Assam and Madhya Pradesh validates effectiveness of SMI in increasing area under irrigation, enhancing crop yield and improving land productivity. Increase in groundwater levels after completion of SMI works is also highlighted by 88%, 14% and 36% respondents in Madhya Pradesh (n= 118), Assam (n= 50) and Manipur (n=25) respectively. • Positive factors affecting scheme implementation: o **Utilisation of latest technology like GIS and Remote Sensing:** Though the scheme guidelines mandate utilisation of GIS maps for monitoring, its current utilisation is limited to few states only. ▪ With the advent of digital mapping, issues of duplication do not exist in Manipur. However, digitisation of existing cadastral maps is time taking due to changes in topography. ▪ GIS technology is being utilized by J&K with support from 'The Ecology and Remote Sensing department'. ▪ Digitisation for planning and monitoring is very relevant for Jharkhand to aid in targeting the irrigation deprived areas first, but it is currently in nascent stage. ▪ Karnataka State Remote Sensing Application Centre provides land data at regular intervals, which is further validated by the state before planning for irrigation. ▪ The ongoing schemes are not geotagged in Uttarakhand. However, creation of GIS portal is under progress in the state and once the proposal for 421

Parameter	Findings from research
	schemes is sanctioned, the state plans to geotag the assets created. ▪ Currently monitoring through GIS is not done in Assam, Himachal Pradesh and Madhya Pradesh. Fund constraint may be a limiting factor for few states in this regard like in Assam. ○ **Lining of canals:** ▪ Lining of canal in states like Uttarakhand has aided in reducing seepage and transmission losses and minimising IPC-IPU gap. Furthermore, O&M cost and instances of waterlogging have also reduced after lining. ▪ In contrast, open channels constructed under SMI are earthen canals in states like Assam and Madhya Pradesh. Such structures are prone to damages and have high seepage losses, thereby reducing water use efficiency. An increase in waterlogging instances after completion of SMI works has been highlighted during HH survey by 23% respondents in Assam, 88% in Madhya Pradesh and 32% in Manipur. ▪ In parts of Assam, pigs damage the earthen canal, leading to leakage, which drains away the entire water supply. Additionally, there have been instances of farmers digging and diverting Minor Irrigation canals towards their fields, in fear of not getting enough water. This results in water losses, thereby reducing efficiency of the system. ○ **Use of treated sewage for irrigation:** In Karnataka, none of the SMI projects under PMKSY were approved by the Ministry in the last 5 years. However, the

Parameter	Findings from research
	state sponsored scheme (equivalent to SMI) is being implemented in the state. Secondary treated sewage from Koramangala and Challaghatta valley is send to the surrounding drought prone districts – Chikkaballapur, Kolara and Bengaluru rural. Despite achieving excellent results and high demand from farmers, the state is unable to scale it up due to fund constraints. • Negative factors affecting scheme: ○ **Restriction of cost per hectare:** The restriction of development cost norm at Rs. 2.5 lakh/hectare, as mentioned in the scheme guideline limits scheme implementation in remote areas of Himachal Pradesh, J&K, Manipur and Meghalaya owing to increased project cost due to reasons like higher labour charges. Despite meeting the B-C ratio criterion, such proposals are sent back by CWC regional office during technical examination. For instance: In Manipur, the construction phase during SMI requires around 120 km to be covered on foot instead of vehicle, owing to the difficult terrain, which increases project cost in comparison to other general category states. ○ **Increasing dependence on groundwater/ private irrigation:** Most of the farmers prefer groundwater based/ private irrigation over SMI. For instance: Majority of farmers in Himachal Pradesh have installed tube wells in their fields while in Madhya Pradesh

	private source of irrigation is preferred over SMI despite higher cost due to easy access to electricity. HH survey further highlights groundwater as preferred mode of irrigation amongst 57% farmers even after completion of SMI works (n= 193). ○ **Drying up of sources:** ▪ Projects had to be dropped in Madhya Pradesh and Uttarakhand due to drying up of sources as a result of natural calamities like landslides/ other climatic factors. Despite being critical for irrigation, canal created on Ranipur dam under SMI in Betul district, Madhya Pradesh is often dry, limiting its utilisation. The village level stakeholders claim that the dam has barely filled 5-6 times since 1996. ▪ Likewise, unavailability of water storage structure in the head region, makes SMI ineffective during the drought season in parts of Baska district, Assam. The river often dries up and the scheme is unable to provide water during Rabi season, when farmers need it the most. ▪ In Manipur, SMI has been successful in increasing water use efficiency and farmers are using it both for agricultural and domestic purposes. However, parts of Kampokpi district were unable to access water through SMI structures due to 'no flow' condition. It is also affected by the mining activities nearby. ▪ Year- round water unavailability after completion of SMI works has been validated by 83%, 46% and 80% farmers in Assam, Madhya Pradesh and Manipur respectively. ○ **Delay in project sanction:** Often states face long delays in project sanctioning.

	For instance: 443 projects submitted by Manipur in 2018-19 have not been sanctioned yet. The lack of clarity on implementation structure, particularly regarding inclusion of projects in District Irrigation Plan (DIP) has been highlighted by the state. The DIP had to be revised due to non-inclusion of SMI projects in it, leading to delay of one year. o **Inadequate and delayed fund release:** Delays in fund release by centre hampers timely execution of schemes**.** ▪ In 2019-20 funds were requested under two clusters by J&K but merely balance amount from 2018-19 was received in the first cluster. ▪ A proposal requesting funds for 68 projects was sent by Meghalaya in 2019-20 but it has not been released yet. ▪ As per the implementation schedule proposed in the DPR, 651 projects were planned to be completed till 2016 in Uttarakhand but many of them are still pending due to delays in fund release. o **Limited working season:** Despite variable terrain and size of different minor irrigation projects, the timeline for completion is uniform i.e. two years only. This is particularly challenging for hilly states like Himachal Pradesh, J&K, Manipur, Meghalaya and Uttarakhand, where working season is limited to 3-6 months only. o **Labour unavailability:** In J&K labour mobilisation is time taking as the availability of local labour is limited and the UT relies on migrant labour. The challenge of labour unavailability has also been highlighted in Assam. o **Delayed land acquisition:** Issues in land acquisition have been highlighted by stakeholders across Assam, Madhya Pradesh, Meghalaya and Uttarakhand; leading to delays in scheme implementation. Often states have to be drop projects

(e.g. Uttarakhand) as unlike major irrigation schemes, there is no mechanism for compensation under SMI.

- **Reluctance to adopt modern agricultural practices:** Farmers are unwilling to adopt modern agricultural practices like multi-cropping, which reduces water use efficiency in Assam, Himachal Pradesh and Meghalaya. Furthermore, most of the farmers in Himachal Pradesh are 'absentee farmers' i.e. those who migrate elsewhere/abstain from farming. This contributes to the widening IPC-IPU gap.
- **Inadequate monitoring by CWC:** Though guideline mandate progress monitoring by CWC regional office through field visits (minimum 20% of schemes), it becomes challenging in north-eastern states.
  - Though more than 1000 SMI projects are ongoing in Assam, CWC was able to visit merely 40 projects in 2019-20 against the target of 200.
  - Since CWC regional office plays a critical role in technically examining the proposal and forwarding to Ministry of Jal Shakti, presence of single regional office for 7 north eastern state leads to delays in scheme implementation. This is further exacerbated by difficult terrain and inconvenient travel in states like Manipur and Meghalaya.

- Reducing command area under major irrigation projects**:** Existing major irrigation schemes are unable to meet the requirements of farmers and need supporting minor irrigation. However, such proposals are beyond the purview of SMI due to overlap with other major irrigation schemes.

  For instance: Loktak lift irrigation project, Manipur which was designed in 1980 to cater to 40,000 ha is currently able to irrigate a mere 2,800 ha. Khuga irrigation project, which was designed in 1980s

Parameter	Findings from research
	and inaugurated in 2012 is unable to serve the designated command area due to reduction in flow. However, district agricultural authorities in Uttarakhand describe subsidiary irrigation channels being created to support major irrigation projects.
	Inference: • Secondary data, KII and HH survey validates scheme effectiveness in increasing area under irrigation, enhancing crop yield and improving land productivity. Increase in groundwater levels after completion of SMI works is also highlighted by states. • However, the outcomes are limited by level of farmer's participation, lining of canals, restriction cost per hectare, groundwater dependence, drying up of sources, delays in project sanctioning, reluctance to adopt modern agricultural practices, limited working season, budget constraints, labour unavailability and issues in land acquisition. Therefore, scheme efficiency may be rated as 'average'.
Efficiency	**Secondary:** • Previous evaluation report on minor irrigation projects (2013-14/2014-15) in Nagaland stated that BCR was not assessed. The proposed cropping pattern was considered as critical for determination of incremental benefits but state Agriculture Department was not consulted in this regard. • This scheme complements MGNREGA in terms of water source creation. While scheme creates 2-10 ha water spread area in urban and more than 5 ha in rural area; MGNREGA creates water spread area of smaller coverage.
	Primary: • As mentioned in scheme guidelines, B-C ratio is mandatorily calculated at DPR stage across all 7 states surveyed: Assam, Bihar, Himachal Pradesh, Jammu & Kashmir, Madhya Pradesh, Manipur and

Parameter	Findings from research
	Meghalaya. Agriculture department is involved in calculating benefit component based on proposed cropping pattern, hydrological dependability, anticipated crop yield and market value of the proposed crop. States don't face any challenge in this regard. • While several projects are being implemented in Assam with assistance from NABARD; the state is reluctant to seek financial assistance from private agencies. Complimentary schemes (e.g. MGNREGA) are being utilized by states like Uttarakhand. However, its utility is limited since it covers only labour component and not the material component. Furthermore, the Panchayati Raj Institutions accords lower priority to irrigation under MGNREGA. • Minor irrigation department, J&K highlights that while agriculture department is the nodal department; the scheme is implemented by minor irrigation department, which comes under Department of Jal Shakti (erstwhile irrigation and flood control department). This creates gaps in coordination and overall scheme harmonization. • The State Agriculture and Horticulture Department, Madhya Pradesh mentions that their involvement in the scheme is limited to STAC meetings and calculation of B-C ratio. They further add that taking inputs from agriculture department while site selection and scheme implementation could aid in more holistic planning.
	Inference: • Benefit – Cost ratio is mandatorily calculated by all states based on inputs from the agriculture department. However, non-involvement of agriculture department during site selection and scheme implementation limits holistic planning. • While coordination between agriculture and irrigation department is satisfactory in most states; gaps in synergy have been highlighted in J&K, which limits scheme harmonisation. Scheme effectiveness may be rated as 'satisfactory'.
Sustainability	**Secondary:**

	• The 5th Minor Irrigation census points out low discharge of water due to continuous droughts and deficit rainfall as the primary reason behind waterbodies 'permanently not in use'. The reasons behind 'temporary non-usage' of water bodies are less discharge, low storage and channel breakdown. • The increasing incidences of drying up of water bodies may be attributed to an increase in average annual temperature (0.48 degrees) and decline in average rainfall (26mm) between 1970 and 2016.[152] • Climate change is an important factor threatening scheme sustainability as SMI is directly dependent on rainfall. • Previous 3rd party evaluation study of Minor Irrigation schemes in Jammu and Kashmir (2014-15) found the projects to be economically viable and sustainable. The study also stated the need to improve awareness about benefits from the scheme, so that beneficiaries develop feeling of ownership for the project which is important for proper maintenance of the assets. • Previous evaluation study on minor irrigation projects (2013-14/2014-15) in Nagaland found that maintenance of the created assets was not given required priority. Arrangement for handing over the completed projects to the WUAs had not been operationalized in most of the cases. • **Minor Irrigation through community management: Case study from West Bengal**: Minor irrigation schemes constructed/rejuvenated under West Bengal Accelerated Development of Minor Irrigation (WBADMI) have been handed over to the WUAs. A significant increase in cropping intensity, agricultural diversity and yield was observed in comparison to the schemes without WUAs. The study concludes that created infrastructure is of minimal use if not managed well and WUAs could be effective institution for management of SMI. Sustainability of WUAs in the long run can be ensured by convergence with other schemes and centralizing scheme operation under WUAs.[153]

Parameter	Findings from research
	Primary: • Minor Irrigation infrastructure in hilly states like Assam, Jammu and Kashmir, Manipur, Meghalaya and Uttarakhand are vulnerable. The states are prone to natural disasters like landslides, siltation, leading to drying up/ temporary/ permanent non-usage of sources. This further exacerbates the need for continuous maintenance and in the absence of adequate mechanism for O&M, states are often forced to spend more later. • Lining of canal is critical to ensure scheme sustainability. For instance: Mundala canal created under SMI in Rajgarh district, Madhya Pradesh is partly earthen/katchha. Hence, it has collapsed at multiple places, leading to leakages and waterlogging. • Though the guidelines mention O&M to be done by WUAs, states face challenges in this regard. In few states, department has to intervene since WUAs are technically and financially unequipped to take care of the maintenance work. o All funds collected by WUA in Assam goes to the government exchequer. In parts of the state, WUAs are utilising the collected levy unofficially for operations and maintenance. o In Bihar, the concept of WUAs is not successful due to limited financial capability of WUAs and internal social issues within villages. Therefore, O&M of SMI structures is done by the state. In some cases, where Gram Panchayat is active, schemes have been handed over to them. o In J&K, WUAs are non-existent. The irrigation department of the UT claims that since Panchayats and BDCs have been constituted recently, the creation of WUAs shall now be

[152] The Economic Survey (2017-18)

[153] 2nd International conference on sustainable water management Pg 23 (http://nhp.mowr.gov.in/Conference-2/Proceeding.pdf.)

Parameter	Findings from research
	prioritised. Hence, the department takes care of current O&M. However, funds allocated for O&M are insufficient. o The state and district authorities in Madhya Pradesh claim that WUAs exist at every 1000 ha and are involved in project operations and maintenance. Though funds are allocated by the state to WUAs at INR120/ha for canal and Rs. 40/ha for annual maintenance; these are inadequate to cater to major damages. Therefore, funds need to be sanctioned under special repair in this regard. Farmers are reluctant to pay for irrigation and revenue recovery is a major challenge for the department. Respondents during FGD in Rajgarh district, Madhya Pradesh highlight that despite giving tariff to the irrigation department, canal repair works are not undertaken by the state, which limits utility of SMI. o Though WUAs are formed across all schemes in Meghalaya, no revenue is generated by them for O&M. Since all beneficiaries are marginal farmers, they contribute through labour only. Hence, major repair works are undertaken by the state. o Since there is no scarcity of water, district authorities in Uttarakhand have highlighted unwillingness of farmers to pay for it. Schemes are handed over to Gram Panchayats for O&M and water management but fund inadequacy in this regard has been stressed by stakeholders across all levels. For instance: In 2019, the budget for O&M was 5 Cr. but since the number of schemes have increased significantly, O&M works could be undertaken for prioritised projects only. Hence, maintenance of the created irrigation potential is a major challenge for the state.

Parameter	Findings from research
	○ Though none of the schemes under PMKSY-SMI have been sanctioned in Jharkhand, the state has pointed out challenges relating to operations and maintenance of existing SMI projects. Since such structures are present in areas with limited habitation, they are in a state of neglect. Additionally, there are issues related to siltation, theft, physical and mechanical damage. ○ Based on HH survey across Assam and Madhya Pradesh 40% respondents highlight inability of WUAs to undertake effective O&M (n= 35) while WUAs were found to be non-existent in Manipur. • The implications of climate change factor on scheme sustainability has been stressed by most of the states. ○ Since the last few years, Assam has witnessed a depletion in rainfall, leading to lower discharge in rivers. This poses a hindrance towards utilisation of SMI. ○ There have been few instances of drying up of water bodies in parts of Bihar. However, the state sponsored 'Jal Jeevan Hariyali Abhiyan' is addressing the issues of groundwater overdraft, waterlogging, and aiding in awareness generation regarding crop-water use efficiency. ○ In J&K, the recent years have witnessed water scarcity as snowfall during winters is not complemented by rains. For instance: In year 2020, rainfall was 70% less than normal while snow was 60% above normal. This disturbing trend threatens sustainability of irrigation. ○ In Uttarakhand, there has been a change in frequency and distribution of rainfall in the last 20 years. Flash floods caused by cloudburst cause irreparable damage to agriculture.

Parameter	Findings from research
	○ The shifting rainfall pattern, as a result of climate change in Himachal Pradesh has been highlighted by the agriculture department.
	Inference: • Current institutional structure for O&M by WUAs is not sustainable as there is no mechanism to ensure their financial independence. • Last few years have witnessed spatial and temporal shift in rainfall pattern. The change in discharge due to climate change threatens scheme sustainability. The scheme may be rated as 'average' under sustainability.
Impact	**Secondary**: • The intended scheme specific impacts are not mentioned in guidelines of SMI. • Scheme guidelines propose evaluation of completed SMI projects to be carried out through independent agency. • Previous 3rd party evaluation report on the MI schemes in Jammu and Kashmir (2014-15) was certain about economic upliftment of the beneficiary communities upon the completion of the project, which would influence their literacy, health, communication and help them to market their produce.
	Primary: • Though scheme guidelines mention states to carry out evaluation of completed SMI projects by independent agency, no such studies have been conducted yet. However, states anticipate assured irrigation after completion of SMI to reduce migration and boost economic status of beneficiaries. For instance: In Rajgarh district, Madhya Pradesh, creation of 3980 ha irrigation potential after completion of Bankpura and Mundala Tank project under SMI has led to reduction in migration.

Parameter	Findings from research
	• The impact of SMI in increasing education and employment has been highlighted by 57% and 41% respondents respectively. Though enhanced income has been mentioned by 40%, increased expenditure on agriculture has also been highlighted by 79% respondents (n= 193).
	Inference: • There is a gap in scheme guidelines with respect to envisaged impact. • Though secondary data indicates economic upliftment of beneficiaries after completion of SMI project, no primary impact assessment studies have been done by states/ CWC/ MoJ/S in this regard. • Based on HH survey, it may be concluded that the scheme is successful in increasing employment, education and income of farmers. Hence, under impact the scheme may be rated as 'satisfactory'.
Equity	**Secondary**: • The scheme targets special category states: North Eastern, hilly and specific areas of general category states/UTs: KBK districts of Odisha, Bundelkhand region of UP and MP, Marathwada and Vidarbha region of Maharashtra, DPAP, DDP, tribal, naxal affected and flood prone areas. • There is favourable funding pattern [90(central):10(state)] for north eastern and hilly states.
	Primary: • KIIs across all states indicate equitable distribution of resources across all section of society through structures created under SMI. FGDs in Assam and Madhya Pradesh further validate this. • Women are actively involved in the scheme, particularly in hilly states like Assam, Meghalaya and Uttarakhand. • In Bihar, areas with higher population of SC/ST/OBC and other weaker section of the society are given priority for inclusion under SMI.

Parameter	Findings from research
	Inference: • Scheme guidelines mention favourable funding pattern for weaker sections of society. The primary survey further indicates equitable access to assets created under SMI. Therefore, under equity, the scheme may be categorised as 'satisfactory'.

Table 54: SMI - summary of performance evaluation using REESIE framework

Parameter	Performance
Relevance	🟢
Effectiveness	🟡
Efficiency	🟢
Sustainability	🟡
Impact	🟢
Equity	🟢

REESI+E performance infographics legend

🟢 Satisfactory 🟡 Average 🔴 Needs Improvement ⚪ No information

Performance on cross-sectional themes

Table 55: SMI - performance evaluation using cross-sectional themes

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
1.	Accountability & Transparency	Monitoring Mechanisms Citizen Accountability	• The envisaged output, outcome and impact are not mentioned under SMI scheme guidelines. • Only irrigation potential created (IPC) is tracked on MIS portal.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			• Guidelines mandate evaluation for completed Minor Irrigation schemes to be carried out by the state government through independent agency. However, no such studies have been done conducted under HKKP-SMI. Concurrent evaluation during implementation phase is ongoing in Himachal Pradesh through NIT, Hamirpur. • Guidelines mandate submission of Utilization Certificate, containing physical achievement of irrigation potential and financial progress/expenditure under SMI – HKKP. States confirm the submission of UC post project completion. • Though the guidelines mention handing over of assets created under SMI to WUA, there is no mechanism to ensure institutional and financial sustainability of WUAs.
Summary Analysis: The scheme guidelines do not have defined output, outcomes and impact parameters, which limits adequate monitoring and evaluation. By design, citizen accountability is ensured through WUAs. However, there is no mechanism to ensure its sustainability.			
2.	Direct/Indirect Employment Generation	Employment generation	• Previous 3rd party evaluation report on the MI schemes in Jammu & Kashmir (2014-15) indicated

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			economic upliftment of the beneficiary communities upon the completion SMI projects. • The KIIs across all states indicate generation of employment as a result of scheme implementation. However, states do not maintain quantitative data on the subject.
Summary Analysis: The secondary and primary data indicates employment generation as a result of SMI but absence of any data on the subject limits validation.			
3.	Gender mainstreaming	Inclusiveness in scheme design/planning	• There are no provisions favouring gender mainstreaming under scheme guidelines. • The KIIs indicate involvement of women during scheme implementation, particularly in hilly states. • The absence of women in WUAs was highlighted during KIIs. This was further validated during HH survey by 75% respondents in Assam and 100% in Madhya Pradesh (n= 10).
Summary Analysis: Though KIIs indicate active involvement of women during scheme implementation, there is a need to have provisions favouring gender inclusiveness as a part of scheme guidelines.			
4.	Climate change & sustainability	Climate resilience Climate impact	• The scheme is completely dependent on rainfall but there is no

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
	including adoption of climate-change resilient practices & diversification		mechanism under current guidelines to address the climate change factor. • The negative implications of climate change in recent years, often leading to 'no flow' conditions have been highlighted by Assam, Bihar, J&K, Uttarakhand and Himachal Pradesh.
Summary Analysis: Climate change factor is critical to scheme sustainability, but it is unaddressed under the current scheme guidelines.			
5.	Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population	Funds allocated under TSP/ SCSP and other provisions for vulnerable communities Inclusion of vulnerable groups in scheme as well as sector	• States like Assam are utilising funds allocated under TSP/SCSP towards inclusion of vulnerable communities under SMI.
Summary Analysis: Inclusion of vulnerable communities is ensured under SMI through utilisation of funds allocated under TSP/SCSP in few states like Assam.			
6.	Use of IT/Technology	Deployment of IT enabled mechanisms for	• The scheme guidelines mandate utilization of Geographic Information System (GIS) for monitoring. Further,

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
	in driving efficiency	monitoring of the Schemes Use of latest technology to improve efficiency and effectiveness of scheme implementation	each minor irrigation project must be given a Unique Identification Code (U.I.C). However, GIS is currently not being utilised by states like Madhya Pradesh, Uttarakhand and Himachal Pradesh. • Manipur and J&K are utilising GIS technology for effective scheme implementation, which has aided in mitigating issues like overlap with similar schemes. The Ecology and Remote Sensing department, J&K aids in providing GIS maps in this regard. • The ongoing schemes are not geotagged in Uttarakhand. However, GIS portal creation in under progress in the state and once the proposal for 421 schemes is sanctioned, the state plans to geotag the assets created. • Though needed for more effective monitoring, fund constraints limit the use of GIS in Assam.
Summary Analysis: The use of technologies like GIS is felt by the state, not only during implementation, but also during monitoring. Though scheme guidelines mandate its usage for monitoring, fund constraints limit its utilisation in some states.			
7.	Stakeholder and	Fund Allocation	• Previous 3rd party evaluation study on Minor Irrigation schemes in

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
	Beneficiary behavioural change	Mechanisms to promote and ensure behaviour change Challenges faced	Jammu & Kashmir (2014-15) stated the need for awareness generation about benefits of the project so that beneficiaries would be motivated to provide their assistance for maintaining the assets. • Previous evaluation report on minor irrigation projects (2013-14/2014-15) in Nagaland stated the proposed cropping pattern to be critical for determination of incremental scheme benefits. • In Uttarakhand, awareness generation activities are done by the agriculture department at block level through BDC meetings every 2-3 months. However, with growing water scarcity, the irrigation department highlights the need to include 'Jal Sanrakshan – Samwardhan' component to ensure sustainable irrigation. Village level stakeholders further validate that though trainings are conducted by the agriculture department; they lack water use efficiency/ water conservation component. • Agriculture department in Himachal Pradesh undertakes awareness

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			generation activities through trainings and door to door IEC activities towards encouraging crop water-use efficiency. Additionally, exposure visits are also organised in this regard to shift mindset of farmers from traditional practices. • 5th census of MI schemes shows declining dependency of farmers on surface minor irrigation and increasing dependency on groundwater for fulfilling their minor irrigation requirement. KIIs and HH survey indicates that farmers continue to adopt traditional agricultural practices like monocropping and flood irrigation.
Summary Analysis: The primary and secondary data indicates the need to include awareness generation component as part of the scheme guideline. Though these activities are being undertaken by few states, they lack crop water use efficiency component.			
8.	Research & Development	Fund Allocation, challenges in undertaking R&D efforts, any Best Practices	• No funds are allocated for R&D as per scheme guidelines. • Considering that flood irrigation is currently practiced across most states after provisioning of SMI, research on water conveyance, application and distribution efficiency is needed to evaluate irrigation

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			system performance and transition towards more effective irrigation technique. • Research institutes like ICAR and state agriculture universities could be involved in such studies.
Summary Analysis: R&D efforts through involvement of ICAR/ state agricultural universities are needed to aid in transition to water efficient minor irrigation.			
9.	Conjunctive use of water	Challenges and awareness	• Though SMI has reduced dependence on groundwater, the conjunctive use of water doesn't form a part of the scheme design. • North eastern states and hilly areas which are well endowed with rainfall, continue to use surface water resources for irrigation. On the other hand, there have been instances of groundwater overexploitation (e.g.: Bihar, Madhya Pradesh). This is being addressed through state sponsored, 'Jal Jeevan Hariyali Mission' in Bihar.
Summary Analysis: Though pressure on groundwater resources has reduced to some extent after provisioning of SMI, there exists a gap conjunctive planning for water resources management.			
10.	Unlocking Synergies with other	Convergence (Inter-Ministerial/Inter-Departmental/Financial/ Human	• This scheme complements MGNREGA in terms of water source creation. While SMI creates 2-10 ha water spread area in urban and more

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
	Government Program	Resource/Administrative /Institutional/Schemes	than 5 ha in rural area, MGNREGA creates water spread area of smaller coverage. Hence, both schemes are being utilised by Bihar towards creation of Minor Irrigation structures. However, in Uttarakhand the utility of MGNREGA is limited since it covers only labour component and not the material component. • State sponsored 'Jal Jeevan Hariyali' mission is ongoing in Bihar to further complement the scheme. This has led to reduced dependence on groundwater and rise in water table. • Gaps in coordination between agriculture and irrigation department was witnessed during primary survey in J&K. • States like Assam have also pointed out more willingness of farmers to take advice from agriculture department, while Minor Irrigation department is the implementation agency.
Summary Analysis: Interdepartmental coordination is critical to scheme performance. While adequate coordination is enhancing scheme effectiveness in states like Bihar; lack of coordination limits scheme harmonisation in J&K.			

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
11.	Impact on and role of private sector, community/ collectives/ cooperatives (e.g. Farmer cooperatives, FPOs, Water User Associations, etc.) and civil society in the scheme	What is the percentage of private investment in the clusters/programs run by the government? How many private sector, community/collectives/cooperatives and civil society have availed the benefits under any Scheme?	• Primary survey indicates no ongoing private investment under SMI. • Previous 3rd party evaluation report on the Minor Irrigation schemes in Jammu & Kashmir (2014-15) highlights close involvement of local stakeholders, users as well as NGOs. The reports also stated that formation of WUA, for maintenance of the completed asset, was under progress that time. • Previous evaluation study on Minor Irrigation projects (2013-14/2014-15) in Nagaland found that maintenance of the created assets was not given adequate priority. Arrangement for handing over the completed projects to the WUAs had not been operationalized in most of the cases. • The scheme guidelines mention handing over of assets created under SMI to WUAs but there is no defined mechanism to ensure its sustainability. At most of the places, the involvement of WUAs is need based.
Summary Analysis:			

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			Based on the primary survey, no private investment is ongoing under SMI. The scheme sustainability relies on WUAs by design, but its implementation mechanism is unclear.

In addition to the above themes, no information was found for 'Development, dissemination & adoption', 'Research & Development' and 'Reform, Regulation' while 'Water sharing treaties/agreements & diplomacy' is not relevant for the scheme.

A summary analysis and performance of the scheme on the identified themes is presented below:

Table 56: SMI - summary of performance evaluation using cross-sectional themes

Parameter	Performance
Accountability and Transparency	🟡
Direct/Indirect Employment Generation	🟢
Gender mainstreaming/Inclusiveness	🟡
Building resilience to climate change (including but not limited to developing water disaster preparedness) and ensuring sustainability	🟡
Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population	🟢
Use of IT/Technology in driving efficiency	🟡
Stakeholder and Beneficiary behavioural change	🔴
Development, dissemination & adoption	⚫
Research and Development	⚫
Water sharing treaties/agreements and diplomacy	⚫
Conjunctive use of water - surface versus groundwater usage optimizations	🟡
Unlocking Synergies with other Government Program	🟡
Reforms, Regulations	⚫

Parameter	Performance
Impact on and role of private sector, community and civil society in the scheme	

Cross-sectional themes performance infographics legend

High Medium Low Not relevant No information

Issues and challenges

This sub-section describes the scheme issues and challenges and their mapping with the source of information viz. primary source, secondary source and household survey (if applicable).

Table 57: SMI – issues and challenges

Sl.no	Area	Issues and Challenges	Secondary	KII	HH
SMI-F1	Non-usage of surface water schemes	• As per 5th Minor Irrigation Census, the main reason behind 'temporary non-usage' of surface water schemes is low discharge. On the other hand, permanent non-usage has been attributed to drying up of water bodies. • Primary survey validates the inability of states to continue cropping during Rabi season as there is no water storage facility in the upstream area and river runs dry, leading to a drought like situation (e.g. Assam, Madhya Pradesh).			

Sl.no	Area	Issues and Challenges	Secondary	KII	HH
		Hence, presence of SMI has not changed the traditional rain dependence in these areas. • As per HH survey, unavailability of year-round water supply after completion of SMI works has been indicated by 73% respondents (n= 193).			
SMI – F2	Delays in project sanction and budget constraints	• Long delays in project sanctioning have been highlighted by the states. For instance: 443 projects submitted by Manipur in 2018-19 have not been sanctioned yet. • Though MoWR claims 100% utilization of the available budget, delayed and insufficient fund release by centre has been pointed out by states which hampers timely execution of schemes**.** For instance: In 2019-20 funds were requested under two clusters by J&K but merely balance amount from 2018-19 was received in the first cluster. Likewise, proposal requesting funds for 68 projects was sent by Meghalaya in 2019-20 but it has not been released yet.			
SMI-F3	Increasing pressure on groundwater resources	• While hilly areas like Assam, J&K, Manipur, Meghalaya and Uttarakhand are primarily dependent on surface water for irrigation; there			

Sl.no	Area	Issues and Challenges	Secondary	KII	HH
		is an increasing dependence on groundwater-based irrigation; particularly in parts of Bihar, Himachal Pradesh, Karnataka and Madhya Pradesh due to easy access to electricity and its advantage of being demand driven instead of supply driven. • HH survey further validates groundwater as preferred mode of irrigation amongst 56% and 50% respondents in Assam and Madhya Pradesh respectively (n= 168). While current irrigation needs are entirely met by rainwater and SMI in Manipur; groundwater is preferred mode of irrigation amongst 76% respondents (n= 25). • As per CGWB estimates of 2017, out of 6881 assessment units, 1186 blocks are 'over exploited', 313 'critical' and 972 under 'semi critical' category.[154] • More than one fourth of these overexploited and critical blocks are limited to Delhi, Haryana, Himachal Pradesh, Karnataka, Punjab, Rajasthan, Tamil Nadu and			

[154] National Compilation on Dynamic Ground Water Resources of India, 2017 (http://cgwb.gov.in/GW-Assessment/GWRA-2017-National-Compilation.pdf)

Sl.no	Area	Issues and Challenges	Secondary	KII	HH
		Puducherry. However, the current scope of SMI is restricted to north eastern states, DPAP, tribal, flood prone and special category areas in general states/UTs. It is not aligned to address regions facing overexploitation of groundwater.			
SMI-F4	Unclear/ Limiting scheme guidelines	• The scheme guidelines of SMI mention aim of PMKSY i.e. 'enhance physical access of water on farm and expand cultivable area under assured irrigation, improve on farm water use efficiency, introduce sustainable water conservation practices', with no reference to envisaged aim/ output/ outcome/ impact of HKKP - SMI. • The restriction of development cost norm of Rs. 2.5 lakh/hectare poses challenge for scheme implementation in Himachal Pradesh, J&K, Manipur, Meghalaya and Uttarakhand due to topographical constraints and high labour cost. For instance: o The construction phase under SMI in Manipur requires around 120 kilometres to be covered on foot instead of vehicle,			

Sl.no	Area	Issues and Challenges	Secondary	KII	HH
		owing to the difficult terrain, which increases the labour cost significantly. o Due to unavailability of local labour in J&K, it relies on migrant labour during construction phase. • Despite variable site topography, working period and size of different Minor Irrigation projects, the timeline for completion is restricted to two years only. This is particularly challenging for hilly states like Himachal Pradesh, J&K, Manipur, Meghalaya and Uttarakhand, where working season is limited to 3-6 months only.			
SMI-F5	Water losses in open channels	• High seepage losses in unlined channels have been found to increase water table, leading to waterlogging in the vicinity.[155] • Though the primary objective of SMI is enhancing water use efficiency, some of the channels constructed under SMI are unlined/ earthen (e.g.: in Assam, Madhya Pradesh). These have high seepage losses and are			

[155] Assessing the impact of canal network on surface waterlogging using remote sensing datasets in Rohtak, Haryana (https://www.researchgate.net/publication/329043645_ASSESSING_THE_IMPACT_OF_CANAL_NETWORK_ON_SURFACE_WATERLOGGING_USING_REMOTE_SENSING_DATASETS_IN_ROHTAK_DISTRICT_HARYANA)

Sl.no	Area	Issues and Challenges	Secondary	KII	HH
		more prone to siltation, waterlogging and damages. • Increase in instances of waterlogging after completion of SMI works has been confirmed by 23% respondents in Assam, 86% in Madhya Pradesh and 32% in Manipur.			
SMI-F6	Reducing command area under major irrigation projects	• Existing major irrigation projects are often unable to suffice the needs of farmers till the tail end, due to change in flow or topographical constraints. However, such areas cannot be supported by SMI as per the current scheme design due to overlap with major irrigation projects. • For instance: The Loktak and Khuga irrigation projects in Manipur are unable to irrigate the command area that they were designed for due to reduction in flow. However, supporting SMI schemes in these areas were rejected by the centre on grounds of overlap.			
SMI-F7	Climatic uncertainties	• Though the scheme is completely dependent on rainfall, there is no mechanism under current guidelines to address the climate change factor. • Considering IPCC prediction of rise in temperature by 3-4 degree Celsius by the end of 21st century and estimated change in rainfall pattern;			

Sl.no	Area	Issues and Challenges	Secondary	KII	HH
		agricultural income is expected to fall by 12% on average and 18% in unirrigated areas under absence of adaptation by farmers.[156] • The negative implications of climate change in recent years, impacting water availability have been highlighted by stakeholders across Assam, Himachal Pradesh. J&K and Uttarakhand.			
SMI-F8	No provision for wastewater reuse	• The CPCB (2015) estimates the available sewage treatment facility as merely 37% of the total sewage generated by Class I and Class II towns in the country. • However, wastewater reuse for SMI is beyond the purview of current scheme design. • Though Karnataka has been successful in using secondary treated wastewater in drought-prone areas under state sponsored scheme, it faces financial constraints in replicating the scheme in other regions, despite of high demand from the farmers.			

[156] Climate change and Indian agriculture, 2018 (https://www.ideasforindia.in/topics/agriculture/climate-change-and-indian-agriculture.html)

Sl.no	Area	Issues and Challenges	Secondary	KII	HH
SMI-F9	Widening IPC-IPU gap	• As per the 5th Minor Irrigation census report, IPC-IPU gap is highest for surface flow irrigation schemes. • States like Assam, Himachal Pradesh and Meghalaya have further validated this gap due to reasons like 'absentee farmers' and reluctance to adopt modern agricultural practices. • Though SMI has enabled 46% farmers to adopt multi-cropping, 50% continue monocropping (HH survey, n= 193).			
SMI-F10	Non-availability of power/fuel	• The 5th Minor Irrigation census points out non-availability of adequate power as one of the reasons behind non-usage of lift irrigation schemes under SMI.			
SMI-F11	Land acquisition delays and gaps in coordination	• Challenges in land acquisition have been highlighted by stakeholders across Assam, Madhya Pradesh, Meghalaya and Uttarakhand. This is further exacerbated by lack of mechanism for compensation under SMI, unlike major irrigation projects. In addition, farmers are often unwilling to let workers from outside work in their fields (e.g. Assam). • Gaps in coordination between minor irrigation and agriculture department have been mentioned by few states which reduces scheme			

Sl.no	Area	Issues and Challenges	Secondary	KII	HH
		effectiveness. For instance: Madhya Pradesh state agriculture department mentions their role being limited to STAC meetings only while their involvement during site selection could aid in more holistic implementation.			
SMI-F12	Lack of mechanism for O&M: Role of WUAs	• SMI structures (particularly unlined canals) are prone to damages from flooding, requiring frequent maintenance. Currently, there are no allocations by the centre for O&M works. Few states carry out such activities on need basis/ request from WUAs. • Though water is a state subject, all states have pointed out inadequacy of funds for O&M. Challenges in O&M have also been highlighted by 32%, 66% and 68% respondents during HH survey across Assam, Madhya Pradesh and Manipur respectively. • The scheme guidelines mention handing over of Minor Irrigation assets to WUAs for future operations and maintenance. However, it doesn't provide any details on mechanism for sustainability/ revenue generation by WUAs. The inability of WUA to undertake O&M			

Sl.no	Area	Issues and Challenges	Secondary	KII	HH
		has been highlighted during KIIs and further validated during HH survey 40% respondents (n= 35). • In Assam, as per the state irrigation act, all the funds collected by WUA goes to the government exchequer. In parts of the state, WUAs are utilising the collected levy unofficially for operations and maintenance.			
SMI-F13	Inadequate monitoring by CWC	• Regular monitoring and visits by CWC regional office is challenging, particularly in north eastern states. • Though they are mandated to visit a minimum of 20% sites annually, it becomes difficult to do so in areas like Assam, which have more than 1000 schemes ongoing under SMI. Hence, CWC was able to visit 40 schemes in 2019-20, against the target of 200. • Since CWC regional office plays a critical role in technically examining proposal and forwarding to Ministry of Jal Shakti; presence of single regional office for 7 north eastern states leads to delays. The issue is further exacerbated by difficult terrain and inconvenient travel in states like Manipur and Meghalaya.			

Sl.no	Area	Issues and Challenges	Secondary	KII	HH
SMI-F14	Output Outcome Framework	• Outcome parameters like IPU, and number of assets handed over to WUAs are not tracked at SMI scheme level.			

Issue relevance legend

	Supported		Partially supported		Not supported		Not applicable

A summary analysis of issues & challenges for the scheme is presented below:

Table 58: SMI– summary of issues and challenges

Parameter	Performance
Institutional Mechanism and governance	🔴
Fund flow efficiency and utilization	🟡
Unavailability of resource persons	🟡
Capacity building	🟡
Monitoring and evaluation	🔴
Non-usage of Surface Water Schemes	🔴

Performance infographics legend

🟢 Satisfactory 🟡 Average 🔴 Needs Improvement

Recommendations and solutions

This sub-section describes the scheme recommendation and solutions from the perspective of scheme design, scheme implementation and monitoring & evaluation, along with their mapping with the issues and challenges described in the preceding sub-section.

Table 59: SMI – recommendations and solutions

Sl.no	Recommendation	Finding
Scheme design		

Sl.no	Recommendation	Finding
SMI-R1	**Ensure adequate upstream storage while planning SMI** • To address the current non-utility of SMI in parts of Assam and Madhya Pradesh due to drying up/low discharge; sequential scheme design needs to be ensured. Provisioning of conveyance system through creation of diversion structures like weirs should be considered only after there is adequate facility for water storage in the upstream. • To implement this, SMI could be planned in close coordination with RRR/ MGNREGA/ WDC/ other state sponsored scheme which includes component of creating/ renovating surface storage structure. • **Rationalisation with RRR:** o **Rationale:** Whilst scope of work under HKKP-SMI is limited to construction of small diversion structures like weir/ check dams; HKKP-RRR is focused on restoration of pre-existing tanks/ponds. Since the objective of RRR, viz. comprehensive improvement and restoration of water bodies could ensure proper operation of SMI projects, scheme rationalization may be considered. o Renovation works in the upstream storage structures could aid in supplementing discharge for SMI during periods of low/no flow. The minimization of water losses would also help in addressing the widening IPC-IPU gap. o **Implementation and sustainability:** Since both SMI and RRR are implemented by the Minor Irrigation department and involve handing over of renovated/ created assets to WUAs, the institutional structure for scheme implementation and sustainability may remain the same. Moreover, capacity building of the	SMI-F1, SMI-F9, SMI-F12

Sl.no	Recommendation	Finding
	communities towards water resources management, which is an objective under RRR could help in improving the sustainability of SMI upon rationalization.	
SMI-R2	**Change in operational policy of SMI to address depleting water table** • Given the growing dependence on groundwater and most of the overexploited and critical blocks being situated in 8 states, there is a need to expand the scope of SMI in these areas. • Change in operational policy of minor irrigation schemes like forgoing one third cultivation/retaining one fourth storage could be considered to revive water table in these areas, as illustrated in Vavuniya district, Sri Lanka. • **Case study: Technical strategies to operate minor and medium irrigation schemes towards improving groundwater systems:** Water balance and economic feasibility modelling was carried out in 185.23 km^2 aquifer in Vavuniya, Sri Lanka. It found that forgoing cultivation under minor and medium irrigation schemes by 25-35% would replenish 45-65% loss of water tables in 80-90% of the catchment area in the consecutive season. An additional reduction in boundary permeability by 40-50% lead to reduced transmissivity and recovery of 60-70% loss in water table in nearly 95% of area under consideration. Economic analysis indicated gain in	SMI-F3

Sl.no	Recommendation	Finding
	water table to reduce cost of energy, thereby increasing economic cultivation per unit irrigation water.[157]	
SMI-R3	**Need for more comprehensive scheme guidelines** • The existing scheme guidelines need to be revised and made more comprehensive, with clearly defined objective, output, outcome and impact. The suggested output-outcome parameters and monitoring mechanism in this regard is described in SMI-R13. • The current 'one size fits all' approach mentioned in the scheme guidelines; which restrict development cost at Rs. 2.5 lakh/hectare and timeline for project completion to two year needs to be revised to allow flexibility considering project size, working period, prevailing topography and labour availability; particularly for north eastern and hilly states.	SMI-F4
SMI-R4	**Lining of canals/ pipe distribution network to improve water use efficiency** • The scheme objective of enhancing water use efficiency can be achieved by minimising high water losses in canals through canal lining/ pipe distribution network. • Replacing earthen canals with lined canals could lead to increase in velocity and rugosity coefficient. Hence, the discharge carrying capacity of the existing canals would increase, while seepage losses, water logging and maintenance cost of the canal would reduce.[158] However,	SMI-F5, SMI-F1, SMI-F9

[157] Sivakumar, 2013; Conjunctive Use of Surface and Groundwater to Improve Food Productivity in Vavuniya District in the Dry Zone Area (https://www.researchgate.net/publication/247773415_Conjunctive_Use_of_Surface_and_Groundwater_to_Improve_Food_Productivity_in_Vavuniya_District_in_the_Dry_Zone_Area)

[158] Seepage losses through lined and unlined canals (http://www.ijaamm.com/uploads/2/1/4/8/21481830/v2n2p9.pdf http://www.ijaamm.com/uploads/2/1/4/8/21481830/v2n2p9.pdf)

Sl.no	Recommendation	Finding
	water losses from unlined canals and infiltration surplus of applied water has also been found to increase aquifer recharge. For instance: Seepage losses in unlined Lower Bhavani Project (LBP) canal was estimated to result in 39.54% groundwater recharge, which reduced to 20% upon canal lining.[159] • While canal lining augments the potential for groundwater development in some geographies; it contributes to issues like waterlogging and soil salinity in others.[160] Hence, decision of canal lining and selection of lining material may be based on local aquifer characteristics likes soil permeability, watershed physiograpy and underlying climatic pattern. • Previous studies suggest HDPE sheets as most favourable material for canal lining, considering its highest B/C ratio. [161] Alternative low-cost method like using a mixture of clay and bentonite have also been found to reduce seepage losses significantly. [162] • **Case Study: Evaluation of seepage losses in earth lined canal, Uyo, Nigeria:** Experimental evaluation of seepage losses in Nsukara Offot through ponding method found reduction in seepage losses	

[159] Mirdhula, 2014 'Impact of Lined/ Unlined canal on groundwater recharge in Lower Bhavani Basin (https://www.ijert.org/research/impact-of-linedunlined-canal-on-groundwater-recharge-in-the-lower-bhavani-basin-IJERTV3IS091115.pdf)

[160] Sahuquillo, 2017 'Water Storage and conjunctive water use (https://www.sciencedirect.com/topics/earth-and-planetary-sciences/aquifer-recharge)

[161] Case Study of "Neera Devdhar" canal seepage losses and canal lining (https://www.ijraset.com/fileserve.php?FID=7155)

[162] Evaluation of seepage losses in an earth lined canal: A case study of University of Uyo farm, Uyo, Nigeria (https://www.researchgate.net/publication/271442829_EVALUATION_OF_SEEPAGE_LOSSES_IN_AN_EARTH_LINED_CANAL_A_CASE_STUDY_OF_UNIVERSITY_OF_UYO_FARM_UYO_NIGERIA)

Sl.no	Recommendation	Finding
	by 82.5% upon lining of earthen canals with clay and bentonite in the proportion of 175 kg clay to 2 kg bentonite.[163] • **Case Study: "Neera Devdhar" canal seepage losses and canal lining:** A comparative analysis of concrete, shotcrete, exposed High-Density Polyethylene (HDPE) and IIT, Delhi (IITD) sheets for canal lining was conducted in Neera Devdhar canal. The results obtained were as follows: The study concludes lining with HDPE sheets as best solution to reduce seepage losses up to 99%.[164] • **Case Study: Improving conveyance efficiency through canal lining: Panchanadi Minor Irrigation Project:** The water losses through seepage and evaporation for Panchnadi Minor Irrigation project was determined using Aquacrop model developed by FAO. While conveyance efficiency of lined, unlined section of main canal and unlined section of field canal was observed at 75.3%, 52.1% and 34.8%; total losses were estimated as 0.184, 0.61 and 0.188 mm^3 respectively. The study inferred that lining of canals could save 0.376 $mm^3$of water through which 43 ha of	

	HDPE + Concrete	HDPE + Shotcrete	IITD + Concrete	IITD + Shotcrete
B/C ratio	10.43	7.33	9.59	6.88

[163] Evaluation of seepage losses in an earth lined canal: A case study of University of Uyo farm, Uyo, Nigeria (https://www.researchgate.net/publication/271442829_EVALUATION_OF_SEEPAGE_LOSSES_IN_AN_EARTH_LINED_CANAL_A_CASE_STUDY_OF_UNIVERSITY_OF_UYO_FARM_UYO_NIGERIA)

[164] Case Study of "Neera Devdhar" canal seepage losses and canal lining (https://www.ijraset.com/fileserve.php?FID=7155)

Sl.no	Recommendation	Finding
	additional area can be irrigated, thereby improving conveyance efficiency by up to 75%.[165]	
SMI-R5	**Plan SMI with due consideration to existing command area under major irrigation** • Given the reduced command area of traditional major irrigation projects (due to changes in topography and flow rates vis-à-vis design), fresh survey to ascertain the present command area of existing major projects is needed. Based on this survey, SMI projects may be planned with the objective of enhancing the coverage and period of assured irrigation in the command area. • Secondary storage structures may be created at the tail end of the canal command which can be used to harvest rainwater. These could provide irrigation facilities during spells of water unavailability from other sources. Further, such structures would also aid in groundwater recharge.	SMI-F6, SMI-F9
SMI-R6	**Create climate resilient agriculture: ICT enabled decision making and research in irrigation technology** • Towards adapting agriculture to increased frequency of extreme climate events like droughts and floods; decision making with regards to crop type and irrigation scheduling may be done through ICT driven tools, like drones (details in SMI-R12). • Considering the prevailing uncertainty regarding resilience of crop, soil and associated microbes to climate change,[166]	SMI-F7

[165] Improving conveyance efficiency through canal lining in command area: A case study (https://ijeir.org/administrator/components/com_jresearch/files/publications/IJEIR_1200_Final.pdf)

[166] Developing climate-resilient crops (https://www.researchgate.net/publication/263068027_Developing_Climate-Resilient_Crops/link/59c7a7b00f7e9bd2c01449df/download)

Sl.no	Recommendation	Finding
	funding towards research in irrigation technology is needed to develop climate resilient agriculture.	
SMI-R8	**Include provision of wastewater reuse under SMI** • Given the vast amount of wastewater generated by the country, which is expected to grow further, reuse of secondary treated wastewater for irrigation could be an efficient mechanism for water resources management. Public acceptance in this regard is highlighted by the HH survey: 74% respondents are willing to use treated wastewater for irrigation if government makes it mandatory. • Investment in such infrastructure could aid in creation of nutrient rich and reliable water supply for irrigation. Furthermore, it could also help in coping up with seasonal water shortages and irregularities due to variability and climate change. • Its inclusion as a part of scheme guidelines, would encourage the states to invest in such infrastructure. Necessary studies in this regard may be undertaken to develop safety norms for use of treated wastewater in agriculture from the perspective of public health. • **Case Study: Use of secondary treated for irrigation, Karnataka** Secondary treated sewage from Koramangala and Challaghatta valley is send to the surrounding drought prone districts – Chikkaballapur, Kolara and Bengaluru rural. The farmers in the region demand further scale up of the project.	SMI-F8
Scheme implementation		
SMI-R7	**Partial desiltation of canals to reduce water losses** • Periodic and frequent partial desiltation of minor canals may be adopted as a low-cost alternative to complete desiltation.	SMI-F12, SMI-F9

Sl.no	Recommendation	Finding
	• **Case Study: Physical restoration of minor irrigation system through partial desilting, Kapiriggama village tank cascade system** Based on hydrological and sedimentation research, it has been inferred that the amount of sediment deposited in minor tanks is 20-35% and half of this sediment is found within one third of tank bed close to bund. Therefore, tank capacity may be maintained by removing sediment in this area. Though primary objective of partial desilting is to minimise water losses, it has also been found to improve agricultural productivity, cropping intensity and extent of cultivation.[167]	
SMI-R8	**Awareness generation through IEC-BCC and interdepartmental coordination** • To overcome resistance to change from traditional agriculture and encourage modern agricultural practices like multi-cropping, IEC-BCC activities could be undertaken. • Moving to a cropping pattern that is appropriate in view of water resources available in an area is important to ensure benefits from the scheme are optimized and water resources are used in a sustainable manner. • In this regard, it is observed that farmers are more willing to take advice from agriculture department. Therefore, interdepartmental coordination and convergence to motivate / incentivize farmers is necessary. Well defined roles and responsibilities for both Minor Irrigation (or equivalent) and	SMI-F9

[167] Physical restoration of irrigation system (https://www.iucn.org/sites/dev/files/content/documents/brief_5_january_28_2016_physical_restoration_1.pdf)

Sl.no	Recommendation	Finding
	Agriculture departments, along with mechanism for coordination needs to be specified. • Complementary state sponsored schemes (such as 'Jal Jeevan Hariyali Abhiyan' in Bihar) to improve awareness (e.g. on crop water-use efficiency) should be tapped into.	
SMI-R9	**Solar energy: alternative to grid connected pumps** • Considering its environmental and sustainability advantages, solar energy for surface lift irrigation schemes should be used as a cost-effective alternative to grid connected pumps under SMI. • Karnataka is utilising solar power towards groundwater-based Minor Irrigation. However, it is yet to be implemented for SMI.	SMI-F10
SMI-R10	**Operations and maintenance through WUAs** • The roles and responsibilities of WUAs should be mentioned in the scheme guidelines and need to include awareness generation component. This is essential to address issues like farmers damaging Minor Irrigation structures, theft etc. Support from local NGOs/ CSR initiatives may be taken for capacity building of WUAs towards overall management; including water availability assessment, water auditing, operations and maintenance. • To address local issues like land acquisition, involvement of WUA needs to be ensured since project inception, to inculcate feeling of ownership within the community. Their understanding of local topographical condition needs to be appreciated and considered during project planning. • Since the mechanism for revenue generation by the WUAs is not defined, the revenue collected by them is retained by the state (e.g.: In Assam, as per the State's Irrigation Act). To ensure O&M sustainability of SMI, WUAs need to be	SMI-F9, SMI F11. SMI-F12,

Sl.no	Recommendation	Finding
	financially independent. A proportion of the revenue should be retained by the WUAs. For example, 30% could be retained by WUAs while the rest can be with the government exchequer. • **Case Study: Minor Irrigation through community management, West Bengal** Handing over of Minor Irrigation schemes constructed/rejuvenated under West Bengal Accelerated Development of Minor Irrigation (WBADMI) to WUAs resulted in significant increase in cropping intensity, agricultural diversity and yield in comparison to the schemes without WUAs. The study concluded that created infrastructure is of minimal use if not managed well and WUAs could be effective institution for management of SMI. Sustainability of WUAs in the long run can be ensured by convergence with other schemes and centralizing scheme operation under WUAs.[168]	
Monitoring and evaluation		
SMI-R11	**Need for additional CWC branch office and ICT based monitoring** • Given the presence of single CWC regional office for seven north eastern states and its inability in meeting mandate of 20% annual monitoring; there is need to have an additional branch office. This would also ensure more efficient scheme implementation, considering the critical role of regional office in preparing, examining and forwarding proposals to MoWR, RD and GR	SMI-F13

[168] 2nd International conference on sustainable water management Pg 23 (http://nhp.mowr.gov.in/Conference-2/Proceeding.pdf.)

Sl.no	Recommendation	Finding
	• ICT driven tools and technologies for monitoring: (e.g. through drones) should be explored, owing to following advantages: o Transparent, fast, evidence based, verification enabled accurate measurement, with minimum manpower requirement. o Cost effective: Rs. 156/ha[169] o Capability to collect high resolution imagery below cloud level, with more detail than satellite imagery.[170] This could ensure frequent (say monthly) monitoring of scheme during the implementation phase. It may also be utilised by the state irrigation department for revenue recovery by estimating accurate area under irrigation, as being done in Maharashtra. Drones with hyperspectral, multispectral and thermal sensors could aid in identifying the dry areas of field and aid in more effective planning.[171] However, existing drone laws in India need to be considered in this regard. • **Case study: Use of drone for mapping command area of irrigation project, Maharashtra** Unnamed Aerial Vehicles (UAVs) are being used in 500,000 ha area in Pune region of Maharashtra. Crop wise area determined is used to estimate water charges. The intervention has been successful in accurate estimation of	

[169] Use of drone for efficient water management: A case study (https://www.icid.org/wif3_bali_2019/wif3_3-1_26-min.pdf)

[170] E-Agriculture in action: Drone for agriculture (http://www.fao.org/3/I8494EN/i8494en.pdf)

[171] Application of drone in agriculture (https://www.ijcmas.com/8-1-2019/S.%20Ahirwar,%20et%20al.pdf)

Sl.no	Recommendation	Finding
	irrigated area, which has aided in bringing transparency, increasing revenue and saving time.[172]	
SMI-R12	**Tracking additional outcome parameters** • Apart from currently tracked IPC; other structural and non-structural outcome indicators need to be included. For instance: Outcome parameters like water use efficiency, agricultural productivity and groundwater levels, which are currently monitored by state agriculture/ minor irrigation department/ CGWB regional office may be linked to SMI dashboard. • In addition, parameters like number of assets handed over to WUAs, training/ capacity building activities conducted may be tracked a) at water body level by WUAs b) at state level by MI department and CWC.	SMI-F14

2.2.2.4 Groundwater Irrigation

This scheme is one of the CSS schemes under Umbrella CSS – PMKSY. This scheme aims to create irrigation potential through groundwater based minor irrigation. The beneficiary under this scheme shall be small and marginal farmers only, with priority to be given to SC/ST and Women farmers.

Some salient features of this scheme:

- Groundwater irrigation facility through dug wells, dug cum bore wells, tube wells and bore wells etc. can be funded for schemes in areas other than Over- Exploited (OE), Critical or Semi-Critical meeting the following criteria:

[172] Use of drone for efficient water management: A case study https://www.icid.org/wif3_bali_2019/wif3_3-1_26-min.pdf

- Less than 60% of the annual replenishable groundwater resources have been developed
- Average annual rainfall of 750 mm or more to have availability of enough water for recharge
- Shallow groundwater levels within range of 15m below ground level or less during pre-Monsoon period

- Groundwater development for irrigation must be planned in such a way that after implementation of the project, Stage of Groundwater Development (SOD) in an area should not exceed 70% at any time.
- This scheme is applicable to individual farmer, group of farmers/ cooperatives, Govt. Scheme utilizing Govt. land etc.
- Each well to be provided with electric/solar pumps for water lifting. Provision of 75% electric and 25% solar pumps may be considered for a cluster/proposal. The ratio of solar pump may be relaxed in Tribal/LWE/infested/difficult areas.
- There is scope of convergence with MGNREGA as well as PMKSY-Watershed component for supporting water harvesting and groundwater recharge interventions to ensure the long-term groundwater sustainability.
- There is scope of convergence with Micro-Irrigation Fund to utilize the corpus for adoption of micro-irrigation facilities in area proposed to be covered under this scheme, to the extent possible.

Background

This scheme was approved under PMKSY along with other CSS schemes – AIBP, CAD, SMI and RRR during July 2015 for a period from 2015-16 to 2019-20. Operational guidelines for Groundwater component were issued by the Ministry of Water Resources, RD & GR in July 2016. However, keeping in view of various requirements to implement the same, guidelines have been revised during May 2019. Post that, the scheme became operational and it is currently in progress in two states – Assam and Arunachal Pradesh.

Performance

The scheme is currently operational in two states: Assam and Arunachal Pradesh. Physical and financial progress for 2019-20 are demonstrated below:

Assam

Table 60 : GWI – Physical progress of Assam[173]

#	Item	Achievement/Target (as on 15th June 2020)
1	Site selection investigations completed	4,779 / 4,779
2	Wells constructed	4,065 / 4,779
3	Installation of Electric Pumps	529 / 2,435
4	Installation of Solar Pumps	402 / 2,344
5	Distribution pipe (in Rm)	Nil / 955,800
6	Command area irrigated (in ha)	3,000[174] / 19,116

Table 61 : GWI – Financial progress of Assam[173]

#	Item	Amount (Rs., in Cr.) (as on 12th June 2020)
1	Total fund release (Central Assistance)	133
2	Total fund release (State share)	8
Total fund release		**141**
1	Total fund utilization (Central Assistance)	73
2	Total fund utilization (State share)	8
Total fund utilization		**81**

Arunachal Pradesh

Table 62 : GWI – Physical progress of Arunachal Pradesh[173]

#	Item	Area (in ha)
1	Irrigation potential planned	1,786

[173] Data shared by Ground Water (HKKP), Mo WR, RD & GR on 9th July 2020

[174] Data shared by CGWB, HQ, Faridabad on 8th October 2020

#	Item	Area (in ha)
2	Irrigation potential created	1,072

Table 63 : GWI – Financial progress of Arunachal Pradesh[173]

#	Item	Amount (Rs., in Cr.)
1	Total balance cost	45
2	Total expenditure	27

Performance on REESI+E framework

Table 64: GWI – Performance evaluation based on REESIE framework

Parameter	Findings from research
Relevance	**Secondary**: • India is facing large gap between IPC and IPU [Around 23 million ha gap (20%)[175]] due to several reasons including high water loss during conveyance through open channel. This IPC-IPU gap also impedes irrigation coverage. This scheme targets to increase irrigation potential created (IPC) through groundwater. Since groundwater irrigation (65-70%) is more efficient than surface water irrigation (30-65%), the scheme helps to improve irrigation potential utilized (IPU) and thus, reduce IPC-IPU gap and improve irrigation coverage. • Agriculture, with its allied sectors, is the largest source of livelihood in India. Around 70 percent of its rural households still depend primarily on agriculture for their livelihood, with more than 80 percent of farmers small and marginal. The scheme aims to provide groundwater irrigation facilities only to the small and marginal farmers, who cannot afford groundwater facilities such as dug wells, bore wells, tube wells,

[175] Report of the Committee on Doubling Farmers' Income (2018)

Parameter	Findings from research
	etc., across the safe groundwater areas (i.e. areas other than over-exploited, critical or semi-critical[176]). Hence, continuation of the scheme will benefit the small and marginal farmers in groundwater rich areas of the country who are otherwise deprived of irrigation facility. This will also help in achieving the objective of doubling farmers' income in the country.
	Primary: • The scheme has provided irrigation facilities to small fragmented landholdings where irrigation facilities through other schemes (such as surface minor irrigation) are not available and where groundwater resources are adequate. • It has emerged from the discussion with national level stakeholder that some State Governments are having subsidy-based schemes for groundwater irrigation, such as construction of shallow/medium and deep tube wells in Uttar Pradesh, "Bihar Shatabdi Niji Nalkup Yojana" in Bihar etc. This GWI scheme has a mandate to provide financial support to the state schemes if they comply with the operational guidelines. • It has emerged from discussion with a stakeholder in Assam that there is another groundwater scheme of the Assam government funded through SOPD (State Owned Priority Development) or through RIDF (Rural Infrastructure Development Fund), NABARD. That state scheme provides irrigation facilities for larger farm area. If that scheme is implemented for such small farm area (in which this groundwater (HKKP) scheme is being implemented), it will not be cost-effective.
	Inference: • The scheme is implemented in small fragmented areas where any other irrigation source is neither available nor feasible and where groundwater availability is very good. The scheme is applicable only for small and

[176] Mo WR, RD & GR (2018), Operational Guidelines for Pradhan Mantri Krishi Sinchai Yojana (PMKSY) Har Khet Ko Pani (HKKP) - Ground Water Irrigation

Parameter	Findings from research
	marginal farmers who cannot bear cost of groundwater irrigation facilities. Therefore, the scheme is rated 'Satisfactory' in respect of relevance.
Effectiveness	**Secondary**: • Although the output, outcome and impact parameters are not specified in the scheme guidelines document, it can be logically inferred that the scheme is expected to increase irrigation potential (output); enhance crop productivity, improve income of farmers, reduce IPC-IPU gap (outcome); improve socio-economic condition of the beneficiaries (impact). • As per the scheme guidelines, the criteria for an area to be eligible for this scheme: - The area should not be classified as over-exploited, critical or semi-critical in respect of groundwater resources - Less than 60% of the annual replenishable groundwater resources have been developed - Average annual rainfall should be 750 mm or more to ensure scope for groundwater recharge - Shallow groundwater levels within a range of 15 m below ground level or less during pre-monsoon period • Groundwater development will be carried out preferably through dug wells, dug cum bore wells in hard rock area tapping shallow aquifers and shallow/deep tube wells in alluvium areas tapping prolific aquifers. Bore wells are to be taken up in areas where hydro-geological setup and groundwater aquifers justifies their suitability[176] • The scheme has dedicated budget allocation, institutional arrangements, guidelines and monitoring mechanism • Scheme guidelines mandate the following mechanism for effective implementation:

Parameter	Findings from research
	- State govt. should identify areas for scheme implementation in consultation with CGWB and the State Ground Water Department - Awareness about this scheme is to be created at state/ district/ block/ panchayat level and application from beneficiaries (individual/ WUA) shall be obtained at panchayat/ block level - The state govt. shall prepare feasibility report/ DPR including cost estimates and technical details in consultation with CGWB - It is to be ensured that the areas proposed under this scheme are not irrigated through any other scheme - State govt. will execute the work under this project/ scheme and institute suitable mechanism to supervise the work in efficient and transparent manner • Scheme guidelines mandate the following mechanism for effective monitoring: - CGWB shall monitor the projects at least twice a year - Ministry may conduct 3rd party monitoring and utilize up to 1.5% CA component for 3rd party monitoring, evaluation and IEC activities - State govt. shall provide necessary assistance to CGWB or 3rd party for monitoring
	Primary: • The scheme is designed considering several factors including groundwater resources, groundwater level, rainfall pattern, demography of farmers, extent of groundwater withdrawal permissible for irrigation without impacting groundwater conditions, technical designs of wells/ pumps etc. • Scheme targets are proposed by the State Governments within the eligible blocks identified based on the operational guidelines.

Parameter	Findings from research
	• Administrative approval of 13 projects has been issued amounting Rs. 1,656.27 Cr. in 11 States[177]. • The projects in Assam and Arunachal have been delayed because supply of construction materials has been disrupted due to heavy rain, flood and COVID-19 pandemic situation. • Assam has utilized a fund of Rs. 81 Cr. (central + state) out of total Rs. 141 Cr. (central + state) fund released during 2019-20. All site selection investigations targeted for 2019-20 have been completed. A total of 4,065 numbers of wells (out of 4,779) have been constructed as on 15th June 2020. An irrigation potential of 3,000 ha has been created. It is planned to complete construction of the remaining wells and achieve the IPC target by September 2020. • Arunachal Pradesh has utilized an amount of Rs. 27 Cr. out of total Rs. 45 Cr. fund released during 2019-20 for creating an irrigation potential of 1,072 ha. • The stakeholder from north eastern region (NER) has described the entire process as below: - Identification of beneficiary: Applications are invited from the small and marginal farmers along with agreement documents at Panchayat level and included in the Block Irrigation Plan/DIP after geo-physical survey following the operational guidelines - Preparation of DPR/proposal by State Implementing Agency in consultation with CGWB, NER - Review of the proposal (DPR), by CGWB, NER, including component-wise cost estimate of admissible items (viz. site selection, well construction, pump installation, electric connection, distribution pipe) as per the operational guidelines - Administrative approval for CA is accorded by MoWR

[177] Information/ comment received from CGWB on 17 Dec 2020 (since the scheme is new, started post May 2019, we have incorporated recent information)

Parameter	Findings from research
	- Release of funds from State Govt to Implementing Agency: After achieving satisfactory progress, the Implementing Agency submits demand for release of fund and accordingly, fund gets released from the State govt. to Implementing Agency as per demand - Tenders for each admissible item are separately done on Turnkey basis - Execution of works on ground is done through the successful bidders under close supervision of the field officers/Executive Engineers and other higher officials of the department • The stakeholder from Assam has stated the below issues, faced during implementation of this scheme: - Requirement of drilling rigs were so high that it could not be fulfilled within the state. Hence, the vendors had to bring many drilling rigs from other states which resulted in delay in progress. - Some projects were in remote areas and road connectivity was not good across those areas. Hence, it was challenging to transport drilling rigs and other facilities to those areas. • Since central level MIS is under development, the physical and financial progress are not currently tracked by any central MIS system. However, it is managed through in-house software application in Assam and state level MIS system in Arunachal Pradesh. • CGWB officials conduct in-person visits to monitor several parameters including number of bore wells dug, number of bore wells developed, level of electric connection, installation of solar panel, additional command created, number of beneficiaries, etc. They conduct review meetings with successful bidder along with Executive Engineer and higher officials of the implementing agency. These meetings are held quarterly for monitoring of the scheme implementation and submit report to the Regional Directorate office, CGWB, NER, Guwahati. Financial progress is also reported to Regional Directorate office, CGWB, NER, Guwahati.

Parameter	Findings from research
	• The CGWB officials do not use technolgical interventions like remote sensing, GIS, etc. for project monitoring activities considering the fact that it would not be cost effective because the scheme covers small farmlands. The stakeholder from Assam has agreed to this fact. However, the officials adopt the below interventions: - Geophysical feasibility Survey (Vertical electrical sounding/ resistivity survey) to study existence of groundwater, identify potential site location for implementation of groundwater irrigation infrastructure, groundwater contamination etc. - Hydrogeological survey to determine the groundwater level, quantity of groundwater available at a location Also, there is a scope for technological interventions like sensor-based water meter, piezometer, etc. for groundwater level measurement to monitor groundwater extraction. As an example, Andhra Pradesh is monitoring extraction of groundwater with the help of piezometers located across the state and groundwater related information is maintained over their APWRIMS portal. For these activities, existing infrastructure of various organizations like CGWB, ISRO, etc. can be leveraged. Also, funding for the monitoring activities can be utilized from the allocation (1.5% of CA component) mandated for 3rd party monitoring, evaluation and IEC activities in the scheme guidelines. • WUAs have been formed during preparation of DPR/proposal for this scheme. They will be involved to operate and maintain the irrigation assets created under this scheme. • It has emerged from the discussions with the stakeholders that CGWB, Groundwater Research Institutes, State Departments are working towards creating awareness among the beneficiaries about importance of extraction of groundwater only up to a certain level, utilization of the infrastructure, cropping pattern, water conservation practices, etc. The department officials involve the beneficiaries for different stages of

Parameter	Findings from research
	project execution (e.g. well construction, installation of pumps etc.) and thus, the beneficiaries are indirectly getting on-field training.
	Inference: • Physical progress in Arunachal is around 60%. In Assam, although 85% wells are constructed, IPC creation is only around 16%. The projects are delayed mainly because the supply of construction materials got disrupted due to heavy rain, flood and COVID pandemic situation. • Although WUAs were formed during proposal stage, managing irrigation assets by them have not yet started. • The officers are involving the beneficiaries in project execution for providing them on-field training opportunity. However, there are no such regular training activities currently being conducted for the beneficiaries. Therefore, the scheme is rated 'average' in respect of effectiveness.
Efficiency	**Secondary**: • Cost of this scheme comprises four components: - Investigation cost for site selection - Construction of groundwater abstraction structure (such as bore well, tube well, dug well etc.) - Cost of pump (electric/ solar) - Water supply pipe • The scheme aims to increase irrigation potential creation in safe areas for small and marginal farmers. It is expected to increase productivity, irrigation coverage and income of farmers. • There is scope of convergence with MGNREGA as well as PMKSY-Watershed component with respect to water harvesting and groundwater recharge interventions to ensure the long-term groundwater sustainability. There is scope of convergence with Micro-Irrigation Fund as well to utilize the corpus for adoption of micro-irrigation facilities in areas proposed to be covered under this scheme.[176] • Convergence with these govt. schemes will help to reduce project cost.

Parameter	Findings from research
	Primary: • It has emerged from the discussions with the stakeholders that creation of additional assured irrigation by surface water through major, medium and minor irrigation projects are much costlier than that by groundwater. Cost of surface water irrigation ranges from Rs. 2.5 lakh per ha to Rs. 4 lakh per ha in SMI projects; whereas MMI irrigation projects cost around Rs. 3.5 to more than 5 lakh per ha. depending upon how fast the project gets completed. Therefore, groundwater irrigation can be considered most economical since it costs in the range of Rs. 1.5 to 2.05 lakh per ha depending upon the yields of wells and type of aquifers. • The stakeholders have also stated that convergence with PMKSY-Watershed Component, MGNREGA, PMKSY-Per Drop More Crop, etc. is envisaged. Further, the State Governments are asked to extend extension services and convergence with other schemes, such as RKVY-RAFTAAR, Bringing Green Revolution to Eastern India (BGREI), Soil Health Card Scheme, Paramparagat Krishi Vikas Yojana (PKVY), National Agriculture Market (e-NAM), Pradhan Mantri Fasal Bima Yojana (PMFBY), etc., including linkages with Krishi Vigyan Kendras (KVKs) in the districts. These schemes will provide support for pre - & post-harvest agri-infrastructure including access to quality inputs, storage, markets, etc. Some of the states are also operating subsidy-based scheme for construction of groundwater wells for irrigation and pump installation like UP and Bihar. Administrative approval has been accorded to Uttar Pradesh Government proposal under PMKSY-HKKP-GWI, complementing one of the schemes of Uttar Pradesh Government in 2019-20. These convergence activities are expected to reduce project cost and thus, enhance efficiency of this scheme. However, convergence activities are in planning stage since the scheme is new. • Stakeholder from NER has reported that they are planning to integrate 30% projects under the scheme with micro-irrigation system for enhancing on-farm water use efficiency.

Parameter	Findings from research
	• The stakeholders from north eastern states have stated that maximum cost norms for groundwater structures and their ancillaries are less attractive to the vendor companies which supply the construction materials. Due to logistical challenges and less availability of construction materials, vendor companies have incurred more cost than estimated and executed the project works at low margin. Therefore, if the volume of projects is not high in upcoming years, the companies might not come forward. However, the national level stakeholder has not heard about any such challenges from the north eastern states so far.
	Inference: • According to MI Census data and other reports on irrigation from surface water as well as groundwater from World Bank, NITI Aayog, Planning Commission, etc., it is well established that IPC and IPU gap in case of groundwater is minimal. Whereas, it is higher in surface water irrigation due to conveyance losses, distance between availability of water source and place of its utilization. Hence, the scheme can generate many benefits since groundwater irrigation facilities can more efficiently fulfil irrigation need than that of surface water irrigation. • It has emerged from the discussion with the stakeholders from national, state and region level that cost of providing irrigation facilities through this scheme is very less as compared to surface water irrigation schemes and other state sponsored groundwater irrigation schemes. However, there is scope for reducing project cost through effective convergence activities across various govt. schemes as discussed above, which are currently in planning stage since the scheme is new. • Considering the scheme being operational from post May 2019, it would be premature to rate the scheme with respect to efficiency.
Sustainability	**Secondary**:

Parameter	Findings from research
	• The scheme guidelines mandate the following measures to ensure sustainability of this scheme in the context of current water stressed situation in India: - The scheme should be planned in safe areas, cannot be planned in areas classified as over-exploited, critical or semi-critical - Project authorities or state government departments should monitor groundwater levels in the project areas to ensure that groundwater development level do not exceed 70% at any time, in any of the areas, after implementation of the project - Farmers will be encouraged for adopting activities through combination of rainwater harvesting and groundwater extraction - Farmers should be educated to adopt water use efficiency and conservations practices, such as micro-irrigation system, diversification to low water demand crops, promoting on-farm rainwater harvesting etc. Awareness campaign should be conducted for promoting such practices. - Suitable recharge measures are to be taken up under NRM component of MGNREGA or any other recharge scheme in the project area.
	Primary: • National level stakeholders have stated the below procedure to maintain sustainable groundwater resources: - Potential assessment unit is identified considering several factors including nature of the aquifer system in the area, spatio-temporal behaviour of water level, groundwater resources availability, artificial recharge structures suitable for that area and sites for their construction, etc. - Limiting the number of wells in any potential assessment unit through the method below:

Parameter	Findings from research
	1) Identify the maximum probable wells that can be drilled which can lead to the Stage of Groundwater Development (SOD) being beyond 70% 2) The limit of admissible number of wells in each assessment unit is kept 20% less than the wells required to lead SOD to 70% (calculated in step1) 3) Number of wells proposed in State Government proposals are significantly less than the admissible wells (calculated in step 2) in each unit which comfortably covers the wells drilled other than this groundwater (HKKP) scheme - Convergence with other schemes, such as PMKSY-Watershed Component, MGNREGA, PMKSY-Per Drop More Crop, etc., for supporting water harvesting and groundwater recharge interventions/demand side interventions will influence long-term sustainability of groundwater resources. • However, marginal risk of failure of bore wells, especially in hard rock areas do exist for which provision of site selection through hydrogeological and geophysical investigation is mandated in the scheme guidelines. • Discussions with the stakeholders from Assam and Arunachal Pradesh have indicated that existing groundwater resources is abundant in these states. Hence, it will take long time to reach groundwater development level beyond 70%. Still, they are planning to have convergence with some groundwater recharge schemes for replenishment of groundwater resources. • The stakeholders have stated that since the project envisages withdrawal of maximum 70% of replenishable dynamic groundwater resources, possibility of deterioration of groundwater quality is very less. However, State Technical Advisory Committee has also recommended the study of the groundwater quality and its regular monitoring by CGWB and PHED in all these areas through their network of observation wells.

Parameter	Findings from research
	Tapping of aquifer zone beyond 50 m is suggested in arsenic prone districts/areas. • The stakeholders have stated that general life span of tube well is 10-15 years; thus, no such maintenance is required for the tube wells. However, the farmers should be provided with extensive training for operations and maintenance of pumps and other electrical components (switch gear, LT panel, etc.) associated with the water abstraction setup.
	Inference: • The states are following the eligibility criteria for site selection to ensure groundwater development does not go beyond safe limit. • The states are planning for convergence with groundwater recharge as well as water conservation schemes for ensuring long-term sustainability of groundwater resources. • Considering the scheme being operational from post May 2019, it would be premature to rate the scheme with respect to sustainability.
Impact	**Secondary**: • The scheme aims to improve the socio-economic condition of the small and marginal farmers in safe areas by providing groundwater irrigation facilities.
	Primary: Since this is a recently launched scheme, impact of the scheme cannot be assessed at this stage.
	Inference: • Since the scheme has been operational post May 2019, it would be premature to evaluate impact of the scheme.
Equity	**Secondary**: • The scheme is targeted only at small and marginal farmers • The scheme guidelines mandate to provide priority to the SC/ST and women farmers
	Primary:

Parameter	Findings from research
	• The stakeholders have stated that the guidelines for SC/ST and women beneficiaries are taken care of during the DPR stage. • It has emerged from the discussion with the stakeholder from Assam that current projects undertaken in Assam under this scheme are expected to benefit 19,643 numbers of small and marginal beneficiaries across 14 districts of Assam. Poor tribal farmers will be greatly benefitted from this scheme. • Stakeholder from Arunachal Pradesh has stated that they have almost 100% small and marginal farmers who belong to ST category. Hence, the scheme has been very helpful for them. Since the scheme is benefitting the households comprising both men and women farmers, it is difficult to quote any percentage of women beneficiaries at this stage.
	Inference: • The stakeholders have stated that the guidelines for SC/ST and women beneficiaries are taken care of during the DPR stage. However, the actual number of SC/ST and women beneficiaries can be assessed only after completion of the projects when the beneficiaries will start realizing the project benefits. • There is scope for inclusion of other weaker/vulnerable sections, such as physically challenged, transgenders, etc. into the scheme guidelines. • Considering the scheme being operational from post May 2019, it would be premature to rate the scheme with respect to equity.

Table 65: GWI – Summary of performance evaluation based on REESIE framework

Parameter	Performance
Relevance	
Effectiveness	
Efficiency	
Sustainability	

Parameter	Performance
Impact	●
Equity	●

REESI+E performance infographics legend

● Satisfactory ● Average ● Needs Improvement ● No information

Performance on cross-sectional themes

Table 66: GWI – Performance evaluation based on cross-sectional themes

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
1.	Accountability & Transparency	Availability of Data Records and Reports in public domain • What data records are available for the scheme in public domain?	• The scheme is currently being implemented in Assam and Arunachal Pradesh, post May 2019. • Dedicated MIS for tracking the progress of this scheme is under development. • Details of this scheme along with replies to public queries are available in public domain.
		Monitoring Mechanisms • Does a robust monitoring mechanism exist and at what level?	• As per the guidelines, state should make necessary arrangements to review monitoring of project progress and submit the quarterly progress reports to regional directorate of CGWB and MoWR, RD & GR.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			• CGWB shall monitor the project at least twice a year. CGWB officials are making frequent in-person visits since the scheme is very new. They monitor several parameters such as number of bore wells developed, pump installation, solar panel installation, etc. • Project authorities/ state govt. department should monitor groundwater levels to ensure that groundwater development level do not exceed 70% in any of the areas. Currently, regular monitoring of groundwater levels and quality is being carried out by CGWB in all areas through their network of observation wells. • MoWR, RD & GR may also get the third-party evaluation/ monitoring done of projects undertaken. • State govt. shall provide necessary assistance to CGWB or 3rd party for monitoring.
		Evaluation Mechanisms • What process/impact evaluation studies conducted in	From the discussions with the stakeholders from north eastern region, it has emerged that a

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		the last decade - frequency, quality, coverage, etc.	proposal for 3rd party evaluation and monitoring for Assam and Arunachal Pradesh has been submitted by North Eastern Regional Institute of Water and Land Management (NERIWALM), Tezpur.
		Financial Accountability • What funding mechanisms are being used?	• The scheme guidelines mandate the following funding mechanism: - Funding pattern: - Central: State split of share – 90: 10 for north eastern and hilly states; 60: 40 for other states - Administrative cost including expense for establishing WUAs, distribution and receiving applications, publicity of the scheme etc. will be maximum 1% of cost of project/ scheme - At the inception, 60% of central assistance (CA) will be released on receipt of proposals as 1st instalment - Remaining 40% of CA will be released as 2nd instalment upon receipt of UC for at least 50% of funds released as 1st instalment

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			- Central and state share releases will be considered on cumulative basis while calculating eligibility for CA release
		Beneficiary involvement • What is the involvement of beneficiaries across the project lifecycle? Is the level of involvement adequate?	• As per the scheme guidelines, the irrigation assets created under this scheme will be maintained by the individual farmers or group of farmers or WUA or state Govt. or PRI on their own arrangements/ funds. • The department officials involve the beneficiaries for several works including well installation, solar panel/ electric pump installation etc.
Summary Analysis: • Although scheme details and replies to public queries are available in public domain, central MIS system to track scheme progress is under development. • CGWB officials conduct in-person visits for project monitoring. • The beneficiaries are involved by the department officials for several works including well installation, solar panel/ electric pump installation, etc. However, managing the irrigation assets created under this scheme by the beneficiary farmers have not yet started.			
2.	Direct/Indirect Employment Generation	Employment generation • What is the level of employment generation through schemes in the sector and overall sectoral contribution	• Since the scheme provides irrigation facilities, it is expected to increase the income of farmers and provide employment opportunities for the persons involved such as

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		in National employment generation? • What is the improvement in income levels? • What is the women participation (%) in the Sector/Program?	mechanics, drillers, pump manufacturers, electricians, etc. • The scheme is very new (operational post May 2019); hence, it would be pre-mature to estimate actual employment generation and increase in income.
Summary Analysis: • It is expected to increase income of farmers and provide employment opportunities for persons involved such as mechanics, drillers, pump manufacturers, electricians, etc. • The scheme is very new (operational post May 2019); hence, it would be pre-mature to estimate actual employment generation and increase in income at this stage.			
3.	Gender mainstreaming	Inclusiveness in scheme design/ planning • Is there a specific mention of gender equality and equity considerations in the scheme guidelines/objectives, i.e. has the scheme been designed keeping gender considerations in mind?	• As per the guidelines, the beneficiary under this scheme shall be small and marginal farmers only with priority to be given to SC/ST and Women farmers. • The key informants from Assam and Arunachal Pradesh have stated that they have followed the mandate during the DPR/proposal stage. However, actual women beneficiary data is not available at this stage.
		Gender-friendly infrastructure and policies • How has empowerment of women improved?	• According to the primary stakeholders, no exclusive training programs for women are proposed under the scheme but

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			priority to be given to women farmers for their empowerment.
Summary Analysis: • Although women beneficiaries are prioritized along with SC/ST in the scheme guidelines, actual information around women beneficiaries is not available at this stage.			
4.	Climate change & sustainability including adoption of climate-change resilient practices & diversifications	Climate resilience • Are there appropriate climate resilient policies for mitigation and/or adaptation (or included as part of scheme objectives and design)?	• Climate resilience aspect has been considered indirectly in the scheme through the eligibility criteria. • For example, one eligibility criterion is to have average annual rainfall of 750 mm or more for having availability of enough water for recharge. If rainfall in any area reduces in future due to climate change, that area will not qualify the eligibility criteria and not be considered under this scheme. • However, it is not clear from the guidelines what will happen (e.g. whether the CGWB/state department officials visit and prohibit the farmers to withdraw groundwater from the existing abstraction structures in those areas) for existing groundwater abstraction structures in any area if annual rainfall falls below the stipulated level in future.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
Summary Analysis: • Climate resilience aspect has been indirectly considered in the scheme through the eligibility criteria (e.g. minimum required average annual rainfall of 750 mm). However, the guidelines do not clearly specify the course of action for the existing groundwater structures in case the area does not qualify the criteria after some years due to climate change (e.g. the average annual rainfall in the existing area falls below the stipulated level i.e. 750 mm).			
5.	Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population	Funds allocated under TSP/ SCSP and other provisions for vulnerable communities • What is the fund allocated under TSP & SCSP for each scheme?	• As per the guidelines, the beneficiary under this scheme shall be small and marginal farmers only with priority to be given to SC/ST and Women farmers. However, the guidelines do not have provision for SCSP and TSP. • The key informants from Assam and Arunachal Pradesh have stated that they have provided priority to SC/ST during the DPR/proposal stage. However, actual SC/ST beneficiary data and fund released/utilized for them are not available at this stage.
		Inclusion of vulnerable groups in scheme as well as sector • What are the interventions implemented for specific vulnerable groups?	• Although, the guidelines mandate to provide priority to SC/ST, there is no provision to include other weaker/ vulnerable sections, such as physically challenged, transgender etc.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
Summary Analysis: • There is no provision for TSP and SCSP in the scheme guidelines. • Although the scheme guidelines provide more focus on SC/ST, actual information on SC/ST beneficiaries, funds released/ utilized for them are not available.			
6.	Use of IT/Technology in driving efficiency	Deployment of IT enabled mechanisms for monitoring of the Schemes • In case of a scheme to create physical assets, is geotagging and use of geotagged photographs being done? • How is technology being used for on-ground data collection?	• The scheme guidelines suggest utilizing appropriate technology including remote sensing to investigate the areas where recharge interventions can be constructed. No such interventions have been adopted so far. • Geo-tagging of irrigation assets has been done to identify them and maintain transparency in scheme implementation. It is also helpful for future planning. • Technologies used for on-ground data collections are: - Geophysical feasibility Survey (Vertical electrical sounding/ resistivity survey) to study existence of groundwater, identify potential site location for implementation of groundwater irrigation infrastructure, groundwater contamination etc.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			- Hydrogeological survey to determine the groundwater level, quality and quantity of groundwater available at a particular location. • Technological interventions have not been adopted for project monitoring yet considering that it would not be cost-effective for such small scale of the projects. • Arunachal Pradesh has state level MIS system to track project progress. In-house software application and WhatsApp group fulfil the purpose in Assam.
Summary Analysis: • The states geo-tag the physical assets, use geo-tagged photographs. • Geo-physical feasibility and hydro-geological survey are carried out to identify potential site location, groundwater availability and level of groundwater contamination. • The scheme guidelines suggest utilizing appropriate technology including remote sensing to investigate the areas where recharge interventions can be constructed. However, no such interventions have been adopted so far.			
7.	Stakeholder and Beneficiary behavioural change	Fund Allocation • What percent of total allocation is directed towards Awareness generation or sensitization? What is the utilization rate? and How much impact has it been able to generate in terms of behaviour change?	• Scheme guidelines mandate that the Ministry may utilize up to 1.5% of central assistance (CA) for IEC activities, evaluation and 3rd party monitoring. However, stakeholder from Assam has suggested to increase this allocation to at least 5%.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		Cropping pattern • How has this scheme impacted cropping pattern?	• Scheme guidelines suggest for promotion and adoption of low water demand cropping pattern for efficient use and conservation of water. • According to the stakeholder from north east region, this scheme will help the farmers to get assured irrigation water for cultivating cereals, vegetables, horticulture crops, etc. throughout the years.
Summary Analysis: • Although the scheme guideline mandates a provision to utilize funding for generating awareness about this scheme, information around actual utilization of this fund is not available. • This scheme is expected to get assured irrigation water for cultivating cereals, vegetables, horticulture crops, etc. throughout the years. However, actual realization is yet to happen.			
8.	Research & Development	Fund Allocation • What percentage of total allocation (Sector as well as Scheme specific) is directed towards R&D? How much of that percent is being utilized?	• The scheme guidelines do not have any provision for R&D. Also, no fund is earmarked for such activities. • However, there is scope of R&D in the following areas: - Aquifer vulnerability assessment to reduce the risk of failure of bore wells and demarcate aquifer zone vulnerable to contaminations

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			- Cleaning up of contaminated aquifer - Regulated use of groundwater so that groundwater extraction under this scheme does not exceed the Stage of Groundwater Development (SOD) beyond 70% in any area - Improvement of accuracy and frequency of groundwater data - Micro level information of depleted aquifers
Summary Analysis: • The scheme guidelines do not have any provision for R&D and no funds earmarked for such activities. However, there is scope for R&D activities in this groundwater irrigation area.			
9.	Unlocking Synergies with other Government Program	Convergence (Inter-Ministerial/Inter-Departmental/Financial/Human Resources/ Administrative/ Institutions/ Schemes • What activities are undertaken to ensure convergence at community level? Are there any Action Plans prepared at State/District/Block level to ensure the same?	• Since the project is new, convergence activities are not undertaken yet across states. However, the state department realizes the importance of convergence and is currently planning for that.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		Potential areas for synergy • What are the areas for potential convergence / synergy across govt. programs?	• There is scope for convergence with PMKSY-Watershed Component, MGNREGA, PMKSY-Per Drop More Crop, etc. for supporting water harvesting, groundwater recharge and water use efficient interventions for sustaining long term groundwater management.
Summary Analysis: • There is scope for convergence with MGNREGA, PMKSY- WDC and PMKSY-PDMC for activities including water harvesting, groundwater recharge and efficient use of water. However, convergence activities are in planning stage since the scheme is new.			
10	Impact on and role of private sector, community/ collectives/ cooperatives (e.g. Farmer cooperatives, FPOs, Water User Associations, etc.) and civil society in the scheme	Private Sector Participation What is the percentage of private investment in the clusters/programs run by the government?	Apart from material supply (pumps, electrical components, pipes, etc.) and EPC contract, private sector involvement is limited.
		FPOs/SHGs/Cooperative's Participation How many private sector, community/collectives/cooperatives and civil society have availed the benefits under any Scheme?	WUAs are supposed to be involved in operations and management of irrigation assets. However, there is absence of adequate data for WUAs. Also, information related to FPOs, SHGs, Cooperative's participation is not available.
Summary Analysis: • Apart from material supply and EPC contract, private sector involvement is limited. • There is absence of adequate data for WUAs, FPOs, SHGs etc.			

In addition to the above, other related themes like 'Development, dissemination & adoption', 'Reforms, regulations' have been rated as 'no information' because the scheme is new and lack of information around those themes; 'Water sharing treaties/ agreements & diplomacy' and 'Conjunctive use of water' have not been evaluated since these themes are not relevant to the scheme.

A summary analysis and performance of the scheme on the identified themes is presented below:

Table 67: GWI – Summary of performance evaluation based on cross-sectional themes

Parameter	Performance
Accountability & Transparency	🟡
Direct/Indirect Employment Generation	⚫
Gender mainstreaming/Inclusiveness	⚫
Building resilience to climate change (including but not limited to developing water disaster preparedness) & ensuring sustainability	🟡
Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population	⚫
Use of IT/Technology in driving efficiency	🟡
Stakeholder and Beneficiary behavioural change	⚫
Development, dissemination & adoption	⚫
Research & Development	⚫
Water sharing treaties/agreements & diplomacy	⚫
Conjunctive use of water - surface versus groundwater usage optimizations	⚫
Unlocking Synergies with other Government Program	⚫
Reforms, Regulations	⚫
Impact on and role of private sector, community and civil society in the scheme	⚫

Cross-sectional themes performance infographics legend

High Medium Low Not relevant No information

Issues and challenges

This scheme is operational post May 2019 in Assam and Arunachal Pradesh. Progress is also good so far. Stakeholder from Assam has indicated very few issues and challenges faced during scheme implementation.

Table 68: GWI – Issues and challenges

Sl.no	Issues & Challenges
GWI - F1	Requirement of drilling rigs were so high that it could not be fulfilled from within the state (Assam). Hence, the vendors had to bring many drilling rigs from other states which resulted in cost escalation as well as delays.
GWI – F2	Some projects were in remote areas and road connectivity is not good across those areas. Hence, it was challenging to transport drilling rigs and other facilities to those areas.
GWI – F3	From the discussions with state level stakeholders, it has emerged that maximum cost norms for groundwater structures and their ancillaries are less attractive to the vendor companies across the north eastern states which supply the construction materials. Due to logistical challenges and less availability of construction materials, vendor companies have incurred more cost than estimated and executed the project works at low margin. Therefore, if the volume of projects is not high in upcoming years, the companies might not come forward for construction of such projects. However, the national level stakeholder has informed that they have not heard about any such challenges from the north eastern states.

Recommendations and solutions

Since this scheme is operational post May 2019 in Assam and Arunachal Pradesh, there are very few improvement areas which can be suggested at this stage. Some of the improvement areas are as follows:

Table 69: GWI – Recommendations and solutions

Sl.no	Recommendation	Finding
GWI - R1	Maximum cost norms for groundwater structures and their ancillaries may be categorised based on terrain, transport cost, presence of manufacturing companies, etc. Hence, cost norms for north eastern and Himalayan states may be increased as compared to that in other states.	GWI-F3

2.2.3 Special Package for Irrigation Projects in agrarian districts of Maharashtra

In July 2018, Government of India approved the Centrally Sponsored Scheme - 'Special Package for completion of Irrigation Projects in suicide prone districts in Vidarbha and Marathwada and other chronically drought prone areas of Rest of Maharashtra' with Central Assistance of Rs.3,831 Cr. The intent was to complete 83 Surface Minor Irrigation (SMI) projects and 8 Major / Medium Irrigation Projects. It was envisaged that the completion of proposed projects would help in the creation of additional 3.77 lakh ha of irrigation potential.

The projects proposed under the special package are over and above the prioritized projects currently being funded under PMKSY and will receive Central Assistance of 25%. If required, the State share can be arranged by borrowing, from NABARD. The monitoring of these projects is on the lines of PMKSY.

2.2.3.1 Background

Maharashtra having a total cultivable area of around 225 lakh ha. has a typical geographical pattern with skewed distribution of rainfall resulting in droughts, impacting many districts of the State, as a recurrent phenomenon. Maharashtra experienced hydrological and agricultural drought during the years 2012 to 2016. The situation was worst in Vidarbha and Marathwada regions. Unfortunate incidences of suicides by farmers occurred in 6 districts of Vidarbha region and 8 districts of Marathwada region. Also, Drought Prone Areas (DPA) in rest of Maharashtra were experiencing distress in the recent years.

The Govt. of Maharashtra reported that irrigation potential created in 14 districts in Marathwada and Vidarbha was around 18%. Only 6.4% of the area was irrigated while the balance 93.6% area was rainfed. Therefore, providing adequate irrigation facilities for sustainable agriculture was the need of the hour. The State Government took various measures to overcome the farmers' distress in these areas. One of the steps was to complete ongoing irrigation projects benefiting such areas.

On 15-5-2017 Govt. of Maharashtra submitted a proposal containing 115 Surface Minor Irrigation (SMI) and Major/medium Irrigation (MMI) projects in Vidarbha, Marathwada and drought prone areas in the rest of Maharashtra for special package. Later in December 2017, it was informed

by the State Govt. that out of 115 projects, 3 projects were completed. Out of balance 112 projects, (83 SMI and 29 MMI), 83 SMI and 7 MMI projects had requisite TAC clearances from State/Ministry of WR, RD & GR as required. Later, one more MMI project (Warkhed Londhe) obtained TAC clearance. The special package was proposed for these 91 projects (83 SMI and 8 MMI). The total estimated balance cost of these projects was Rs. 13,651.61 Cr. as on 01.04.2018.

These projects were ongoing and Rs.11,552.15 Cr. had already been spent by the State Government on these projects as on 31.3.2018. The completion of balance works of these projects would help in creation of additional 3.77 lakh ha of potential and reduce distress conditions in 12 districts of Vidarbha and Marathwada regions of Maharashtra and certain other drought prone areas of rest of Maharashtra.

2.2.3.2 Performance

There are total 91 projects considered under this scheme across 16 districts in Vidarbha and Marathwada regions.

Physical Progress[178]

Ultimate irrigation potential of these 91 projects is 406,440 ha. As on 1st April 2018, balance irrigation potential to be created was 372,938 ha. From 2018-19 to 2019-20, irrigation potential creation was 90,410 ha.

Table 70: SPFM – Physical Progress[178]

#	Projects	Balance Irrigation Potential as on 01.04.2018 (Ha)	Irrigation Potential Created (2018-19 to 2019-20) (Ha)	Progress
83 Surface Minor Irrigation (SMI) Projects				
1	Vidarbha	53,826	12,121	23%
2	Marathwada	11,762	1,018	9%
SMI Total		**65,588**	**13,139**	**20%**
8 Major/Medium Irrigation (MMI) Projects		**307,350**	**77,271**	**25%**
Total Maharashtra State		**372,938**	**90,410**	**24%**

[178] Data shared by SPR wing under MoWR, RD & GR on 27 Aug and 1 Sep 2020

Financial Progress[178]

As on 1st April 2018, total approved balance cost of these 91 projects was Rs. 11,969 Cr. From 2018-19 to 2019-20, an amount of Rs. 800 Cr. was released as central assistance (CA).

Table 71: SPFM – Financial Progress[178]

#	Projects	Balance Cost as on 01.04.2018 (Rs. in Cr.)	CA Release (2018-19 to 2019-20) (Rs. in Cr.)
1	Vidarbha	2,525	294
2	Marathwada	352	43
SMI Total		**2,877**	**337**
8 Major/Medium Irrigation (MMI) Projects		**9,092**	**463**
Total Maharashtra State		**11,969**	**800**

Performance on REESI+E framework

Table 72: SPFM – Performance evaluation based on REESIE framework

Parameter	Findings from research
Relevance	**Secondary**: • Maharashtra experienced hydrological and agricultural drought during the years 2012 to 2016 and the situation was worst in Vidarbha and Marathwada regions[179] • Unfortunate incidence of suicides by famers occurred in 6 districts of Vidarbha region and 8 districts of Marathwada region[179] • Irrigation potential created across 14 districts of Vidarbha and Marathwada regions was only around 18%[179] • Therefore, the scheme was incorporated for providing adequate irrigation facilities for sustainable agriculture, water for domestic use in these suicide prone districts and drought prone areas. The scheme is expected to improve the socio-economic condition of the farmers of

[179] Scheme guidelines, Special Package for Maharashtra, MoWR, RD & GR (June 2018)

Parameter	Findings from research
	these regions by enhancing crop productivity and creating employment opportunities for unskilled, semi-skilled and skilled workers.[179]
	Primary: • It has emerged from the discussions with the key informants at state and district level that 83 SMI and 8 MMI projects had started prior to incorporation of this Special Package scheme. These projects had been facing financial constraints for long time; hence, these projects were brought under Special Package. Also, the projects are very important considering drought prone and suicide prone areas across these regions. Therefore, it might impact the socio-economic status of these districts if the scheme is scaled down or stopped. • The stakeholders from various levels have confirmed that the scheme is focusing on providing irrigation facility and drinking water to the beneficiary villages. • The stakeholders at state and district levels have stated that the projects, which have been completed, are quite successful since the beneficiaries have got livelihood options (agriculture, animal husbandry, etc.) due to assured availability of water through these irrigation projects.
	Inference: • The scheme covers 91 irrigation projects which were delayed for long time due to financial constraints before incorporation of this scheme. These projects are also important since these will help to improve socio-economic condition of the farmers across drought prone and suicide prone districts of Vidarbha and Marathwada. Therefore, the scheme is quite relevant to these districts of Maharashtra. Therefore, the scheme has been rated as "satisfactory" with respect to relevance.
Effectiveness	**Secondary**:

Parameter	Findings from research
	• The scheme is expected to increase irrigation potential creation (output). It is expected to enhance productivity and generate employment opportunities (outcome). • This irrigation facility will provide an opportunity to boost the socio-economic condition of the farmers of these suicide prone districts of Vidarbha and Marathwada and draught prone areas (impact). • Although output, outcome, impact parameters can be assumed (as mentioned above) from scheme objectives, these parameters are not specified in the scheme guidelines. • The scheme is operational from 2018-19 to 2022-23. The scheme has created an irrigation potential of 90,410 ha (as on 31st March 2020) out of targeted potential of 3.73 lakh ha[178]. • There is a dedicated MIS for tracking the progress of this scheme where the physical progress, financial progress and project related issues and constraints are being tracked. There is a scope for tracking the outcome parameters in the MIS as well. • Scheme guidelines mandate that the major and medium projects under the proposal shall be monitored by field offices of CWC twice a year. SMI schemes shall be monitored periodically by field offices of CWC on sample basis (25%) twice a year[179]. • The scheme guidelines have specified the following milestones for implementation of this scheme: - Completion of 13 SMI projects by June 2019 - Completion of 56 SMI and 2 MMI projects by June 2020 - Completion of 14 SMI and 2 MMI projects by June 2021 - Completion of 2 MMI by June 2022 - Completion of 2 MMI by June 2023
	Primary: • State Water Resources Department is accountable for planning and execution of the projects on ground; whereas CWC looks after monitoring of the projects.

Parameter	Findings from research
	• Physical and financial targets of the projects were set by the state govt. during inception of the projects (before incorporation of this scheme). Therefore, scheme target was specified based on remaining project works as on 1st April 2018. • 18 SMI projects have been completed so far. It is targeted to complete the remaining 65 SMI projects and 4 MMI projects by June 2021[178]. • The stakeholders from state and district levels have mentioned that funding was a challenge prior to inclusion of these projects into special package. However, they are not currently facing any funding issues. • The first two milestones have not been achieved. As per national level stakeholders, this is mainly because project mobilisation took longer time than expected and they are expecting to complete all the projects by the final milestone. However, the stakeholders from state and district levels have mentioned about the following factors which have negatively impacted the project implementation: - Land acquisition: Although new land acquisition act has reduced this challenge because the land holders receive good compensation for acquiring their lands, some projects (such as Shelgaon Barrage Medium project, Jigaon, Bhagadi, Karajgaon etc.) are delayed due to pending clearances from several departments like roads, railway, environment, land resources and others. Sometimes, although the quantum of land requirement is small, resistance of land holders and legal cases lead to delay in project progress. - Rehabilitation and Resettlement: Some of the significant contributors to this issue are delays in administrative approvals (like getting clearances from respective land resources departments), non-involvement of the local stakeholders (Project Affected Persons) at the project inception stages and compensation amount related challenges, etc. Some projects (such as Lower Chargad, Barbada, Jigaon etc.) are delayed due to this issue. - COVID-19 pandemic situation

Parameter	Findings from research
	• Prior to this scheme, it was mandated to monitor the irrigation projects (MMI and SMI) only once in a year. This scheme has increased the frequency to twice in a year for better project monitoring. Most of the stakeholders from state and district levels have stated that CWC conducts in-person monitoring of the MMI as well as minor irrigation projects following the guidelines. However, the stakeholder from Amravati Irrigation Project circle has stated that CWC conducts holistic monitoring for medium projects; but monitoring has not been satisfactory for the minor projects. The state level stakeholder has also suggested that innovative technologies (such as drone survey, remote sensing etc.) can be adopted along with in-person monitoring for further improving project monitoring. For example: - Remote sensing technologies can be helpful on account of the huge span and difficult terrains of project areas - Survey of ongoing construction works and monitoring of projects (to detect canal breeches, unauthorized water withdrawals) can be explored using drones • National level stakeholder has stated that project monitoring through remote sensing has already been arranged through Bhaskaracharya Institute of Space Applications and Geo-informatics (BISAG). A mobile application for geo-tagging project components has been developed along with a GIS based web portal for monitoring the progress of canal works. Drone monitoring of the projects is under consideration by the Ministry. A pilot study has been done by Government of Maharashtra for one irrigation project in the State on the use of Drone Technology. The technology would be promoted in the future for the purpose of progress monitoring, as required. However, the stakeholders from state and district levels do not have information of such technological interventions (e.g. remote sensing, drone survey, etc.) in the projects under SPFM scheme.

Parameter	Findings from research
	• Discussion with national level stakeholder has indicated that Govt. has taken the following major initiatives to improve implementation of these projects: - *Extensive Review*: The progress of the projects is being reviewed extensively at the level of Secretary (WR, RD&GR), Hon'ble Minister (Jal Shakti). - *MIS*: Online Management Information System (MIS) has been developed for monitoring of the projects. Physical and financial progress of the projects is regularly updated in the MIS by the State Government of Maharashtra. - *UGPL*: Use of Underground Pipeline (UGPL) has been actively promoted to resolve the issue of Land Acquisition (LA) and increase water conveyance efficiency. Guidelines for Planning and Design of Piped Irrigation Network were released by this Ministry in July'2017. - *Extensive Monitoring*: The progress of the projects in terms of physical as well as financial is monitored through the field units of Central Water Commission.
	Inference: • Incorporation of this scheme is very relevant in the existing context. Govt. has taken several measures, including extensive review by senior officials of MoWR, RD&GR, progress tracking through online MIS; extensive monitoring by CWC; use of Underground Pipeline (UGPL) to resolve the issue of Land Acquisition (LA) and increase water conveyance efficiency, etc. for improving implementation of this scheme. • However, the scheme has not achieved first two milestones (as envisaged in the scheme guidelines) because of issues related to land acquisition, rehabilitation, longer mobilization period etc. Therefore, the scheme has been rated as "average" with respect to effectiveness.

Parameter	Findings from research
Efficiency	**Secondary**: • Total balance cost for the 91projects under SPFM as on 1st April 2018 is Rs. 11,969 Cr. Total central assistance (CA) released from 2018-19 to 2019-20 is Rs. 800 Cr. [178] • Direct benefit of the scheme is to increase irrigation potential. Indirect benefits are productivity increase, employment generation and improvement in socio-economic scenario etc. • The projects are expected to generate immediate wage and other employment opportunities during construction phase. It is expected to generate 341 lakh man-days for unskilled, semi-skilled, and skilled workers.[179] • There is scope of convergence with MGNREGA and other state/central level schemes. [179]
	Primary: • At the time of inclusion in the SPFM scheme, the total cost of the projects considered in the scheme guidelines was Rs. 25,203.76 Cr.[178] The approved cost of works of the projects under SPFM was Rs. 22,836.01 Cr.[178] However, the latest cost of the projects under SPFM is Rs. 24,331.11 Cr.[178]; thus, there is a cost over-run of 6.55%, which is not that significant. Hence, it can be concluded that the financial burden on the State in respect of these projects has effectively reduced with the help of Central Assistance under the scheme. • This cost over-run depends upon variety of factors and many of these factors may not be entirely under control of implementing authorities such as inter-state issues, revision in Land Acquisition Act, R&R issue, change in design due to geological surprises encountered while execution, lack of financial resources, State Government's priority, delay in getting statutory clearances, time taken in the public hearing process and limited working season in hilly and troubled areas, etc. However,

Parameter	Findings from research
	there should be a systematic and time-bound response to these issues to improve efficiency of the projects. • There is a provision for state department to utilize NABARD loan. As per agreement between Govt. of Maharashtra and NABARD, there are two instruments available: - Rural Infrastructure Development Fund (RIDF): loan at lesser interest rate than market - NABARD Infrastructure Development Assistance (NIDA): loan at market rate • State department also utilizes another source of fund, i.e. state borrowing from the market. However, other sources of fund have 2-3% higher rate of interest than that of NABARD loan. • Private sector companies are not coming forward to invest owing to lack of returns in this sector. In view of the financial burden on state exchequer, state govt. is exploring options to involve private parties through innovative PPP models like Hybrid Annuity Model (HAM model has already been successfully implemented in financing road and sewage treatment infrastructure in India) mainly in O&M of the irrigation assets. • There is further scope of reducing project cost through achieving convergence with other state/central schemes. However, discussions with the stakeholders at the district level have indicated mixed feedback about convergence activities. The stakeholder from Upper Wardha Irrigation circle has reported that convergence activities with MGNREGA is effectively going on. However, the stakeholder from Amravati Irrigation Project circle has not mentioned about any such convergence activities. • The stakeholders at state and district levels have validated the immense benefit of these irrigation projects to improve socio-economic condition of the beneficiary farmers. They have mentioned that benefit is realized in terms of employment generation during the construction phase and

Parameter	Findings from research
	improvement in agricultural activities, cropping pattern, etc. during post construction phase.
	Inference: • After inclusion of these 91 projects in the SPFM scheme, there has been no significant cost over-run in these projects. • The cost of the projects depends upon variety of factors and many of these factors may not be entirely under control of implementing authorities such as inter-state issues, revision in Land Acquisition Act, R&R issue, change in design due to geological surprises encountered while execution, lack of financial resources, State Government's priority, delay in getting statutory clearances, time taken in public hearing process and limited working season in hilly and troubled areas etc. There is scope to make the projects more cost efficient by providing systematic and time-bound response to these issues. • There is a scope to make the projects more cost efficient with several measures including private sector involvement, convergence with other state/ central schemes, etc. Therefore, the scheme has been rated as "average" with respect to efficiency.
Sustainability	**Secondary**: Since the scheme is relatively new (operational since April 2018), there is a lack of information across secondary sources to evaluate its sustainability.
	Primary: • Considering water-scarce situation and popularity of water intensive crop (such as cotton, sugarcane etc.) cultivation in Vidarbha and Marathwada regions, the state department. has undertaken the below measures to maintain sustainable water sources management: - Volumetric Supply of Water: Farmers are informed the amount of water they will receive in a period so that they can plan cropping pattern based on availability of water. Also, they are educated to save water during Rabi season in order to compensate the water

Parameter	Findings from research
	requirement during summer months. In this way, sustainability of water resources is managed without curbing their freedom of cropping. - Participatory Irrigation Management: Water Users Association (WUA) is formed for monitoring water use by different farmers. • It has emerged from the discussions with the stakeholders at district level that integration of irrigation projects (major, medium and minor) with micro-irrigation system (e.g. drip, sprinkler etc.) can be implemented to improve on-farm water use efficiency, resulting in sustainable water resources management. • User's participation into management of the assets can be mandated for maintaining sustainability because it would be difficult and not cost effective for the Govt. to manage the assets over entire life. • States organize training sessions and capacity building activities for the Water Users Associations (WUA) so that they can manage the irrigation assets after certain years (e.g. 3-5 years) of O&M by the Govt. or any NGO or any private body appointed by the Govt. However, the district level stakeholders have stated that training and capacity building activities are not adequately organized at present; thus, there is huge scope of extensive training and capacity building activities.
	Inference: • State department has taken several measures such as volumetric water supply, participatory irrigation management, etc. for sustainable water resources management. There is a scope of further improvement of water resources management through integration of irrigation projects with micro-irrigation systems. • Since WUAs are accountable for O&M of irrigation assets, there is a need of extensive training and capacity building activities.

Parameter	Findings from research
	• However, it would be premature to rate the scheme in terms of sustainability since the scheme is relatively new (operational since April 2018).
Impact	Since the scheme is relatively new (operational since April 2018), it would be premature to evaluate impact of the scheme
Equity	**Secondary**: • As per the scheme guidelines, the implementation of the Scheme would help all categories of farmers including marginal farmers in the command of the projects proposed to be completed, spread across Marathwada, Vidarbha and rest of the drought prone areas of Maharashtra.
	Primary: • Equity aspects (gender, weaker section) were taken into consideration during the DPR preparation • Women participation is ranging from 25% to 33% across projects.
	Inference: Since the scheme is relatively new (operational since April 2018), it would be premature to evaluate the scheme with respect to equity aspect.

A summary analysis and performance of the scheme on the identified themes is presented below:

Table 73: SPFM – Summary of performance evaluation based on REESIE framework

Parameter	Performance
Relevance	🟢
Effectiveness	🟡
Efficiency	🟡
Sustainability	⚪
Impact	⚪
Equity	⚪

REESI+E performance infographics legend

🟢 Satisfactory 🟡 Average 🔴 Needs Improvement ⚪ No information

Performance on cross-sectional themes

Table 74: SPFM – Performance evaluation based on cross-sectional themes

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
1.	Accountability & Transparency	Availability of Data Records and Reports in public domain • What data records are available for the scheme in public domain?	• There is a dedicated online Management Information System (MIS) for tracking the progress of this scheme where output parameters (such as physical progress, financial progress) along with project related issues and constraints are being tracked. This progress data is regularly updated in the MIS by the State Government of Maharashtra. The progress of the projects is being reviewed extensively at the level of Secretary (WR, RD&GR), Hon'ble Minister (Jal Shakti). • Tracking of outcome (such as enhance productivity, generate employment opportunities etc.) and impact (such as improve socio-economic status of farmers etc.) parameters can be explored in future.
		Monitoring Mechanisms • Does a robust monitoring mechanism exist and at what level?	• As per the scheme guidelines, monitoring for environment safeguards stipulated by MoEF&CC, if any, to be activated immediately by the state Govt. for these projects. Dedicated Land Acquisition & Rehabilitation and Resettlement arrangements for these projects shall be established by the state to ensure that

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			there is no delay on account of these activities. • As per the scheme guidelines, monitoring of each of the minor irrigation scheme has to be done by the State Government physically and they would be geo-tagged, and each Minor Irrigation project would be given a Unique Identification Code (U.I.C) • The major and medium projects under the proposal shall be monitored by field offices of CWC twice a year. SMI schemes would also be monitored periodically by field offices of CWC on sample basis (25%) twice a year. • Most of the stakeholders from state level have stated that CWC conducts in-person monitoring of the MMI as well as minor irrigation projects following the guidelines. However, stakeholder from Amravati Irrigation Project circle has stated that CWC conducts holistic monitoring for medium projects; however, monitoring has not been satisfactory for the minor projects. • Stakeholders from state and district levels have suggested to improve monitoring mechanism by adopting technological interventions (such as remote sensing, drone survey etc.).

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		Evaluation Mechanisms • What process / impact evaluation studies conducted in the last decade - frequency, quality, coverage, etc?	• The guidelines mandates that the evaluation studies shall be carried out by state after completion of the projects. • However, no such evaluation has been conducted so far.
		Financial Accountability • What funding mechanisms are being used?	• As per scheme guidelines, - 25% of the expenditure incurred in the projects will be provided as Central Assistance - The central assistance may be provided from budget of ministry in reimbursement mode - Ministry may facilitate possibility of NABARD loan for state share funding within FRBM limit
		Beneficiary involvement • What is the involvement of beneficiaries across the project lifecycle? Is the level of involvement adequate?	• Irrigation water users are primary project beneficiaries. They are mainly involved in post construction phase. They form Water Users Association and WUAs are responsible for managing the irrigation assets.
Summary Analysis: • Dedicated MIS (PMSKY-SPFM) keeps track of output parameters; tracking of outcome and impact parameters in the MIS can be explored in future.			

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
• Although most of the stakeholders have stated that CWC conducts in-person monitoring of the MMI as well as minor irrigation projects following the guidelines, stakeholder from Amravati Irrigation Project circle has indicated lack of satisfactory monitoring by CWC for the minor projects. • No evaluation studies have been carried out so far. • Project beneficiaries are mainly involved during the O&M phase.			
2.	Direct/Indirect Employment Generation	Employment generation • What is the level of employment generation through schemes in the sector and overall sectoral contribution in National employment generation? • What is the improvement in income levels? • What is the women participation (%) in the Sector/Program?	• As per the scheme guidelines, the completion of the identified irrigation projects is expected to generate immediate wage and other employment opportunities in good measure during the construction phase. • It is expected that implementation of scheme can generate employment of about 341 lakh man-days for unskilled, semi-skilled and skilled workers. • The stakeholders have mentioned that many skilled, unskilled, semi-skilled workers are employed for construction work of the projects. However, employment generation data is not currently available.
		Institutional barriers • Are there institutional barriers to employment generation (e.g. access to markets)?	• The stakeholders have not mentioned about any institutional barriers which can negatively impact employment generation.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		Private sector involvement • Is there scope for private sector to be involved with a view to increase employment opportunities?	• Private companies are involved for construction of irrigation infrastructures and they are generating employment opportunities for skilled, un-skilled, semi-skilled workers.
Summary Analysis: • Currently, many skilled, unskilled, semi-skilled workers are employed for construction work of the projects**.** However, actual data related to employment generation and increase in income is not currently available.			
3.	Gender mainstreaming	Inclusiveness in scheme design/ planning • Is there a specific mention of gender equality and equity considerations in the scheme guidelines/objectives, i.e. has the scheme been designed keeping gender considerations in mind?	• As per the scheme guidelines, the implementation of the scheme would help all categories of farmers including marginal farmers in the command of the projects proposed to be completed, spread across Marathwada, Vidarbha and rest of the drought prone areas of Maharashtra. However, there is no specific mention of women beneficiaries in the guidelines.
		Gender-friendly infrastructure and policies	Women are also beneficiary of these projects. Hence, they are also getting water for cultivation or any other livelihood options. It improves their economic status as well.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		• How has empowerment of women improved?	However, information specific to women empowerment, is not available.
Summary Analysis: • There is no specific mention of gender mainstreaming in the scheme guidelines. • Although women are involved as beneficiaries of these projects, actual data related to women beneficiaries, activities undertaken to empower them is not available.			
4.	Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population	Funds allocated under TSP/ SCSP and other provisions for vulnerable communities • What is the fund allocated under TSP & SCSP for each scheme?	There is no specific mention of TSP and SCSP in the scheme guidelines
		Inclusion of vulnerable groups in scheme as well as sector • What are the interventions implemented for specific vulnerable groups?	As per the scheme guidelines, the implementation of the scheme would help all categories of farmers including marginal farmers in the command of the projects proposed to be completed, spread across Marathwada, Vidarbha and rest of the drought prone areas of Maharashtra.
Summary Analysis: • There is no specific mention of TSP and SCSP in the scheme guidelines. • Although the scheme guidelines mandate to include all categories of farmers, actual data of SC/ST is not currently available.			
5.	Use of IT/Technol	Deployment of IT enabled mechanisms for	• As per the scheme guidelines, the minor irrigation assets would be geo-tagged, and

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
	ogy in driving efficiency	monitoring of the Schemes • In case of a scheme to create physical assets, is geotagging and use of geotagged photographs being done? • How is technology being used for on-ground data collection?	each Minor Irrigation project would be given a Unique Identification Code (U.I.C). • From the discussions with the stakeholders at district level, mixed feedback about geo-tagging has been received. While the stakeholder from Amravati Irrigation Project circle has stated that geo-tagging, geo-tagged photographs, etc. are used in the projects within his circle, stakeholder from Upper Wardha Irrigation circle has stated that geo-tagging has not been done for all projects within his circle.
		Use of latest technology to improve efficiency and effectiveness of scheme implementation • What are the technologies being used in project implementation, service delivery?	• The national level stakeholders have stated that project monitoring through remote sensing has been arranged through Bhaskaracharya Institute of Space Applications and Geo-informatics (BISAG). Drone monitoring of the projects is under consideration of the Ministry. A pilot study has been done by Government of Maharashtra for one irrigation project in the State on the use of Drone Technology. The technology would be promoted in the future for the purpose of progress monitoring, as required. However, the stakeholders from state and district levels do not have information of such

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			technological interventions in the projects under SPFM scheme.
Summary Analysis: • The stakeholders at district level provided mixed feedback about geo-tagging. While the stakeholder from Amravati Irrigation Project circle has stated that geo-tagging, geo-tagged photographs, etc. are used in that circle, stakeholder from Upper Wardha Irrigation circle has stated that geo-tagging has not been done for some projects in the circle. • There is a scope of technological interventions (e.g. remote sensing, drone survey, etc.) for better project monitoring.			
6.	Research & Development	Fund Allocation • What percentage of total allocation (Sector as well as Scheme specific) is directed towards R&D? How much of that percent is being utilized?	• This scheme is a niche package targeted to drought prone areas of Vidarbha and Marathwada regions for faster completion of irrigation projects. There is no provision for R&D in scheme guidelines. Also, no fund is earmarked for such activities.
Summary Analysis: • There is no provision for R&D in the scheme guidelines and no fund currently allocated for these activities.			
7.	Unlocking Synergies with other Government Program	Potential areas for synergy • What are the areas for potential convergence / synergy across govt. programs?	• As per the scheme guidelines, there is scope of convergence with MGNREGA and other state/central level schemes. • Discussions with the stakeholders at district level have indicated mixed feedback about convergence activities. The stakeholder from Upper Wardha Irrigation circle has reported that convergence activities with MGNREGA is

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			effectively going on. However, the stakeholder from Amravati Irrigation Project circle has indicated lack of convergence activities
Summary Analysis: • Convergence with MGNREGA is happening effectively across some projects (e.g. Upper Wardha Irrigation Circle); however, stakeholder from Amravati Irrigation Project circle has indicated lack of convergence activities in that circle.			
8.	Impact on and role of private sector, community/ collectives / cooperatives (e.g. Farmer cooperatives, FPOs, Water User Associations, etc.) and civil society in the scheme	Public-Private Partnership • How well have PPP functions in the Sector? What are the challenges faced?	• Although private companies are involved for construction of irrigation infrastructures, no project is currently being undertaken in PPP mode.
		Private Sector Participation • What is the percentage of private investment in the clusters/programs run by the government?	• Private sector companies are not coming forward to invest due to lack of returns in this sector. However, the govt. is very keen to involve private companies. Currently, the state govt. is exploring options to involve private parties through innovative PPP models like Hybrid Annuity Model (HAM model has already been successfully implemented in financing road and sewage treatment infrastructure in India) mainly in O&M of the irrigation assets.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
Summary Analysis: • Apart from material supply and EPC contract, private sector participation is limited. • Private sector companies are not coming forward to invest due to lack of returns in this sector. However, the state govt. is exploring options to involve private parties through innovative PPP models like Hybrid Annuity Model.			

In addition to the above, other related themes like 'Building resilience to climate change', 'Development, dissemination & adoption', 'conjunctive use of water', 'Reforms, regulations', 'Stakeholder and Beneficiary behavioural change' have been rated as 'no information' because the scheme is new and lack of information around those themes; 'Water sharing treaties/agreements & diplomacy' has not been evaluated as this theme is not relevant to the scheme.

A summary analysis and performance of the scheme on the identified themes is presented below:

Table 75: SPFM – Summary of performance evaluation based on cross-sectional themes

Parameter	Performance
Accountability & Transparency	🟡
Direct/Indirect Employment Generation	⚫
Gender mainstreaming/Inclusiveness	⚫
Building resilience to climate change (including but not limited to developing water disaster preparedness) & ensuring sustainability	⚫
Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population	⚫
Use of IT/Technology in driving efficiency	🟡
Stakeholder and Beneficiary behavioural change	⚫
Development, dissemination & adoption	⚫
Research & Development	⚫

Parameter	Performance
Water sharing treaties/agreements & diplomacy	●
Conjunctive use of water - surface versus groundwater usage optimizations	●
Unlocking Synergies with other Government Program	●
Reforms, Regulations	●
Impact on and role of private sector, community/ collectives/ cooperatives (e.g. Farmer cooperatives, FPOs, Water User Associations, etc.) and civil society in the scheme	●

Cross-sectional themes performance infographics legend

● High ● Medium ● Low ● Not relevant ● No information

2.2.3.3 Issues and challenges

Since the scheme includes implementation of 83 SMI and 8 MMI projects, the issues and challenges identified for SMI and AIBP schemes are applicable for this scheme.

Table 76: SPFM – Issues and Challenges

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
Scheme implementation					
SPFM-F1	**Land acquisition and R&R issues**	• Some projects under this scheme are delayed due to land acquisition and R&R issues. This delay may be attributed to cost escalation due to new land acquisition act, various administrative deficiencies, lack of stakeholder engagement and non-payment of compensation fees • For example: - Shelgaon Barrage Medium project, Jigaon, Bhagadi, Karajgaon etc. are			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		delayed due to land acquisition issues - Lower Chargad, Barbada, Jigaon etc. are facing rehabilitation issues			
SPFM-F2	**Environmental clearance issue**	• Some projects were delayed because of not getting environment clearances in time bound manner. e.g. there is forest area in Vidarbha. A few projects in Vidarbha were delayed by 3-4 years. However, there is no such issue after bringing those projects under this scheme. The projects have been included in the SPFM only after they have got requisite statutory clearances.			
SPFM-F3	**Lack of coordination**	• There are railway crossing or highway crossing over the span of some projects. Some projects were delayed due to lack of coordination with these concerned departments. However, there is no such issue after incorporation of this scheme. Those projects were included under this scheme only after getting required clearances from various departments.			
SPFM-F4	**Project design issue**	• It has emerged from the discussions with stakeholders from state and district levels that some projects are spanned through soft soil strata, which makes the project design and drawings more complicated. CDO,			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		Nashik, sometimes, has involved WAPCOS for such cases because CDO has a shortage of skilled engineers for carrying out such designs. This has resulted in two issues: a) timeline delay due to coordination issues between CDO and WAPCOS b) escalation of project cost since WAPCOS designs with more factor of safety (i.e. heavy design). • However, the national level stakeholder has provided different perspective in this regard. According to him, project design issues are not covered under the scope of SPFM. The Detailed Project Report (DPR) of irrigation and multipurpose projects is to be prepared by the State Government/Project Authority as per the "Guidelines for Preparation of Detailed Project Reports of Irrigation & Multipurpose Projects" issued by MoWR, RD & GR and submitted to CWC for techno-economic acceptance. Techno-economic appraisal of DPRs submitted by State Govt./Project authority is done by CWC through its specialized Directorates dealing with technical and cost/economic aspects and other concerned departments like CSMRS,			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		CGWB, CEA, Do WR, RD& WR, etc. If deficiencies are found during the process of examination of DPR, the same are conveyed to the project authority/state govt. for needful compliance. The studies, surveys and investigations carried out at the DPR preparation stage are required to be supplemented/ firmed-up by undertaking additional studies/ surveys during pre-construction stage when the project is taken-up for implementation.			
SPFM-F5	**Low conveyance efficiency**	• The major and medium irrigation (MMI) projects involve construction of conventional open channels which are prone to huge seepage and evaporation losses, resulting into overall low conveyance efficiency. Hence, inadequate water is supplied in the branch and distributary canals (particularly in the tail end areas). Seepages losses in irrigation canals contributes to around 98.37% of water conveyance loss[180]. • The national level stakeholder has stated that the use of underground pipelines (UGPL) in the projects			

[180] P.B. Jadhav and others (April 2014), IJIRSET, Conveyance Efficiency Improvement through Canal Lining and Yield Increment by Adopting Drift Irrigation in Command Area

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		wherever feasible, has been promoted by the GoI to improve water conveyance efficiency. Detailed guidelines on design and use of UGPL were issued by MoWR, RD & GR and Central Water Commission during July 2017.			
SPFM-F6	**Lack of extensive training and capacity building**	• It is difficult for the govt. to manage the irrigation assets over entire lifetime. WUAs should be accountable for that. However, WUAs are currently not able to manage the assets effectively due to lack of capacity/ requisite knowledge. • States organize training sessions and capacity building activities for the Water Users Associations (WUA) so that they can manage the irrigation assets after certain years (e.g. 3-5 years) of O&M by the Govt. or any private body appointed by the Govt. However, the district level stakeholders have stated that training and capacity building activities are not adequately organized at present.			
Monitoring and evaluation					
SPFM-F7	**Lack of technological interventions for project monitoring**	• SPFM scheme guidelines mandates that the MMI projects will be monitored by CWC field offices twice a year and the SMI projects will be monitored periodically by CWC field			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		offices in sample basis (25%) twice a year. The projects are located throughout the entire states. CWC field officials comply with the mandate. • Discussions with the stakeholders at state and district levels have indicated that projects are not effectively monitored because they conduct physical monitoring and it is difficult to monitor all areas physically, especially the remote locations. Therefore, there is a scope of technological interventions such as remote sensing, drone survey etc. • However, stakeholder at national level has stated that project monitoring through remote sensing is already arranged through Bhaskaracharya Institute of Space Applications and Geo-informatics (BISAG). Drone monitoring of the projects is under consideration of the Ministry. A pilot study has been done by Government of Maharashtra for one irrigation project in the State on the use of Drone Technology. The technology would be promoted in the future for the purpose of progress monitoring, as required. The state and district level officers do not have			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		information of such technological intervention.			
SPFM-F8	**MIS platform**	• The national MIS platform is a significant step forward towards data consolidation and reporting. But currently recorded parameters are limited only to the output indicators like status of completion of SPFM projects, irrigation potential created, but the outcome indicators like irrigation potential utilized, increase in crop yield, employment generation etc. are not tracked in the same dashboard. National level stakeholder has stated that the indicators mentioned such as increase in crop yield through works of projects are not realized immediately and may take some time to be realized. The irrigation potential utilized depends upon the completion of CADWM Works. In case of projects under SPFM, the CADWM works are not covered and these are to be completed by the State Government from their own funds. Hence, tracking outcome parameters might be difficult at this stage. • However, these is a scope for tracking outcome parameters in future, and it will be helpful to realize benefits of the			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		irrigation projects from same online platform.			

Issue relevance legend

	Supported		Partially supported		Not supported		Not applicable

A summary analysis of issues & challenges for the scheme is presented below:

Table 77: SPFM – Summary of issues and challenges

Parameter	Performance
Institutional Mechanism and governance	●
Fund flow efficiency and utilization	●
Unavailability of resources (fund, manpower and others)	●
Monitoring and evaluation	●
Capacity building	●
Any other issues (scheme specific issue can be added)	Not applicable

Performance infographics legend

● Satisfactory ● Average ● Needs Improvement

2.2.3.4 Recommendations and solutions

Since the scheme includes implementation of 83 SMI and 8 MMI projects, the recommendations and solutions proposed for SMI and AIBP schemes are applicable for this scheme.

Table 78: SPFM – Recommendations and solutions

Sl.no	Recommendations	Finding
SPFM-R1	To minimize the delay due to land acquisition, rehabilitation and resettlement, the below measures can be considered:	SPFM-F1

Sl.no	Recommendations	Finding
	• Periodic review meeting among high level officials (e.g. secretary): This will expedite the administrative process required for obtaining clearance • Separate agency for managing rehabilitation and resettlement related activities: Such activities are currently looked after by several officials such as water resources/irrigation officials, collector, land resource officials etc. These officials have other priority works. Hence, the rehabilitation and resettlement work get delayed. Therefore, creation of a dedicated agency can be explored for better coordination and accelerated clearances • Local NGOs to be involved to educate PAPs about project benefits: Besides Govt. officers, PAPs trust their local people. Hence, if NGOs (involving local people) can be engaged for building trust among the PAPs about project benefits, requirement for rehabilitation and resettlement, assurance of compensation etc., the land acquisition, rehabilitation and resettlement process can be expedited	
SPFM-R2	• There is a need of extensive training and capacity building activities for the WUAs to enable them for managing the irrigation assets after certain years (e.g. 3-5 years) of O&M by the Govt. or any private body appointed by the Govt. • In view of this, involvement of local NGO can be explored for educating the beneficiaries about how to operate and maintain the irrigation assets for their better life and larger benefits.	SPFM – F6

2.2.4 Per Drop More Crop

The Centrally Sponsored Scheme – 'Per Drop More Crop' was launched on 1st July 2015 under Department of Agriculture, Cooperation and Farmers Welfare (DAC&FW). The primary objective of this scheme is to enhance water use efficiency in the agriculture sector by promoting

precision/micro-irrigation such as drip and sprinkler irrigation technologies and encourage the farmers to use water saving and conservation technologies.

The PMKSY- Per Drop More Crop mainly focuses on enhancing water use efficiency at farm level through micro-irrigation viz. Drip and Sprinkler Irrigation. Besides promoting precision irrigation and better on-farm water management practices to optimize the use of available water resources, this component also supports micro level water storage or water conservation/management activities as Other Interventions (OI) to supplement Micro-irrigation. However, the OI activities must be linked with Micro-irrigation to make potential use of the available funds for higher water use efficiency.

Background

The government has implemented various schemes over time for promoting micro-irrigation. Some notable schemes launched to promote micro-irrigation are mentioned in this section.

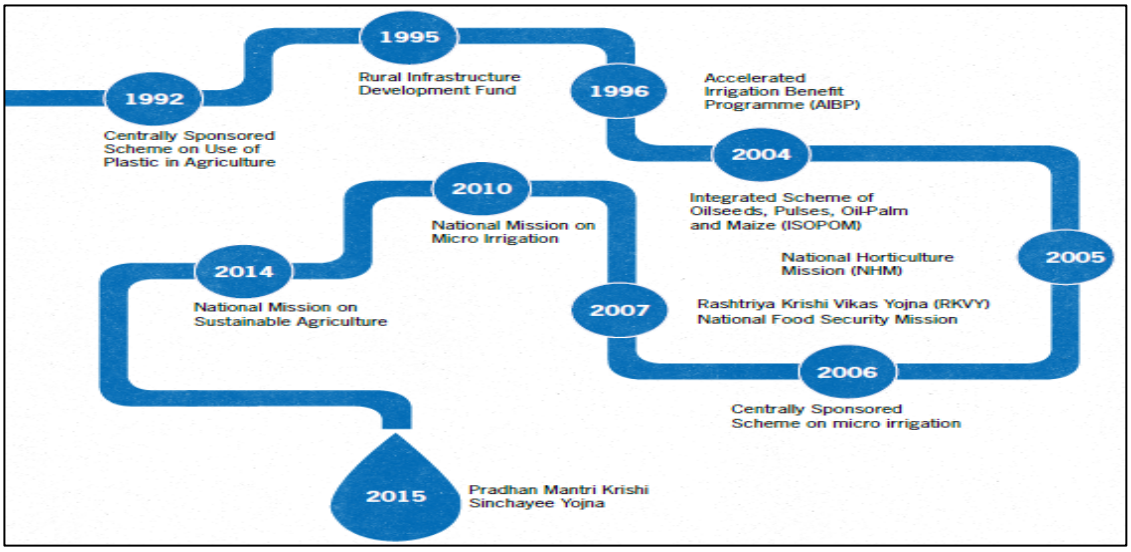


Figure 39: Micro – irrigation journey in India

Source: Strategy paper by Irrigation Association of India and FICCI, 2016

National Mission on Micro-irrigation (NMMI) (2010)[181]

[181] Vaibhav Bhamoriya et al (2014), An Analysis of Resource Conservation Technology: A Case of Micro-Irrigation System (Drip Irrigation), IIM Ahmedabad

The Centrally Sponsored Scheme on micro–irrigation being implemented by the Ministry of Agriculture since 2005–06 for promoting the use of drip / sprinkler irrigation was reintroduced as a national mission during the XIth Plan period (2010). Under this scheme, the central subsidy was revised to 60% of the total cost of the system for small and marginal farmers and 50% for general farmers, including 10% of state share. Some of the states increased their share of subsidy to 20–50% instead of 10%, to incentivise more to the farmers. About 3 million ha were brought under micro-Irrigation. The ministry of agriculture had set a target of covering 0.7 million ha under the scheme in 2010 – 11 (MoA, 2010).

The NMMI promoted cultivation of vegetables with close spacing of laterals and use of micro and mini sprinklers in the field resulting in saving of water and enhanced productivity within a short period so that the farmers could get more income from the same land. NMMI promoted latest technologies like valves, filters and fertigation etc. to increase water use efficiency, productivity of crops and savings in use of fertilizers, water and electricity.

The Govt. of India Task Force on Micro-irrigation under N. Chandrababu Naidu had recommended increasing the area under micro-irrigation by 3 million ha in the Tenth Plan and 14 million ha in the Eleventh Plan with investments of Rs.10,500 Cr. and Rs.51,000 Cr. respectively[182].

National Mission on Sustainable Agriculture (NMSA) (2014)[181]

NMSA was formulated in 2014 to enhance agricultural productivity (mainly in rain fed areas) focusing on integrated farming, water use efficiency, soil health management and resource conservation. It was devised based on the basic premise that sustaining agricultural productivity depends on quality and availability of natural resources such as soil and water. NMSA derived its mandate from Sustainable Agriculture Mission, one of the eight missions outlined under the National Action Plan on Climate Change (NAPCC).

NMSA has four components – Rainfed Area Development, On Farm Water Management (OFWM), Soil Health Management and Climate Change & Sustainable Agriculture. The ongoing

[182] Department of Agriculture & Cooperation (2004), Report of Task Force on Micro-irrigation

NMMI (since 2010) was subsumed under NMSA and implemented as 'On Farm Water Management (OFWM)' during 2014-15.

Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) (2015)[181]

Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) was launched in 2015. This is an umbrella scheme conceived by the Central Government to ensure access to some means of protective irrigation for all agricultural farms in the country, to increase productivity, thus bringing much desired rural prosperity, and, to achieve convergence of investments in irrigation at the field level. The micro-irrigation component of OFWM was subsumed under PMKSY and implemented as Per Drop More Crop. In addition to that, other main components of PMKSY – Accelerated Irrigation Benefit Programme (AIBP), Har Khet Ko Pani (Command Area Development & Water Management; Surface Minor Irrigation; Repair, Renovation & Restoration) and Watershed Development Component.

Performance

From 2015-16 to 2019-20, this scheme has covered 4.8 mha area under micro-irrigation. State-wise physical progress is tabulated below:

Table 79 : PDMC - Area covered under micro-irrigation (Ha)

#	State	2015-16	2016-17	2017-18	2018-19	2019-20	Total
1	Karnataka	64,220	139,405	236,107	234,853	250,591	925,176
2	Andhra Pradesh	94,104	141,098	186,441	200,269	122,080	743,992
3	Gujarat	142,681	165,948	143,134	140,778	107,649	700,190
4	Tamil Nadu	32,288	44,778	105,695	172,445	263,494	618,700
5	Maharashtra	35,242	106,172	132,829	159,959	171,098	605,300
6	Rajasthan	56,346	47,650	48,205	53,982	58,573	264,756
7	Telangana	39,864	61,980	89,474	40,381	4,548	236,247
8	Madhya Pradesh	75,224	54,323	39,761	35,195	14,270	218,773
9	Uttar Pradesh	1,598	32,511	28,235	55,086	56,953	174,383
10	Chhattisgarh	8,056	19,227	13,087	18,929	27,688	86,987
11	Haryana	3,117	5,701	10,751	10,469	22,652	52,690

#	State	2015-16	2016-17	2017-18	2018-19	2019-20	Total
12	West Bengal	0	0	2,137	13,370	21,825	37,332
13	Odisha	2,907	4,611	3,036	10,081	8,498	29,133
14	Jharkhand	4,528	5,810	1,544	3,978	5,989	21,849
15	Bihar	5,155	4,228	3,143	924	3,967	17,417
16	Uttarakhand	721	3,199	2,182	4,256	6,790	17,148
17	Assam	0	0	782	70	10,873	11,725
18	Himachal Pradesh	3,306	937	1,197	422	1,086	6,948
19	Punjab	1,799	1,950	600	507	942	5,798
20	Manipur	0	0	0	1,600	1,882	3,482
21	Sikkim	773	0	0	0	2,524	3,297
22	Nagaland	0	0	0	0	2,830	2,830
23	Kerala	561	310	358	965	583	2,777
24	Mizoram	398	0	0	0	2,348	2,746
25	Goa	92	123	236	0	285	736
26	Jammu & Kashmir	0	0	0	0	35	35
	Total	**572,980**	**839,961**	**1,048,934**	**1,158,519**	**1,170,053**	**4,790,447**

Source: Data shared by RFS, MoA&FW on 3rd July 2020

From 2015-16 to 2019-20, an amount of Rs. 11,986 Cr. has been released as Central Allocation for implementation of this scheme. State/UT wise CA release is tabulated below:

Table 80 : PDMC – CA release to states (Rs., in Cr.)

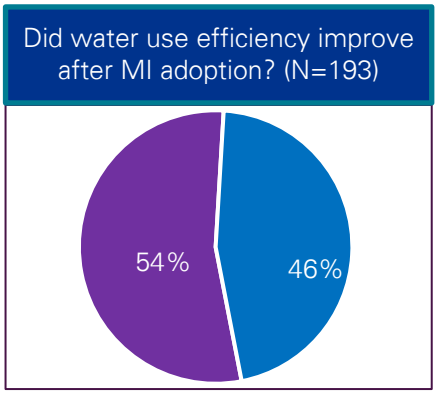
#	State/UT	2015-16	2016-17	2017-18	2018-19	2019-20	Total
1	Andhra Pradesh	206	309	517	520	452	2,004
2	Karnataka	213	229	385	372	410	1,609
3	Tamil Nadu	130	144	370	355	523	1,521
4	Maharashtra	107	306	363	360	325	1,460
5	Gujarat	213	274	300	273	280	1,340
6	Telangana	111	189	257	122	0.0	679
7	Madhya Pradesh	162	121	150	133	102	667

#	State/UT	2015-16	2016-17	2017-18	2018-19	2019-20	Total
8	Rajasthan	143	129	108	168	75	623
9	Uttar Pradesh	38	41	55	88	100	322
10	Odisha	29	40	48	58	30	204
11	Chhattisgarh	20	45	55	43	32	196
12	Uttarakhand	10	15	27	43	32	127
13	Haryana	35	27	14	27	17	120
14	West Bengal	5	20	31	40	20	116
15	Nagaland	2	5	12	35	53	107
16	Jharkhand	15	31	25	10	23	104
17	Sikkim	5	5	4	55	32	101
18	Manipur	3	4	8	40	40	94
19	Assam	5	11	3	30	42	91
20	Bihar	29	22	13	28	0.0	91
21	Mizoram	3	8	12	28	28	79
22	Himachal Pradesh	8	9	19	26	18	79
23	Punjab	43	1	0	9	0.0	53
24	Jammu & Kashmir	5	5	3	8	27	48
25	Arunachal Pradesh	3	2	8	13	18	43
26	Tripura	2	0	4	15	18	38
27	Kerala	9	0	25	4	0.0	38
28	Meghalaya	1	0	3	12	0.0	17
29	Goa	0	1	0	1	1	3
30	Ladakh	-	-	-	-	2	2
31	Puducherry	2	0	0	0	0.0	2
32	A & N Island	0	0	1	0	0.0	1
33	HQ	1	1	1	3	0	7
	Total	**1,557**	**1,991**	**2,819**	**2,918**	**2,700**	**11,986**

Source: Data shared by RFS, MoA&FW on 3rd July 2020

Performance on REESI+E framework

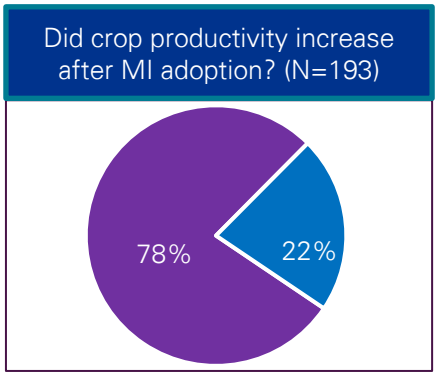
Table 81: PDMC – Performance evaluation based on REESIE framework

Parameter	Findings from research
Relevance	**Secondary:** • India is expected to face a water demand-supply gap of 50% by 2030[183]. On account of inefficient water use across the irrigation value chain, irrigation coverage[184] is lower. PDMC targets to improve on-farm water use efficiency to address the widening demand-supply gap and improve irrigation coverage. Micro-irrigation has high water use efficiency (85-90%) compared to flood irrigation (60-75%).[185] • Water source creation under the 'other interventions' (OI) component of the scheme has improved availability of surface water, and thereby reduced dependency on groundwater (as source for micro-irrigation) and improved soil-moisture content. • The scheme guidelines clearly specify the scheme objectives and the guidelines are aligned to deliver the same. The scheme objectives are clear and can be easily represented in terms of outputs and outcomes.
	Primary: • Scheme is designed to address several national priorities such as improving on-farm water use efficiency, enhancing crop productivity, generating employment etc. • In the beneficiary survey, around 54% of farmers have indicated improvement of water use efficiency after adoption of MI for cultivation. Around 78% of farmers have reported increase in crop productivity after use of MI. 

[183] 2030 Water Resources Group

[184] Agriculture Statistics at a glance, 2018, Ministry of Agriculture and Family Welfare, GoI

[185] Guidelines for improving water use efficiency in Irrigation, Domestic and Industrial sectors, Central Water Commission

Parameter	Findings from research
	• One of the key outcomes expected of the scheme is to increase irrigation coverage through improved water use efficiency. Discussions with the key informants across all states have also supported this aspect of scheme design.  • Under National Mission on Micro-irrigation (i.e. predecessor to PDMC), only those farmers who already had access to an irrigation water source were eligible. PDMC has bridged this gap and provides support for water source creation (under the Other Interventions (OI) component) in addition to Micro-irrigation (MI) system. This component has increased the coverage of eligible farmers under the scheme. Other schemes like MGNREGA also allow for water source creation (e.g. ponds). However, generally, the primary purpose of such sources is not for irrigation. On the other hand, OI component of the scheme allows for creation of water sources exclusively for MI. In this way, PDMC fills-in an important interventional gap. • The scheme has also started intervening another sectoral area i.e. water security by using treated wastewater for agriculture. Government of India promotes the use of treated wastewater for MI through Micro-irrigation Fund (MIF). This fund (a corpus of Rs. 5,000 Cr.) was created with NABARD during 2017-18. The major objective of the fund is to facilitate the States in mobilizing the resources for expanding coverage of Micro-irrigation by taking up special and innovative projects and for incentivizing micro-irrigation beyond the provisions available under PMKSY-PDMC to encourage farmers to install micro-irrigation systems. As per guidelines of the MIF, a Tripartite Memorandum of Agreement (MoA) must be signed between State, NABARD and Govt. of India for availing the fund. Tripartite MoA has been signed by States of Andhra

Parameter	Findings from research
	Pradesh, Gujarat, Tamil Nadu, Haryana, Uttarakhand and West Bengal. Steering Committee of MIF and PSC of NABARD has approved projects for Tamil Nadu, Andhra Pradesh, West Bengal and Haryana. One of the proposal for availing MIF is use of treated wastewater for Micro-irrigation. In Karnataka, recycled wastewater is being used for vegetable cultivation at Kolar district. There are a few pilot projects underway in Tamil Nadu as well. While several countries (e.g. Israel, USA) are successfully using treated wastewater for agriculture, there is a need to conduct research for the Indian context and formulate necessary guidelines for using treated wastewater in agriculture, horticulture and fodder crops as was pointed out by a key informant from Andhra Pradesh. In the absence of safety regulations and ensuring that wastewater is adequately treated, there exists health risks including introduction of harmful elements / metals into the food chain. • Certain technological, regulatory and institutional modifications are necessary to enhance the adoption of MI. For example: - Discussion with the national stakeholders has revealed that while the scheme remains popular in areas with bore well prevalence or other perennial water sources, adoption rates are significantly lower in areas served through canal irrigation. This is due to the fact that MI requires pressurized water supply while canal irrigation relies on gravity flows. Technological innovation in outlet design that allow for pressurized supply from existing canal network may help to address the above issue. - New Major and Medium Irrigation (MMI) projects being planned or implemented should have provision for integration with MI system at the farm level. Since new MMI projects are generally undertaken by the states, necessary directions / guidelines at the state level for MI integration need to be adopted and implemented. In fact,

Parameter	Findings from research
	present guideline[186] requires that for existing MMI projects at least 10% of the projects are to be linked to MI system. However, compliance in regard has not been satisfactory. - Key informants from Andhra Pradesh, Rajasthan emphasised the necessity of integrating MMI projects to MI systems to enable multiple cropping and water saving across the cultivable area served by the MMI projects.
	Inference: The scheme is relevant in achieving national priorities such as substantially improving on-farm water use efficiency, enhancing crop productivity, generating employment opportunities etc. Also, the scheme fills in interventional gap by allowing water source creation exclusively for MI through its Other Intervention component. Therefore, the scheme is rated as 'satisfactory' with respect to relevance.
Effectiveness	**Secondary:** • The scheme has resulted in increase in MI coverage, creation of micro-water harvesting structures, etc. (outputs). The scheme has enhanced productivity; reduced the consumption of water, fertilizer, power etc. (outcomes). The scheme has also created employment opportunities, increased incomes of farmers and helped in ensuring food security etc. (impact). • Impact Evaluation Study (2014) shows, on average, reduction in irrigation cost of 32%; saving in electricity consumption of 31%, fertilizer saving of 7% to 42%; productivity increases in yields of fruits and vegetables of about 42% and 53% respectively; increase in farmers' income of 48.5%.

[186] Mo WR, RD & GR, Guidelines for Central Assistance for Command Area Development Works in Prioritized AIBP funded Irrigation Projects (section 2.4)

Parameter	Findings from research
	• Recent field study (in Himachal Pradesh) by TERI shows increase in crop productivity of 35% to 86%; increase in farmers' income of 230%; water saving of 50% to 90%. However, this study did not show any reduction in fertilizer consumption. • Karnataka, Andhra Pradesh, Gujarat, Tamil Nadu, Maharashtra, Rajasthan, Telangana, Madhya Pradesh, Uttar Pradesh have performed well from 2015-16 to 2019-20. Goa, Mizoram, Kerala, Nagaland, Sikkim, Manipur, Punjab, Himachal Pradesh, Assam have performed poorly from 2015-16 to 2019-20. Arunachal Pradesh, Meghalaya, Tripura, A&N and Puducherry have not reported any progress. • The physical- financial targets and its progress are uploaded by the states on the PMKSY- PDMC portal. Physical targets are finalized from the approved Annual Action Plan of the States which is approved by the State Level Sanctioning Committee (SLSC) of the states headed by Chief Secretary of the states. • Higher capital investment for MI system discourages small and marginal farmers from adopting it[187]. In contrast, another study has pointed out that the upper cap of 5 ha for a beneficiary farmer excludes large farms and therefore reduces the adoption rate[190]. • Previous studies have identified delay in fund release as a cause for delays in project progress[188]. • A previous study[189] has shown that increase in subsidy beyond a certain limit has little or no impact on increasing MI coverage. Previously, Rajasthan, Tamil Nadu and Bihar provided 90%, 75% and 90% subsidy respectively; however, MI penetration was 7.3%, 4.5%, and 3.1% respectively.

[187] IAI, FICCI, Grant Thornton (2016), Accelerating growth of Indian agriculture: Micro-irrigation an efficient solution

[188] Department of Agriculture Cooperation & Farmers Welfare (2017), Presentation on Pradhan Mantri Krishi Sinchai Yojana (PMKSY)- "Per Drop More Crop"-Micro-irrigation

[189] Ministry of Agriculture (2014), National Mission on Micro-irrigation (NMMI) – Impact Evaluation Study

Parameter	Findings from research
	• A previous study[189] has recommended more subsidy on drip irrigation as compared to sprinkler irrigation as drip irrigation is more expensive • The scheme has dedicated budget allocation, institutional arrangements, guidelines and IT infrastructure for progress monitoring. State Agriculture Department is responsible for reporting the progress data and National Committee on Plasticulture Applications in Horticulture (NCPAH) is involved in monitoring & reviewing the progress of the scheme • National Rainfed Area Authority (NRAA) is involved in mid-term/end-term evaluation of the programme. State Govts are free to appoint any reputed agencies for monitoring and evaluation of the scheme in their states. There is a requirement that 25% of the projects sanctioned by the state should be considered for third party monitoring and evaluation by the implementing state. • Scheme guidelines does not provide for a separate allocation for IEC and capacity building activities but are to be incurred under the head of admin expense (i.e. 5% of central allocation) • Absence of a single department/body for implementation of the scheme at state level adversely impacts scheme performance[190].
	Primary: • There is a two-pronged approach to improve MI penetration – i) demand driven (i.e. farmer) and ii) supply driven (i.e. integrating MI to major and medium irrigation projects). The target for the demand driven approach is based on available budget and demand (during 2015-16 to 2019-20, average ~1 mha per year) during a year. There is an established process (e.g. educating farmers, demonstrating benefits of MI, etc.) to achieve this target which is working well. However, in respect of supply driven MI adoption, the progress has not been significant. It is noteworthy that

[190] Planning Commission, GoI (2014), Evaluation Study on Integrated Scheme of Micro-irrigation

Parameter	Findings from research
	supply driven target flows from the CADWM scheme guideline[186] (viz. for 10% of MMI projects to be integrated with micro-irrigation). • Out of 12 states selected for primary research under the present study, Karnataka, Andhra Pradesh, Tamil Nadu, Maharashtra, Rajasthan, Uttar Pradesh have performed well. The factors that have positively contributed for their performance include: - Dedicated agency responsible for MI implementation in Andhra Pradesh (Andhra Pradesh Micro-irrigation Project) and Tamil Nadu (Tamil Nadu Horticulture Development Agency) - Arid or semi-arid or drought prone region where assured irrigation facility is low, such as Rajasthan (e.g. Jalore, Sri Ganganagar district), Karnataka (e.g. Koppal district), Maharashtra (e.g. Buldhana district), Andhra Pradesh (e.g. Kurnool district) - Prevalence of perennial water sources such as dug well, bore well in Maharashtra (e.g. Jalgaon district), Karnataka, Uttar Pradesh, Andhra Pradesh, Tamil Nadu (e.g. Krishnagiri district) - Continuous monitoring of progress and quality (e.g. 3rd party monitoring in Andhra Pradesh, Tamil Nadu etc. by NABCONS, educational institutes etc.) - Extensive awareness campaign and training programs in these states - Single agency / department responsible for implementation of both MI and OI components of the scheme in Tamil Nadu, Maharashtra - Predominance of horticulture (vegetables, fruits etc.) and high value crops (sugarcane, cotton, banana etc.) in the cropping pattern of the states - Financing facilities available for farmers (e.g. Kisan Credit Card in Andhra Pradesh, post-dated cheque in Uttar Pradesh etc.) - Presence of many MI system manufacturing companies (e.g. around 37 empanelled companies in Andhra Pradesh, around 120 in Maharashtra, around 68 in Uttar Pradesh)

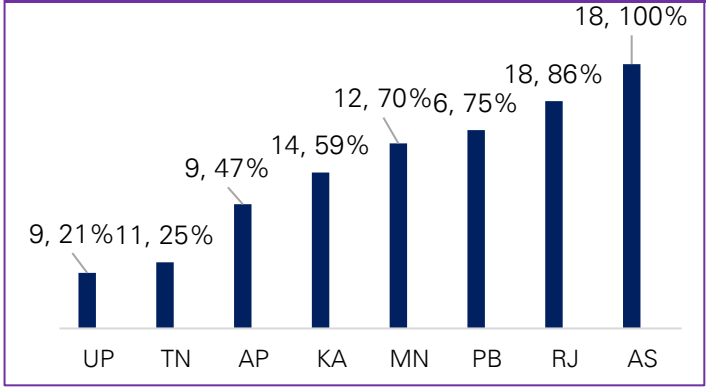
Parameter	Findings from research
	- Measures such as in Rajasthan that requires farmer who desires to install solar pump to necessarily implement MI system in his farm - Mandatory fertigation along with drip irrigation in Rajasthan - Innovative arrangements such as mulching along with drip, auto-irrigation schedule with drip, weed control etc. - A few district specific favourable factors: Tamil Nadu provides free electricity and 100% subsidy to the small and marginal farmers. Hence, these farmers get both drip system as well as water at free of cost. In Krishnagiri district, there is lack of adequate water to cultivate crops during the period from December to first week of June. However, since the district is located close to Bangalore, the farmers are motivated to use drip irrigation during these 6 months period for growing vegetables and increase their income. Krishnagiri is one of the well-performing districts in Tamil Nadu with respect to MI coverage. • The performances of Jharkhand, Bihar, Assam, Himachal Pradesh, Punjab, Manipur in respect of MI implementation have been below par. The factors that have contributed to this are: - Assured canal-based irrigation facilities and free electricity in Punjab - High rainfall in Assam, Manipur - Lack of perennial source of water in Assam (e.g. Goalpara, Golaghat districts), Bihar, Manipur (e.g. Chandel district) - Inadequate awareness campaign and training programs especially in north eastern states (e.g. Assam, Manipur) - Hilly terrain in Jharkhand, which is difficult for boring - More than 90% landholdings are fragmented in Bihar, Jharkhand, Assam, Manipur - High transportation cost for Assam, Manipur resulting in higher cost of MI systems • Key informants from states, districts, villages have mentioned about several benefits of MI including productivity increase, fertilizer saving,

<table>
<tr><th>Parameter</th><th>Findings from research</th></tr>
<tr><td></td><td>
energy saving, saving of labour, reduction in pesticide consumptions, enhancement of crop quality. Key benefits from the scheme for various states as stated during the key informant interviews are:
- Increase in crop productivity: Around 30 to 100% in Andhra Pradesh; 30 to 80% in Karnataka; 30% in Tamil Nadu; 20 to 60% in Bihar; 9 to 25% in Uttar Pradesh, 40 to 60% in Punjab; 60% in Ranchi district of Jharkhand
- Reduction in fertilizer consumption: Around 30 to 40% in Karnataka; 43% in Punjab
- Reduction in power consumption: Around 20 to 25% in Andhra Pradesh; 80% in Bihar; 46% in Punjab; 25% to 40% in Karnataka; 25% to 30% in Meerut district of Uttar Pradesh
- Saving of labour: Around 50% in Kishanganj district of Bihar and Meerut district of Uttar Pradesh; 20% to 40% in Andhra Pradesh; 44% in Punjab
- Reduction in pesticide consumption: Around 10% in Krishnagiri district of Tamil Nadu; 19% in Andhra Pradesh
• A few farmers' success stories collected from the key informants of state/ district level showing the benefits of micro-irrigation are tabulated below:
<table>
<tr><th>District</th><th>Success Story</th></tr>
<tr><td>Cuddalore, Tamil Nadu</td><td>100% productivity increase (30 ton per ha to 60 ton per ha) after use of MI for cultivation of Brinjal</td></tr>
<tr><td></td><td>30% productivity increase (10 ton per ha to 13 ton per ha) after use of MI for cultivation of Tuberose</td></tr>
<tr><td>Krishnagiri, Tamil Nadu</td><td>33% productivity increase (6 ton per ha to 8 ton per ha) after use of MI for cultivation of Marigold</td></tr>
<tr><td></td><td>50% productivity increase (8 ton per ha to 12 ton per ha) after use of drip for cultivation of Cabbage</td></tr>
<tr><td>Krishna, Andhra Pradesh</td><td>100% productivity increase (12.5 ton per ha to 25 ton per ha) after use of drip for cultivation of Guava</td></tr>
</table>
</td></tr>
</table>

Parameter	Findings from research

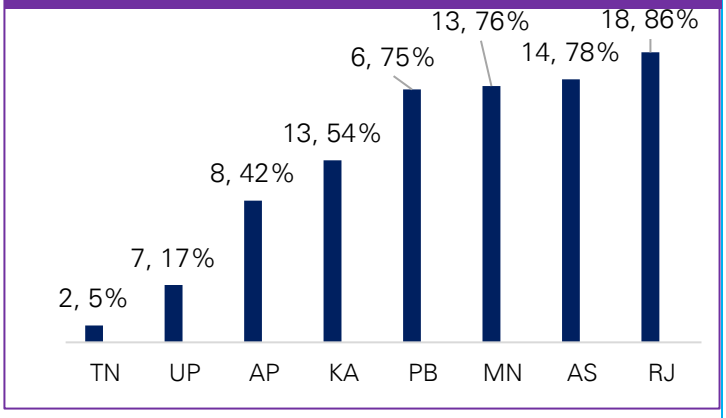
Krishna, Andhra Pradesh	37.5% productivity increase (40 ton per ha to 55 ton per ha) after use of drip for cultivation of Papaya
Prakasam, Andhra Pradesh	50% productivity increase (10 MT per ha to 15 MT per ha) after use of drip for cultivation of Maize
Chandauli, Uttar Pradesh	12.5% productivity increase (80 ton per ha to 90 ton per ha) after use of drip for cultivation of Watermelon
	71% productivity increase (85 ton per ha to 145 ton per ha) after use of drip for cultivation of Bitter Gourd
Meerut, Uttar Pradesh	100% productivity increase (85 ton per ha to 170 ton per ha) after use of drip for cultivation of Sugarcane

- FGD in Andhra Pradesh has reported increase in crop yield, reduction in fertilizer consumption etc. after adoption of MI. FGD in Uttar Pradesh has reported increase in crop yield, reduction in power consumption, reduction in fertilizer consumption, multi-cropping practice among farmers etc. after use of MI. FGD in Karnataka has indicated increase in crop yield after use of MI system for cultivation. FGD in Tamil Nadu has reported increase in crop yield, reduction in fertilizer consumption, reduction in pesticide use, saving in labour etc. after adoption of MI. FGD in Assam has revealed increase in crop yield, saving of labour, reduction of electricity consumption as benefits of MI.
- In the beneficiary survey, around 78% beneficiary farmers (N=193) have reported that crop yield has increased after adoption of MI. Around 60% beneficiary farmers have stated that MI has enabled them to do multi-cropping.
- Some states, such as Assam, Bihar, Andhra Pradesh, Uttar Pradesh are facing challenges in linking water sources created under OI activities with MI system. This is especially attributed to the fact that agriculture/

Parameter	Findings from research
	horticulture department is responsible for implementation of micro-irrigation component; whereas watershed department is responsible for other interventions component and lack of coordination between these departments. In contrast, some states, such as Maharashtra, Tamil Nadu, Punjab, are not facing such challenges because a single department (agriculture/ horticulture) is responsible for implementation of both components. • All the states selected for primary research under the present study have indicated that there is no delay in fund release from the Central Ministry. However, the key informants from either district level nodal departments or the empanelled MI companies have indicated that most states (such as Assam, Andhra Pradesh, Himachal Pradesh, Jharkhand, Maharashtra, Manipur, Punjab, Rajasthan) find it difficult to arrange their share of funds since they provide additional subsidy over and above the subsidy stipulated in the guidelines. This in turn delays fund release and rate of progress. Discussions with the village level key informants from a few states have also supported this. • In the FDG, the farmers have reported 2-3 months of delay in subsidy payment in Andhra Pradesh. Some farmers from Uttar Pradesh, Assam and Karnataka have also supported such delay during FGD. • In the beneficiary survey, around 50% farmers (N=193) have reported that they have either not received subsidy or received with delay. The percentage is highest in Assam (100%). State-wise distribution of beneficiaries not received subsidy on time (absolute no., %) (N=193) 

Parameter	Findings from research
	• In the beneficiary survey, around 42% farmers (N=193) have stated that they have not received any support (like technical, financial) from the Government. • Favourable periods for cultivation using MI system are pre-monsoon (April to June) and Rabi (October to March) seasons. Discussions with the key informants from a few states (e.g. Jharkhand, Maharashtra etc.) and a few empanelled MI companies have indicated that currently, the farmers, in most of states, are able to avail MI in the Rabi window for cultivation due to the existing administrative process (communication of tentative allocation by ministry to states, approval of action plan at state and central level etc.). Although GOI approves GOI share or guideline, the work orders are not in place across many states due to several reasons such as: - States do not have action plan ready - States cannot arrange for their matching share of fund - Approval is pending from State Level Sanctioning committee (SLSC) Hence, the overall funding gets delayed to July, August; however, it is difficult to start the work because MI installation is difficult during the monsoon. As a result, it is postponed to September, October. If the timelines for administrative processing can be modified to enable the fund release (both central and state's share) in the 1st week of April, the work can be started from mid-April and the farmers will be able to utilize the pre-monsoon window for cultivation using MI. Such adjustment to timelines will further enhance the productivity utilizing

State wise distribution of beneficiaries not received any Govt. support (absolute no., %) (N=193)



Parameter	Findings from research
	same quantity of fund. A few states (e.g. Tamil Nadu, Gujarat etc.) have already made such changes to timelines. There is opportunity for other states to make similar adjustments to their timelines. • A few states, such as Punjab, Tamil Nadu, have pointed out that the exclusion of farms with acreage in excess of 5 ha negatively impacts MI adoption. Farmers with large farms do not implement MI on account of not being eligible for subsidy. However, the Ministry clarified that the scheme is targeted at small and marginal farmers who are unable to bear the full cost of MI systems. Further, it was pointed out that recovery of investment for small and marginal farmers happens within 8-18 months. It was also pointed out that based on interactions with some of large farmers, that the exclusion of large farms from the scheme was not a hindrance and in fact such farmers have implemented MI at their own cost. • The progress/ achievement of the scheme is being regularly monitored through online Monitoring Information System (MIS), desk reviews, filed visits. Some of the success stories of farmers from PDMC adoption have been documented for various states. However, the outcome may be assessed through third party evaluation of the scheme. Further, outcome/ impact parameters should be reported through PMKSY-PDMC dashboard. • The present study is the first post-2014 to independently evaluate the scheme at a national level. Apart from this, a few states (e.g. Andhra Pradesh, Jharkhand, Uttar Pradesh, Tamil Nadu) have either conducted or are currently conducting (e.g. Karnataka) independent third-party evaluation to verify the progress as well as assess the impact of the scheme in their states. • Discussions with the key informants of state, district level have indicated that many states (e.g. Andhra Pradesh, Tamil Nadu, Bihar, Karnataka, Jharkhand, Maharashtra etc.) have their own exclusive, transparent MIS system (e.g. Andhra Pradesh Micro-irrigation Project [APMIP] in Andhra

Parameter	Findings from research
	Pradesh, Micro-irrigation Management Information System [MIMIS] in Tamil Nadu, Horticultural Application for Scheme Intervention and Regulating Utilization of Funds [HASIRUF] in Karnataka) for managing data and monitoring progress. The end-to-end process starting from beneficiary selection to subsidy disbursement are tracked through these online systems. The key informants have also indicated several challenges (e.g. delay due to troubleshooting) of using Bhuvan app for data capture and PMKSY-PDMC MIS for data upload. Therefore, integration of respective state level MIS with the PMKSY-PDMC MIS can be explored, which will reduce the effort currently being made by the state or district level officers to upload the data and enable real-time data transfer to the central dashboard (i.e. PMKSY-PDMC). • Some best practices or innovative initiatives taken across states are discussed below: - Cultivation of Musk Melon, Watermelon using drip along with plastic mulching sheet and solar system in Ananthapur, Nellore districts of Andhra Pradesh. Plastic Mulching sheet with Drip in farmland is more effective in the aspects of water conservation and weed control when compared without mulching sheet plots - Cultivation of paddy with drip in Vishakhapatnam, Andhra Pradesh - Cultivation of vegetables using drip along with plastic mulching in Dharwad, Karnataka - Cultivation of Banana using drip along with mulching and solar system in Goalpara, Assam - Cultivation of vegetables using drip along with mulching in Chandauli, Uttar Pradesh - Drip irrigation in combination with mulching and weed removing technology in Krishnagiri, Dharmapuri districts of Tamil Nadu - In Bihar, Agricultural Technology Management Agency (ATMA) broadcasts the success stories of farmers, who have been

Parameter	Findings from research
	benefitted using MI system for cultivation, in Doordarshan and other channels over TV. It has been quite effective for awareness creation. - Awareness campaign through displaying small videos, audio-visual sessions (e.g. MI system installation, MI system maintenance, benefit of MI etc.) at village level kiosks of Rythu Bharosa Kendra (RBK) in Andhra Pradesh. This is cost effective as compared to in-person demo or workshop for extension programs. - Direct involvement of sugar mill owners in case of providing financing assistance to the farmers, coordination with the empanelled MI companies for creating awareness among farmers about benefit of MI, importance of water conservation practices, installation and maintenance of equipment etc. in West Champaran district of Bihar. This has reduced financial burden on the beneficiary farmers, enhanced sugarcane production and income of the beneficiary farmers in the district.
	Inference: • The scheme is effective in achieving its demand side targets; however, there is a need to take remedial measures to improve supply driven MI implementation. • Secondary reports as well as key informants from state, district, village level have confirmed that the scheme has been quite effective in terms of showing benefits (e.g. increase in productivity; reduction in fertilizer consumption, water consumption, power consumption etc.). • Primary survey across 12 states has shown that the scheme is effective in southern India, and there is significant scope for improvement in north-eastern as well as Himalayan states. • The scheme progress is uneven across the country. Around 81% scheme coverage is limited to only top 6 countries (i.e. Karnataka, Andhra Pradesh, Tamil Nadu, Maharashtra, Rajasthan, Gujarat).

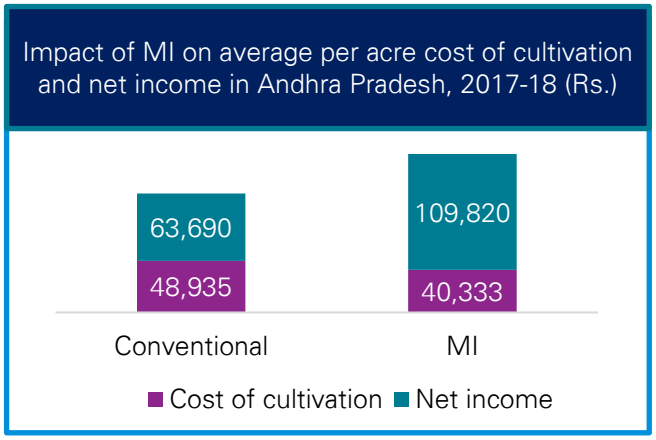
Parameter	Findings from research
	• Coverage across the remaining states is less mainly because of several issues such as lack of coordination among various departments, high logistics cost in hilly areas, delayed fund flow due to unavailability of states' share of fund, lack of awareness campaign and capacity building activities etc. Therefore, the scheme is rated as 'average' with respect to effectiveness.
Efficiency	**Secondary:** • Previous evaluation study showed that overall expenditure on MI system were higher because of fragmented landholding by farmers across states, resulting in separate MI installation in each farm. This factor is a risk in improving the adoption rates of MI systems • The scheme is helpful in providing many social and economic benefits, like productivity increase, energy saving, water saving, off-farm employment generation, increase in farmer's income etc. • Different components of cost are – cost of subsidy to the Govt.; forced investment on well for drip[191]; cost of inputs like water, fertilizer, manure, seeds; labour cost, cost of maintenance of MI system, etc. • According to the previous studies, many farmers could not opt for MI because of the high upfront investment. For such cases, alternate business model needs to be evaluated. • This scheme complements MGNREGA and PMKSY-WDC in terms of source creation and efficient water resources management
	Primary: • All key informants at state, district, village levels have indicated that benefit cost ratio (BCR) for MI system is more than that of conventional irrigation system. However, most states do not maintain such data viz.

[191] Economic Affairs (2018), Social Costs and Benefits Analysis of Drip Irrigation System in Northern Maharashtra

Parameter	Findings from research

cost of cultivation (with and without MI), income from cultivation (with and without MI) and thus, BCR of MI implementation.

- It has revealed from the data received from Andhra Pradesh that after MI adoption, cost of cultivation reduces due to lesser use of farm inputs like power, fertilizer, labour etc. On the other side, benefit in terms of net income of farmers increases due to enhanced crop yield after MI adoption. Therefore, BCR improves in case of MI as compared to conventional irrigation.



- Very few states (e.g. Andhra Pradesh, Tamil Nadu) gather such data especially in the form of farmers' success story. BCR data for a few selected farmers are tabulated below:

District	Crop	BCR – with MI	BCR – without MI
Krishna, Andhra Pradesh	Guava	3.5	1.5
Prakasam, Andhra Pradesh	Maize	5.6	3.0
Krishna, Andhra Pradesh	Papaya	2.3	1.3
Nilgiris, Tamil Nadu	Carrot	2.4	Not available
Cuddalore, Tamil Nadu	Brinjal	6.0	Not available

Parameter	Findings from research

Cuddalore, Tamil Nadu	Tuberose	5.0	Not available
Krishnagiri, Tamil Nadu	Turmeric	1.7	Not available
Krishnagiri, Tamil Nadu	Marigold	1.0	Not available

- Fragmented landholding is an issue across many states (such as Bihar, Assam, Manipur etc.) because more than 80-90% farmers are small and marginal in these states. The farm holding is as low as 0.1 acre. Since minimum area mentioned in the MI guideline is 0.4 ha (around 0.99 acre) and subsidy for farm size smaller than that is calculated on pro-rata basis, it leads to comparatively higher costs for MI systems in case of such smaller farms. For example, let us consider two farms - 0.4 acre and 0.2 acre. If all other factors remain same, the subsidy calculated for 0.2 acre will be half of that for 0.4 acre. However, the actual cost of MI implementation for 0.2 acre will not be half of that for 0.4 acre, instead it will be more than that because there are a few fixed cost components (e.g. filter, venturi fertilizer injector assembly etc.) and costs of those components do not vary with the farm size (in case of such smaller farms).
- The adoption of the scheme is higher in those states that offer a higher (top-up) subsidy. The states are, on occasions, unable to arrange funds for the top-up subsidy, which then negatively impacts scheme progress. In view of the above, states have proposed certain measures to reduce overall cost without compromising on the scheme objectives:
  - Skill upgradation of farmers is necessary so that farmers can install MI systems by themselves. This will help farmers avoid the installation charges. The village level key informants from Uttar Pradesh have supported this view.

Parameter	Findings from research
	- Low cost MI solutions can be helpful to improve affordability among small and marginal farmers. - Drip along with fertigation is more effective than drip without fertigation because fertigation reduces fertilizer consumption, resulting in overall cost reduction and enhances quality of crops. However, water soluble fertilizer is comparatively expensive and thus, many farmers cannot afford fertigation, even if they use drip system for cultivation. Therefore, most states, district and village level key informants have stated that water soluble fertilizer can be made available in the market at subsidized rate (under this scheme). This will encourage many farmers (especially small and marginal) to adopt fertigation. - For some states (e.g. Assam, Manipur, Udupi district in Karnataka), the cost associated with transportation and logistics of MI systems is significant. Accordingly, factories for manufacturing MI components can be set-up in such states which will reduce the logistics cost and therefore the overall cost of the MI system. - Discussions with the key informants at state, district levels (such as: Goalpara, Golaghat districts of Assam, Andhra Pradesh, Kishanganj district of Bihar, Manipur, Rajasthan, Meerut district of Uttar Pradesh, Tamil Nadu etc.) has revealed that convergence with other schemes, such as MGNREGA, PMKSY-WDC, is not happening effectively in the above-mentioned states. It is mainly attributed to coordination issues between departments responsible for implementing various schemes. However, a few states and districts (such as Punjab, Maharashtra, Jharkhand, Himachal Pradesh, Kurnool, Udupi district of Karnataka) have reported no issue with respect to convergence. - Therefore, convergence with other schemes, such as MGNREGA, PMKSY-WDC needs to be strengthened. The guidelines should

Parameter	Findings from research
	allow the water sources created under such schemes to be linked to MI system. This will help in saving funds spent on OI component. - Discussions with a few state (e.g. Uttar Pradesh) level key informants have indicated that MI manufacturing companies have different price structures. MNC companies' prices of MI system are higher (e.g. while cost of drip for 1.2 m x 0.6 m from a local company is around Rs. 1.3 lakh per acre; MNC like Netafim charges Rs. 1.6 lakh per acre).
	Inference: • The scheme has effectively resulted in many benefits across the states. The benefit cost ratio is found to be more than that of conventional irrigation as per a few selected success stories and the key informants from various levels. However, it appears, based on responses of state, district level stakeholders that there is scope to reduce project cost without compromising on scheme objectives (e.g. low-cost MI solutions, training of farmers for skill upgradation, etc.), thus improving efficiency. • There is a need for improved coordination mechanisms across ministries and state department to be able to secure the benefits of convergence with other central as well as state schemes (e.g. MGNREGA, PMKSY-WDC, etc.) in terms of water source creation. If water sources created under those schemes can be utilized for MI based cultivation, this will help in saving fund spent on other intervention component of this scheme. Therefore, the scheme is rated as 'average' with respect to efficiency.
Sustainability	**Secondary:** • As per the guidelines, in order to ensure sustainability of benefits from the schemes, manufacturers are required to provide training to farmers for O&M, detailed O&M manual in vernacular language at the time of installation and provide after sales services for a period of 3 years post installation of MI assets. Also, the manufacturers are supposed to

<table>
<tr><th>Parameter</th><th>Findings from research</th></tr>
<tr><td></td><td>operate a toll-free customer care number where beneficiaries can register their complaints/queries.
• As per operational guidelines, 5% of the funding can be spent for admin works. Some states spend towards IEC or capacity building activities from this allocation. Effective capacity building will improve operations and maintenance of the MI systems and thus, improve sustainability of the scheme.</td></tr>
<tr><td></td><td>Primary:
• Most of the states provide additional subsidy over and above the existing 55% and 45% for small and marginal farmers, and other farmers respectively as mandated in the scheme guideline. They believe that fewer farmers will be encouraged to adopt high cost MI system with the current subsidy levels and therefore additional subsidy is required. However, most states are currently facing challenges to arrange their share of subsidy funds. This might pose a risk towards sustainability of this scheme.
• Overall subsidy across different states is displayed below:
<table>
<tr><th>State</th><th>Total Subsidy</th></tr>
<tr><td>Assam</td><td>85% for small and marginal farmers and 75% for others</td></tr>
<tr><td>Andhra Pradesh</td><td>Cumulative subsidy of 90% for all farmers</td></tr>
<tr><td>Bihar</td><td>Cumulative subsidy of 90% for small and marginal farmers</td></tr>
<tr><td>Himachal Pradesh</td><td>Cumulative subsidy of 80% for small and marginal farmers and 55% for others</td></tr>
<tr><td>Jharkhand</td><td>Cumulative subsidy of 90% for small and marginal farmers and 80% for others</td></tr>
<tr><td>Karnataka</td><td>Cumulative subsidy of 90% for all farmers</td></tr>
<tr><td>Maharashtra</td><td>80% for small and marginal farmers</td></tr>
<tr><td>Manipur</td><td>55% for small and marginal farmers and 45% for other farmers</td></tr>
<tr><td>Punjab</td><td>Cumulative subsidy of 80% for all farmers</td></tr>
</table></td></tr>
</table>

Parameter	Findings from research

Rajasthan	70% for drip and 60% for sprinkler system to small and marginal farmers and 50% for remaining farmers
Tamil Nadu	Cumulative subsidy of 100% for S&M farmers
Uttar Pradesh	90% for small and marginal farmers and 80% for other farmers

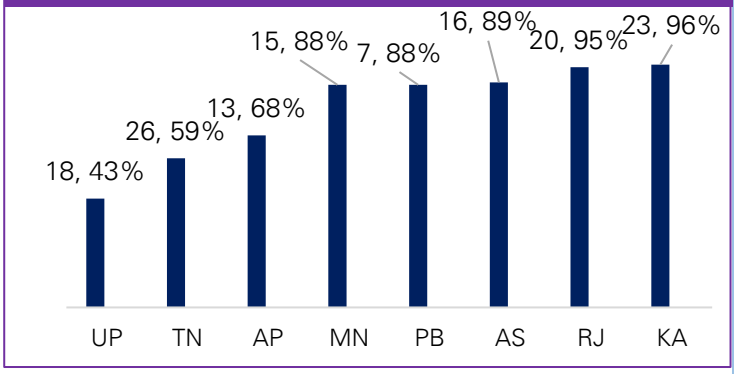
- States conduct awareness campaign and capacity building activities to demonstrate the benefits of MI, educate the farmers about how to use MI, perform maintenance activity etc. through various media such as radio broadcasting (Akashvani), TV advertising (Doordarshan), wall painting, leaflet distribution, exposure visits, demo of best practices over workshops, user manual of MI system etc. along with the empanelled MI companies, educational institutes and Krishi Vigyan Kendra (KVK).
- All the well-performing states (e.g. Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra, Rajasthan etc.) conduct extensive awareness campaign and capacity building programs. However, discussions with the key informants from some states (e.g. Assam, Manipur, Bihar, Jharkhand, Punjab etc.) departments and the empanelled MI companies have indicated a need for enhancing awareness campaign and capacity building activities in those states. In their view, this is necessary to improve the sustainability of the scheme because the beneficiary farmers are accountable for O&M activities. Village level key informants from a few states (e.g. Bihar, Jharkhand, Uttar Pradesh) have also supported this view.
- In the FGD, the farmers from Andhra Pradesh, Assam and Karnataka have reported lack of training and capacity building activities. They have stated that they have learnt from their neighbour farmers. In Tamil Nadu, it has emerged from FGD that the Govt. as well as the empanelled MI companies provide training to the beneficiary farmers to create awareness about this MI cultivation, enable them to operate and

Parameter	Findings from research

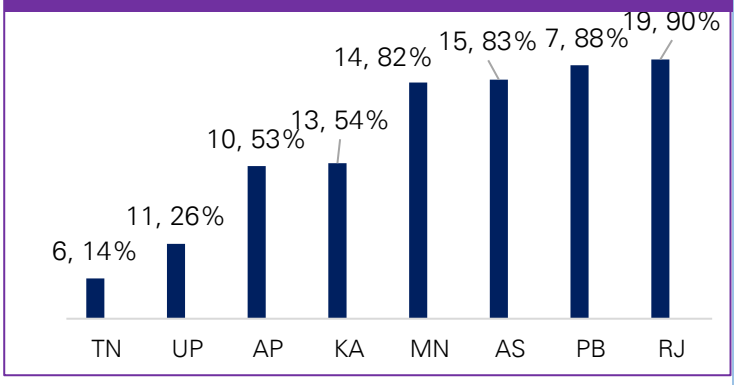
maintain the MI systems. However, they have reported lack of after sales support from the MI companies during the O&M period.

- In the beneficiary survey, it has been reported that only around 28% beneficiary farmers (N=193) have attended training sessions. Hence, it also supports the need of extensive extension programs.

State-wise distribution of beneficiaries not received any training (absolute no., %) (N = 193)

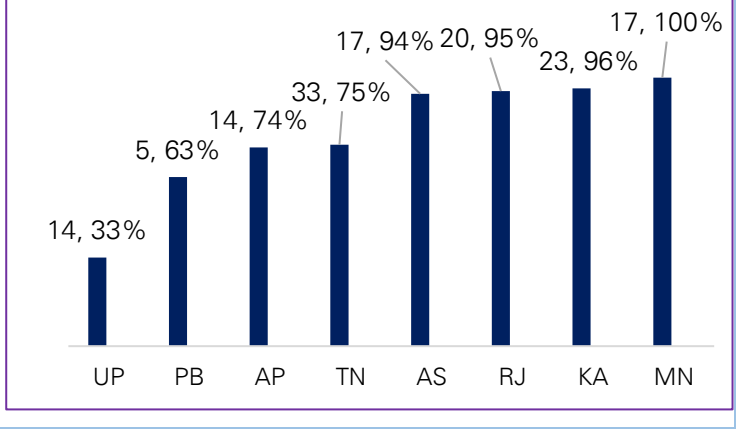


State-wise distribution of beneficiaries not received technical support from Govt. (absolute no., %) (N = 193)



- In addition to that, around 49% and 74% beneficiary farmers have reported not receiving any technical support from the Govt. and the MI

State-wise distribution of beneficiaries not received technical support from companies (absolute no., %) (N = 193)



Parameter	Findings from research
	companies respectively, which also supports the requirement of adequate capacity building program. • No separate funding is available for the awareness campaign and capacity building activities. States spend for those activities from the 5% funding allocated for admin expenses or other extension schemes. A few states, districts (viz. Rajasthan, Tamil Nadu, Punjab, Maharashtra, Manipur, Goalpara, Golaghat districts of Assam, Kurnool district of Andhra Pradesh) have expressed the need for a separate fund to conduct such activities. However, Ministry has clarified that 5% of the funding set aside for administration expenses is on the higher side and it is expected to be enough to cover the said expenses. Some states and district level officers (such as Uttar Pradesh, Bihar, Karnataka, Himachal Pradesh, Ranchi district of Jharkhand) have agreed to this view. • Discussions with most state, district level officers have indicated that the empanelled MI companies/ manufacturers are following the guideline in most states and providing after sales services to the beneficiary farmers and respond to their questions/issues in timely manner. However, the village level key informants across a few states (e.g. Jharkhand, Bihar) have provided negative feedback about them because of not getting timely after sales support from them, poor quality of products etc. • In the beneficiary survey, around 73% beneficiary farmers (N=193) have reported that they have not received any support from the MI companies. Out of the remaining beneficiaries, who have received support from the MI companies, around 94% have reported of receiving technical support (such as installation, maintenance etc.) and 83% have reported of receiving support related to benefit of MI, importance of water conservation etc. Also, around 78% beneficiary farmers have reported that there is either not any toll-free customer care number provided by the empanelled companies to resolve queries or they do not know about such number. Out of 22%, who are aware of toll-free

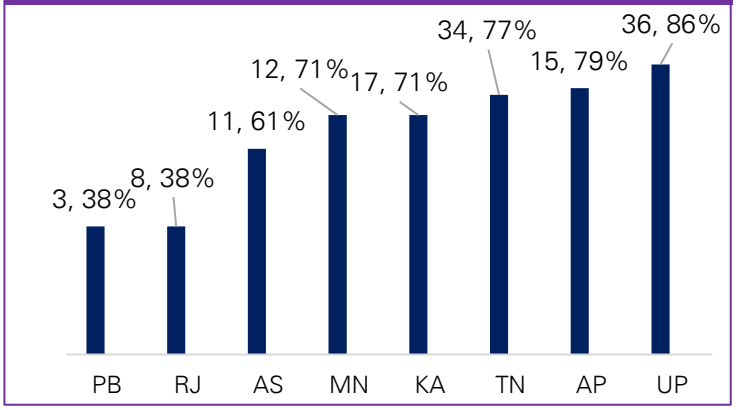
Parameter	Findings from research
	number, around 46% beneficiaries have used that for raising queries and around 42% have reported receiving satisfactory responses from the empanelled companies towards the raised queries. • Ministry indicated that a period of 7 years, has been set in the guideline as the period before which a beneficiary is not eligible for a second round of subsidy for replacing the MI system on his farm, is not based on the economic life of the assets which is generally more than this period if the MI system is handled properly. Maharashtra, Bihar indicated their agreement to this gap of 7 years between consecutive subsidies. However, some states have expressed different opinions in this regard: - Andhra Pradesh, Uttar Pradesh, Rajasthan: have suggested that this period can be reduced to 5 years considering all practical views, feedback from farmers and longevity - Karnataka: has indicated 7 years is appropriate for some components, such as lateral, filter, venturi manifold etc. However, it may be extended to 15 years for PVC pipes. - Punjab, Jharkhand: have illustrated the scenario that if any farmer implement MI on a small portion of his farm on a pilot basis, he will have to wait until the expiry of the 7-year period before he can implement the system in the entire farm even if he is convinced of its efficacy. Hence, there is a need to offer some flexibility in the guideline for such situation. • Ministry indicated that demand driven (i.e. farmers) target can be sustainably achieved by following the established process (e.g. educating farmers, demonstrating benefits of MI, etc.). However, states should strengthen their institutional arrangement and mandate necessary guidelines/ directions to manage supply driven ((i.e. integrating MI to major and medium irrigation projects) target.
	Inference: • Since many states have started providing significant top-up subsidy over and above what is provided under the scheme guidelines and they are

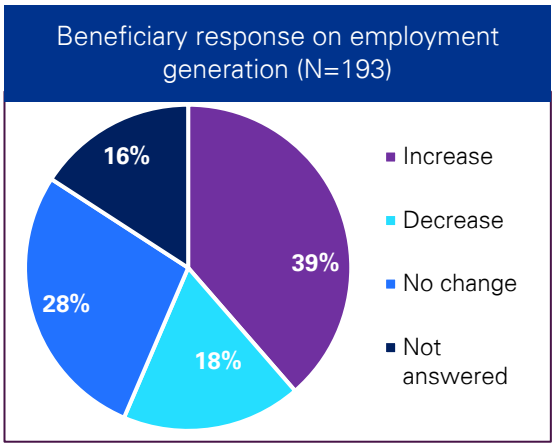
Parameter	Findings from research
	facing challenges to arrange for that additional fund, it is currently not clear if scheme will be sustainable in the present form. • Lack of capacity building programs across some states (e.g. Assam, Manipur, Bihar, Jharkhand, Punjab etc.) lead to ineffective operations and maintenance of MI assets which hampers proper utilization of the assets. • During KII and FGD, the village level key informants across a few states (e.g. Jharkhand, Bihar) have provided negative feedback about the MI companies because of not getting timely after sales support from them, poor quality of products etc. In the beneficiary survey, around 73% beneficiary farmers have reported not receiving any support from the MI companies during the O&M period. Therefore, the scheme is rated as 'needs improvement' with respect to sustainability.
Impact	**Secondary**: • Previous study[189] showed that micro-irrigation had increased income of farmers in the range of 20% to 68%; generated employment opportunity in the range of 21% to 50%. • It is evident that more area can be irrigated with the same amount of water as compared to conventional method of irrigation, thus improving water use efficiency.
	Primary: • All the key informants from state, district and village level have stated that MI has increased income of farmers. Increase in income of farmers as intimated by the key informants during interviews: - Andhra Pradesh: approx. 10 to 60% - Karnataka: approx. 30 to 40% - Bihar: approx.60% for vegetables, 40%for fruits, 20% for cereal crops, 30-40% for sugarcane, 20-25% for wheat - Uttar Pradesh: approx. 14% to 32% cole crops, onion, cucumber & other vegetables

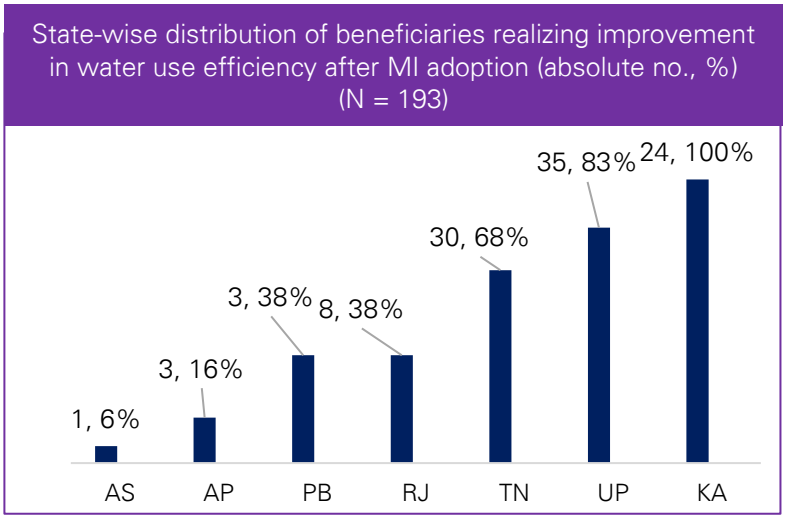
<table>
<tr><th>Parameter</th><th>Findings from research</th></tr>
<tr><td></td><td>
- Punjab: approx. 31% to 69%
- Krishnagiri, Tamil Nadu: approx. 20% to 40%
• A few farmers' success stories showing the increase in income after use of micro-irrigation are tabulated below:
<table>
<tr><th>District</th><th>Success Story</th></tr>
<tr><td>Nilgiris, Tamil Nadu</td><td>29% increase in income after use of sprinkler for cultivation of Carrot</td></tr>
<tr><td>Cuddalore, Tamil Nadu</td><td>100% increase in income after use of MI for cultivation of Brinjal</td></tr>
<tr><td>Cuddalore, Tamil Nadu</td><td>50% increase in income after use of MI for cultivation of Tuberose</td></tr>
<tr><td>Krishnagiri, Tamil Nadu</td><td>50% increase in income after use of MI for cultivation of Turmeric</td></tr>
<tr><td>Krishnagiri, Tamil Nadu</td><td>100% increase in income after use of drip for cultivation of Marigold</td></tr>
<tr><td>Krishnagiri, Tamil Nadu</td><td>134% increase in income after use of drip for cultivation of Cabbage</td></tr>
<tr><td>Krishna, Andhra Pradesh</td><td>100% increase in income after use of drip for cultivation of Guava</td></tr>
<tr><td>Prakasam, Andhra Pradesh</td><td>50% increase in income after use of drip for cultivation of Maize</td></tr>
<tr><td>Krishna, Andhra Pradesh</td><td>37.5% increase in income after use of drip for cultivation of Papaya</td></tr>
</table>
• FGDs in Andhra Pradesh, Karnataka, Uttar Pradesh, Tamil Nadu, Assam have reported increase in income after adoption of MI.
</td></tr>
</table>

Parameter	Findings from research
	• In the beneficiary survey, around 70% beneficiary farmers (N=193) have reported that adoption of MI has increased their income. The percentages are high in Uttar Pradesh (86%), Andhra Pradesh (79%), Tamil Nadu (77%). However, only around 38% beneficiaries have supported the fact in Punjab, while around 38% have not answered there. • Most states have realized the benefit of employment generation out of MI cultivation. The key informants from Andhra Pradesh and Maharashtra have mentioned that around 10,000 and 16,000 people (respectively) are directly and indirectly working with MI cultivation. • Discussion with the key informant of Kurnool district of Andhra Pradesh has revealed that many unemployed youths from local villages are working as fitters for MI installation and getting income out of it. The empanelled MI companies are also employing local people as field coordinators, district coordinators. Also, educated people are employed as MI engineers by the companies. • Discussion with the key informants of Ranchi district of Jharkhand has revealed that local people are employed for maintenance of MI systems, running shops as dealer or sub-dealers in remote areas to provide convenience to the farmers and getting income out of it. • Discussion with the key informants of Meerut district of Uttar Pradesh has revealed that local people are involved for drip trenching.

State-wise distribution of beneficiaries realizing increase in income after MI adoption (absolute no., %) (N = 193)



Parameter	Findings from research
	• In the beneficiary survey, around 39% beneficiary farmers (N=193) have reported that MI has generated new employment opportunities. The percentage is highest in Manipur (71%) followed by Tamil Nadu (52%), Karnataka (42%).  • Key informants from states, districts and villages have indicated that MI adoption has helped to save water. Saving of water across various states as communicated during key informant interviews are as below: - Andhra Pradesh: around 30 to 50% - Karnataka: around 50% - Tamil Nadu: around 30% - Maharashtra: more than 100% - Jharkhand: around 70% - Uttar Pradesh: around 40 to 50% - Punjab: more than 50% - Kishanganj, Bihar: around 40% • FGDs in Uttar Pradesh, Karnataka, Tamil Nadu have indicated saving of water after use of MI.

Parameter	Findings from research
	• In the beneficiary survey, around 54% beneficiary farmers have reported that adoption of MI has improved water use efficiency. 
	Inference: • Impact of this scheme has been realized in terms of increase in farmer's income, employment generation and water savings. • Income of farmers has increased in the range of 10% to 69% • Water use efficiency has improved around 30% to 70% • The scheme has created direct and indirect employment opportunities as field contractors, dealers, sub-dealers, field workers for installation, drip trenching etc. Therefore, the scheme is rated as 'satisfactory' with respect to impact.
Equity	**Secondary**: • As per the guidelines, available financial assistance is 55% for small and marginal farmers; while it is 45% for other farmers • At least 50% of the allocation to state is to be utilized for small and marginal farmers, of which, at least 30% must be for women beneficiaries/ farmers • Further, 16% and 8% of the total allocation or in proportion of Scheduled Cast (SC)/Scheduled Tribe (ST) population is to be utilized for Special Component Sub-Plan (SCSP) and Tribal Sub-Plan (TSP) respectively

Parameter	Findings from research

Primary:

- Most states have been able to follow the guideline for small and marginal beneficiary, since more than 70% farmers are small and marginal on an average in every state.
- Some states (e.g. Andhra Pradesh, Bihar, Manipur, Punjab, Tamil Nadu etc.) are able to follow the guideline for including women beneficiary.
- State-wise beneficiary distribution of small and marginal farmers, and women farmers is shown below:

State	Small and marginal farmers	Women
Assam	85-90%	5-10%
Andhra Pradesh	>70%	20-25%
Bihar	>90%	>20%
Himachal Pradesh	>85%	Data not available
Jharkhand	>80%	Data not available
Karnataka	50-55%	10-15%
Maharashtra	Data not available	Data not available
Manipur	>90%	>50%
Punjab	Data not available	16%
Rajasthan	Data not available	Data not available
Tamil Nadu	80-85%	>25%
Uttar Pradesh	>90%	>10%

- Some states (e.g. Punjab, Uttar Pradesh, Maharashtra, Bihar, Karnataka, Rajasthan) cannot utilize the complete funding allocated to SC/ST farmers because they have comparatively less land holding by SC/ST and current subsidy allocation is linked to SC/ST population but not their land holding.
  - Punjab: SC/ST landholding is only 4-5%. However, around 29% fund is allocated for SC/ST farmer since subsidy allocation is based on SC/ST population. Hence, the remaining fund remains unutilized.

Parameter	Findings from research
	• Tamil Nadu has given special focus to transgender and physically challenged beneficiaries along with SC/ST and women farmers. They have created Self Help Group (SHG) for women farmers. They have asked the MI companies to enrol transgender, physically challenged people, women as dealer or sub-dealer across various districts.
	Inference: • Although most states follow the principle of equity for small and marginal farmers viz. minimum 50% fund to be utilized for them, some states (e.g. Assam, Uttar Pradesh etc.) do not follow the principle of equity for women beneficiaries viz. minimum 15% to be utilized for them. • SC/ST allocation is based on their population. Some states (e.g. Punjab, Uttar Pradesh, Maharashtra, Bihar, Karnataka, Rajasthan) cannot utilize the complete funding allocated to SC/ST farmers because they have comparatively less land holding by SC/ST and hence, a portion of this fund remains unutilized in those states. Therefore, the scheme is rated as 'average' with respect to equity.

A summary analysis and performance of the scheme on the identified themes is presented below:

Table 82: PDMC – Summary of performance evaluation based on REESIE

Parameter	Performance
Relevance	🟢
Effectiveness	🟡
Efficiency	🟡
Sustainability	🔴
Impact	🟢
Equity	🟡

REESI+E performance infographics legend

Satisfactory Average Needs Improvement No information

Performance on cross-sectional themes

Table 83: PDMC – Performance evaluation based on cross-sectional themes

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
1.	Accountability & Transparency	Availability of Data Records and Reports in public domain • What data records are available for the scheme in public domain?	• Physical and financial progress at state and district level for scheme output parameters are reported on PDMC website. • Scheme guideline has provision to track/ assess outcomes (such as increase in crop yield) and impacts (such as increase in income) of the scheme through 3rd party evaluation. That data can be made available over public domain (e.g. PDMC portal).
		Monitoring Mechanisms • Does a robust monitoring mechanism exist and at what level?	• As per scheme guideline, National Rainfed Area Authority is involved in mid-term/end-term evaluation of the programme. State Govts are free to appoint any reputed agencies for M&E of the scheme in their states. An Impact Evaluation Study on Micro-irrigation at the National level is to be undertaken through an independent Agency with involvement of NCPAH once every three years to assess the impact of the scheme in increasing water use efficiency, productivity, enhancement of farmers' income, technology

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			adoption and other parameters. There is a provision that 25% of the projects sanctioned by the state should be considered for 3rd party M&E by the implementing state. • Well-performing states, such as Andhra Pradesh, Tamil Nadu, Karnataka conduct quality monitoring of the project progress through 3rd party (e.g. NABCONS), empanelled MI companies, research institutes and govt. officers.
		Evaluation Mechanisms • What process / impact evaluation studies conducted in the last decade - frequency, quality, coverage, etc.	• Previously, an impact evaluation study was conducted on NMMI (predecessor of PDMC) in 2014. • A few states (e.g. Uttar Pradesh, Tamil Nadu, Karnataka) have conducted independent 3rd party evaluation to verify progress of the scheme in their states.
		Financial Accountability • What funding mechanisms are being used?	• Fund allocation mechanism, eligibility etc. are covered in the scheme operations guidelines. Some points: - Subsidy: - 55% and 45% for small and marginal farmers and other farmers respectively - Funding pattern: - Central: State split = 90: 10 for North Eastern and Himalayan states; 60: 40 for other states

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			• Farmers receive subsidy in their bank accounts linked to their AADHAAR through Direct Benefit Transfer (DBT) mechanism. • A few states have introduced financing instruments, such as: Kisan Credit Card in Andhra Pradesh, Post Dated Cheque in Uttar Pradesh, to ensure that farmers pay back to bank or vendor after receiving subsidy amount through DBT.
		Beneficiary involvement • What is the involvement of beneficiaries across the project lifecycle? Is the level of involvement adequate?	As per the guidelines, the beneficiaries are accountable for O&M of installed MI systems and the manufacturers are supposed to provide after sales services up to 3 years from the installation period. Discussions with most state, district level officers have indicated that the empanelled MI companies/ manufacturers are following the guideline in most states and providing after sales services to the beneficiary farmers and respond to their questions/ issues in timely manner. However, the village level key informants across a few states (e.g. Jharkhand, Bihar) have provided negative feedback about them because of not getting timely after sales support from them, poor quality of products etc. Also, FGD in some states (e.g. Andhra Pradesh, Assam, Tamil Nadu, Karnataka) have indicated lack of after

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			sales support by these companies during O&M.
Summary Analysis: • Scheme progress (physical as well as financial) data is available over PMKSY-PDMC website. Although scheme guideline has provision to track/ assess outcomes and impacts of the scheme through 3rd party evaluation, that data/ reports can be made available over public domain (e.g. PDMC portal). • Only a few states (e.g. Uttar Pradesh, Tamil Nadu, Karnataka) have conducted 3rd party evaluation so far. • According to state and district officers, MI manufacturing companies provide after sales service to the beneficiary farmers during O&M stage (3-5 years post installation). However, village level stakeholders during KII and FGD have reported lack of support from them.			
2.	Direct/Indirect Employment Generation	Employment generation • What is the level of employment generation through schemes in the sector and overall sectoral contribution in National employment generation? • What is the improvement in income levels? • What is the women participation (%) in the Sector/Program	• According to primary stakeholder consultation, majority of the states have realized the benefit of employment generation out of MI based cultivation. Stakeholders from Andhra Pradesh, Maharashtra have mentioned that around 10,000, 16,000 (respectively) people are directly or indirectly working with MI based cultivation. • Discussion with the key informant of Kurnool district of Andhra Pradesh has revealed that many unemployed youths from local villages are working as fitters for MI installation and getting income out of it. The empanelled MI companies are also employing local people as field coordinators, district coordinators. Also,

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			educated people are employed as MI engineers by the companies. • Discussion with the key informants of Ranchi district of Jharkhand has revealed that local people are employed for maintenance of MI systems, running shops as dealer or sub-dealers in remote areas to provide convenience to the farmers and getting income out of it. • Discussion with the key informants of Meerut district of Uttar Pradesh has revealed that local people are involved for drip trenching. • In the beneficiary survey, around 40% beneficiary farmers have reported that MI has generated new employment opportunities. The percentage is highest in Manipur (72%) followed by Karnataka (45%). However, around 34% beneficiaries have not noticed any change in employment due to MI adoption. • Many states are following guidelines for women beneficiaries. Women participation across a few states are as below: - Andhra Pradesh: 20 to 25% - Karnataka: 10 to 15% - Uttar Pradesh: around 10%

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			- Punjab: around 16% - Bihar: >20% - Tamil Nadu: >25%
		Institutional barriers • Are there institutional barriers to employment generation (e.g. access to markets)?	None of the states indicated any institutional barriers to employment generation.
		Private sector involvement • Is there scope for private sector to be involved with a view to increase employment opportunities?	Empanelled MI companies have provided employment opportunities to many people in some well-performing states (e.g. Andhra Pradesh, Tamil Nadu).
Summary Analysis: • According to primary stakeholders during KII and FGD, majority of the states have realized benefit of direct or indirect employment generation (such as field coordinators, dealers, sub-dealer, field workers for installation, drip trenching, etc.). However, in the beneficiary survey, only around 40% beneficiaries have reported that the scheme has generated new employment opportunity. • MI manufacturing companies have provided employment opportunities to many beneficiaries for O&M, capacity building and other activities.			
3.	Gender mainstreaming	Inclusiveness in scheme design/ planning • Is there a specific mention of gender equality and equity considerations in the scheme guidelines/ objectives, i.e. has the	• As per the guidelines, at least 50% of the allocation to state is to be utilized for small and marginal farmers, of which, at least 30% must be women beneficiaries/ farmers viz. at least 15% women beneficiaries should be there. • Out of 12 states selected for this study, we have information for 8 states. Out of

<table>
<tr><th>#</th><th>Cross-cutting theme</th><th>Indicative Areas of Enquiry and Key Questions</th><th>Findings from research</th></tr>
<tr><td></td><td></td><td>scheme been designed keeping gender considerations in mind?</td><td>these 8 states, Andhra Pradesh, Bihar, Karnataka, Manipur, Punjab, Tamil Nadu have at least 15% women beneficiaries who have availed benefits of this scheme.</td></tr>
<tr><td></td><td></td><td>Gender-friendly infrastructure and policies
• How has empowerment of women improved?</td><td>Women beneficiaries are being enrolled by the empanelled MI companies as dealer or sub-dealer across districts.</td></tr>
<tr><td colspan="4">Summary Analysis:
• Many states have taken measures towards gender equality and provided opportunity to the women beneficiaries to realize benefit of this scheme.
• However, some states (e.g. Assam, Uttar Pradesh etc.) do not follow the principle of equity for women beneficiaries viz. minimum 15% of fund to be utilized for them.</td></tr>
<tr><td>4.</td><td>Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population</td><td>Funds allocated under TSP/ SCSP and other provisions for vulnerable communities
• What is the fund allocated under TSP & SCSP for each scheme?
• What has been the effect of the TSP & SCSP funds on improving equity?</td><td>• As per scheme guideline, a portion of scheme subsidy is allocated to ST and SC either based on their population or 8% for ST and 16% for SC which form TSP and SCSP respectively.
• However, it has emerged from the primary stakeholder consultation and SCSP/TSP fund release data that this fund is allocated based on SC/ST population. For example, SC/ST population and SCSP/TSP fund release data is tabulated below for some states:
State | Proportion of total population | Proportion of total fund release, 2016-17</td></tr>
</table>

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research

(2011 census data)[192] (Rs. in lakh)[193]

	SC	ST	SCSP	TSP
AP	16%	7%	17%	7%
HP	25%	4%	26%	6%
JH	12%	26%	12%	26%
MH	10%	9%	12%	6%
PB	29%	0%	33%	0%
KA	16%	7%	18%	7%
RJ	17%	13%	18%	13%
UP	21%	0%	21%	1%

- Some states (e.g. Punjab, Uttar Pradesh, Maharashtra, Bihar, Karnataka, Rajasthan) were unable to use the entire funding allocated to SC/ST farmers because they have comparatively less landholding by SC/ST farmers
  - Punjab: SC/ST landholding is only 4-5%. However, around 29-33% fund is allocated for SC/ST farmers. Hence, the remaining fund remains unutilized

[192] https://censusindia.gov.in/tables_published/a-series/a-series_links/t_00_005.aspx

[193] https://pmksy.gov.in/microirrigation/Archive/MI_Release20162017.pdf

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		Inclusion of vulnerable groups in scheme as well as sector • What are the interventions implemented for specific vulnerable groups?	There is no appropriate definition of vulnerable group in the scheme guideline.
		Best Practices	Tamil Nadu has given special focus to transgender and physically challenged beneficiaries along with SC/ST and women farmers. They have asked the MI companies to enrol transgender, physically challenged people, women as dealer or sub-dealer across various districts
Summary Analysis: • As per scheme guideline, a portion of scheme subsidy is allocated to ST and SC either based on their population or 8% for ST and 16% for SC which form TSP and SCSP respectively. However, it has emerged from the primary stakeholder consultation and SCSP/TSP fund release data that this fund is allocated based on SC/ST population. • Since SC/ST fund allocation is based on their population and not based on landholding by SC/ST farmers, this leads to higher allocation but lower utilization of funds in some states (e.g. Punjab, Uttar Pradesh, Maharashtra, Bihar, Karnataka, Rajasthan).			
5.	Use of IT/Technology in driving efficiency	Deployment of IT enabled mechanisms for monitoring of the Schemes • In case of a scheme to create physical assets, is geotagging and use of	• An android based Bhuvan integration app is used for geo-tagging of interventions. This app has been developed in collaboration with NRSC, Hyderabad. This app is designed for field data collection of micro-irrigation

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		geotagged photographs being done? • How is technology being used for on-ground data collection?	projects. This app also includes a facility to upload photos on to the Bhuvan PDMC Web Portal. • Most states indicated that they use geotagging (including geotagged photographs). • Geo-tagging has helped the states in the below aspects: - Maintain transparency and check irregularities in implementation of the scheme - Identify location of land and other non-movable assets - Strictly monitor utilization of MI assets - Monitor if there is any misuse of subsidy • Actual MI coverage in a district/state can be easily evaluated with the help of geo-tagging. Hence, it is helpful to estimate future requirement of MI assets in that district/state. In this way, it has played an important role in planning and targeting phase of the scheme implementation. • Some states, like Andhra Pradesh, Bihar, Karnataka, Tamil Nadu, are leading in the use of technology. They have their own online system for

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			beneficiary application to subsidy disbursement - Karnataka: HASIRUF (Horticultural Application for Scheme Intervention and Regulating Utilization of funds) - Andhra Pradesh: APMIP (Andhra Pradesh Micro-irrigation Project) - Tamil Nadu: MIMIS (Micro-irrigation Management Information Service)
Summary Analysis: • Most states use geotagging and geotagged photographs • Many states use an android based Bhuvan app for on-ground data collection of micro-irrigation projects. This app also includes a facility to upload photos on to the Bhuvan PDMC Web Portal. • A few states (e.g. Andhra Pradesh, Bihar, Karnataka, Tamil Nadu) are leading with respect to use of technology; they use their own state level MIS. The entire process starting from beneficiary selection to subsidy disbursement are tracked through these online MIS systems.			
6.	Stakeholder and Beneficiary behavioural change	Fund Allocation • What percent of total allocation is directed towards Awareness generation or sensitization? What is the utilization rate? and How much impact has it been able to generate in terms of behaviour change?	• Scheme guidelines has not specified any separate allocation for awareness campaign and capacity building activities. It is to be incurred from admin expense (5% of CA allocation). • Ministry indicated that 5% of the funding for admin expense is quite high. States can use fund for IEC activities from this allocation. There is no need for separate funding. Some states like – Uttar Pradesh, Bihar, Maharashtra

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			agreed to that. However, some states, such as Rajasthan, Tamil Nadu, Punjab have expressed that dedicated fund allocation may be provided for extensive awareness generation and capacity building.
		Mechanisms to promote and ensure behaviour change • What activities are undertaken at District/Block level to promote adoption of good practices?	Some activities are taken to promote and ensure behavioural change: • Collaboration with Krishi Vigyan Kendra (KVK) which is Agricultural extension centre • Campaign through Akashvani, Doordarshan • Demo of best practices • Workshops at Choupals • Exposure visits
		Challenges faced • What are the major challenges? Are there any areas which needs more attention in terms of bringing behaviour change?	Majority of the states agree that extensive awareness program is required for behaviour change. Some states (e.g. Assam, Manipur, Jharkhand, Punjab, etc.) are lacking sufficient awareness activities. Some states, such as Rajasthan, Tamil Nadu, Punjab find it challenging to run extensive awareness program without separate funding for these activities.
		Cropping pattern • What are the key constraints in crop planning based on local water availability with a	Since MI system is highly water efficient, it is very useful for water intensive crops. For example, it is popular for sugarcane in Karnataka, Maharashtra, Uttar Pradesh, Bihar, etc.; cotton in Maharashtra,

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		view to reduce water intensive crops?	Karnataka, etc.; Banana in Uttar Pradesh, Maharashtra, Bihar, etc.
Summary Analysis: • Majority of the states agree that extensive awareness program is required for behaviour change. Many states (e.g. Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra, Rajasthan, etc.) conduct several activities such as campaign through TV/ radio, demo of best practices, exposure visits, workshops at Choupals etc. under awareness program. • However, some states (e.g. Assam, Manipur, Bihar, Jharkhand, etc.) are lacking in terms of required awareness campaign and capacity building activities and some states (e.g. Rajasthan, Tamil Nadu, Punjab) find it challenging to run extensive awareness program without separate funding for these activities.			
7.	Research & Development	Fund Allocation • What percentage of total allocation (Sector as well as Scheme specific) is directed towards R&D? How much of that percent is being utilized?	• There is no provision for R&D in the scheme guidelines. Also, no fund is earmarked for R&D activities. • States have suggested for R&D work for the following activities: - Develop low cost MI system considering high set up cost of existing system is a challenge for many small and marginal farmers (e.g. an NGO, International Development Enterprises (IDE), worked in Maharashtra and Gujarat to innovate low cost systems) - Effective use of MI system for high density crops like paddy, wheat etc. (for example, field trials were conducted for paddy cultivation in 2012 and 2013 by Tamil Nadu Agricultural University, Coimbatore

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			and successful paddy cultivation using drip system in Tirupur district of Tamil Nadu; paddy cultivation in Kota district of Rajasthan in collaboration with Jain Irrigation; Netafim is promoting rice cultivation using MI systems; on-farm trial conducted in Kurukshetra district of Haryana for paddy cultivation, APMIP has started promoting paddy cultivation using MI system in Andhra Pradesh; Punjab Agricultural University successfully conducted filed trials on wheat cultivation using drip system, etc.) - Cost-effective and durable underground piping system for sugarcane because pipelines are penetrated by sugarcane roots in existing set-up and, sometimes pipelines are damaged by rats • However, according to primary stakeholders, there is limited evidence of R&D activities being undertaken with respect to this scheme.

Summary Analysis:

- There is no provision for R&D in the scheme guidelines. Also, no fund is earmarked for R&D activities.
- There is scope of R&D activities in several areas like developing low cost MI system, suitable MI system for high density crops like paddy, etc. On these areas, t**here** have been

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
	limited research activities, field trials and thereafter successful implementation across a few areas in the country. However, there is scope for further R&D activities to commercialize low cost MI system, use of MI system for high density crops like paddy, etc. across the country.		
8.	Unlocking Synergies with other Government Program	Convergence (Inter-Ministerial/Inter-Departmental/Financial/Human Resources/ Administrative/ Institutions/ Schemes • What activities are undertaken to ensure convergence at community level? Are there any Action Plans prepared at State/District/Block level to ensure the same? • What are the challenges hindering effective convergence?	• This scheme complements MGNREGA and PMKSY-WDC in terms of source creation and efficient water resources management. Main activity undertaken to ensure convergence is to create water sources for MI. • Discussions with the key informants at state, district levels (such as: Goalpara, Golaghat districts of Assam, Andhra Pradesh, Kishanganj district of Bihar, Manipur, Rajasthan, Meerut district of Uttar Pradesh, Tamil Nadu etc.) have indicated that convergence with other schemes, such as MGNREGA, PMKSY-WDC, is not happening effectively. It is mainly due to coordination issues between departments responsible for implementing various schemes. However, a few states and districts (such as Punjab, Maharashtra, Jharkhand, Himachal Pradesh, Kurnool, Vishakhapatnam districts of Andhra Pradesh, Udupi district of Karnataka) have reported no issue with respect to convergence.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			• The departments concerned should collaborate at state/district level to enable effective convergence.
		Potential areas for synergy • What are the areas for potential convergence / synergy across govt. programs?	• If water sources created under other govt. programs can be used as source of MI systems, potential synergy will be realized, and fund spent for Other Intervention component can be saved.
Summary Analysis: • Convergence with other govt. schemes (MGNREGA, PMKSY-WDC etc.) are happening effectively in some states (e.g. Punjab, Maharashtra, Jharkhand). • However, many states (e.g. Assam, Bihar, Tamil Nadu, Manipur etc.) have indicated that there is lack of convergence across govt. schemes and there is a need to strengthen inter-departmental coordination mechanism to achieve this.			
9.	Impact on and role of private sector, community/ collectives/ cooperatives (e.g. Farmer cooperatives, FPOs, Water User Associations, etc.) and civil society in the scheme	Public-Private Partnership • How well have PPP functions in the Sector? What are the challenges faced?	• In a few states (Maharashtra, Bihar), sugar mills are involved with implementation of this scheme through contract farming model. Farmers cultivate sugarcane using MI under these sugar mills on contractual basis. They are providing loans to the farmers for covering MI cost because the farmers, many cases, are unable to afford the cost. Later, they receive their payment from the farmers through the subsidy provided by the Govt. • No further information is available on any other private investment related to the scheme.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		Private Sector Participation • What is the percentage of private investment in the clusters/programs run by the government?	• Apart from MI installation, after sales services and capacity building activities, private sector involvement is limited.
		FPOs/SHGs/Cooperative's Participation • How many private sector, community/ collectives/ cooperatives and civil society have availed the benefits under any Scheme?	• FPOs/SHGs/Cooperatives are active in States like Andhra Pradesh, Tamil Nadu. However, the number of these FPOs/SHGs/Cooperatives, which have availed benefits under this scheme, is not available.
Summary Analysis: • Apart from MI installation, after sales services and capacity building activities, private sector involvement is limited. • Contract farming model is prevalent across very few states (e.g. Maharashtra, Bihar); however, no further information is available on any other private investment related to the scheme.			

In addition to the above, other related themes like 'Development, dissemination & adoption', 'Reforms, regulations' have been rated as 'no information' due to lack of information around those themes; 'Building resilience to climate change', 'Conjunctive use of water', 'Water sharing treaties/agreements & diplomacy' have not been evaluated as these themes are not relevant to the scheme.

A summary analysis and performance of the scheme on the identified themes is presented below:

Table 84: PDMC - Summary of performance evaluation based on cross-sectional themes

Parameter	Performance
Accountability & Transparency	🟡
Direct/Indirect Employment Generation	🟡
Gender mainstreaming/Inclusiveness	🟡
Building resilience to climate change (including but not limited to developing water disaster preparedness) & ensuring sustainability	⚫
Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population	🟡
Use of IT/Technology in driving efficiency	🟢
Stakeholder and Beneficiary behavioural change	🟡
Development, dissemination & adoption	⚪
Research & Development	🟡
Water sharing treaties/agreements & diplomacy	⚫
Conjunctive use of water - surface versus groundwater usage optimizations	⚫
Unlocking Synergies with other Government Program	🟡
Reforms, Regulations	⚪
Impact on and role of private sector, community and civil society in the scheme	⚪

Cross-sectional themes performance infographics legend

🟢 High 🟡 Medium 🔴 Low ⚫ Not relevant ⚪ No information

Issues and challenges

This sub-section describes the scheme issues and challenges and their mapping with the source of information viz. primary source, secondary source and household survey (if applicable).

Table 85: PDMC – Issues and Challenges

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
Scheme Design					
PDMC – F1	**Cost norms not suitable**	In most cases, farmers' landholdings are divided into many smaller fragments			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
	for small land holding	which are not adjoining to each other. So, beneficiary farmers need to install separate MI units for each fragment of land resulting in escalation of the overall cost of the system. This cost escalation acts as a deterrent for adoption of such systems by the farmers.[190] Many states (such as Bihar, Assam, Manipur etc.) have indicated fragmented landholding as an issue because more than 80-90% farmers are small and marginal in these states. The farm holding is as low as 0.1 acre. Since minimum area mentioned in the MI guideline is 0.4 ha (around 0.99 acre) and subsidy for farm size smaller than that is calculated on pro-rata basis, it leads to comparatively higher costs for MI systems in case of such smaller farms. For example, let's consider two farms - 0.4 acre and 0.2 acre. If all other factors remain same, the subsidy calculated for 0.2 acre will be half of that for 0.4 acre. However, the actual cost of MI implementation for 0.2 acre will not be half of that for 0.4 acre, instead it will be more than that because there are a few fixed components (e.g. filter, venturi fertilizer injector assembly etc.) and costs of those components do not vary with the farm size (in case of such smaller farms).			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
PDMC – F2	**Additional costs**	The additional cost towards 12% GST levied on MI equipment is not covered through subsidy under the scheme and is borne entirely by the farmer. This increase the total cost of ownership for farmers. This issue has been stated by the state, district, village level key informants.			
PDMC – F3	**Variance between market prices and cost norms per guideline**	It has emerged from the discussions with the key informants at state, district, village level that unit cost norms of the MI components as per the guideline has not been revised since 2017. Current market rates are significantly higher than the unit costs (material cost). Hence, farmers end up bearing additional cost in this respect. Similarly, unit cost norms (material cost, installation cost etc.) for OI activities in the guideline are lower than the market rates. Hence, it is very difficult to undertake OI activities (i.e. water source creation) and very few farmers are willing to undertake such activities.			
PDMC – F4	**Fund allocated for SC/ST unutilized**	Subsidy allocation is made based on SC/ST population in a state. Some states (e.g. Punjab, Uttar Pradesh, Maharashtra, Bihar, Karnataka, Rajasthan) are unable to utilize the entire funding allocated for SC/ST farmers since their landholding is significantly lower compared to their population.			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		Punjab: SC/ST landholding is only 4-5%. However, around 29% fund is allocated for SC/ST farmers. Hence, the remaining fund remains unutilized.			
PDMC – F5	**Upper cap on landholding**	Some states, such as Punjab, Tamil Nadu, have indicated that the upper limit of 5 ha for the provision of subsidy restricts adoption of MI by farmers having large landholding.[190] However, it needs to be noted that subsidy provided under this scheme is mainly targeted at small and marginal farmers.			
PDMC – F6	**Low awareness on OI guidelines**	As per the Ministry, the states are expected to follow the operational guidelines of National Mission for Sustainable Agriculture (NMSA), 2014 for OI activities. Discussions with the key informants from some states, districts (e.g. Tamil Nadu, Maharashtra, Goalpara district of Assam) have revealed that there is lack of knowledge about all components included in the OI guidelines. For example: - State level key informant from Tamil Nadu has stated that OI guidelines restrict creation of water source on a sharing basis or for a group of farmers. - State level key informant of Maharashtra has stated that there			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		is no provision to cover farm pond under OI component. - State level key informant of Bihar and district level key informant from Assam have stated that shallow tube well, bore well is not included under OI components. However, all these components are already covered in NMSA guidelines (thus OI guidelines). Although OI component is part of PMKSY-PDMC scheme, its implementation is governed by NMSA (2014) guidelines. Based on primary survey, it was observed that there is lack of awareness or complete knowledge about OI guidelines among stakeholders.			
Scheme Implementation					
PDMC – F7	**Lack of coordination**	It is observed that multiple departments are responsible for implementation of this scheme in most states[190] (e.g. Assam, Bihar, Uttar Pradesh, Jharkhand, Andhra Pradesh, Manipur, Karnataka, Rajasthan). In some states (e.g. Assam, Bihar, Jharkhand, Uttar Pradesh), separate departments are responsible for MI and OI components (e.g. Agriculture/ Horticulture department is responsible for MI and Watershed department is			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		responsible for OI component). Hence, there is either less focus on water storage structure creation under OI component or such structures under OI are not effectively linked to MI systems and it hampers the progress of MI cultivation. Convergence with other schemes, such as MGNREGA, PMKSY-WDC, is not happening effectively across most states, districts (e.g. Goalpara, Golaghat districts of Assam, Andhra Pradesh, Kishanganj district of Bihar, Manipur, Rajasthan, Meerut district of Uttar Pradesh, Karnataka etc.). State level stakeholders have mentioned that it is mainly due to coordination issues between departments responsible for implementing various schemes.			
PDMC – F8	**Non-uniform pricing**	There is variance in the pricing of MI system across manufacturers. For example, prices of MI system provided by MNCs are significantly higher compared to local manufacturers. Prices and quality are not regulated.			
PDMC – F9	**High logistics cost**	There is absence or very low presence of MI manufacturing companies across a few states/districts (e.g. Assam, Manipur, Udupi district in Karnataka). Due to logistics/ transportation cost, the cost of			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		MI system is higher in such states/districts.			
PDMC – F10	**MMI projects not integrated with MI**	While the scheme remains popular in areas with bore well prevalence or other perennial water sources, adoption rates are significantly lower in areas served through canal irrigation. This is due to the fact that MI requires pressurized water supply while canal irrigation relies on gravity flows. Hence, Major and Medium Irrigation (MMI) projects should be linked to MI system[186] by adopting technological innovation in outlet design that will allow for pressurized supply from existing canal network. However, MMI projects are currently not planned to be integrated with MI system. Hence, farmers, who draw water from MMI projects, prefer flood irrigation over MI due to abundance of water. This negatively impacts efficient water resources management and defeats the objectives of the scheme.			
PDMC - F11	**High initial investment by farmer**	High initial investment required to be made by farmers, especially small and marginal farmers, for MI system is one of the factors constraining its wider adoption.[190] In the beneficiary survey, around 54% farmers (N=193) have stated that the subsidy amount is not adequate considering high set-up cost of MI system.			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
PDMC – F12	**Delay due to unavailability of states' share of fund**	Unavailability of states' share of funds is a major cause of delays.[194,190] Many states have decided to provide additional subsidy over and above the existing 45% to 55% subsidy available under PDMC. Some of the states (e.g. Assam, Andhra Pradesh, Himachal Pradesh, Jharkhand, Maharashtra, Manipur, Punjab, Rajasthan), however, find it difficult to arrange their share of funds including the additional subsidy in timely manner that leads to delay. In the beneficiary survey, around 50% farmers (N=193) have reported not receiving subsidy on time.			
PDMC – F13	**Lack of extensive awareness and capacity building**	Many farmers still do not have complete knowledge about the usefulness of the MI resulting in uneven spread across India.[195] Most states are organizing awareness campaign, training sessions, capacity building programs. However, the need to rapidly scale up such activities with a view to improve adoption rates was widely acknowledged among the stakeholders across many states (e.g. Assam, Manipur, Bihar, Jharkhand, Punjab etc.). In the beneficiary survey, around 72% beneficiary farmers (N=193) have			

[194] Department of Agriculture Cooperation & Farmers Welfare (2017), Presentation on Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)- "Per Drop More Crop"-Micro-irrigation

[195] Ministry of Agriculture (2014), National Mission on Micro-irrigation (NMMI) – Impact Evaluation Study

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		reported not receiving any training sessions under the scheme and around 49% farmers have mentioned about not having any technical support from the Govt. Also, some states (e.g. Maharashtra, Rajasthan, Tamil Nadu, Andhra Pradesh etc.) have reported that absence of dedicated allocation could be possible reason for inadequate training and capacity building in some states. Another possible reasons could be inadequate support provided by the MI companies. In the beneficiary survey as well, around 74% farmers have reported not having technical support from the MI companies.			
PDMC – F14	**Lack of easy financing**	Farmers face a major challenge in securing financing for purchasing MI systems. Even if they can find financing, they are required to provide a high value collateral for securing this financing. This prevents wider adoption of MI.			
PDMC – F15	**High-cost technology**	According to some states (e.g. Andhra Pradesh, Karnataka, Tamil Nadu, Punjab, Uttar Pradesh, Maharashtra, Jharkhand), there is an absence of low-cost technology solution for MI system. Since the scheme targets small and marginal			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		farmers, high cost equipment makes it unaffordable for them. There is a need to lower the cost of MI systems to allow for wider adoption.			
Monitoring and Evaluation					
PDMC – F16	**Outcomes and impact not monitored**	The PMKSY MIS or any other system does not monitor outcomes (productivity increase, reduction in fertilizer consumption etc.) and impact (increase in income of farmers, employment opportunity etc.) of the scheme.			
PDMC – F17	**Cumbersome progress reporting**	PMKSY-PDMC MIS requires district wise and crop wise physical and financial progress data from the state and thus, the format is very lengthy. States are required to fill around 50-60 columns for reporting financial progress and 50-60 for physical progress reporting. Apart from that, server issues are also there. Hence, many states find it very difficult to upload the data over the dashboard at regular interval as mandated in the scheme guidelines.			

Issue relevance legend

	Supported		Partially supported		Not supported		Not applicable

A summary analysis of issues & challenges for the scheme is presented below:

Table 86: PDMC – Summary of Issues and Challenges

Parameter	Performance
Institutional Mechanism and governance	●

Parameter	Performance
Fund flow efficiency and utilization	🟡
Unavailability of resource persons	⚪
Capacity building	🟡
Monitoring and evaluation	🟡

Performance infographics legend

🟢 Satisfactory 🟡 Average 🔴 Needs Improvement

Recommendations and solutions

This sub-section describes the scheme recommendation and solutions from the perspective of scheme design, scheme implementation and monitoring & evaluation, along with their mapping with the issues and challenges described in the preceding sub-section.

Table 87: PDMC – Recommendations and Solutions

Sl.no	Recommendation	Finding
Scheme design		
PDMC - R1	Short-term solution: The scheme guideline may include provision for drip system with class I grade of laterals along with class II or class III which are currently mandated in the guideline for reducing the cost of drip system. In drip system, laterals account for around 65-70% cost of the entire drip system. Wall thickness of class II grade laterals of 16 mm dia. is 0.7 to 0.9 mm. Drip system with such class II grade laterals with 1.2 m spacing costs around Rs. 50,000 for 1-acre (~ 0.4 ha) land. Class I grade of laterals are also available in the market. It is used by the farmers who are not taking subsidy through this scheme. These laterals have wall thickness of 0.4-0.5 mm and rest of the specifications remain same. Drip system with class I grade laterals costs around Rs. 28,000 for 1-acre (~0.4 ha) land; thus, around 44% less cost as compared to class II (grade mandated in the guidelines).	PDMC-F11, PDMC-F12 & PDMC-F15

Sl.no	Recommendation	Finding
	Hence, cost of drip system can be significantly reduced by using lower grade of laterals. Usage of thin walled lateral (0.4 mm wall thickness) is also observed in developed countries (such as US). However, there is caveat related to longevity. This class I grade laterals last for around 3 years whereas class II grade laterals last for 5-6 years. However, as per the key informants of the MI companies (e.g. Jain Irrigation, Netafim, Mahindra EPC etc.), there are many instances where farmers have used class I grade laterals for 6-7 years with proper maintenance. Similarly, as a short-term measure, cost of sprinkler system can be reduced by using plastic nozzle instead of metal nozzle. Long-term solution: R&D on development of low-cost MI technology may be explored given the focus of the scheme is on small and marginal farmers. Also, a separate allocation may be considered for such R&D activities. Govt. can collaborate with MI companies and the research institutes to find out other ways to reduce the cost of MI systems. Low-cost technology can be expected to significantly improve the adoption rates since the target beneficiary group may be unable to adopt MI technology on account of high investment required of them. If cost of MI system can be reduced, this will also reduce the subsidy requirement and thus, the financial burden on states.	
PDMC-R2	Central Govt. may increase the central assistance by a certain percentage for small and marginal farmers and proportionately decrease it for general farmers considering the fact that the primary target is small and marginal farmers. It will help to reduce top-up subsidy provided by the states for small & marginal.	PDMC – F12

Sl.no	Recommendation	Finding
	State Govt. may reduce the top-up subsidy by a certain percentage for general farmers considering that they can afford the non-subsidy portion of MI cost. This will also reduce the overall funding requirements by the states.	
PDMC – R3	A separate allocation of fund for IEC and capacity building may be made considering their importance in improving awareness and adoption of MI technology. This fund may be carved out of the 5% funding currently provided for administrative expenses. The guideline should lay down the specific objectives of IEC and capacity building, activities to be undertaken, how the outputs and outcomes of such activities will be tracked.	PDMC-F13
PDMC-R4	The scheme guideline has already mandated for a satisfaction certificate towards successful installation of the system from the beneficiaries. Based on which payment towards MI companies is processed. It may also include provision for mid-term assessment certificate after certain years (say, 3 years) of O&M. This will help to monitor after sales services provided by the MI companies during O&M period.	PDMC-F13
PDMC – R5	Unit cost norms in the scheme guideline for subsidy calculation are exclusive of GST and other taxes (if any). The farmers bear these taxes at their end. Hence, if rate of GST or other taxes can be reduced for the MI components, this will reduce the cost burden on farmers.	PDMC-F2
PDMC – R6	Unit cost norms for material cost of MI system (such as drip, sprinkler etc.) and material and installation cost of OI components (construction of tube well/ bore well, water lifting devices, construction of community tanks/ farm ponds etc.) specified in the scheme guidelines should be revised so that base prices for all components reflect current market price. Then, base prices should	PDMC-F3

Sl.no	Recommendation	Finding
	be escalated annually using an appropriate index and escalation formula to take care of inflation.	
PDMC – R7	Farm holding of less than 0.4 ha and appropriate cost norms for such farms to be provided in the guidelines. This will help to increase MI adoption rate among the farmers having fragmented landholdings.	PDMC-F1
PDMC – R8	SC/ST fund allocation at a state should be determined based on their landholding instead of their concentration in the overall population in the state. This will reduce instances of unutilized funds allocated for SC/ST farmers on account of mismatch between population and their landholding.	PDMC-F4
PDMC – R9	Separate OI guidelines should be published under PMKSY-PDMC which are currently available under NMSA (2014). This will improve awareness around OI activities and help the states to get subsidy benefit for various components (e.g. bore well, farm ponds etc.) which are currently not being used in some states due to lack of knowledge.	PDMC-F6
Scheme implementation		
PDMC-R10	Govt. may mandate release of subsidy in phased manner for general farmers. It may reduce upfront fund requirement by the states and smoothen the fund flow.	PDMC-F12
PDMC – R11	Single department should be accountable for implementing the entire PDMC scheme (both MI as well as OI components) at state level. This will help to integrate the water sources created under OI components with MI systems effectively, which is currently not happening across many states due to presence of two different departments for managing these two components. This arrangement would help to achieve better progress of MI. Such arrangement is observed in some states (e.g. Maharashtra, Tamil Nadu); where single department (i.e. Horticulture department)	PDMC-F7

Sl.no	Recommendation	Finding
	manages both the components and there is no such challenge in linking water sources under OI with MI components.	
PDMC – R12	Govt. may mandate to integrate water sources created under other central/state schemes (e.g. MGNREGA, PMKSY-WDC) with MI system. The nodal department of these schemes should collaborate at state level. This will help in saving funds currently spent on OI components.	PDMC-F7
PDMC – R13	Digital media should be adopted for awareness campaign, training program and capacity building activities. One innovative model could be awareness creation through social media platforms, such as Facebook, YouTube etc. Since most of the farmers, now-a-days, have access to smartphone and internet, it would be helpful in spreading awareness. Short 5-minute video (e.g. video for MI installation, video for maintenance, video for Do's and Don'ts, video for crop wise cultivation using MI etc.) can be uploaded over such digital platforms. It will increase reach while reducing cost of awareness program and capacity building activities. For example, Andhra Pradesh has started such activities through displaying small videos, audio-visual sessions (e.g. installation, maintenance, benefit of MI etc.) at village level kiosks of Rythu Bharosa Kendra (RBK).	PDMC-F13
PDMC-R14	Key Performance Indicators (KPI) for the services being offered by the MI companies can be defined and the MI companies can be incentivized/disincentivized based on KPI ratings. This may help to improve monitoring of the work undertaken by the MI companies.	PDMC- F13
PDMC – R15	The existing MMI projects, where pressurized supply is available, should be linked to MI system. New Major and medium irrigation projects should be necessarily focusing on technological innovation in outlet design that will allow for pressurized supply from existing canal network and comply with the provision for integration with MI system[186].	PDMC-F10

Sl.no	Recommendation	Finding
	The existing MMI projects, where gravity supply is available, can also be integrated with MI through installation of storage tanks and facilitating pressurized water supply from them using pump. The nodal departments of CADWM and PDMC at state level may collaborate and enable such measures.	
PDMC – R16	Govt. may mandate policy, regulatory framework for private investment in collaboration with states. Majority of the states are facing challenges to arrange for upfront fund requirement. Also, farmers are showing lack of interest in some states where the beneficiary farmers pay the cost of MI system upfront and after successful installation, they receive the subsidy amount from the Govt which is also delayed due to unavailability of funds at state level for their part of share. Since huge amount of money remains blocked for a long time than expected, the farmers are unable to carry out effective O&M of the MI system and they get reluctant to continue using the MI system under this scheme. As a result, overall, MI coverage gets negatively affected. In view of this, suitable PPP model can be explored, where • Capex of MI system will be catered through investment by the private companies • Subsidy mandated in scheme guideline (without top-up facility) will be given to the companies as a grant by the Govt. • Farmers will pay a fixed fee or a certain percentage of their profit to the companies for the MI service being offered by them This is expected to reduce the financial burden on the states as well as farmers. Also, it will help to improve the O&M activities and hence, both the private companies as well as the farmers will be able to reap benefits of MI for longer time.	PDMC-F11, PDMC-F12, PDMC-F14

Sl.no	Recommendation	Finding
Monitoring and evaluation		
PDMC – R17	PMKSY-PDMC MIS system at the central level may be integrated with the MIS system at the state level for the states which currently maintain separate MIS dashboard. This will help in seamless data flow without any lag. Also, this will reduce the effort made by the state officials for uploading district wise, crop wise data over the dashboard. For the states which do not have their own state level MIS, central and state should strengthen their arrangement to make meaningful data available over the PMKSY-PDMC dashboard at regular interval as specified in the guidelines.	PDMC-F17
PDMC – R18	Outcomes (such as increase in crop yield, reduction in fertilizer consumption, reduction in power consumption, saving of labour etc.) and impacts (such as increase in income, employment opportunity etc.) of the scheme may be tracked on a regular basis through 3rd party evaluation. That data can be made available over public domain (e.g. MIS dashboard). This may enable meaningful evaluation of scheme impact from time to time and help in assessment of to what extent scheme objectives are being achieved.	PDMC-F16

2.2.5 Watershed Development Component

India is primarily a rural economy and agriculture development forms the backbone of the governments' efforts to tackle poverty and enhance food security. The rainfed areas are the hot spots of poverty, undernourishment, water and food insecurity, prone to severe land degradation, and poor institutional and social infrastructure. A balanced approach is thus required to meet demands for food on one hand and to preserve natural resources and tackle climate change on the other.

Out of India's total geographical area of 329 million hectares, only 140 million hectares can be categorized as net sown area. Of this, 47 per cent is irrigated and the remaining 53 per cent is rainfed. Even if we can achieve full irrigation potential in the country, still around 40 per cent of the net cultivated area will remain rainfed.[196] Therefore, rainfed agriculture is vital to the country's economy and food security as it also contributes to about 40 per cent of the total food grain production.[197] Rainfed regions also support two-thirds of livestock and 40 per cent of the human population. Moreover, 80 per cent of small and marginal farmers that are most vulnerable to monsoon failures depend on these areas for livelihoods.[198]

Given that the rainfed areas are the most backward, there is a need to ensure profitability, economic and social equity in these areas at an accelerated pace.[199] The main challenge of rainfed agriculture in future will be sustaining the livelihoods of small and marginal farmers, who will still depend on farming despite increased climate variability and dwindling landholding size. Hence it becomes imperative that agriculture productivity must be duly taken care of and efforts need to be taken to address concerns of irrigation and enhance productivity in rainfed areas. Watershed development programmes are considered as a valuable instrument for addressing many of these problems in fragile soil areas, in intensively cultivated lands and marginal rainfed areas.

[196] Potential and Challenges of Rainfed Farming in India, Srinivasrao Ch, et al., Advances in Agronomy 133:115-181 · July 2015

[197] farmer.gov.in

[198] Report of the Committee on Doubling Farmers' Income, Volume VI, November 2017, "Strategies for Sustainability in Agriculture", Department of Agriculture, Cooperation and Farmers' Welfare, Ministry of Agriculture & Farmers' Welfare.

[199] Sustainable Agriculture, FAO and the post- 2015 development agenda issue papers, Post 2015 and SDGs. Nourishing people, Nourishing the planet. Available at http://www.fao.org/fileadmin/ user_upload/mdg/doc/SustAg-12.pdf, last accessed on 25 October 2019.

Watershed management leads to scientific conservation of soil and water, thereby increasing agriculture and biomass production. It helps in increasing the income of the people living in the watershed community and lessens the occurrence of drought and flood leading to an increase in the life of the downstream dam and reservoirs. Therefore, Watershed Development Component of Pradhan Mantri Krishi Sinchayee Yojana (WDC-PMKSY erstwhile IWMP) is a necessary step in the direction of achieving the larger goal of PMKSY which is to provide economic and social sustainability to agriculture in rainfed regions of India.

Moreover, WDC-PMKSY is extremely relevant to SDG 15.3, which specifically deals with Land Degradation Neutrality. India has committed to improving degraded land of 26 million hectares by 2030 which includes 13 million hectares committed as part of Bonn Challenge 2020, 8 million hectares committed by 2030 as GoI is a signatory to UNCCD and additionally, Prime Minister has committed to improving an additional 5 million hectares.

2.2.5.1 Background

Under the umbrella of the former Planning Commission, the National Rainfed Area Authority (NRAA) framed the Common Guidelines (2008) for watershed programmes for all Ministries and Departments.[200] The provisions in the Common Guidelines and the observations of the Parthasarathy Committee necessitated modifications in the Watershed Schemes of the Department of Land Resources (DoLR). Accordingly, during 2009-10, the Schemes of Integrated Wasteland Development Programme (IWDP), Desert Development Programme (DDP) and Drought Prone Areas Programme (DPAP) of the DoLR were integrated and consolidated into a single tailored programme called the Integrated Watershed Management Programme (IWMP). This programme is being implemented with effect from 26.02.2009 as per the Common Guidelines for Watershed Development Projects, 2008 (revised in 2011). The IWMP programme has been continued as one of the four components of Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) under the 14th Finance Commission period (starting in 2015-16).

WDC-PMKSY is principally for development of rainfed part of net cultivated area and culturable wastelands/degraded lands. The activities being undertaken include ridge area treatment,

[200] www.dolr.gov.in

drainage line treatment, soil and moisture conservation, rainwater harvesting, nursery raising, afforestation, horticulture, pasture development, livelihoods for asset-less individuals, etc. Watershed development activities are not only limited to engineering and vegetative measures but also ensure sustainability in food production, eco-development and soil health care through social mobilization, community organisation and capacity building of the affected community.

Stated Objective of the Scheme

The primary objectives of the Watershed Development Component of PMKSY are[201]:

i. harnessing, conserving and developing degraded natural resources
ii. prevention of soil run-off;
iii. rainwater harvesting and recharging of groundwater table;
iv. increasing the productivity of crops;
v. introduction of multi-cropping and diverse agro-based activities;
vi. promoting sustainable livelihoods; and
vii. increasing household incomes.

Key features of the Scheme

The main features of WDC-PMKSY are as below[202]:

- As per the Common Guidelines for Watershed Development Projects-2008 (thereafter revised in 2011), the period for completing projects is between 4-7 years (Figure 40).

[201] Report of Standing Committee on Rural Development, Sixteenth Lok Sabha (2016-2017) on Watershed development component (WDC-PMKSY), 39th Report

[202] www.dolr.gov.in

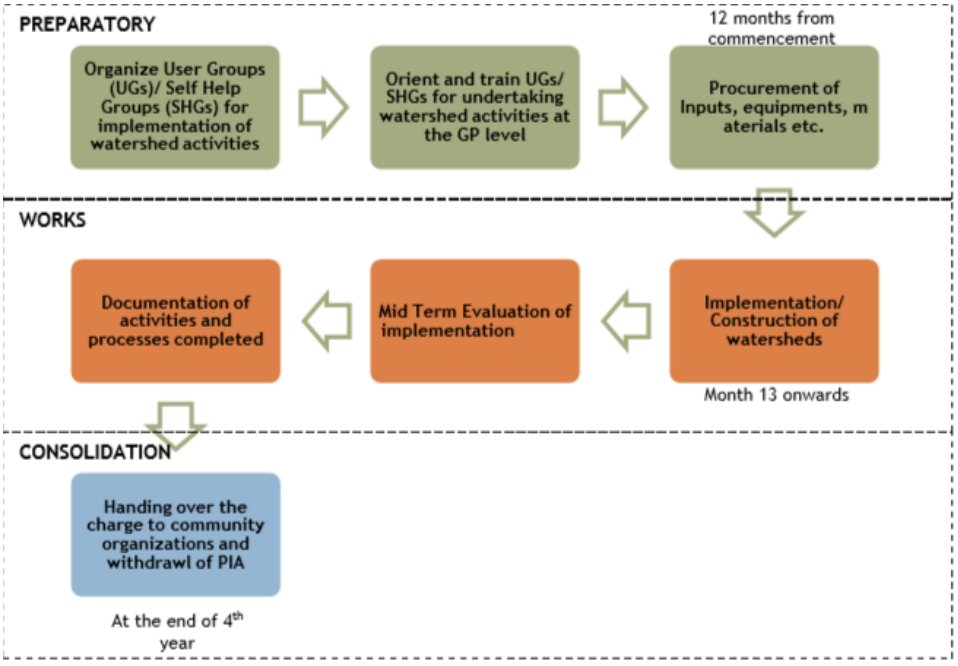


Figure 40 Process/Implementation of Watershed Activities by PIAs (Tentative Timeline of 4 years)[203]

- The projects undertake a cluster of micro-watersheds of the area of about 5,000 hectares in rainfed/ degraded areas having no assured irrigation.

- The activities under the project are spread over three phases (Figure 40)[204].

    a) The **Preparatory Phase** (1 to 2 years) is for the preparation of the Detailed Project Report (DPR), Institution & Capacity Building and Entry Point Activities.

    b) The **Watershed Works Phase** (2 to 3 years) is for the watershed Development works, livelihood activities for the asset-less persons and facilitating production system & micro-enterprises.

[203] Manual for District- Level Functionaries (2017), Pradhan Mantri Krishi Sinchayee Yojana(PMKSY), available at https://darpg.gov.in/sites/default/files/Pradhan%20Mantri%20Krishi%20Sichai%20Yojana.pdf , accessed on 4.11.2019

[204] www.dolr.gov.in

c) The **Consolidation and Withdrawal Phase** (1 to 2 years) involves the consolidation and completion of various works and handing over to community concerned.

- The funding pattern under the Watershed Development Component of PMKSY is 60:40. However, for the North-Eastern States and Hill States (J&K, H.P & Uttarakhand) the funding pattern between the Centre and the States continues to be 90:10.

- The cost norm is Rs. 15,000 per hectare for hilly & difficult area, Rs. 12,000 per hectare for other areas and up to Rs. 15,000 per hectare for WDC projects in the Integrated Action Plan (IAP) Districts.

- The programme emphasizes careful planning and capacity building, by providing a special provision of 1 per cent for preparation of Detailed Project Report (DPR) and 5 per cent for Institution and Capacity Building.

- Dedicated institutions are also provided at Centre, State and District levels for decentralised management of the scheme[205]:

    1. **Ministry Level:** The Department of Land Resources has the necessary institutional mechanism in the form of a **Steering Committee** chaired by the Secretary, DoLR.[206] This Committee inter alia appraises and clears the project proposals of the States.

[205] www.dolr.gov.in

[206] The Steering Committee consists of members from Department of Land Resources, the National Institution for Transforming India (NITI) Aayog, Ministry of Science and Technology, Department of Drinking Water Supply, Department of Agriculture, Cooperation & Farmers Welfare, Department of Rural Development, Ministry of Water Resources, River Development & Ganga Rejuvenation, Ministry of Environment, Forest and Climate Change, National Rural Livelihoods Mission, (Ministry of Rural Development), Department of Animal Husbandry, Dairying & Fisheries, Department of Agricultural Research & Education, Ministry of Skill Development & Entrepreneurship, Central Ground Water Board, Indira Gandhi National open University (IGNOU), National Bank for Agriculture and Rural Development (NABARD), organizations in Space Technology (NRSA,ISRO,FSI), three organizations in the field of watershed management (ICRISAT, CRIDA, MANAGE etc.), National Informatics Centre (NIC) , representative from NRAA as a Special Invitee for policy matters, three to five experts in the field of watershed management and three reputed NGOs.

2. **State Level:** A **State Level Nodal Agency (SLNA)** has been constituted with professional support. SLNA is a dedicated institution for the implementation of projects in a State.

3. **District Level: Watershed Cell-cum-Data Centre (WCDC)** is the District level institution to supervise and coordinate the projects in the District. WCDC is set up in DRDA/ Zilla Parishad/ District Level Implementing Agency/ Department in all programme districts as per the convenience of the State Governments.

4. **Project Level:** Supervision of project implementation is under the **Project Implementing Agency** (PIA). As per the Common Guidelines for Watershed Projects, 2008 (Revised in 2011), Panchayats, Government and Non-Government agencies may function as PIAs. A **Watershed Development Team** (WDT) comprising 3 to 4 technical experts will assist each PIA.

5. **Village Level: Watershed Committee (WC)** is constituted by the Gram Sabha for the execution of the projects at ground level. It comprises at least 10 members, half of which are representatives of Self Help Groups and User Groups (UGs), SC/STs, women and landless. One member from WDT is also represented in WC.

- As a systemic improvement, a protocol on formal completion and closure of WDC-PMKSY projects has been formulated by the DoLR in consultation with the then Ministry of Water Resources, River Development & Ganga Rejuvenation and NITI Aayog. The protocol inter alia envisages ensuring (i) the due completion of unfinished works (if any), (ii) maintenance, (iii) security and (iv) sustainability of the watershed development projects. It also includes (v) an apt, quick and low-cost/cost-effective end-line evaluation of the project or a group of projects within the approved cost norm for M&E component[207].

- Before the projects are formally treated as closed by the DoLR, the completion and closure protocol have to be duly adopted by the States in respect of the projects administratively reported to have been completed. All States have been accordingly

[207] www.dolr.gov.in

requested on 12th July 2017. States have reported that the end-line evaluation of 2052 completed projects has been undertaken.

- A geospatial portal SRISHTI is being implemented from 2015 with the assistance of National Remote Sensing Centre (NRSC) for near real-time monitoring. It has been extended to all 28 States by 2016. Geo-coded and time-stamped photographs on a near real-time basis are uploaded on SRISHTI portal using a mobile application DRISHTI specifically developed for the purpose. A total of 13.75 lakh photographs have been uploaded by the States on the portal as on 20.09.2020[208].

Progress and Achievements

About 8,214[209] number of watershed development projects were sanctioned between the period of 2009-10 to 2014-15 in 28 states (except Goa) involving an area of about 39.07 million hectares (Table 89).[210] The normative period for completion of a project is 4 to 7 years, WDC-PMKSY was getting over by March 2020. However, GoI has extended the same for one year viz. up to March 2021. Project life of Batch-VI projects (total 118) spans up to March 2022. State-wise projects have been displayed in the table below (Table 88) according to the stage of completion. The evaluation report has been submitted for 2052 projects. 1487 projects are in the Preparatory Phase and have been transferred to the states.

[208] https://bhuvan-app1.nrsc.gov.in/iwmp/

[209] For the discussion with DoLR it was learnt that there were 8,214 projects under the scheme – out of these 1,832 projects were handed back to the state government due to various reasons, mainly due to lack of preparedness on these projects. Thus, currently, there are 6,382 projects under the scheme.

[210] Report of the Committee on Doubling Farmers' Income, Volume VI, November 2017, Ministry of Agriculture & Farmers' Welfare.

Table 88: State-wise status of WDC projects[211]

State	Total Projects Sanctioned	Uninitiated ed Projects transferred to State*	Preparatory phase projects transferred to State**	Work Phase	Consolidation Phase	Completion Reported (Administrative reports received)#	End-line evaluation reported
Andhra Pradesh	432	0	59	77	36	260	260
Arunachal Pradesh	156	0	42	101	0	13	13
Assam	372	0	92	54	0	226	226
Bihar	123	0	59	15	0	49	0
Chhattisgarh	263	0	55	27	0	181	112
Gujarat	610	61	60	59	0	430	0
Haryana	88	13	0	60	0	15	0
Himachal Pradesh	163	0	32	104	0	27	0
Jharkhand	171	28	0	56	0	87	0
Karnataka	571	2	140	28	0	401	261
Kerala	83	0	14	11	17	41	26
Madhya Pradesh	517	3	68	162	15	269	0
Maharashtra	1186	6	156	122	113	786	351
Manipur	102	0	41	34	0	27	0
Meghalaya	96	12	23	0	0	61	33
Mizoram	89	0	40	0	0	49	32
Nagaland	111	0	0	0	33	78	78
Odisha	310	0	76	39	0	195	127
Punjab	67	8	26	27	0	6	0
Rajasthan	1025	41	164	173	46	601	383
Sikkim	15	4	5	0	0	6	0
Tamil Nadu	270	0	0	0	70	200	74
Telangana	330	0	54	155	0	121	47
Tripura	65	0	9	8	19	29	29
Uttarakhand	65	0	3	23	8	31	0
Uttar Pradesh	612	125	238	0	0	249	0
West Bengal	163	42	2	42	31	46	0
UT							
Jammu & Kashmir	144	0	25	119	0	0	0
Ladakh	15	0	4	11	0	0	0

[211] #As on 31.10.2019

*on 08.02.2018

**on 01.08.2018

State	Total Projects Sanctioned	Uninitiated ed Projects transferred to State*	Preparatory phase projects transferred to State**	Work Phase	Consolidation Phase	Completion Reported (Administrative reports received)#	End-line evaluation reported
Total	**8,214**	**345**	**1,487**	**1,507**	**388**	**4,487**	**2,052**

Out of 8,214 sanctioned projects, 345 uninitiated projects and 1,487 projects in Preparatory Phase (Total 1,832) had been transferred to States to be taken up under their respective States' budget. Out of balance 6,382 projects being funded by DoLR, as on 22.09.2020, 4,487 (70.31%) have been reported completed, 388 (6.08%) projects are in Consolidation Phase and 1,507 (23.61%) are in Works Phase. A total of approx. 14.67 lakh hectare has been brought under protective irrigation benefitting 31.15 lakh farmers.[212]

The central share is Rs. 33,642.24 Cr.[213] out of the total project cost of Rs. 50,739.58 Cr. So far, Rs. 19,185.26 Cr. of Central Share has been released to States.

The following table (Table 89) shows the state-wise allocation of the projects and the aggregate area of the projects sanctioned. Both Rajasthan (1,025) and Maharashtra (1,186) have been allocated the maximum share of the projects (above 1,000 project). The maximum area has been covered in four states i.e. Maharashtra, Rajasthan, Uttar Pradesh and Gujarat with 5.128, 5.764, 3.045 and 3.013 Million Hectares respectively.

Table 89: State-wise allocation of projects and area covered

Sr. No.	State	Sanctioned (from 2009-10 to 2014-15)@			Central share released$ (up to 31.10.2019) (in Cr.)
		No. of sanctioned projects	Area covered (m ha)	Total project cost (in Cr.)	
1	Andhra Pradesh	432	1.810	2290.00	1148.68
2	Arunachal Pradesh	156	0.467	701.48	300.04
3	Assam	372	1.577	1946.11	522.99
4	Bihar	123	0.612	841.53	239.68

[212] WDC-PMKSY Booklet provided by DoLR

[213] DoLR dashboard for WDC-PMKSY

Sr. No.	State	Sanctioned (from 2009-10 to 2014-15)@			Central share released$ (up to 31.10.2019) (in Cr.)
		No. of sanctioned projects	Area covered (m ha)	Total project cost (in Cr.)	
5	Chhattisgarh	263	1.195	1517.87	354.95
6	Gujarat	610	3.103	4022.19	1366.57
7	Haryana	88	0.362	437.25	112.67
8	Himachal Pradesh	163	0.840	1259.94	350.45
9	Jammu & Kashmir	159	0.652	979.73	230.82
10	Jharkhand	171	0.911	1142.7	228.29
11	Karnataka	571	2.569	3324.45	1894.70
12	Kerala	83	0.423	589.54	158.07
13	Madhya Pradesh	517	2.937	3568.11	1631.15
14	Maharashtra	1186	5.128	6517.49	2516.95
15	Manipur	102	0.491	735.13	150.56
16	Meghalaya	96	0.236	351.99	174.22
17	Mizoram	89	0.373	560.87	282.16
18	Nagaland	111	0.476	714.91	637.95
19	Odisha	310	1.700	2191.5	1087.42
20	Punjab	67	0.314	377.61	60.42
21	Rajasthan	1025	5.764	7892.61	2738.15
22	Sikkim	15	0.066	98.07	24.21
23	Tamil Nadu	270	1.368	1643.19	924.94
24	Telangana	330	1.399	1742.27	623.80
25	Tripura	65	0.213	320.31	214.83
26	Uttarakhand	65	0.346	492.88	131.08
27	Uttar Pradesh	612	3.045	3583.7	808.49
28	West Bengal	163	0.693	896.16	271.02
	Total	8214	39.07	50739.5950	19185.26

@ Sanctioned under the erstwhile Integrated Watershed Management Programme (IWMP), which has been amalgamated as the Watershed Development Component (WDC) of the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) with effect from 2015-16.
$ Includes releases under the erstwhile IWMP
Note: There is no sanctioned project in Goa.

Year-wise Centre and State allocation and expenditure by States are given below (Table 90). The total amount of underutilized fund is Rs. 2,554.68 Cr. till 2019-20.

Table 90: Year-wise Centre and State allocation and expenditure by States from FY 2009-10 (Rs. in Cr.)

All amounts are Rs. in Cr.

Financial Year	Central Share Released	State Share Released	Expenditure by State
2009-10	501.47	26.45	27.66
2010-11	1496.86	167.17	276.77
2011-12	1865.92	203.12	841.37
2012-13	2720.52	257.92	1962.55
2013-14	2162.81	255.32	3436.23
2014-15	2284.64	186.01	3413.49
2015-16	1487.83	1107.28	2400.35
2016-17	1471.72	658.62	2603.51
2017-18	1691.81	461.42	1947.46
2018-19	1780.55	349.91	1522.79
2019-20	1472.33	608.64	2385.03
2020-21	248.807	27.27	-
Total	**19,185.26**	**4,309.13**	**20,817.21**

Financial progress of the scheme from 2015-16 to 2019-20 is given in the table (Table 91) below. The percentage release (of Revised Estimate) is almost above 99 per cent for most years.

Table 91: Financial Progressfrom FY 2015-16 (Rs. in Cr.)

Year	RE	Release	% Release	Expenditure
2015-16	1530.00	1527.39	99.83	2580.80
2016-17	1495.00	1494.92	99.99	2818.97
2017-18	1700.00	1699.40	99.96	2897.12
2018-19	1826.00	1791.49	98.11	2665.21
2019-20	1732.64	1478.83	85.33	2385.03

Physical progress has been shown in the table below (Table 92). Since 2015-16 around 0.581 million water harvesting structures have been created and additional area brought under irrigation is 1.28 million hectares. Numbers of farmers benefitting from the aforementioned initiatives is 2.674 million. Since 2018-19, 28.121 million man-days have been generated and total area brought under plantation (Afforestation / Horticulture) etc. is 0.137 million hectares and area of culturable wastelands treated in completed watershed development projects are 0.263 million hectares.

Table 92: Physical Progress

Indicators / Parameters	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21*	Total
No. of Water Harvesting Structures (in million)	0.105	0.155	0.137	0.081	0.090	0.013	**0.581**
Additional Area brought under Irrigation (in million hectare)	0.247	0.307	0.287	0.257	0.152	0.030	**1.28**
No. of Farmers Benefited (in million)	0.507	0.52	0.473	0.652	0.424	0.098	**2.674**
Area brought under plantation [Afforestation / Horticulture etc.] (in million hectare)	-	-	-	0.07	0.057	0.01	**0.137**
Area of culturable wastelands treated in completed / closed watershed development projects (in million hectare)	-	-	-	0.178	0.078	0.007	**0.263**
No. of man-days generated (in million)	-	-	-	16.896	8.667	2.558	**28.121**

Table 93 shows the Water Harvesting Structures (WHS) created/rejuvenated in 28 states is about 6.90 lakh. Andhra Pradesh by far has the maximum share in this with 1,94,308 structures with Rajasthan as second with 1,23,993 structures. The additional area brought under irrigation is 14.67 lakh hectares. The number of farmers benefitted is 31,15,453 during the said period.

Table 93: State-wise details of Water Harvesting Structures (WHS) created/rejuvenated, additional area bought under irrigation and farmers benefitted under WDC-PMKSY during 2014-15 to 2020-21 (as on 30.06.2020)

State	WHS created/ Rejuvenated (in Nos.)	Additional area brought under irrigation (Ha)	Farmers benefitted (in Nos.)
Andhra Pradesh**	194308	298405	275670
Arunachal Pradesh	654	3955	25434
Assam	7034	111254	260529
Bihar	6226	23945	72599
Chhattisgarh	9258	27149	51067
Gujarat	44627	46416	73373
Haryana	3423	44751	34870
Himachal Pradesh	9329	11900	65649
Jammu & Kashmir	4826	17211	88241
Jharkhand	3718	3746	73475
Karnataka	29651	74040	185968
Kerala	28660	29049	166534
Madhya Pradesh	29495	127415	139303
Maharashtra	11880	125107	181258
Manipur	11659	3343	167077
Meghalaya	2521	4075	15956
Mizoram	9909	51061	55646
Nagaland	3603	4534	16267
Odisha	24592	53436	88370
Punjab	365	6943	5151
Rajasthan	123993	78273	280786
Sikkim	169	33	1005
Tamil Nadu	51612	140718	285034
Telangana	21637	47011	63995
Tripura	3153	5891	9984
Uttar Pradesh	22696	109480	314110
Uttarakhand	17186	2334	53695
West Bengal	14018	15655	64407
Total	690202	1467130	3115453
Note: Provisional and subject to change (As per information received from states)			

State	WHS created/ Rejuvenated (in Nos.)	Additional area brought under irrigation (Ha)	Farmers benefitted (in Nos.)
**including achievements in convergence with MGNREGA in the watershed area			

2.2.5.2 Performance

Performance on REESI+E framework

The scheme has been assessed on REESI and Equity framework based on available secondary literature and primary data collected so far. The initial findings of the assessment are presented in the table below:

Table 94: WDC - performance evaluation using REESIE framework

Parameter	Findings from research
Relevance	**Secondary:** • Rainfed areas constitute about 53 per cent of India's 140 million hectares cultivated mostly by small and marginal farmers who are chronically poor and depend heavily on subsistence farming with low productivity. • Desertification and Land Degradation Atlas of India (2016) released by ISRO reveal, 96.4 million hectare land (30 per cent of the total geographical area of the country) in India is witnessing land degradation. The main causes of land degradation identified inter alia include water erosion, wind erosion, vegetation loss, salinity and alkalinity. These impacts are very severe in rainfed regions when compared to the irrigated area. • India aims to double current annual agriculture productivity (2,509 kg/hectare) to 5,018 kg/hectare by 2030. Rainfed agriculture is vital to the country's economy and food security as it contributes to about 40 per cent of the total food grain production. Hence, WDC-PMKSY is extremely

	relevant for increasing productivity in rainfed regions and ensuring food security. • WDC-PMKSY is also extremely relevant to achieve SDG 15.3 which targets combating desertification, restoring degraded land and soil, including land affected by desertification, drought and floods, and to achieve a land degradation-neutral world. India has committed to improving degraded land of 26 million hectares by 2030 which includes 13 million hectares committed as part of Bonn Challenge 2020, 8 million hectares committed by 2030 as GoI is a signatory to United Nations Convention to Combat Desertification (UNCCD). Additionally, the Hon'ble Prime Minister, during UNCCD-COP14 held in September 2019 in India, has announced a raised NDC of 26 million hectares by adding 5 million hectares. • Most effective principle of rainfed and degraded area development is the conservation and efficient use of natural resources. This can best be achieved through watershed development. Watershed management is an effective and scientifically proven approach for the development of rainfed and degraded areas. Moreover, impact assessment studies reveal improvement in surface and groundwater availability and increase in productivity and livelihood opportunities. • About 62.74 million hectares rainfed and degraded land is available for treatment. There is a need for continuation of the watershed programme in the country to cover untreated areas. • Standing Committee on Rural Development (2016-2017) submitted its report on 'Watershed Development Component of Pradhan Mantri Krishi Sinchayee Yojana (WDC-PMKSY) erstwhile IWMP in July 2017 in consultation with Department of Land Resources (Ministry of Rural Development). The Committee strongly felt that projects under WDC are essential for the development of rainfed areas given the overall vision of the government for the agriculture sector. • As per Dr Radhika Rani, who heads the Centre for Agrarian Studies at the National Institute for Rural Development and Panchayati Raj

Parameter	Findings from research
	(NIRD&PR), the watershed development project is the only option for rainfed areas, contributing to water conservation and recharge, and preventing soil degradation.
	Primary: • The interviews conducted amongst scheme implementers, National Rainfed Area Authority and interviews conducted with stakeholders in SLNA clearly emphasise the importance of Watershed Development projects in rainfed areas to reclaim degraded land, improving productivity and availability of surface water and groundwater recharge and livelihood opportunities. • Stakeholders also cited numerous impact assessment/end-line evaluation studies which reveal that watershed development programmes are well placed to tackle the major sectoral challenges in rainfed areas. • As per the stakeholders, the scheme is not overlooking/bypassing any sectoral challenge. The scheme has provision to include all interventions that are required to holistically enhance the welfare and economic status of the beneficiary. The scheme design is meant for developing the intervention area which includes all-natural resources on a sustained basis by transforming resource users into managers.
	Inference: • Watershed development projects undertaken under WDC-PMKSY are one of the prime strategies to deal with key sectoral challenges in rainfed and degraded areas. The benefits include reclamation of degraded land, improving the availability of surface and groundwater, checking soil erosion and enhancing livelihood opportunities. • The WDC scheme mainly addresses SDG-15.3 (By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods and strive to achieve land degradation – neutral world). Besides, the scheme addresses Sustainable Development Goal-1 (SDG-1, No poverty), SDG -2 (Zero hunger), SDG -3

Parameter	Findings from research
	(Good health and well-being), SDG -5 (Gender equality) and SDG -15 (life on land). • Therefore, the performance on this parameter is satisfactory.
Effectiveness	**Secondary:** • The effectiveness of the scheme is gauged by assessing its performance on various output and outcome indicators with respect to its stated objectives. Watershed projects take four to seven years to complete; according to the scheme guidelines and secondary sources (KIIs in Karnataka and Rajasthan), results are positive in the long run in states where the project has been implemented as per the guidelines. • As per End line Evaluation of PMKSY-WDC watershed projects in Kerala undertaken by Centre for Water Resources Development and Management in 2018-19, various stakeholders including BDOs, Block level staff and the beneficiaries in the watershed areas agreed that the PMKSY-WDC projects are well-conceived given the overall vision of the government for rainfed areas and had enhanced the management of natural resources and improved the socio-economic status of beneficiaries. • Institute of Economic Growth conducted an evaluation study (in May 2018) of MGNREGA's (Mahatma Gandhi National Rural Employment Guarantee Act) water and land management projects, a chunk of which are implemented in convergence with the PMKSY's watershed component. About 78% of beneficiaries saw an increase in the water table, while 66% also reported benefiting from better availability of fodder, thanks to such water conservation works. Increase in irrigation potential was reported as the prime benefit from the creation of community assets. Both individual and community beneficiaries experienced an increase in the groundwater table. Similarly, Natural

Parameter	Findings from research
	Resource Management (NRM) assets have helped small and marginal farmers to improve livelihood opportunities.[214] • When the groundwater table increases as a result of watershed management projects, farmers in the area go for water-intensive crops like paddy and sugarcane causing over-extraction. After execution, proper post-implementation management is critical. Otherwise, even after the achievement of planned outputs, desired outcomes may not be realized. If Panchayati Raj leadership and water user associations are not strengthened and empowered, benefits from the scheme will be short-lived.[215] • **Case study of Jangalahalli village of Kapalamadagu GP in Kolar (Karnataka)[216]:** By overall upliftment of farmers' economic condition along with sustainable management and conservation of soil and water the watershed project in Jangalahalli village has contributed substantially towards the sectoral challenge, national priority and Sustainable Development Goals (SDG). Under Batch-4 PMKSY-WDC programme implemented in Mulbagal taluk, Schedule Caste (SC) farmers having aggregate landholdings of up to 10 hectares in Jangalahalli village of Kapalamadagu GP were migrating to towns in search of jobs. Their lands were unproductive and were left barren/fallow. But after project intervention due to land treatment from upper reach to lower reach and via various watershed activities such as bunding, construction of Nalabund and check dams, agroforestry, dry land horticulture, boulder checks and diversion channels have converted uncultivable land into productive cultivable lands. Water stored in the water harvesting structure has helped the farmers to undertake intensive cultivation of commercial crops. In Jangalahalli village, watershed development programme has not only raised the income level of SC farmers but also facilitated them to sustainably settle down in their farm, thereby reducing migration and poverty.

Parameter	Findings from research
	Primary: • Poor water harvesting system, land degradation, poor water quality, environmental protection, poverty alleviation are the major criteria considered during selection of watershed projects. Therefore, WDC aligns with sectoral challenges. Watershed Development programme is most ideal for achieving desired objectives and conforms to many of the core objectives of SDG. The scheme aligns to SDG-15 which focuses on "Sustainably manage forests, combat desertification and halt and reverse land degradation and halt biodiversity loss". Moreover, since the scheme also emphasises on the livelihood of marginalised/women/landless in rainfed areas, it also tackles SDG-1 (No poverty), SDG -2 (Zero hunger), SDG -3 (Good health and well-being), SDG -5 (Gender equality). • As per DoLR, there is no duplication of objectives with any other schemes/sub-schemes. Watershed development projects are implemented with an objective of holistic development of project area by taking up all possible measures. Before sanctioning any watershed projects, the Department of Land Resources (DoLR) obtains a certificate from the State concerned that the area taken up under the watershed project is not being funded by a similar scheme of any other Ministry of either the State or Central Government. Each state has to prepare a perspective plan indicating details of the area already taken up, balance area required to be developed and are to be taken up in the next 5 years. • Meeting the output targets are subject to the availability of required funds. Some states like Jharkhand, Punjab, Andhra Pradesh (Srikakulam district), Assam (Barpeta district), Bihar (Kaimur district), Karnataka (Kolar and Devanagere district) and UP reflect that at times there is a delay by

[214] www.zuccess.in

[215] Watershed development projects lagging behind Badly by Priscilla Jebaraj published in The Hindu on Oct 28, 2019 11:08:02 AM

[216] As reported by WCDC of Kolar in the written response to the questionnaire

	the Centre or State in the release of funds. In case of absence of proper documentation by the states or deficiencies in the proposals submitted by the states, such delays are caused. Moreover, there are cases where delay in the release of funds from States' finance departments to SLNAs has been reported. DoLR, moreover, invariably takes up such issues with appropriate levels from time to time.By the time it was released at the district level, it is already the end of the year and it is very difficult to complete the project in time. Therefore, there are concerning issues with respect to the delayed release of funds. • As per the information provided by Department of Land Resources (DoLR), in the cabinet note WDC target was set at 11.50 lakh Hectares for 'Area to be bought under assured irrigation' during the period 2015-16 to 2020-21 and against this the achievement is 13 lakh Hectares. Similarly, the cabinet note stipulated '70 per cent projects to be completed' in the period and against that 70.31% has been achieved. This is the information on physical progress. • In terms of Financial Progress, Table 91 highlights the present situation. The Revised Estimate (RE) is the target amount and against that the Central Assistance released has been over 98% in most of the years under evaluation as per the information provided by Department of Land Resources. • One of the key problems cited by the states was with regards to the inadequate staff to carry out the implementation work. Some states like UP, Bihar, Andhra Pradesh (Chittoor and Srikakulam district) and Jharkhand (Koderma district) have mentioned that they are working below the desired manpower requirement. Another issue that was highlighted by DoLR was that problems have been faced at the State and District level to retain trained manpower and there is high attrition of contractual manpower. These issues have a detrimental impact on scheme performance and effectiveness. • There have been cases of unregulated extraction of groundwater in watershed areas post groundwater recharge as was suggested by the

	state of Rajasthan, Odisha and Bihar. It was also highlighted that SLNA does not monitor this aspectbut this phenomenon is happening wherever there is groundwater based irrigation. It is very difficult to change the behaviour of farmer unless there is an exclusive capacity building component in the scheme for it, although this is not covered in WDC-PMKSY. • Following findings are drawn from the household survey: o As per the Household Survey in 72 per cent of the cases, water is fetched by adult women for household needs. Besides, about 41 per cent of respondents reported that the water source is more than 100 meters away from their house. Additionally, 26.80 per cent of the respondents reported that there was an increase in the availability of surface water in the summer months. On the other hand, 32.10 per cent of respondents reported an improvement in groundwater table owing to watershed activities. Therefore, women are one of the key segments which has benefitted by reducing drudgery. This finding was also reiterated in the KIIs with women members of Watershed Committees (WC) and Watershed Development Team (WDT). o Out of the respondents, 35.80 per cent reported that the source of irrigation was groundwater and 37.40 per cent reported rainwater as a source of irrigation. Around 8.90 per cent reported Surface-water [River/stream] as the source of irrigation and 13 per cent reported Surface-water [Farm Pond] as their source of primary irrigation. Therefore, the majority of the farmers are dependent on rainwater for irrigation and are dependent on the watershed scheme to bring about change in their lives. Besides, 35.80 of the farmers use groundwater emphasising the need to build capacity at the local level for sustainable use of groundwater sources. o About 86.40 per cent of the respondents who reported that they practice mono-cropping (N=81) are willing to switch to cropping pattern. Around 13.60 per cent were unwilling to change the

Parameter	Findings from research
	cropping pattern. Out of respondents that are not willing to change (N=11) the primary reasons are; profitability (27.30%), water scarcity (63.60%) and lack of know-how (18.20%). Hence with proper handholding and capacity building, farmers can be induced to grow more sustainable cropping patterns. o Out of 25 respondents (9.80% of total respondents) who have received training under the watershed project, 20 received training in intercropping, 22 for crop varieties, 14 for contour cultivation and 21 received training for crop management. Respondents from Karnataka were the main contributors to these responses. However, a very limited number (N=25) of stakeholders have received training in alternate cropping strategies and crop management practices. Therefore, there is a scope to further encourage these training practices thereby inducing a sustainable change. o Concerning training on common property in the villages (N=246), merely 4.10 per cent reported they were trained to maintain Nursery, 6.90 per cent reported Soil and moisture conservation, 6.10 per cent for Livestock development activities, and low percentage reported for Fisheries (4.90%), Crop demonstration (5.30%) and Bio-fuel plantations (4.50%). o Concerning training on farmers' land, 2.80 per cent respondents reported they were trained to maintain Nursery, 5.70 per cent reported Soil and moisture conservation, 4.10 per cent for Livestock development activities, 4.10 per cent for Fisheries, 4.90 per cent for Crop demonstration, 4.10 per cent for Bio-fuel plantations, 11 per cent for Fodder cultivation, and 5.30 per cent were trained for Establishment of milk cooperatives. Hence there is enough scope to encourage alternate income sources amongst the community and at present very limited effort is being put in this regard.
	Inference:

Parameter	Findings from research
	• Various reports show that the scheme has led to some positive outcomes as planned under the objectives. • Moreover, KIIs with state functionaries also reiterate that watershed projects have led to benefits as envisaged in the scheme objectives. • • The scheme progress (both physical and financial) has been satisfactory and targets have been achieved to a significant extent (as per the information provided by Department of Land Resources) • Effectiveness or attainment of desired objectives also depends on many factors exogenous to the scheme, such as lack of market connectivity, weak post-harvest management, lack of transport facility, etc. • State-level implementing agencies should focus on capacity building of farmers in alternate income sources and crop management practices as shown by survey data. • The scheme design is appropriate to achieve the stated objectives and states like Rajasthan and Karnataka that have implemented the scheme as per the guidelines have reaped desired benefits. • Therefore the performance on this parameter is satisfactory.
Efficiency	**Secondary:** • A meta-analysis of the benefit-cost (BC) ratio of WDC-PMKSY project is yet to be done. However, the BC ratio in respect of pre-IWMP projects was analysed by a third party i.e. ICRISAT. The meta-analysis shows that the mean benefit to cost ratio of Watershed program was at 2.14 indicating that investment in watershed programs that are situated in fragile and uncertain rainfed environments yielded more than double the initial investment. The analysis also reveals that carefully planned and executed watershed activities yielded returns of at least 2.1 times more than the initial investment. Also, other factors determine the efficiency of watershed programs. These include geographical location, rainfall pattern, the focus of the watershed program, implementing agency, the

Parameter	Findings from research
	status of the target population, people's participation, activities performed under the program and the soil types in the area. • **Case study of Tamil Nadu[217]:** SLNA of Tamil Nadu reported that they have adopted the construction of Recharge Shafts to improve groundwater table as a cost-effective and innovative intervention. It was reported by the SLNA that Recharge Shafts are the most efficient and cost-effective structure to recharge the shallow aquifers. Recharge Shafts of 0.5 to 1 metre diameter and 10 to 15 metres deep were constructed across the state watersheds. The impact reported was the rise in groundwater level from 0.33 meter to 3.28 meter in the watershed areas of Tamil Nadu. Given the success and cost-effectiveness, so far 17,879 Recharge Shafts have been created with an expenditure of Rs. 68.10 Cr..
	Primary: • In the KIIs in the states it was suggested that for the selection of new projects, it will be better to focus on micro-watersheds rather than the whole watershed to bring in efficiencies. A watershed has about 4 to 5 micro watersheds. It is not hydrologically feasible to work on the entire watershed at once. An alternate could be to give preference to micro-watersheds in sequence and then move to complete watershed. • As far as the guidelines are concerned, per hectare cost of Rs. 12,000 for development works is very low. This cost norm has been used since 2008-09. There should be a mechanism for revision in the cost every 3 or 4 years based on inflation and other relevant factors. Due to highly constraining cost norms, the work in the watershed is impacted thereby reducing project effectiveness. Cost norms should be developed using an expert committee by arriving at estimates of key components like man-day cost, materials and consumables, etc. A method should be

[217] Based on written response against queationnair submitted by the SLNA of Tamil Nadu

	devised for year-on-year escalation or period escalation or one round of escalation every 3rd year. • As per DoLR, taking the rate of inflation during last 11 years into consideration, the department intends to increase the unit cost to Rs. 22,000 per hectare for plain areas and Rs. 28,000 per hectare for hilly & difficult areas for new generation watershed projects proposed to be taken up with effect from 2021. However, DoLR also accepts that the proposed enhancement in the cost norm is not sufficient for the development of watershed projects on a saturation basis. Keeping this in mind, the department has been emphasizing with States to improve convergence with other schemes of the Central and State Governments towards addressing the gaps in fund requirement for achieving the desired impact in the watershed areas. • All States are making efforts to use the latest technology like IT (for example MJSA app in Rajasthan), Remote Sensing and Geographic Information System (GIS). However, NE and some Eastern States are lagging due to internet connectivity issues. The States like Karnataka, Andhra Pradesh, Telangana, Gujarat, Maharashtra, Madhya Pradesh, Rajasthan are leading in the use of technology to improve efficiency. • It was reported by states like UP, Punjab and Bihar that inter-departmental coordination is lacking in terms of information and data sharing concerning respective schemes and programmes. It was informed that in these states departments work in silos. This has a negative impact on the convergence between departments leading to inefficiencies. Moreover, states like UP pointed out this also leads to duplication of work by different departments under different schemes. • Central Funds are released based on the Annual Action Plans submitted by the States and Annual Budget allocated for the scheme by the Government of India. In a financial year, funds are released in two instalments (the first instalment of 60 per cent after deducting unspent balance & second instalment of 40 per cent). As per Jharkhand, Punjab, Andhra Pradesh (Srikakulam district), Assam (Barpeta district), Bihar

	(Kaimur district), Karnataka (Kolar and Devanagere district) and UP, it has been observed that there is a delay in the release of funds from the Central and State Government. In case of absence of proper documentation by the states or deficiencies in the proposals submitted by the states, such delays are caused. Moreover, there are cases where delay in the release of funds from States' finance departments to SLNAs has been reported. This negatively impacts work on the ground affecting efficiency (e.g. cost and time over-runs). • Further, in some districts, Watershed Committees are unable to complete the works in time and hence unable to utilize the available funds as per the schedule. Consequently, the State is unable to claim instalment from the Central Government in a timely manner. WC should submit the utilization certificate on time to enable State nodal agency to furnish consolidated UC to DoLR to avoid any delay on the release of funds from central government. • As per the household survey: o Only 28.90 per cent of the respondents were satisfied with the quality of works executed through watershed development activities. About 31.30 per cent were dissatisfied with works and 20.70 were neutral. Around 81.50 per cent of respondents in Karnataka stated that they were satisfied. Around 92.30 per cent of respondents in Maharashtra and 61.10 per cent in Assam were dissatisfied with the quality of watershed activities executed in their villages. o Around 32.50 per cent of respondents were satisfied with the equipment provided by the government. 35 per cent were dissatisfied and remaining were neutral or had no information. 77.80 per cent of the respondents were satisfied in UP followed by 55.60 per cent in Karnataka and 51.10 per cent in Andhra Pradesh. Around 92.30 per cent of

Parameter	Findings from research
	respondents in Maharashtra reported that they were dissatisfied. o About 26.40 per cent of the respondents were satisfied with the financial support provided by the government and 42.30 per cent were dissatisfied. Remaining were neither satisfied nor dissatisfied. 55.60 per cent in UP, 44.40 per cent in Karnataka, 46.20 per cent in Maharashtra reported that they are satisfied with the financial support. 66.20 per cent in Rajasthan, 66.70 per cent in Himachal Pradesh and 66.70 per cent in Assam reported that they were dissatisfied. o Majority of the respondents (40.20 per cent) were dissatisfied with the information provided about the scheme. 100 per cent in Maharashtra and 77.80 per cent in UP were the main contributors in the dissatisfied respondents. About 28.90 per cent of respondents reported that they were satisfied. The remainder were neutral or had no opinion. Around 66.70 per cent of respondents in Karnataka reported that they were satisfied.
	Inference: • Given that the cost norms have not been modified since 2009, it was reported by all states that they are undertaking the development work at full efficiency, that is, at a lower cost or at par when compared to actual market prices. • DoLR has been urging states to maximize the convergence of the relevant schemes of Central and State Governments for the fulfilment of the fund gaps for achieving the desired impact in the watershed areas. DoLR also issued advisories to States from time to time for maximization of convergence for increasing the rainwater harvesting, conservation and also improving water use efficiency through micro-irrigation etc. However, some states like UP, Punjab and Himachal Pradesh are lagging

Parameter	Findings from research
	and have not created a viable institutional structure say in the form of the committee under the chairmanship of Chief Secretaries to facilitate convergence. • It was also reported by WCDCs at the district level that due to shortage of funds and delay in the release of funds, many of the works required in the watershed are left incomplete causing inefficiencies. • Many of the respondents reported that they are dissatisfied with technical and financial support provided by the implementing agencies, therefore there is room for further improvement. • Moreover, the majority of respondents were dissatisfied with the information provided about the scheme. This point was further emphasised in the Focus Group Discussions held at Maharashtra. • There is much scope to improve efficiency by optimal utilisation of funds and by ensuring effective convergence. Therefore, the performance of this parameter is average.
Sustainability	**Secondary:** • In the End line Evaluation of PMKSY-WDC watershed projects in Kerala undertaken by Centre for Water Resources Development and Management in 2018-19, it was observed that many of the interventions/ structures implemented under the scheme were under poor condition due to the lack of maintenance from the end-user. Minor repairs and maintenance of assets created should be done by the beneficiaries for getting sustainable results. Awareness regarding the various aspects of the project and its advantages/benefits should be created among the stakeholder to ensure their participation and they should be encouraged to take ownership of the project. • Given the funding pattern under Watershed Development Component has been revamped to 60:40 between Centre and states, the Standing Committee on Rural Development (2016-2017), while examining the physical progress of the projects felt that given the change in the funding pattern, the role of the states holds, even more, importance vis-à-vis fund

release and proper fund management for scheme implementation. However, KIIs reflect that the states have been lagging in releasing payments to SLNA which is negatively impacting work at the ground level.

- **Environment Sustainability: A Case study of Salulamang village in Mokokchung district of Nagaland[218]:** Salulamang is one of the few villages in Mokokchung district where public transportation is not available. The main occupation of the villagers was Jhum cultivation and Jhum cultivation was practised extensively before the intervention of PMKSY-WDC. Around 60 households were engaged in Jhum cultivation over a total area of around 90 Hectares in 2012. However, after the intervention of WDC, Jhum cultivation has gradually decreased and the villagers have taken up rubber plantation. During the study and monitoring visits by the evaluating agency, it was noted by the agency that the Land Resources Department has been performing commendably in reaching out to villages through PMKSY-WDC. In the initial 2-3 years, mixed cropping was done in the rubber plantation area. About 27 units of piggery have been initiated under livelihood activities, rubber plantation has been encouraged on a large scale and setting up of micro-enterprise unit has provided a source of income for the villagers. Technical inputs on land use and construction of engineering structures, viz. water harvesting structures and gully plugs have made water available for use in fields and other plantation areas. The technical assistance provided through the programme for management of orange plantation has been beneficial to the farmers and contributed to the success of the activity, eventually increasing production and generating more income for the farmers. The average land under Jhum per household has exhibited a decreasing trend, i.e. 1.5 Hectare per household in 2012 to 0.75 Hectare per household in 2016, resulting in a reduction of the total area under Jhum to 22.5 Hectares (2016) from 90 Hectares (2012). Green coverage created by plantation crops over

Parameter	Findings from research
	abandoned Jhum land provides safe shelter for wildlife, birds, insects and microbes. Thereby, through watershed intervention and promotion of economic activities in the villages under PMKSY-WDC, there has been a significant reduction in Jhum practice in the state which has a favourable impact on the environment.
	Primary: • Scheme design is appropriate for meeting the stated objectives. However, ensuring people's participation at all levels of project implementation and post-project management issues are required to be taken care of at the community level for sustained benefits. • One of the key aspects for post-project sustainability is to formulate a proper guideline for the utilization of Watershed Development Fund (WDF) for maintaining assets during the post-project period. It was found that on completion of projects, the remaining WDF under the project lies unutilized in their respective WDF accounts. DoLR has communicated to the states on multiple occasions to formulate guidelines for the utilisation of WDF. The model template of WDF guidelines has been circulated by DoLR among all the States for customization and adoption as per States specific conditions. It needs better monitoring from Central as well as from state levels. • There is need for sensitization of local institutes and handholding the community for proper maintenance of assets during the O&M phase. In places where the community is not involved (such as UP, Odisha, Punjab and Himachal Pradesh), ensuring sustainability becomes difficult[219][220]. • As per DoLR, it is felt that (a) long gestation period of projects has led to loss of focus etc.; (b) some states such as Punjab, UP and Himachal

[218] Various social impacts of PMKSY-WC with special focus on reduction of Jhum cultivation, 2016, MELD in Nagaland-NABARD Consultancy Services Pvt. Ltd.

[219] Final/End Term Impact Evaluation Consolidated Report, IWMP Batch-II (2010-11) Projects, Odisha, Year-2017-18

[220] AFC INDIA LIMITED MUMBAI & GVT, NOIDA, Odisha-END TERM/FINAL IMPACT EVALUATION REPORT OF BATCH- I/2009-10

	Pradesh took up schemes despite no contribution from the community, which led to a reluctance to take up WDC-PMKSY activities whole-heartedly, (c) frequent transfer of officials at SLNA / district level and operating with temporary officers has hampered work progress. • There is a growing need for convergence with MGNREGA for maintenance of the structures during the O&M phase. • Designing proper usufructs rights especially for assets created on common property resources. • Natural Resource Governance is one of the key issues after the project is completed and assets/infrastructures are handed over to the community. There is a need for efficient management of natural resources. When the groundwater table increases as a result of watershed management projects, farmers in the area go for water-intensive crops like paddy and sugarcane causing over-extraction. Post-project management of natural resources like water, soil, etc. has not been given priority in the ongoing watershed programs. • On account of frequent extreme weather events because of climate change, disaster resilience needs to be brought into the watershed design. There is a need to bring in better resilience strategies to the production system with climate change mitigation and adaptationpractices in rainfed areas to the core of the watershed programme design. • Although infrastructure and resources have been developed there is a need to focus on how to translate those into economic terms. Though productivity has been increased, potential economic gains have not been achieved by the farmers because of lack of market connectivity, weak post-harvest management, lack of transport facility etc. Therefore there is a need to accommodate these things in the watershed programme design. • During the KIIs (UP, Bihar, Andhra Pradesh (Chittoor and Srikakulam district) and Jharkhand (Koderma district) it was generally highlighted

	that there is a shortage of manpower at the state and district level to efficiently implement the project. • Key aspects of institutional and financial sustainability that are brought out from the household survey are as follows: o Around 60.60 per cent reported that no consultation meeting was organized with the farmers for planning activities under the WDC scheme against 22.40 per cent who reported that such meetings were organized. A total of 17.10 per cent reported 'Don't Know' in their responses. Out of respondents who reported that consultation meetings were organized, 81.80 per cent of respondents reported that they have attended the meetings for planning Watershed Development works. Around 55.60 per cent of the respondents in Karnataka reported that consultation meetings were organised indicating relatively better community participation. o 64.20 per cent of the respondents reported that they have not attended any training for O&M under the scheme. Around 25.60 per cent reported that no such training was organized and 10.20 per cent attended training for operations and maintenance. 37 per cent of the respondents in Karnataka reported that they have attended the training. While Maharashtra, Tamil Nadu and Punjab reported that none of the respondents have attended the training. o In case of any breakdown in the infrastructure created under WDC scheme, 11% reported that implementing agency is responsible for maintenance. About 19.50 (N=67) reported that user associations are responsible for maintenance and 21.50 per cent reported that contractor is responsible. There

Parameter	Findings from research
	is a need to raise awareness about O&M responsibilities at the ground level. o Out of the respondents that stated that user associations are responsible for the maintenance (N=67), 23.90 per cent of respondents reported that they were members of an association to carry out repair and maintenance. About 76.10 per cent reported that they were not a member of any association. o Around 18.70 per cent reported that there is a WDF for repair and maintenance and on the other hand 55.30 per cent reported that there is no such fund. Around 26 per cent reported that they don't know about such fund. o Around 56.10 per cent stated that Government is the contributor in the watershed fund, 21.50 per cent stated that villagers contribute and the remainder (36.60 per cent) responded that they don't know. o Amongst those who know watershed development fund (N=46), 47.80 per cent opined that the fund is sufficient for repair and maintenance and 39.10 per cent were of the view that the fund is insufficient. About 13 per cent of the respondents reported that they don't have an opinion on this. o Amongst those who know the WDF (N=46), 26.10 per cent of the respondents give user fees into the fund and 73.90 per cent do not contribute any fees. o Amongst those who contribute fees in the watershed development fund (N=12), 25 per cent feel that the fees are appropriate and 25 per cent feel it is high and the remainder feel that it is low.

Parameter	Findings from research
	Inference: • It was reported by 39.10 (N=46) per cent of the respondents in the HHS that watershed development fund was not adequate to sustain all the repair and maintenance in the post-project period. Secondary sources[221][222] and KIIs in states like Rajasthan and Jharkhand (Latehar district) also reiterate the same point. • Majority of respondents in the HHS stated that no formal training was given for operations and maintenance and many didn't know who was responsible for operations and maintenance. • Climate change resilience, mitigation and adaptation have not been brought into the watershed design. Moreover, post-project management of natural resources like water and forest has not taken much focus in the ongoing generation of Watershed Programs. • Therefore, the projects lack environmental, financial and institutional sustainability and therefore the performance on this parameter "needs improvement".
Impact	**Secondary:** • In Kerala, as on date, 83 watershed development projects are being implemented under WDC-PMKSY in different districts. The Commissionerate of Rural Development (SNLA) Govt. of Kerala had delegated to Centre for Water Resources Development and Management (CWRDM) the conduct of end-line evaluation of 26 Batch-II watershed projects in 14 Districts in the State completed in March 2018. The key findings of the report show that groundwater recharge has taken place and the water table in the wells and bore wells have gone up in all the watersheds, there is prolonged stream-flow in summer months after the execution of various interventions, the soil erosion has

[221] Final/End Term Impact Evaluation Consolidated Report, IWMP Batch-II (2010-11) Projects, Odisha, Year-2017-18

[222] AFC INDIA LIMITED MUMBAI & GVT, NOIDA, Odisha-END TERM/FINAL IMPACT EVALUATION REPORT OF BATCH- I/2009-10

reduced and positive changes in soil moisture content, crop growth, greenery/biodiversity was also observed.

- Impact evaluation of IWMP projects in Rajasthan, Meghalaya and Assam were undertaken by WAPCOS Ltd. (July 2019). State-wise project impact summary is given below:
    - **Rajasthan (Alwar, Bikaner, Kota and Udaipur):** Impact evaluations of all the four districts show some common features. The expected post-project target of an increase in the groundwater table, total irrigated area, the area under agriculture crops, the area under horticulture crops, wasteland development was not achieved as planned in the DPR. However, there is an increase when compared to the pre-project level. The water table has not increased up to the expected post-project stage because the planned target of water harvesting structures was not achieved in the area. A positive impact was observed in terms of crop productivity, annual income and reduction in migration. The productivity of certain crops like Maize, Bajra, Mustard, Wheat and Gram was better than the target due to adoption of High Yield Variety (HYV) seeds, adoption of crop technologies and due to hired irrigation water from private tube wells in Rabi season. There was a limited impact on horticulture crops due to the lack of farmers interest and shortage of irrigation water. Similarly, the partial achievement was seen in Self Help Groups (SHG) to implement the livelihood action plan and increase in members' income. The household income on general had seen an increase across districts over the pre-project level mainly due to increase in crop productivity, increase in the price of agriculture produces, higher wage rate and adoption of livelihood programme in the project area.

	○ **Meghalaya (East Khasi Hills):** The anticipated (as per DPR) increase in groundwater table has not been achieved against the target; however, significant increase has been seen when compared to pre-project levels in almost all blocks surveyed. The progress was limited since the Water Harvesting Structure was not constructed as per plan. The area under agriculture crop did not increase as expected due to less progress in the conversion of wasteland into agricultural land. The expected post-project target of an increase in the water table, irrigated area, area under agriculture crops, the area under horticulture crops, wasteland development was not achieved. However, better results were observed on almost all fronts when compared to the pre-project level. The impact observed in respect of crop productivity, annual income and reduction in out-migration were positive. The expected outcome of the area under horticulture crops was not achieved as farmers did not show interest owing to lack of marketing facilities for horticulture /vegetable crops. The productivity of Maize, three seasons (rice autumn, summer and winter) of rice and potato crops have been more than the target due to adoption of HYV/ Hybrid crop variety, adopting crop management practices and judicial use of limited irrigation water in crops. Reduction in migration is observed mainly due to availability of work under MGNREGA and adoption of livelihood programme. ○ **Assam (Goalpara, Jorhat, Nagaon):** Cropping intensity remained short of DPR targets even though showing improvement over pre-project level. The area under horticulture crops did not rise as expected due to lack of marketing facilities for horticulture crops. The expected

	outcome of SHG has been achieved to implement the livelihood action plan to increase their income. The household income increased due to an increase in crop productivity, the higher price of agriculture produce, higher wage rate and adoption of livelihood programme in the project area. The anticipated (as per DPR) increase in groundwater table has been not achieved against the above target; however, a significant increase has been seen when compared to pre-project levels in almost all blocks surveyed. Reduction in migration is observed against the expected post-project outcome mainly due to availability of work under MGNREGA and adoption of livelihood activities. The area under agriculture did not increase as expected due to less progress on the conversion of wasteland into agricultural land. o **Tripura (Gomati and North Tripura):** Expected post-project target of an increase in water table, irrigated area, area under agriculture crops, the area under horticulture crops, wasteland development was not achieved as planned due to under-construction of Water Harvesting Structure (WHS). The impact on crop productivity, annual income and reduction in migration were observed positively. • Key findings from the final evaluation report for the project (IWMP-II) in Koijhar Nala, Dharamjaigarh block, Raigarh district, Chhatisgarh are as follows: o It has been observed that the assets created under the said project in some of the cases need maintenance. o It is observed that farmers are adopting new agricultural practices like line-sowing, intercropping, etc. after project intervention.

	○ The participation of landless, destitute, women-headed households in the watershed activity is not as encouraging as desired. ○ There has been a significant shift to water-efficient crop in some of the treated areas. ○ Most of the fallow lands have been diverted to crop coverage after treatment with different soil and moisture conservation measures. ○ Community mobilization needs to be strengthened to make the exit strategy more effective. ○ The availability of drinking water facility increased after treatment of watersheds. ○ There has been a marginal change in the land use pattern in the watershed villages after treatment of watersheds. ○ The labour migration has reduced by around 25-35 per cent after the implementation of the watershed programme. ○ The wage of the labourers increased at least by 10 to 20 per cent in comparison to the pre-watershed development programme. The labourers are getting minimum wage declared by the state in the area. ○ Some of the SHGs especially by women have been actively engaged in production and marketing activities along with credit and thrift activities. ○ The water level increased in different watersheds after implementation of watershed development works as is evident from the interview of the farmers. • **Case Study of Gokak Taluk of Belagavi district:**[223] Karnataka Watershed Development Department is implementing PMKSY-

[223] 'Rejuvenation of defunct Dug wells due toss watershed development activities', 2020, Watershed Development Department, Government of Karnataka.

	WDC (formerly IWMP) in a phased manner all over the State. As per the department, the watershed development activities have helped in water conservation, groundwater recharge, reduction in soil erosion, increased productivity etc. The project (IWMP-20/11-12) was sanctioned in the year 2011-12 to treat an area of 2,080 hectare in Gokak Taluk of Belagavi district at an estimated cost of Rs. 312 lakh under Batch-III. In an area of about 548 hectares bunding was done and 127 Water Harvesting Structures (WHS) was constructed by spending Rs. 265.77 lakh. The interventions made through watershed development activities in the form of rainwater harvesting structures have led to a spurt in recharge of the aquifers in the area. Thus, cumulatively 20,310 cubic metres of rainwater is made available for recharge to groundwater body in the area annually. The latest Assessment of Dynamic Groundwater Resources of the State 2017 is made jointly by the Central Ground Water Board and the State Ground Water Department. As per the last report, Gokak taluk was categorised as "Semi Critical" based on the stage of groundwater development ('Semi Critical' is where Groundwater extraction is between 70 to 90%). However, the watershed development activities have helped in augmenting the water resources in the taluk and has restored the taluk to "Safe" category. The permeable topsoil and weathered and fractured rocks underneath are the factors that lead to good recharge. Such recharge has rejuvenated the defunct wells, can sustain additional wells in the area, and also can sustain the water yield from wells over an extended period. The farmers were favourably impacted as their wells were getting groundwater inflows as before. The effect of watershed activities observed in the rejuvenation of defunct wells is demonstrated as the irrigated area increased from 0 to 37 acres in Kharif and 0 to 25 acres in Rabi.

Parameter	Findings from research
	• Despite very meagre support (the cost norm is based on 2008-09 price base), the scheme has been able to bring about notable changes in the outcome parameters in the project areas.
	Primary: • At present, the end line impact evaluations referred above (except WAPCOS studies) are sanctioned by the SLNA for the projects undertaken in their respective states. SLNA themselves commission the evaluation studies to a suitable agency. This leaves the issue of transparency and objectivity in question. There should be an arms-length distance between the implementing agency and evaluating agency so that unbiased assessment could be made. • As per the DoLR, states that have performed well in terms of implementation and impact are Nagaland, Karnataka, Andhra Pradesh, Rajasthan and Madhya Pradesh. These States have dedicated State Level Nodal Agencies with requisite professional support. Some of the States like Punjab, Himachal Pradesh and Uttar Pradesh have not performed as expected concerning the implementation, utilization of funds and completion of the projects. The main reasons being administrative constraints at the State level. • As per DoLR, about 60 per cent of the expenditure incurred on Natural Resource Management Activities under the Watershed Project goes as wages to labour and generate employment. The 'Meta-Analysis to Assess Impact of Watershed Program and People's Participation' by ICRISAT reported that watershed projects have a positive impact of alleviating rural poverty and reducing income disparities among households. As per the study, the mean additional annual employment generation in the watershed area on various activities and operations was 181 person-days/ha/year. In those watershed projects that included multiple activities, employment generation increased to 900 person-days/ha/year. The generation of employment opportunities within these rural

	communities will invariably increase their purchasing power with a corresponding decline in rural poverty. Based on these observations, the watershed investments could be viewed as a poverty alleviation program in fragile areas. • Third-party end-line evaluation reports of completed projects furnished by DoLR (submitted by states to DoLR) reveal that there is an improvement in the availability of surface and groundwater, increase in productivity and vegetative cover, enhanced livelihood opportunities and household income in project areas. The environmental impact is a very important aspect of the benefits. Various soil & water conservation activities of watershed projects help in increasing the moisture content of the soil, increase in the availability of surface & groundwater, enhance the microbial activity, building organic matter content in the soil and increase the greenery of the surroundings. The conserved water is used for domestic and wild animals as well. As reported by DoLR following benefits has been observed in the select states as per end-line evaluation report available with DoLR: o In Maharashtra, the groundwater table has risen by 0.2 to 2 meters. The cultivated area has increased by 2.29 per cent. Crop productivity has seen an upward rise by 2-3 Quintals per Hectare. Apart from these, cropping intensity has seen a favourable rise by 18.3 per cent. Annual income has risen by 70.3 per cent and outmigration has fallen by 32 per cent. o In Andhra Pradesh groundwater table has risen by 15 per cent. The cultivated area has increased by 30 per cent. Crop productivity has seen an upward rise of 30 per cent. Apart from this vegetation cover has seen a favourable rise by 50 per cent. Crop production has risen by 20 per cent and milk production by 40 per cent. The area under water bodies has risen by 8 per cent.

	○ In Karnataka, the water table has gone up by 2 to 30 meters. Irrigated area has gone up by 6 per cent. Gross cropped area has gone up by 6.82 per cent. Cropping intensity has gone up by 6 per cent. Crop productivity has gone up by 41.5 to 61.5 per cent. Milk production has gone up by 14 to 29 per cent. Per capita income has risen by 21 per cent to 254 per cent. And lastly, vegetation density has gone up by 3 to 24 times (Forestry). ○ In Rajasthan, the groundwater table has risen by 0.41 to 1.32 meters. Irrigated area has gone up by 26.29 per cent. Gross cropped area has gone up by 26.28 per cent. Cropping intensity has gone up by 3.23 per cent. Crop productivity has gone up by 7.03 to 97.62 per cent. Average annual income has risen by 8.28 to 18.72 per cent and milk production by 18.60 to 37.86 per cent. Out-migration has fallen by 1.34 per cent. • WDC-PMKSY projects are being implemented by the respective SLNAs following the Common Guidelines for Watershed Development Projects. These Guidelines inter alia provide for the distribution of budget for specific watershed projects for the various components which includes allocation of 9% and 10% of the budget for 'livelihood activities' for the asset fewer persons and 'production system and micro-enterprises' respectively. Livelihood activities taken up, by constituting Self Help Groups (SHGs), vary from project to project and inter alia include goat rearing, poultry, dairy, vegetable production, fishery, bamboo art, small grocery shop, tailoring, vermicompost, nursery raising, making of pickle, papad, paper/leaf plates, soft toys, artificial jewellery etc. It was reported by states (Karnataka, Rajasthan, Nagaland and Assam) that the livelihood component has been successful in the upliftment of the marginalised. • Findings of the Household survey are as follows:

	o Around 28.90 per cent of the respondents reported that there is an increase in the quality of drinking water and 10.20 per cent reported that there is a decline in the quality after the implementation of the project. Approximately 48.80 per cent noted that there was no change in the quality and 12.20 per cent reported that they don't know. o Around 33.30 per cent of respondents opined that there has been an increase in their personal household income due to the watershed development project. 43.90 per cent responded that there has been a decrease. Approximately 10.60 per cent reported that there has been no change and 12.20 per cent reported that they don't know. 77.80 per cent of respondents in Karnataka stated that there was a positive impact. Also, 46.70 per cent of respondents in Andhra Pradesh reported that there was a rise in household income. Surprisingly, 73.90 per cent of the respondents in the Tonk district of Rajasthan and 84.60 per cent in Solapur in Maharashtra stated that there has been a decrease in household income due to watershed development activity. o Around 35.40 per cent of respondents opined that there has been an increase in community income due to the watershed development project. Approximately 43.10 per cent reported that there has been no change and 8.90 per cent reported that they don't know. o Around 38.60 per cent of the respondents reported that they observed an increase in agriculture land owing to the watershed development project. Respondents in UP (100%), Karnataka (66.70%), Andhra Pradesh (64.40%) has registered the maximum increase.

	o 14.60 per cent reported that there was an increase in horticulture land post project completion. 51.90% of respondents in Karnataka registered the increase in land under horticulture other states were below 33.30 per cent. o 9.80 per cent reported that there was an increase in area under plantation and forest. The maximum percentage of respondents (37%) in Karnataka reported an increase in the forest and plantation. o Only 14.20 per cent of respondents reported that there was an increase in irrigated area. Karnataka again was the best performer with 70.40 respondents reported an increase in irrigated area. o 22.80 per cent reported that there was an increase in crop yield. Manipur and Karnataka performed better than other states in crop yield with 62.50 per cent and 59.30 per cent respondents reported a favourable response respectively. None of the respondents in Tamil Nadu, Himachal Pradesh and Assam reported an increase in crop yield. o Only 11.80 per cent reported an increase in the number of crops cultivated. About 44.40 per cent of the respondents in Karnataka reported that they were able to do multiple cropping. None of the respondents in Assam, Tamil Nadu, Himachal Pradesh, Maharashtra, Manipur and Punjab reported a shift to multiple cropping. o Only 5.30 per cent reported an improvement in land productivity, 22.80 per cent reported improved crop yield and 6.10 reported improved cropping intensity. o 32.10 per cent of respondents reported an improvement in groundwater table owing to watershed activities. 17.10 per cent responded no change and 13.40 per cent responded

	'don't know'. About 37.40 per cent reported a decline. Maximum respondents in Karnataka (70.40%) and UP (88.90%) stated an improvement in the water table. o About 24.40 per cent of the respondents reported that there has been an increase in the grazing land for the livestock. On the other hand, 15.9 per cent of respondents reported a decline. Remaining respondents either found no change or were unaware. The best performer was Karnataka with 70.40 per cent respondents in Karnataka reported an increase in grazing land. o Around 30.10 per cent of the respondents opined that the soil fertility has improved due to watershed development project. About 43.50 per cent reported no change. A minority of 17.50 per cent reported that soil fertility has gone down after the project. Karnataka was the good performer with 70.40 per cent of respondents reporting an increase in soil fertility. o About 25.20 per cent have reported that soil erosion has fallen due to the watershed project. However, at the same time, 18.30 per cent reported that it has increased when compared to the pre-project level. 66.70 per cent of respondents in Karnataka reported a decline in soil erosion. o About 26.80 per cent of the respondents reported that there was an increase in the availability of surface water in the summer months. Around 35.40 per cent reported that there was no change. Karnataka (70.4%) and Uttar Pradesh (66.70%) were the best performers. o Around 28.50 per cent reported that they observed improvement in the water table in the tube well and dug well. Respondents in UP (88.90%), Karnataka (55.60%) and

	Assam (13.30%) reported maximum benefits in water recharge in tube wells and dug wells. o 17.90 per cent reported that they observed wasteland converted to cultivable land on their farmland. Around 55.60 per cent respondents in Karnataka and 55.60 per cent in UP reported positively. Whereas 17.10 per cent reported wasteland converted to cultivable land on common property. Here again, as per the responses, Karnataka (63%) and UP (66.70%) performed better than other states. o About 19.90 per cent of respondents reported an increase in revenue from forest land as a result of watershed development. On the other hand, 40.70 per cent reported that there has been no change. UP (77.80%), Karnataka (37%) and Andhra Pradesh (46.70%) had maximum respondents giving a positive response. o Around 9.30 per cent of respondent reported that there was a positive impact on migration owing to watershed activities in villages. Around 50 per cent of respondents in HP reported that the migration has gone down. o 28.90 per cent of the respondents reported that there is an increase in employment opportunities owing to watershed development activity. Maharashtra (69.20%) and Karnataka (74.10%) were the top states giving a favourable response. Around 21.50 per cent reported a fall in employment opportunities and 39.40 per cent reported no change. 44.40 per cent respondents in Assam and 55.60 per cent respondents in Himachal Pradesh reported a fall in employment. o 23.60 of the respondents reported that there has been an increase in migratory bird population in the intervention

Parameter	Findings from research
	areas. Major contributors were UP (88.90%), Himachal Pradesh (38.90%) and Andhra Pradesh (40%).
	Inference: • Looking at the data reported in the Household Survey (HHS), the impact has been limited to a few states with other states lagging behind. • Karnataka stands out as one of the better performing states. Good performance of Karnataka in impacts show that positive outcomes can be ensured if the proper implementation is done with the complete involvement of the local community. Karnataka model is worth replicating in other states and other states have much to learn from Karnataka. • Various reports, KIIs at the state and district level show, that the scheme has led to positive impacts in the intervention watersheds. However, given that at present, the end-line impact evaluations sanctioned by the SLNA leaves the issue of transparency and objectivity in question. There should be an arms-length distance between the implementing agency and evaluating agency. • However, it takes time for outcome/impact to show on the ground considering the gradual flow of benefits from natural resources like afforestation and slow acceptance of new technology by the farmers. Therefore, the time of evaluation is a crucial criterion for impact assessment and assessment should be done after 2 to 3 years post-completion of the project. Also, other factors determine the efficiency of watershed programs. These include geographical location, rainfall pattern, the focus of the watershed program, implementing agency, the status of the target population, people's participation, activities performed under the program and the soil types in the area. • Moreover, a few impact studies highlight that the benefits are not up to the level that was envisaged in the DPRs. However, it is evidenced that despite very meagre support (the cost norm is based on 2008-09 price

Parameter	Findings from research
	base), the scheme has been able to bring about notable changes in the outcome parameters in the project areas vis-à-vis pre-project level. • In light of the mixed evidence from secondary and primary sources, the performance on this parameter is" Average".
Equity	**Secondary:** • The common guidelines for watershed development projects are based on the principle of Equity and Gender Sensitivity. As per the guidelines Project Implementing Agencies (PIAs), must facilitate the equity processes such as a) enhanced livelihood opportunities for the poor through investment in their assets and improvements in productivity and income, b) improving access of the poor, especially women to the benefits, c) enhancing the role of women in decision making processes and their representation in the institutional arrangements, and d) ensuring access to usufruct rights from the common property resources for the resource-poor. • The Gram Sabha will constitute the Watershed Committee (WC) to implement the Watershed project with the technical support of the WDT in the village. The Watershed Committee (WC) will comprise at least 10 members, half of the members shall be representatives of SHGs and User Groups, SC/ST community, women and landless persons in the village. • The WDT will involve WC in the formulation of the watershed action plan by also mobilising women to ensure that the perspectives and interests of women are adequately reflected in the watershed action plan. • The WC shall constitute SHGs in the watershed area with the help of WDT from amongst poor, small and marginal farmer households, landless/asset-less poor agricultural labourers, women, shepherds

Parameter	Findings from research
	and SC/ST persons. Each Self Help Group will be provided with a revolving fund of Rs. 25,000. • As per the guidelines, the DPR should include, among other things, Expected Outcomes and Benefits, especially concerning livelihoods for different segments, benefits to women. • **Case Study of Yeiikha and Yow Miijaiim Self-Help Groups (SHGs) in Phek district of Nagaland[224]:** Land Resource Department of Phek District facilitated the formation of two SHGs, namely; Yeiikha SHG & Yow Miijaiim SHG in the year 2017 with ten women members in each group. The primary purpose of collectivizing and forming the groups was to improve the socio-economic status of poor rural women, especially to enhance their income. Seed money amounting to Rs. 10,000 each was given to both the groups. Each SHG has been earning Rs. 40,000-50,000 annually from the sale of Parkia. The Self-Help groups collect the entire produce of their village and transport it to the nearest market which is 114 km away from their village and sells it. Tree beans (Parkia), a very important multipurpose tree species, having many utilities such as rich nutritional value as it is abundant in minerals and vitamins, medicinal value, use as insecticides and pesticides, enriching the soil by fixing atmospheric nitrogen, etc. Besides, tree bean (Parkia) the SHG members are also engaged in weaving and kitchen gardening. The group maintains cash book, savings book, meeting minutes register and all other relevant registers. The livelihood component of the programme has helped the women in the SHGs to earn a sustainable livelihood thereby contributing to equity.
	Primary:

[224] Success stories: Bringing visible changes in the economy of the rural community, Booklet provided by SLNA of Nagaland

	• State of Karnataka informed that the watershed selection is based on the guidelines given by the National Rainfed Area Authority (NRAA) which are based on the principle of equity. NRAA brought out the guidelines in 2008 (revised in 2011) for the watershed selection. There are 12 sets of indicators such as poverty, percentage of SC/ST population, the percentage of the small and marginal farmers, the groundwater status, the area under rainfed agriculture, the drinking water status, etc. Weightage is given to each of them and based on those weightage selections of the watershed is done under this program. • Each Project Implementing Agency (PIA) is having a Watershed Development Team (WDT) for implementation of the projects.[225] As per the Watershed Guidelines, at least one of the WDT members is a woman. This guideline is being followed in sprit on the field as reported by the state and district level KIIs and women members of the Watershed Committee and Watershed Development Team. • As per states, the WDT has also the responsibility of mobilising women to ensure that the perspectives and interests of women are adequately reflected in the watershed action plan. • States informed that most of the SHGs formulated in the projects are women-oriented and supported under the livelihood component of the project. A total of 9 per cent funds are kept for the livelihood activities and they are basically for the people (mostly women) who do not have land or other assets. • Women participation in the scheme has been reported from 33 per cent to 60 per cent depending on the state. • It was also reported that this scheme holds special importance when it comes to women empowerment because many of the farmers are women. If one is supplying water to the farmer, benefits will go to women, because they are the ones who carry drinking water from far off to fulfil the requirement of their family. As per the household survey, 67 per cent of the cases, water is fetched by adult women

[225] The WDT consists of at least four members, broadly with knowledge and experience in agriculture, soil science, water management, social mobilisation and institutional building.

	for household needs. They are the ones who go to the field and carry the fodder for their livestock. Therefore, converting wasteland for pasture development benefits those women who rear the livestock. Scheme guidelines reflect that equity and women empowerment are two things which are addressed by this program. • As reported by the states, landless people are also the beneficiaries of the scheme and special weightage is given for SC/ST population, small and marginal farmers. • The formation of women and marginalized SHGs paved the way for the improvement of the general awareness level, provided opportunities to have access to credit systems, banks and other financial institutions, savings, internal lending, initiating income generation activities and achieving sustainable development. Women development activities like providing of the sewing machine, backyard poultry, beehives, Azolla cultivation, vermicomposting, and goat rearing were the major income generation activities taken up by the women SHG members and the landless families. The additional income realized by the women members increased the total family income and facilitated the rise of the status in the family and village. This has also reduced the level of migration of the male and female members of the family. The members of the SHGs have developed a rapport with the bank, financial institutions, villager panchayat, and other government departments. The various training programmes, capacity building programmes and the Revolving Fund (RF) provided them with opportunities to get employment and achieve economic freedom. The following are the benefits realised by the women members with the result of the revolving fund provided by the watershed project; (a) Families of underprivileged of the watershed are released from the clutches of the high-interest money lenders; (b) Initially the RF helped them to clear their old debts; (c) With the result of the micro-

	enterprises they ventured into with the support of the RF, the basic livelihood needs are met. • The following findings are drawn from the household survey: o Around 30.10 per cent reported that scheme benefits are accessible to all farmers, 25.60 per cent reported that benefits are accessible to some farmers and 19.10 per cent reported that benefits are accessible to a few farmers. Majority of respondents in Andhra Pradesh (60%), Uttar Pradesh (44.40%) and Himachal Pradesh (50%) reported that the benefits are available to all farmers. 84.60 per cent of farmers in Maharashtra reported that benefits are available to a few farmers. o About 39.80 per cent reported that there is equitable distribution of water to all farmers however 60.20 responded that there is inequity in the distribution of water. Majority of respondents in Andhra Pradesh (60%) and Himachal Pradesh (66.70%) have reported equitable distribution. o Only 13 per cent of respondents reported that they faced hurdles in accessing benefits under the scheme. 87 per cent reported that they faced no hurdles in accessing benefits. o Around 40.20 per cent reported that they have been involved in income generation activities carried out in the village through wage-earning through community asset creation such as community building and village road. Majority of respondents in Andhra Pradesh (84.40%), Assam (72.20%) and UP (77.80%) gave a favourable response. o Around 14.60 per cent reported that they have been involved in income generation activities carried out in the village through the cottage industry (Bamboo, cane, woodcraft etc).

Parameter	Findings from research
	77.80 per cent of respondents in UP and 38.90 per cent in Assam gave a favourable response. o As per the Household Survey in 72 per cent of the cases, water is fetched by adult women for household needs. Besides, about 41 per cent of respondents reported that the water source is more than 100 meters away from their house. Additionally, 26.80 per cent of the respondents reported that there was an increase in the availability of surface water in the summer months. On the other hand, 32.10 per cent of respondents reported an improvement in groundwater table owing to watershed activities. About 24.40 per cent of the respondents reported that there has been an increase in the grazing land for the livestock. Therefore, women are one of the key segments which has benefitted by reducing cost and drudgery in the collection of water and fodder. This finding was also reiterated in the KIIs with women members of Watershed Committees (WC) and Watershed Development Team (WDT).
	Inference: • Scheme guidelines have ensured that the watershed projects follow the principle of equity which keeps women, SC/ST, landless/asset less in mind from the DPR phase onwards to the consolidation phase. • From KIIs at the state level and district level, we can infer that the guidelines are being followed in spirit. • While selecting the project area, due weightage is given for SC/ST population, poverty index and percentage of the small and marginal farmer. Scheme guidelines also provide for inclusion of women,

Parameter	Findings from research
	SC/ST representation in Watershed Committees. Similarly, for recruiting WDTs, 25 per cent is reserved for women. • Guidelines earmarked 9 per cent of the project cost for livelihood activities for asset-less persons in the project area. The majority of the SHGs constituted in the project are comprised of women and marginalized people. • About 89.40 per cent of respondents reported that they faced no hurdles in accessing benefits. 26.90 per cent reported that scheme benefits are accessible to all farmers. • 63.60 of the responded reported that there is inequity in the distribution of water. This was also reiterated in the FGD where it was pointed out that the benefits of the watershed project are confined to select a few influential people in the village. • Given that the scheme guidelines are based on the principle of equity and KIIs at the state, district and village (women members of WC and WDT) level have reported that they are following the guidelines on the ground and the overall feedback on this aspect has been positive,the performance on this parameter is satisfactory.

A summary analysis and performance of the scheme on the identified themes are presented below:

Table 95: WDC - summary of performance evaluation using REESIE framework

Parameter	Performance
Relevance	🟢
Effectiveness	🟢
Efficiency	🟡
Sustainability	🔴
Impact	🟡
Equity	🟢

REESI+E performance infographics legend

Satisfactory Average Needs Improvement No information

Performance on cross-sectional themes

Table 96: WDC - performance evaluation using cross-sectional themes

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
1.	Accountability & Transparency	Availability of Data Records and Reports in the public domain: • Is data available for the scheme in the public domain? • What data records are available for the scheme in the public domain?	• The data related to the location of sanctioned projects, the area covered, funds released, achievements, etc. are available on MIS-IWMP site. Besides, five editions of Wastelands Atlas of India are also available on DoLR website. • The data related to the location of sanctioned projects, the area covered, funds released, achievements etc are available on MIS IWMP site. • Besides, five editions of Wastelands Atlas of India are also available on DoLR website. The latest Wasteland Atlas of India 2019 was released in

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			November 2019 which gives the extent of the wasteland in the country as well as change analysis between 2008 and 2015. • DPRs are available at SLNA's website for many states such as Rajasthan, Karnataka, Maharashtra, etc.
		Monitoring Mechanisms • Does a robust monitoring mechanism exist and at what level?	• Srishti, the Bhuvan-IWMP geoportal and the downloadable mobile app called Drishti is beneficial for effective monitoring of WDC-PMKSY activities. • DoLR monitors the progress of works under watershed projects through the instruments of Review Meetings, Management Information System (MIS), progress reports, utilization certificates, Audited Statement of Accounts, etc. • As per DoLR, States have contracted independent

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			agencies that would monitor the implementation of the projects which includes process and input-output monitoring. • To monitor the quality in the implementation of programmes of the Ministry including watershed programme, the Vigilance & Monitoring Committees are constituted with Members of Parliament and elected representatives of the people in State Legislatures and Panchayati Raj Institutions. • The DoLR holds Steering Committee Meetings & Regional Review Meetings under the Chairpersonship of

			Secretary (LR) to monitor the Programme. • Officers, dealing with the implementation of the programmes at State Headquarters & districts, visit project areas to ensure that the programmes are being implemented satisfactorily. • At the State-level, the SLNAs have been made responsible for monitoring the State-level Watershed Programme. • Public Financial Management System (PFMS) is utilised for financial monitoring. • Officers, dealing with the implementation of the programmes at State headquarters and districts, visit project areas to ensure that the programmes are being implemented satisfactorily.

			• At the state level following information is shared with DoLR; (a) Detailed Project Report (DPR); (b) MIS on monthly basis; (c) Output-outcome indicators on monthly basis; (d) PFMS on transaction basis; (e) Audited Statement of Accounts (ASA) on annual basis; (f) Monitoring Evaluation Learning and Documentation (MELD) reports; and (g) Phase wise evaluation reports • Under PMKSY-WDC program there is a provision of Monitoring Evaluation Learning and Documentation (MELD) agency which have their people on the field and they keep on monitoring whether the works are happening as per plan, the quality is satisfactory, are records being maintained. MELD agency collects the records and gives feedback at the district level and the district level

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			feedbacks are given at SLNA level every month. Follow-up is done with the districts regarding certain observation if there are certain quality issues or the meetings not happening regularly, etc.
		Evaluation Mechanisms • Process/Impact evaluation studies conducted in the last decade - frequency, quality, coverage, etc.	• For evaluation of IWMP projects by the independent evaluating agencies, specific financial provision of 1% of project fund has been provided in the Guidelines. • As per DoLR, evaluation studies are also undertaken through reputed and independent Research Institutions/Organizations from time to time to evaluate the performance of watershed projects at the field level, to assess the impact of the programmes.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			• As per data provided by DoLR, as on 20.09.2020 only 2052 end line evaluation reports have been submitted to the department against 4487 projects reported as completed. • At present, key outcomes indicators being monitored are: (a) creation/rejuvenation of Water Harvesting Structures, (b) farmers benefited, (c) additional area brought under protective irrigation, (d) afforestation including horticultural plantation, (e) wastelands brought into productive use and (f) man-days of employment generated.
		Citizen Accountability • Are there functional grievance redressal mechanisms that successfully	• All states have reported that there is not a dedicated grievance redressal mechanism. • Some states like Karnataka, Andhra

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		incorporate beneficiaries and non-beneficiaries' concerns? • Is the RTI mechanism functioning effectively?	Pradesh and Bihar reported that the regular Grama Sabha and Executive committee meetings act as beneficiaries and Non-beneficiaries functional grievance redressal forum. • RTI applies to the scheme.
		Financial Accountability • What funding mechanisms are being used?	• Central Funds are released based on the Annual Action Plans submitted by the States and Annual Budget allocated for the scheme by the Government. • The Department is implementing the Public Finance Management System (PFMS) developed by the Office of Controller General of Accounts in IWMP. The system is being used to make payments, execute expenditure filing and track expenditure of funds in near real-time during the implementation of

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			watershed projects. PFMS is adopted to bring in transparency in the financial transactions. • MIS is utilized per month for monitoring physical & financial achievements.
Summary Analysis: • In terms of accountability and transparency, DPRs are available in the public domain for many states such as Rajasthan, Karnataka, Maharashtra, etc. • The data related to the location of sanctioned projects, the area covered, funds released, physical and financial plan, physical and financial achievements, etc are available on MIS IWMP site. • Evaluation reports are not readily available in the public domain. • In terms of citizen accountability, a separate grievance redressal mechanism has not been established. • RTI applies to the scheme.			
2.	Direct/Indirect Employment Generation	Employment generation • What is the level of employment generation through schemes in the sector and overall sectoral contribution in national employment generation?	• As per DoLR about 60 per cent of the expenditure incurred on Natural Resource Management Activities under the Watershed Project goes as wages to labour and generate employment. • The 'Meta-Analysis to Assess Impact of Watershed Program and People's Participation' by

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		• How has the scheme contributed to an improvement in income levels? • What is the improvement in the availability of employment opportunities?	ICRISAT reported that watershed projects have a positive impact of alleviating rural poverty and reducing income disparities among households. • As per the same report, the mean additional annual employment generation in the watershed area on various activities and operations was 181 person-days/ha/year. In those watershed projects that included multiple activities, employment generation increased to 900 person-days/ha/year. • The generation of employment opportunities within these rural communities invariably increases their purchasing power with a corresponding decline in rural poverty. Based on these observations, the watershed investments

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			may be viewed as a poverty alleviation program in fragile areas.
Summary Analysis: • The project plays a role in facilitating employment in rainfed areas. • Support is provided for self- employment opportunities under the livelihood component.			
3.	Gender mainstreaming/Inclusiveness	Inclusiveness in scheme design/planning • Is there a specific mention of gender equality and equity considerations in the scheme guidelines/objectives, i.e. has the scheme been designed keeping gender considerations in mind? • What is the women participation (per cent) in the sector/program?	• As per guidelines, each Project Implementing Agency (PIA) is having a Watershed Development Team (WDT) for implementation of the projects. At least one of the WDT members should be a woman. This guideline is being followed in sprit on the field as reported in the KIIs at the state, district and village (women members of WC and WDT) level. • The WDT has also the responsibility of mobilising women to ensure that the perspectives and interests of women are adequately reflected in the watershed action plan.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			• Similarly, half of the members of the Watershed Committees constituted to implement the Watershed project should be the representatives of SHGs and User Groups, SC/ST community, women and landless persons in the village. • Most of the SHGs formulated in the projects are women-oriented and supported under the livelihood component of the project. A total of 9 per cent funds are kept for the livelihood activities and they are basically for the people (mostly women) who do not have land or other assets. • Women participation in the scheme has been reported from 33 per cent to 60 per cent depending on the state. Also, the SC, ST representation has to

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			be there as per guidelines and circulars issued by DoLR. • It was also reported that this scheme holds special importance when it comes to women empowerment because many of the farmers are women. If one is supplying water to the farmer, benefits will go to women, because they are the ones who carry drinking water from far off to fulfil the requirement of their family. They are the ones who go to the field and carry the fodder for their livestock. Therefore, converting wasteland for pasture development is to benefits those women who rear the livestock. Equity and women empowerment are two things which are completely addressed by this program.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			• The formation of SHGs comprised of women and marginalized sections of society paved the way for the improvement of the general awareness level, provided opportunities to have access to credit systems, banks and other financial institutions, savings, internal lending, initiating income generation activities and achieving sustainable development. Women development activities like providing of the sewing machine, backyard poultry, beehives, Azolla cultivation, vermicomposting, goat rearing, etc. are the major income generation activities taken up by the women SHG members and the landless families. The additional income realised by the woman members increased the

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			total family income and facilitated in the rise of the status in the family and village. This has reduced the level of migration of the male and female members of the family. The members of the SHGs have developed a rapport with the bank, financial institutions, villager panchayat, and other government departments. The various training programmes, capacity building programmes and the Revolving Fund (RF) provided them with opportunities to get employment and achieve economic freedom. The following are the benefits realised by the women members with the result of the RF provided by the watershed project: (a) Families of underprivileged of the watershed are relieved out

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			from the clutches of the high-interest money lenders; (b) Initially the RF helped them to clear their old debts; (c) With the result of the micro-enterprises they ventured into with the support of the RF, the basic livelihood needs were met.
Summary Analysis: • Scheme guidelines have ensured that the watershed projects follows the principle of equity which keeps women in mind from the DPR phase onwards to the consolidation phase. • From KIIs at the state level and district level, we can infer that the guidelines are being followed in spirit.			
4.	Building resilience to climate change (including but not limited to developing water disaster preparedness) & ensuring sustainability	• Are there appropriate climate-resilient policies for mitigation and/or adaptation (or included as part of scheme objectives and design)? • Are there any training sessions held regularly for reducing pollution, adopting green practices,	• Climate change issue is very pertinent when talking about rainfed areas as rainfed agriculture is highly vulnerable to climate change. • The GoI included agriculture as a priority sector for climate change adaptation in its Nationally Determined Contribution (NDC) to the UNFCCC

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		using local materials etc.? • What are the main impacts of climate change on the sector and scheme beneficiaries?	under the Paris Agreement. The National Rainfed Area Authority (NRAA) prioritized 168 rainfed districts in India based on the climate vulnerability characteristics and risks. • Increased investment in climate-smart agriculture measures to reduce vulnerability is essential to sustain productivity in rainfed areas. • The scheme guidelines do not focus on the topic of climate change resilience in rainfed areas. Far and few efforts are being made on the ground from the states. • As per NRAA, many extreme climatic events are being observed because of climate change, resilience has not been brought into the watershed design. There is a need to bring better

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			resilience strategies to the production system with climate change mitigation and adaptation practices in rainfed areas. • Post-project management of natural resources like water has not taken much focus in the ongoing generation of Watershed Programs. Besides, it is observed in states like Rajasthan, although rarely, that farmers over-extract groundwater owing to water-intensive crops. Hence, the scheme lags in environmental sustainability. • The climate change concept has not made way at the village level. There is a strong lack of awareness for climate change in the implementation of programs and there is a need to educate the people at the grass-root level.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			• The drought-proofing activities like Trench Cum Bunding and farm ponds to harvest the running water of the field have helped the farmer to mitigate the drought to a greater extent by providing protective irrigation under rainfed condition during the critical growth period of the crop. • Crop diversification and movement of farmer towards allied activities empowered the farmer to economically sustain crop failure under drought condition. • The National Rainfed Area Authority has given ample consideration to understand the impact of climate change in the new guidelines.
Summary Analysis:			

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
	• Climate change resilience strategies have not been brought into the watershed design and new guidelines should focus on this. • Post-project management of natural resources like water has not taken much focus in the ongoing generation of Watershed Programs. • On the ground, some states like Rajasthan, Andhra Pradesh (Chittoor district) and Karnataka are giving exclusive training concerning water-saving technologies and climate-resilient crops. However, this is confined to only a few states. • There is a strong lack of awareness for climate change in the implementation of programs and there is a need to educate the people at the grass-root level.		
5.	Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population	Funds allocated under TSP/ SCSP and other provisions for vulnerable communities • What is the fund allocated under TSP (Tribal Sub Plan) & SCSP (Scheduled Caste Sub Plan) for each scheme? • What has been the effect of the TSP & SCSP funds on improving equity?	• Around 16.6 per cent of the budget is released for Schedule Caste sub-plan and 10 per cent is released for Tribal sub-plan. In north-eastern states, only 10 per cent for Tribal sub-plan is released in the budget. • One of the selection criteria of the watershed at the national level is the per cent of SC/ST population. • The involvement of SC/ST population is ensured amongst the beneficiaries. • SC/ST farmers with the land of their own are

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			covered under the watershed activities. Those who are landless or asset-less, it is ensured that they are covered under the livelihood activities for which 9 per cent is earmarked. • While forming SHGs adequate representation of SC/ST population is ensured by giving them a priority. • Participation of SC/ST is also ensured in the Watershed Committee.
Summary Analysis: • Around 16.6 per cent of the budget is released for Schedule Caste sub-plan and 10 per cent is released for Tribal sub-plan. • Involvement of SC/ST population is ensured as one of the selection criteria of the watershed at the national level is the per cent of SC/ST population. • SC/ST population who are landless or asset-less, it is ensured that they are covered under the livelihood activities for which 9 per cent is earmarked. • While forming SHGs adequate representation of SC/ST population is ensured.			
6.	Use of IT/Technology in driving efficiency	Deployment of IT-enabled mechanisms for	• Srishti & Drishti 'Bhuvan Portal' developed by ISRO/NRSC has been

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		monitoring of the Schemes • In case of a scheme to create physical assets, is geotagging and use of geotagged photographs being done? • How is technology being used for on-ground data collection? • Is there an online scheme MIS to ensure regular update of progress and effective supervision? • What is the granularity of data available in MIS? • What is the frequency at which the information is being updated/reported on the MIS/Dashboard?	launched on 19.02.2015 for planning and monitoring of projects. • Srishti is a GIS-based Geo-portal developed to assist in monitoring, evaluation, change assessment and provide inputs in planning for watershed management and preparation of Detailed Project Reports (DPR). • Drishti is the Mobile Application tool to capture data including visuals from the field for real-time monitoring of IWMP projects. The tool can also be used for community monitoring of IWMP works. • As on 20.09.2020, about 13.75 lakh photos of activities undertaken during the implementation of PMKSY-WDC of 27 States and 2 UTs have been uploaded on Shristi portal. These tools aid in

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			the physical and qualitative assessment of the works undertaken. Any shortcomings as evidenced through Shristi portal are appropriately taken up on a continuous basis by the project implementers at the various levels. • The Department is implementing the Public Finance Management System (PFMS) developed by the Office of Controller General of Accounts in IWMP. The system is being used to make payments, execute expenditure filing and track expenditure of funds in near real-time during the implementation of IWMP. • The States like Karnataka, Andhra Pradesh, Telangana, Gujarat, Maharashtra, Madhya Pradesh, Rajasthan are leading in the use of

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			technology in bringing in efficiency. • All States are making efforts for the use of the latest technology. However, North-East and some Eastern States are lagging due to internet connectivity and other issues. • **Case study of Andhra Pradesh[226]:** Within a year of the launch, the Andhra Pradesh government realised that due to the absence of comprehensive information communication technology (ICT) solution, planning, execution and monitoring of many watershed projects will turn out to be a complicated task. The manual system led to a

[226] Watershed scheme gets a digital push in Andhra Pradesh, Viswanath Pilla , 23 Feb 2015, The Mint

			slow pace of implementation, funds getting parked at various levels unutilised and lack of standardisation of works leading to reduced accuracy in terms of budgeting. The Andhra Pradesh government tied up with software services firm Tata Consultancy Services Ltd (TCS) to build an end-to-end application that works on a basic Internet connection. TCS also runs the data centre for the project. There are three levels of users of the application. One is the state-level nodal agency that oversees implementation, financial, analytical and performance of the project; the second is the district-level agency which monitors physical and financial progress and the field level agency, which is called the project implementing agency, enters details for project sanction, generates fund

			transfer orders and work status reports. The project implementing agency works closely with village panchayats and women's self-help groups in training, enlisting workers, execution and maintenance of projects. Technology allowed the government to automate all critical functions of IWMP which include detailed project reports, basic and specific details of work, generation of estimates, technical and administrative sanctions, execution of work, entry of muster details, and payments[227]. • In Rajasthan, there is a single mobile app and a single portal where all the line departments update the progress, plan and generate the completion certificate. All the departments are supposed to use the MJSA app for planning in

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			that particular watershed area and all the geo-tagged works are uploaded on a single portal. This helps in convergence. Moreover, the app also helps in real-time monitoring of watershed works over different stages of planning and completion at different levels.
Summary Analysis: • Srishti & Drishti 'Bhuvan Portal' developed by ISRO/NRSC has significantly improved the planning and monitoring of watershed projects. • There is a fair use of technology that has been adopted for monitoring of physical and financial progress of the scheme. • There is further scope for the adoption of technical application for planning and monitoring by other States as in the case of Rajasthan, Karnataka and Andhra Pradesh.			
7.	Stakeholder and Beneficiary behavioural change	• What per cent of total allocation is directed towards Awareness generation or sensitization? • How much impact has it been able to	• There have been cases of unregulated extraction of groundwater in watershed areas post groundwater recharge as was suggested by the state of Rajasthan and Bihar. It was also highlighted that

[227] Watershed scheme gets a digital push in Andhra Pradesh, Viswanath Pilla , 23 Feb 2015, The Mint

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		generate in terms of behaviour change? • What are the existing mechanisms at the State/District/Block level to promote beneficiary awareness and sensitization? • What activities are undertaken at the District/Block level to promote the adoption of good practices?	SLNA does not monitor the same but such cases have been observed. A behavioural change towards sustainable practices is required on behalf of farmers. There is a need for an exclusive and robust planning system for it, although this component is not covered under WDC-PMKSY. • As per the National Rainfed Area Authority, Natural Resource Governance is one of the key issues after the project is completed and assets/infrastructures are handed over to the community. There is a need for efficient management of natural resources in the post-project period. When the groundwater table increases as a result of watershed management projects, farmers in the

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			area go for water-intensive crops like paddy and sugarcane and drain it again. This post-project management of natural resources which also includes behaviour change of the beneficiary has not taken much focus in the scheme guidelines. • On the ground, some states like Rajasthan, Andhra Pradesh (Chittoor district) and Karnataka are giving exclusive training concerning water-saving technologies and climate-resilient crops. However, this is confined to only a few states. • Convergence is being promoted with the scheme Per Drop More Crop. • There is a need to develop and impart knowledge concerning cropping system in sync with the natural resources. The

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			Sujala III project in Karnataka can be referenced as a best practice. Land Resource Inventory (LRI) is an assessment of the status and changing condition of the soil, water and related resources at the field level. Based on the LRI generated under the project information related to crop selection, crop management and crop water management is imparted to the farmers.
Summary Analysis: • Not much effort is being put to change the behaviour of the beneficiary towards sustainable practices. Far and few efforts are being made by states on the ground. • The scheme does not focus on developing cropping strategies in sync with natural resources. • States like Rajasthan, Andhra Pradesh (Chittoor district) and Karnataka are giving exclusive training concerning water-saving technologies and climate-resilient crops. • Convergence is being promoted with the scheme Per Drop More Crop.			
8.	Research & Development	• Is there fund allocation for research and development?	• There is no dedicated fund allocation for research and development under the guidelines.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		• What activities are being carried out under this fund?	• Government of India has come out with a flexi-fund scheme to carry out state-specific innovations w.r.t watershed development. The guidelines for the same have been issued by the Finance Ministry. • Earlier the amount earmarked for innovation was 10 per cent of the budget. Recently it has been revised up to 25 per cent.
Summary Analysis: • There is no dedicated fund allocation for research and development under the guidelines. • Government of India has come out with a flexi-fund scheme to carry out state-specific innovations w.r.t watershed development. • Earlier the amount earmarked for innovation was 10 per cent of the budget. Recently it has been revised up to 25 per cent.			
9.	Acts/regulations, regulatory bodies and reforms	• What are the key Acts/regulations, regulatory bodies and reforms governing the scheme?	• The guidelines are the primary guiding document for implementing the scheme. • Since the implementation is done at the state level,

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			the state-level financial rules, vigilance and anti-corruption laws are applicable. • Right to Information applies to the scheme. • This scheme also comes under the DISHA committee which monitors all rural development schemes.
Summary Analysis: • The guidelines are the primary guiding document for implementing the scheme. • The state-level financial rules, vigilance and anti-corruption laws are applicable. • Right to Information applies to the scheme.			
10	Conjunctive use of water - surface versus groundwater usage optimizations	• How has conjunctive use of water lead to efficiencies? • Surface versus groundwater usage optimizations • What is the impact on water use efficiency?	• As per stakeholders given the prolonged availability of surface water in the monsoon, pressure on groundwater extraction has come down during this period. • Groundwater is used mainly in the rabi season when surface water is scantly available. • Unregulated extraction of groundwater in certain pockets in Rajasthan and

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			Karnataka have been observed leading to groundwater depletion. • DoLR has issued advisories to the States, SLNA and Agriculture Ministry to ensure convergence with the scheme Per Drop More Crop (PDMC) to enhance water use efficiency. • The department has been promoting the use of drip and sprinkler irrigation with water-saving crops for optimisation of water use.
Summary Analysis: • Given the prolonged availability of surface water in the monsoon, pressure on groundwater extraction has come down during this period. • Groundwater is used mainly in the rabi season when surface water is scantly available. • DoLR has issued advisories to the States, SLNA and Agriculture Ministry to ensure convergence with the scheme Per Drop More Crop (PDMC) to enhance water use efficiency.			
11	Unlocking Synergies with other Government Program	• What are the challenges hindering effective convergence?	• It was reported by states like Uttar Pradesh, Nagaland and Punjab that inter-departmental coordination is lagging

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		• What are the areas for potential convergence/synergy across govt. programs?	which adversely affects the convergence between state departments. • Moreover, states like Uttar Pradesh and Nagaland highlighted that due to lack of convergence there has been duplication of work between efforts under various schemes such as Jal Sanchay Yojna, MGNREGA and funds under Gram Panchayat, Fourteenth Finance Commission and State Finance Commission. All doing the same work, therefore, there is scope for better convergence. In UP, sometimes the work done by one department is shown by the other department as its own and the funds for that work are dishonestly claimed.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			• The cost norm of Rs. 12,000 per hectare should be revised in the new guidelines. Various states quoted the cost norms to be between Rs. 25,000 per hectare to Rs. 30,000 per hectare for plains. In the new guidelines, the DoLR intends to increase the unit cost to Rs. 22,000 per hectare for plain areas and Rs. 28,000 per hectare for hilly & difficult areas for new generation watershed projects proposed to be taken up with effect from 2021. However, DoLR accepts the proposed enhancement in the cost norm is not sufficient for the development of watershed projects on a saturation basis. Keeping this in mind, the department has been emphasizing with States

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			to maximize the convergence of the relevant schemes of Central and State Governments for the fulfilment of the gaps for achieving the desired impact in the watershed areas. • It is pertinent to mention here that, as per the available information with DoLR, about 19% of the expenditure in the watershed project areas has been mobilized through convergence with the other relevant schemes. • As per DoLR, the States should expedite the implementation and completion of projects on priority by optimal utilization of available funds and mobilizing funds through convergence with schemes of similar

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			nature like MGNREGA etc. There is also a need to ensure convergence with MGNREGA for the maintenance of the built structures. • DoLR has been taking measures to guide states to effective convergence however some states like UP, Punjab and Himachal Pradesh have been found wanting in this respect. Secretaries of D/o Drinking Water and Sanitation, D/o Water Resources, River Development and Ganga Rejuvenation, Ministry of Jal Shakti, D/o Rural Development & D/o Land Resources, Ministry of Rural Development, GOI wrote a joint D.O letter No.J-11060/4/2019-RE-VI dated 24.04.2020 addressed to Chief Secretaries of all States / UTs, emphasizing on the

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			utilization of all the available resources of Central schemes for effective rainwater harvesting and water conservation. Besides, DoLR also issued advisories to States from time to time for maximization of convergence for increasing the rainwater harvesting, conservation and also improving water use efficiency through micro-irrigation etc. Some states like Uttar Pradesh and Punjab have not yet created an institutional arrangement at the field level for effective convergence. Few states, namely Andhra Pradesh, Karnataka, Telangana, Tamil Nadu and Bihar have shown good progress but states like Uttar Pradesh and Punjab

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			have been lagging behind.
Summary Analysis: • About 19% of the expenditure in the watershed project areas has been mobilized through convergence with the other relevant schemes. • DoLR has been taking measures to guide states towards effective convergence. However, some states have been found wanting in this respect. • Few states, namely Rajasthan, Andhra Pradesh, Karnataka, Telangana, Tamil Nadu and Bihar had shown good progress but states like Uttar Pradesh, West Bengal, Madhya Pradesh and north-eastern states have been lagging.			
12	Reforms, Regulations	What are the key reforms pertinent to the scheme?	• There have been various reforms in the evolution of WDC-PMKSY. • During 2009-10, the Schemes of Integrated Wasteland Development Programme (IWDP), Desert Development Programme (DDP) and Drought Prone Areas Programme (DPAP) of the DoLR were integrated and consolidated into a single tailored programme called the Integrated Watershed Management Programme (IWMP).

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			• Initially, the scheme had a sectoral focal point primarily focusing on soil and water conservation. • Gradually the scope of the scheme has widened incorporating crop production, horticulture and plantation. • Before IWMP there was no component of livelihood and separate component for asset-less people. • Dedicated institutions with appropriate expertise such as SLNAs and WCDCs were created under IWMP. • The mechanism of fund release has been changed in 2014-15 where the funds are channelized via State government. • Initially, the funding pattern was 90:10 for all states 90 being the Centre's contribution.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			Later it was changed to 60:40 with north-east continuing with 90:10. • Initially, projects were sanctioned in the SLNA committee meeting, but now State Leve Sanctioning Committee has been formed under the chairmanship of the Chief Secretary for approving the projects. • Under WDC funds have been allocated for monitoring and evaluation with 1 per cent each respectively. • Earlier there was no allotment for DPR preparation. Now 1 per cent has been earmarked for the same. • Under WDC 4 per cent has been earmarked for entry point activities for capacity building and raising awareness.
Summary Analysis: • There have been various reforms in the evolution of WDC-PMKSY.			

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
	• During 2009-10, the Schemes of Integrated Wasteland Development Programme (IWDP), Desert Development Programme (DDP) and Drought Prone Areas Programme (DPAP) of the DoLR were integrated and consolidated into a single tailored programme called the Integrated Watershed Management Programme (IWMP). • Dedicated institutions with appropriate expertise such as SLNAs and WCDCs were created under IWMP. • Dedicated funds have been provided for DPR preparation, monitoring and evaluation and entry point activities which were not there in the earlier avatar of IWMP. • Funding pattern was revised 60:40 from 90:10 for general category states. • State Level Sanctioning Committee has been formed under the chairmanship of the Chief Secretary for approving the projects. • Various reforms in the original scheme have taken place to tackle evolving sectoral challenges.		
13	Impact on and role of the private sector, community and civil society in the scheme	What is the role of the a) private sector, b) community and c) civil society in the scheme	• Madhya Pradesh has experimented to implement projects with private corporations like ITC to provide technology and forward linkages for the buyback of produce such as potato. • In cases where no contribution was ensured from the community, outcomes are often poor. On the other hand, in places where the community has been actively involved

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			throughout the project, the success rate has been observed to be higher. • WDC is the only scheme where the involvement of the community is absolutely necessary for the success of the projects. • There is need for sensitization of the local community with proper handholding for appropriate maintenance of assets during the O&M phase. • As per stakeholders Civil society and NGOs play a very crucial role in the WDC project. In many states, like Gujarat, Karnataka, Maharashtra, NGOs have been fully involved in DPR preparation, capacity building and raising awareness. • Some states like Andhra Pradesh, Madhya

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			Pradesh, Maharashtra, Uttarakhand, Telangana have allowed NGOs to act as Project Implementing Agency (PIA). • NGOs have also been used for evaluation of WDC projects.
Summary Analysis: • Madhya Pradesh has experimented to implement projects with private corporations like ITC to provide technology and forward linkages for the buyback produce such as potato. • WDC is a scheme where the involvement of the community is absolutely necessary for the success of the projects. • In places where the community has been actively involved throughout the project, the success rate has been observed to be higher. • There is need for sensitization of the local community with proper handholding for appropriate maintenance of assets during the O&M phase. • Civil society and NGOs play a very crucial role in the WDC project. NGOs have been fully involved in DPR preparation, capacity building and raising awareness. NGOs have also been used for evaluation of WDC projects. • Some states like Andhra Pradesh, Madhya Pradesh, Maharashtra, Uttarakhand, Telangana have allowed NGOs to act as Project Implementing Agency (PIA).			

The CST theme 'Water sharing treaties/agreements & diplomacy' is noted to be 'not relevant' for the WDC scheme and hence it has not been evaluated.

A summary analysis and performance of the scheme on the identified themes are presented below:

Table 97: WDC – summary of performance evaluation using cross-sectional themes

Parameter	Performance
Accountability & Transparency	●
Direct/Indirect Employment Generation	●
Gender mainstreaming/Inclusiveness	●
Building resilience to climate change (including but not limited to developing water disaster preparedness) & ensuring sustainability	●
Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population	●
Use of IT/Technology in driving efficiency	●
Stakeholder and Beneficiary behavioural change	●
Development, dissemination & adoption	●
Research & Development	●
Water sharing treaties/agreements & diplomacy	●
Conjunctive use of water - surface versus groundwater usage optimizations	●
Unlocking Synergies with other Government Program	●
Reforms, Regulations	●
Impact on and role of the private sector, community and civil society in the scheme	●

Cross-sectional themes performance infographics legend

● High ● Medium ● Low ● Not relevant ● No information

2.2.5.3 Issues and challenges

This sub-section describes the scheme issues and challenges and their mapping with the source of information viz. primary source, secondary source and household survey (if applicable).

Table 98: WDC - issues and challenges

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		Scheme Design			
WDC–F1	**Cost-norms are inadequate**	• The per hectare cost norm of Rs. 12,000 (Rs. 15,000 for hilly areas) which has been prevailing since 2008-09 is very low for WDC projects. Although it is factored in that this cost is not exhaustive and the gap needs to be filled by effective convergence, even the states which have good convergence like Rajasthan, Karnataka and Maharashtra have also pointed out that these cost norms are outdated and needs to be revised.			
WDC–F2	**Need climate change resilience**	• There is an urgent need to incorporate measures to improve climate change resilience into the design of watershed schemes.			
WDC–F3	**Weak forward linkages beyond the farm gate**	• The full potential of economic gains from watershed projects has not been realized by the farmers due to weak forward linkages such as market connectivity, weak post-harvest management, lack of transport facility etc. Various studies conducted by WAPCOS in Rajasthan, Assam and Meghalaya have shown that due to lack of			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		market facility farmers are not taking up income-generating activities like horticulture, raising nursery, etc.			
WDC–F4	**Role of National Rainfed Area Authority**	• At present National Rainfed Area Authority is only involved in drafting the guidelines for watershed scheme. Besides NRAA is also playing a very limited role in facilitating convergence. However, a much greater role was envisaged for NRAA in the 2009 guidelines (revised in 2011) where many other tasks were assigned to it. The primary reason cited for the diminished role is that earlier various ministries were involved in the watershed projects but now only one scheme is there and is being administered by a single nodal department that is the Department of Land Resources. In 2015-16, recognising that watershed development is the best strategy for the development of rainfed areas, NRAA was entrusted to undertake a study to prioritise the most vulnerable districts in India. This composite index ranked the districts of the country based on			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		vulnerability. There are around 14 natural resource indicators and 18 livelihood indicators. Using a composite index these indicators are assigned different weightage. Subsequently, 168 districts were prioritised.			
WDC–F5	**Technical strengthening of DoLR**	• It is observed that DoLR needs further strengthening in terms of professional and technical support and requires additional capacity to give appropriate guidance and advisories to the states on technical matters.			
		Scheme Implementation			
WDC–F6	**Delays in the release of funds by States**	• States often delay in the release of their matching share making it very difficult to complete the projects on time. KIIs with states like UP, Andhra Pradesh, Jharkahnd, Punjab, Assam (Barpeta district), Bihar (Kaimur district), and UP have highlighted this fact. This has resulted in stretching the project beyond the proposed timeline. In the end-line evaluation of PMKSY-WDC watershed projects in Kerala (2018-19), it was reported that in all the Blocks/watersheds, timely availability of funds was an			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		important constraint leading to undue delay in payment for the completed works. As a result, some works planned could not be taken up which has unfavourably affected the reliability and effectiveness of implementation. Earlier funds were directly transferred to SLNA but now it is channelized via state government. It has been informed by the SLNAs and WCDC that it can take as much as 4 to 6 months to release the payment and delay is on behalf of slow processing and tedious financial approvals. It was also reported that delay is also caused as a result of state utilising the released fund for some other work.			
WDC–F7	**Delay in fund release by GoI**	• Delayed, staggered and inadequate release of funds by GOI stated by Jharkhand, Punjab, Andhra Pradesh (Srikakulam district), Assam (Barpeta district), Bihar (Kaimur district), Karnataka (Kolar and Devanagere district) and UP has resulted in stretching the project beyond the proposed timeline. In case of absence of proper documentation by the			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		states or deficiencies in the proposals submitted by the states, such delays are caused. As per DoLR it releases the funds to States as soon as the SLNA submits proposals and fulfil all criteria as per scheme guidelines. Therefore, proper capacity building should be done at the state level to ensure proper documentation and submission of complete proposals in all respect. Further, it must be noted that whatever funds released to date have not been fully utilized by the States and every State is having unspent balance.			
WDC–F8	**Delays by Watershed Committees**	• Watershed Committees within the district do not complete the works in time and therefore are unable to utilize the available funds as per the schedule leading to delay in receipt of share from the Central Government. The key reasons for this delay are a collection of watershed development fund taking more time than planned, bad weather impeding the completion of work and contractors not completing the work on time.			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
WDC–F9	**Inadequate staffing**	• States like UP, Bihar, Andhra Pradesh (Chittoor and Srikakulam district), Karnataka (Devanagere district) and Jharkhand (Koderma and Latehar district) have mentioned that they are working with significantly lower manpower than what is required. This adversely impacts project execution. This shortage is due to both organisational structural issues and vacancy of sanctioned posts.			
WDC–F10	**High attrition of trained manpower**	• Problems are being faced at the state and district level to retain trained manpower. There is high attrition of contractual manpower having a detrimental impact on project success. The Watershed Development Team (WDT) comprises four members. One each from social, engineering, micro-enterprise and livelihood background. The WDT member receives Rs. 10,000 to 15,000. As the budget is increasing for everything on a day-to-day basis, their salaries also should be increased. It has been observed that in some cases like in South Bihar Districts, the salaries of			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		manpower or WDT have not been increased for the last 5 to 10 years. It was mentioned that hiring competent professionals with the requisite background is difficult at these salary levels. Even if such professionals are hired retaining them is difficult. As per the guidelines, only 10 per cent of the project cost can be sanctioned under administration head, therefore, the onus is on states to ensure that proper remuneration is given to the employees to retain the trained manpower. Another issue is the inability to pay salaries on time which is because of delay in the release of funds.			
WDC–F11	**Quality of DPR**	• The DPR, the most important planning document, is found to be below the desired quality in states like Odisha, Punjab, Bihar (Kaimur district), Jharkhand (Koderma and Latehar district) and UP. The DoLR informed the Standing Committee on Rural Development that more often than not, the major obstacle in the delay/non-starting of the projects was due to the low quality of DPR which			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		failed to take into its ambit all the issues and peculiarities of the geographical location, its challenges and ways for the successful completion of the project efficiently. There is scope for significant improvement. A total of 1 per cent of the fund has been earmarked for DPR preparation that is sufficient to hire a reputed organisation and procurement of scientific data. It was reported that most technical consultants engaged in DPR preparation copy paste from existing DPRs and local risk factors are overlooked. It is also suggested that local beneficiaries, SHGs be more involved in the DPR preparation phase.			
WDC–F12	**Ensuring community participation**	• In cases where no contribution was ensured from the community (for example Chittoor district in Andhra Pradesh, Devanagree district in Karnataka and Latehar district in Jharkhand), outcomes are poor. On the other hand, in places where the community has been actively involved throughout the project, the success rate has been observed to be higher.			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		Funds earmarked for capacity building, raising awareness and institution building is 5 per cent and besides 4 per cent is kept for Entry Point Activities which include confidence-building of the local community. It was found that these funds are not fully utilised in some cases owing to loss of focus and laid back approach.			
WDC–F13	**Behaviour change for sustainable practices**	• There have been cases of unregulated extraction of groundwater after implementation of watershed projects. It was also pointed out that it is very difficult to change the behaviour of the farmers unless there is an exclusive planning system inbuilt in the scheme in coordination with Agriculture Department, State Groundwater Board and Electricity Distribution Utilities. As per guidelines, once the project is handed over to the community all manpower is withdrawn and no effort is made to ensure long term sustainability of the natural resources. The scheme guidelines			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		are silent on long term environmental sustainability.			
WDC–F14	**Need for effective convergence**	• Inter-departmental coordination is lacking in terms of information and data sharing in some states like Uttar Pradesh, Punjab and Himachal Pradesh. This affects the convergence between departments leading to inefficiencies. DoLR has been taking measured to guide states to effective convergence however states have been found wanting in this respect. Secretaries of D/o Drinking Water and Sanitation, D/o Water Resources, River Development and Ganga Rejuvenation, Ministry of Jal Shakti, D/o Rural Development & D/o Land Resources, Ministry of Rural Development, GOI wrote a joint D.O letter No.J-11060/4/2019-RE-VI dated 24.04.2020 addressed to Chief Secretaries of all States / UTs, emphasizing on the utilization of all the available resources of Central schemes for effective rainwater harvesting and water conservation. Besides, DoLR also issued advisories to States from			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		time to time for maximization of convergence for increasing the rainwater harvesting, conservation and also improving water use efficiency through micro-irrigation etc. • States like Karnataka, Maharashtra, Rajasthan, Andhra Pradesh, Odisha and Chhattisgarh have done well in convergence. On the other hand, states like Uttar Pradesh, Madhya Pradesh, West Bengal and the North-Eastern states are lagging. • As recommended by the Parliamentary Standing Committee on Rural Development, a dedicated institutional mechanism has not been created to facilitate convergence in some states Uttar Pradesh, Madhya Pradesh, West Bengal and the North-Eastern states are lagging. • Also, convergence is not brought in at the planning phase of the project. • Convergence fails because the departments work in silos and do not cooperate.			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		• Rajasthan launched Mukhyamantri Jal Swavlamban Abhiyaan (MJSA) in 2016. 10 line departments that are related to water like watershed department, the irrigation department, the public health engineering department, the forest department, the groundwater department, the NREGA implementing agencies and the agriculture department, the horticulture department, etc. came together and planned and implemented the scheme. The results of the scheme were very positive as was found in the impact evaluation done after the first phase. Analysis conducted by the expert committee found that our of 21 desert districts, 16 districts showed an average groundwater rise of 4.66 feet. Remaining 5 districts showed a decline in the rate of depletion. • In addition, involvement at the level of Chief Secretary is lacking and regular meetings are not held in lagging states. • As per DoLR, coordination with programme officers at block and			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		field level is one of the main challenges in relation to effective convergence. Initiatives should also be taken at the level below the District/Block, at the watershed cluster level, where actual implementation is envisaged to address common concerns and realize mutual benefits. The roles of the Panchayati Raj Institutions (PRIs) are particularly important in this respect and an effort needs to be made to make them involved at all stages of the project.[228]			
WDC–F15	**O&M phase sustainability**	• Watershed Development Fund that is being generated through the Watershed Programs is on occasions not sufficiently utilised to manage, repair and maintain assets being created under the project. In places where the community is not concerned or actively participating, ensuring post-project sustainability by full utilization of WDF becomes difficult. There is no handholding from the Department after the			

[228] Evaluation Report of Bellampalli Sub Watershed, PMKSY-WD Batch-II, Block Name- Bagepalli, District Name- Chickballapur, Karnataka

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		exit protocol which leads to lack of motivation to ensure the sustainability of the structures using WDF. Moreover, utilisation of WDF is low as once the sarpanch of Gram Sabha is changed focus is lost and he/she is not interested in the utilisation of WDF to maintain the created structures.			
WDC–F16	**Post project sustainability**	• There is need for mobilisation of the local community from DPR preparation to maintenance of assets during the O&M phase. There is no handholding after the exit protocol which leads to lack of motivation to ensure O&M is carried out in a systematic manner. Moreover, the focus on O&M is also lost once the sarpanch of members of Gram Sabha is changed. Also, the HH survey shows that lack of awareness also contributes to the poor condition of assets. Scheme guidelines do not cover post-project environmental sustainability.			
WDC–F17	**Frequent transfers**	• Frequent transfer of officials at SLNA / district level and operating with in-charge officers has proved			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		to be a significant bottleneck in the implementation of the scheme as the new staff are not familiar with the area. Moreover, these transfers lead to a loss of focus in the project.			
WDC–F18	**Proper maintenance of assets**	• Impact evaluation studies conducted earlier show that many of the interventions/structures implemented under the scheme were under poor condition due to the lack of maintenance from the end-user. There is no support after the exit protocol which leads to lack of impetus to guarantee O&M is carried out efficiently. As reported, the scope of work is not clear during the O&M phase, therefore there should be clear guidelines for O&M in WDC scheme. Moreover, once the gram sabha functionaries change the whole focus is lost and WDF is not fully utilised.			
WDC–F19	**Long gestation period**	• The long gestation period of the projects leads to loss of focus. Project duration was kept at 4 to 7 years to give some flexibility to the states in the completion of the projects. However, as per DoLR, most of the states are completing			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		projects in 7 years which has led to weak monitoring of the projects and loss of focus. Also, due to a long gestation period, many project staff are changed or transferred which also further leads to loss of focus.			
WDC–F20	**Post-project management of natural resources**	• As per the National Rainfed Area Authority, Natural Resource Governance is one of the key issues after the project is completed and assets/infrastructures are handed over to the community. There is a need for efficient management of natural resources once the structures are handed over to the community and Gram Sabha. Once the project is over the implementors hand over the assets and moves to another project site. Post-implementation no handholding support is provided to the community on how to manage natural resources. This post-project management of natural resources has not been given much focus in the ongoing Watershed Programs.			
WDC–F21	**Political interference**	• Many states (Karnataka (Devanagere district), Assam			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		(Barpeta and Cachar District), Andhra Pradesh (Chittoor and Srikakulam district) and Bihar (Kaimur and Banka district) indicated that they face political interference during the implementation of the scheme. Elected members put pressure on the implementers to build structures on the land of their choice. Moreover, some politicians at the district level concentrate only on certain pockets of the district and this is influenced by personal or political parties' agenda rather than the importance of the scientific rationale for watershed management.			
WDC–F22	**Unutilised Watershed Development Fund**	• It was found that on completion of projects, the remaining WDF under the project lies unutilized in their respective WDF accounts. DoLR has communicated to the states on multiple occasions to formulate guidelines for the utilisation of WDF. However, not much progress has been made on this front. The model template of WDF guidelines has been circulated by DoLR among all the			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		States for customization and adoption as per States specific conditions. It needs better monitoring from Central as well as from state levels. It must be noted that for most states completion has started in the last 2-3 years. Watershed development fund utilization shall only take place after completion of the project, not during implementation.			
WDC–F23	**PSME vs Livelihood Component**	• Under the PSME (Production System and Micro Enterprise) assistance is provided to farmers who have land and this amount is sanctioned as one time grant. However, the grant under the livelihood component is given to landless and women as a revolving fund which needs to be returned in one year. It was reported that this anomaly leads to difficulty in implementation.			
WDC–F24	**Dedicated watershed development department at the state level**	• It is observed that the states which have a dedicated watershed development department have performed better than other states. Such states are Rajasthan, Karnataka, Nagaland and Odisha. It is felt that it is an added advantage to have			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		professionals from a multidisciplinary background on a full-time basis and therefore, good results are observed on the ground.			
WDC–F25	**Systemic delays in project completion**	• It has been observed that there have been systemic delays in the completion of the projects despite a generous 5-7 years which have been given for project completion. In some states, very few projects out of the total sanctioned projects have reached the consolidation and completion phase as in the case of Punjab, Himachal Pradesh and UP. For other states, completion has been reported in the last 2-3 years only.			
WDC–F26	**The slow progress of the scheme in some states**	• From the KIIs, it is learnt that the primary reasons impeding the progress of sanctioned projects are; (a) strength of officials at State Level has been reduced over a period as the number of ongoing projects is decreasing year after year and no new projects are being sanctioned with effect from 2015; (b) Frequent transfers of key officials at the State Government level; and (c) In many States, the key positions			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		related to implementation are held only as an additional responsibility.			
WDC–F27	**Training and capacity building**	• One of the key areas that need to be addressed is training at the state, district and village level on new innovations, climate change, crop management practices, etc. Although currently a few steps have been taken to impart training on various issues of watershed management, yet there is a need to enhance them in terms of quality and quantity. DoLR and NRAA should play a greater role in this respect.			
WDC–F28	**Delay in the release of the instalments**	• At present, GOI releases the funds in two instalments every year. The first instalment is released after submitting the Utilisation Certificate (UC) of the previous year. The second instalment is released after utilizing 60 per cent of the first instalment. Assuming that GoI releases the first instalment in June, the G.O for this release will be issued in October. 60 per cent of this amount will be utilized by January and after submitting the UC, the second instalment will be			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		released by March. The G.O for the second instalment will be issued in June of the next year. By this time it is impossible to complete the work within the financial year.			
WDC–F29	**Development based on watershed boundaries**	• At present some development programmes of the government are executed based on the administrative boundary, while watershed development works are undertaken on the watershed boundary. It was suggested by the stakeholders that it is worth undertaking all development programmes based on a watershed boundary such that convergence across all programmes is facilitated avoiding duplication and redundancies.			
WDC–F30	**The scientific approach of watershed development.**	• In some districts in states like Assam and Chhattisgarh the ridge to valley approach is not followed dedicatedly; rather, they followed a village-based development approach. It was reported by Assam and Chhattisgarh that it is a failure on the part of State Government that when the project was proposed, micro watershed wise project area			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		selection was not done. They had done the selection village wise. In the preliminary project report, the development plan was village oriented instead of the micro watershed-based. It is important that the scientific approach of watershed development is adopted.			
WDC–F31	**Scientific preparation of DPRs**	• In some states Odisha, Punjab, Bihar (Kaimur district), Jharkhand (Koderma and Latehar district) and UP, DPRs lack scientific rigour. DPRs should be based on the state-of-the-art scientific approaches with the latest GIS maps, land resource inventory approaches, remote sensing technology and they should be based on scientific inputs from various databases.			
WDC–F32	**Equitable distribution of benefits to beneficiaries residing in the Ridge vis a vis Valley**	• One of the challenges in watershed implementation is to equitably distribute the benefits to beneficiaries residing in the upper (Ridge) and lower reaches (Valley). Generally, the upper reaches are defined by poor farmers with less water availability, less accessibility, not so good quality of the land or landless, who are			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		the most marginalized in the area. Whereas in the lower reaches, people have fertile land, good water availability, and most of the harvesting structures are constructed in the valley. Hence equity issues are there and there is a need to plan how to ensure that small and marginal farmers, landless families and artisans can also be part of the development plan during the planning stage.			
WDC–F33	**Adequacy of Watershed Development Fund (WDF)**	• It was reported by 39.10 per cent of the respondents in the HHS that watershed development fund was not adequate to sustain all the repair and maintenance in the post-project period. Secondary sources[229][230] and KIIs in states like Rajasthan and Jharkhand (Latehar district) also reiterate the same point. The mechanism at present is that 10 per cent of the individual investment goes to the WDF fund (in case of SC/ST only 5 per cent). However, poorest of the poor cannot contribute. This leaves the			

[229] Final/End Term Impact Evaluation Consolidated Report, IWMP Batch-II (2010-11) Projects, Odisha, Year-2017-18

[230] AFC INDIA LIMITED MUMBAI & GVT, NOIDA, Odisha-END TERM/FINAL IMPACT EVALUATION REPORT OF BATCH- I/2009-10

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		sustainability of assets/structures in question.			
WDC–F34	**Cropping system in a sink with the natural resources**	• As per NRAA, though water conservation has been the focus in ongoing watershed projects, the crop production aspect is missing. There is a need to develop and impart knowledge concerning cropping system in sync with the natural resources.			
		Monitoring and Evaluation			
WDC–F35	**Use of technology for monitoring**	• All States are making good efforts for the use of the latest technology for monitoring. However, NE and some Eastern States are lagging due to internet connectivity and other issues.			
WDC–F36	**Accuracy of SRISHTI-DRISHTI platform**	• Geospatial portal SRISHTI is being implemented from the year 2015. Geo-coded and time-stamped photographs on a near real-time basis are uploaded on SRISHTI portal using a mobile application DRISHTI. However, accuracy is an issue with the app. The accuracy level varies by as much as 30 to 40 meters. As per DoLR required modifications are being made in the design of the portal to mitigate inaccuracies. Besides, there is no			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		facility for approval at the District level. All approvals have to be made at the State level. So, the officials in District face problems as they need to come again and again to the State Head Office.			
WDC–F37	**The objectivity of end-line evaluation reports**	• At present, the end line impact evaluations are sanctioned by the SLNA for the projects undertaken in their respective states. This leaves the issue of transparency and objectivity in question. It is observed that multiple reports for the same state but different watersheds have the same set of recommendations. Moreover, there should be an arms-length distance between the implementing agency and evaluating agency.			

Issue relevance legend

	Supported		Partially supported		Not supported		Not applicable

A summary analysis of issues & challenges for the scheme is presented below:

Table 99: WDC - summary of issues and challenges

Parameter	Performance
Institutional Mechanism and governance	●
Fund flow efficiency and utilization	●
Unavailability of resource persons	●
Capacity building	●

Parameter	Performance
Monitoring and evaluation	●

Performance infographics legend

● Satisfactory ● Average ● Needs Improvement

2.2.5.4 Recommendations and solutions

This sub-section describes the scheme recommendations and solutions from the perspective of scheme design, scheme implementation and monitoring & evaluation, along with their mapping with the issues and challenges described in the preceding sub-section.

Table 100: WDC - recommendations and solutions

Sl.no	Recommendation	Finding
Scheme design		
WDC – R1	The cost norms for the scheme should be revised to reflect the current market conditions. During the interaction with stakeholders from various states, it has emerged that the cost norms should be between Rs. 25,000 to 30,000 per hectare for the plains. Instead of adopting an ad hoc measure, it is proposed that the cost norms should be rationalized by a committee of experts who will frame a base value for major cost heads (based on current market price). Further, an escalation formula should be devised for year-on-year escalation or period escalation or one round of escalation every 3rd year, which will be linked to appropriate inflation indices (e.g. WPI).	WDC – F1
WDC – R2	While framing new guidelines, the focus should be there on climate resilience (as it affects the rainfed areas the most). The following areas should accommodate components pertaining to climate change and its mitigation: • Project planning and prioritization • Preparation of DPR	WDC – F2

Sl.no	Recommendation	Finding
	• Long-term O&M • Capacity Building of stakeholders	
WDC – R3	Development of forward production linkages in the form of market connectivity, post-harvest management, and transportation facilities provides significant benefits to farmers under all schemes, including those under WDC projects. The new guidelines should focus on the creation and nurture of Farmer Producer Organisations (FPOs) and Farmer Cooperatives (FCs) to facilitate forward linkages. The representative of the Agriculture Department in the block and district level should be responsible for coordination with the FPOs and FCs.	WDC – F3
WDC – R4	A total of 168 districts have been prioritised by NRAA based on a composite index. The composite index ranked these districts on the basis of vulnerability. The scheme should target these 168 districts in the first stage which are most vulnerable Districts. In this regard, NRAA can play a crucial role in prioritising investment in rainfed areas. Besides, NRAA can play a bigger role in the following: • Conducting third-party impact evaluations of watershed projects to ensure transparency and objectivity • Capacity building through training workshops amongst states and districts on technical matters, especially innovations	WDC – F4
WDC – R5	For effective implementation of projects under WDC component, technical assistance and capacity building support is required which should be ensured through active involvement of reputable central government agencies such as National Rainfed Area Authority, the Indian Council of Agricultural Research, Indian Institute of Soil and Water Conservation, etc.	WDC – F5
WDC-R6	Post-project management of natural resources requires focus to ensure the sustainability of benefits. The scheme guidelines are silent on long term environmental sustainability. Scheme	WDC – F13 & WDC – F20

Sl.no	Recommendation	Finding
	guidelines should specify objectives and strategies in this regard. This will require a holistic approach with support from the state agriculture department, animal husbandry, state groundwater board, regulatory bodies, electricity distribution utilities, etc. As per guidelines, once the project is handed over to the community all manpower is withdrawn and no effort is done to ensure long term sustainability of the natural resources. Therefore, this aspect of post-project handholding support should be incorporated.	
Scheme implementation		
WDC – R7	• To incentivize Centre and State to work together in completion of these projects, and to ensure that funds are released without delay, an annual or biennial ranking of the states could be carried out based on their performance in WDC projects. NITI Aayog could assist in the creation of the ranking methodology. States with better ranking may be given fiscal incentives/priority while sanctioning new projects under WDC. • A suitable financial system should be set up/devised to ensure a faster flow of information between PFMS EAT module at Centre and similar finance modules at State level.	WDC – F6 & WDC – F7
WDC – R8	Progress on works being undertaken by Watershed Committees (WC) needs to be monitored closely to ensure they adhere to the agreed schedule. To this end, IT tools and technologies (for project-specific MIS) may be employed including: • Satellite Data • Geo-tagging of assets • Mobile apps to report progress through timestamping and photo/video upload of project progress	WDC – F8

Sl.no	Recommendation	Finding
	The data should be available for viewing/download by concerned officials and the general public.	
WDC – R9	There is a need to improve the availability and quality of manpower for project implementation at ground level for faster and better implementation. This shortage is due to both organisational structural issues and vacancy of sanctioned posts. The following options could be explored: • By leveraging resources from various departments involved in the implementation of the projects at watershed level (in line with a subsequent recommendation under R11) • By engaging contractual project executives with performance-linked payments • Carrying out extensive training of staff to increase their capacity and quality • Retraining reallocated staff in specific areas	WDC – F9, WDC– F26 & WDC – F10
WDC – R10	The DPR, the most important planning document, is found to be below the desired quality (as in the case of Odisha, UP and Punjab) – they are often generic without capturing the specific aspects of a particular watershed, and there is a scope for significant improvement. To improve the quality of DPRs and the overall scheme, the following could be adopted: • Each state creates a list of empanelled reputable consultants/agencies to prepare DPR. This could be based on some minimum technical and financial parameters set by the Centre for such consultants/agencies • Centre could publish guidelines for DPR preparation, which among other things emphasizes on extensive local consultations and a bottom-up approach • Centre could prepare a model DPR document, which could be used by states or agencies appointed by them in preparing DPRs	WDC – F11 & WDC– F31

Sl.no	Recommendation	Finding
	• An automated IT based system for preparing DPRs could be created, which generates a DPR on the input of technical information. However, such standardisation should be done keeping in mind the large diversity of Watershed projects and significant customisation that may be required considering project location, topography, climatic conditions, rainfall pattern, hydrology, etc. Further, it is important to involve local stakeholders in the formulation of DPR – since significant local knowledge lies with them. So, the standard templates should be flexible enough to incorporate such customizations that may be required. • A national-level PMU is formed for vetting and approving all DPRs for the scheme.	
WDC – R11	Community participation in some projects (for example Chittoor district in Andhra Pradesh, Devanagree district in Karnataka and Latehar district in Jharkhand) is low and this can be increased by undertaking entry point activities and capacity building (for which 9% of funds are allocated under the scheme guidelines). To ensure adequate community participation, there should be proper documentation of community oversight (digitized attendance registers, photo/video uploads of meetings with timestamps). Further, before and during project implementation, the project benefits should be properly disseminated, and awareness created. A social audit should be performed, and beneficiaries and stakeholders should be encouraged to report any deviation during project implementation.	WDC – F12 & WDC – F16
WDC – R12	The States should expedite the implementation and completion of projects on priority by mobilizing funds through convergence with schemes of similar nature. Similar to what has been suggested by the Parliamentary Standing Committee on Rural Development a dedicated institutional mechanism may be	WDC – F14

Sl.no	Recommendation	Finding
	created to handle watershed issues, remove bottlenecks, coordinate and undertake quick decision making at the state level. In order to ensure convergence in project implementation, it is recommended that the responsibility of implementation at watershed level be entrusted with inter-departmental team/ committee consisting of members from following line departments: • Agriculture Department • Panchayati Raj/Rural Development Department • Land Resource Department • Water Resources Department • Forest Department • PHE/RWSS Department	
WDC – R13	The states should expedite the implementation and completion of projects on priority by mobilizing funds through convergence with schemes of similar nature. As suggested before, the formation and involvement of an inter-disciplinary committee/ team should enable effective convergence. Further, a few "quick-wins" should be identified, implemented well and then these success stories should be showcased, and their learnings documented to plan for larger or more complex projects.	WDC – F14
WDC – R14	As reported, the scope of work is not clear during the O&M phase, therefore there should be clear guidelines ensure the utilization of Watershed Development Fund (WDF) for maintenance of assets during the O&M period. DoLR has communicated to the states on multiple occasions to formulate guidelines for the utilisation of WDF and this should be further encouraged in all forums. The model template of WDF guidelines has been circulated by DoLR among all the Sates for customization and adoption as per States specific conditions. It	WDC – F15 & WDC – F22

Sl.no	Recommendation	Finding
	needs better monitoring from Central as well as from state levels. Guidelines issued by Karnataka can be treated as model guidelines and can be modified by states as per their requirement. Alternatively, guidelines to manage WDF can be formulated and incorporated in the new scheme guidelines by the ministry. This is essential for the sustainability of watershed projects. Capacity building of new functionaries at the gram sabha should be done in the post-project period to ensure continued support for O&M. Transparency in the WDF fund utilization and its social scrutiny is a must for all watersheds.[231]	
WDC – R15	In the O&M phase of watershed projects, proper monitoring should be carried out and awareness should be created among the beneficiaries and handholding support should be provided after the implementation of the scheme to ensure proper maintenance of project assets by the beneficiaries. To enable capacity building at the village level, a multi-level programme could be adopted: • State-level officials to be trained by Central organizations (like NRAA) as Trainers • District-level officials to be trained by trainers in State Level as grassroot trainers • Block and Village level stakeholders to be trained by the grassroot trainers Further, a booklet or guidebook could be created in multiple languages for knowledge dissemination and training of village level stakeholders. All training materials for the above training programs should also be made available through a portal to be created for the program.	WDC – F18

[231] Final Evaluation Report, Project name: IWMP-II, Koijhar nala, BLOCK–Dharamjaigarh, DISTRICT-Raigarh, CHHATTISGARH

Sl.no	Recommendation	Finding
	The same portal may also be utilized for disseminating best practices, sharing success stories between states, rolling out e-learning courses, etc.	
WDC – R16	To reduce subjectivity and undue influence on the projection selection and planning process, it is recommended that all activities should be planned based on scientific principles using satellite and other reliable/authentic data and properly documented guidelines. The DPR documents should be very specific and identify the area where structures should come up. Once, this is frozen, with proper monitoring using IT-based tools it should be ensured that there is no deviation. Further, the work and the locations where the structures should come up should be communicated to all stakeholders through signages and the beneficiaries should be encouraged to report any deviation.	WDC – F31 & WDC – F11
WDC – R17	There are equity issues between upper reaches (Ridge) and lower reaches (Valley), which are inhabited by poor farmers and rich farmers respectively. Most of the harvesting structures are constructed in the valley. This can be mitigated to an extent by the involvement of multiple departments as recommended. In addition to this, the scheme planning, and design should also ensure social equity – by ensuring the involvement of and benefits to weaker sections including SC/ST, women, landless farmers, etc. This may be ensured by putting weightage on social equity at the time of selection of SHGs as well as selection and prioritization of projects. There should be an added emphasis on livelihood component, which supports the poorer farmers/stakeholders in a watershed. Two possible options based could be: • Reallocation of the one-time grant currently provided to the PSME to the livelihood component • Ensuring the livelihood component is covered under NRLM	WDC– F23 & WDC– F32

Sl.no	Recommendation	Finding
WDC – R18	It is observed that the states, which have dedicated watershed development departments have performed better than other states. Therefore, other states which have a very high percentage of the rainfed area may explore setting up a dedicated watershed department or watershed cell (under an existing department) to undertake watershed development activities.	WDC– F24
WDC – R20	As already mentioned under R5 and R15, the issue of inadequate training and workshops should be addressed at each level starting from state to village. For this purpose, the central ministry should identify a set of reputed academic/ research/ training institutes for each state or group of states. These institutes should undertake training programs at the state and select village levels, which should be further cascaded downwards. Further, e-learning courses and propagation of training materials through a dedicated portal should also be explored.	WDC– F27
WDC – R21	At present, GOI released the funds in two instalments every year. It may be explored if GoI could release funds in a timely manner or release the entire amount in single instalment such that sufficient time is available for utilizing the entire amount within the financial year. This should be evaluated in the context of existing financial rules and procedures.	WDC– F28
WDC – R22	All states should dedicatedly follow the ridge to valley approach rather than a village-based development approach. For the selection of new projects, it is advisable to focus on the sequential development of micro-watersheds rather than the complete watershed in one go. A watershed has 4-5 micro watersheds. There should be a priority among micro watersheds. Working sequentially through micro watersheds is more feasible as they are hydrologically linked.	WDC– F30

Sl.no	Recommendation	Finding
WDC – R23	For post-project maintenance, there should be a fixed amount from the project itself which will enhance project sustainability. Moreover, there should be a mechanism to enhance these resources by CSR funds or involvement of IFIs. An appropriate amount of money can be left with SLNA as a fixed deposit for the maintenance of assets which have been created under a project.	WDC– F33
WDC – R24	There is a need to develop and impart knowledge concerning cropping system in sync with the natural resources. Therefore, the capacity building and training modules should incorporate specific topics on cropping system for overall success and sustainability of the watershed projects.	WDC– F34
Monitoring and evaluation		
WDC – R25	At the National level, there is a need to augment professional capacity for better and effective monitoring. This should be ensured through active involvement of National Rainfed Area Authority, the Indian Council of Agricultural Research, Indian Institute of Soil and Water Conservation, etc. Further, the central ministry should also consider engaging professional agencies for setting up a program monitoring unit.	WDC – F35
WDC – R26	The accuracy of Bhuvan-SRISHTI portal varies by as much as 30 to 40 meters sometimes. Accuracy of the app should be improved by technical upgradation.	WDC – F36
WDC – R27	All approvals for WDC projects are currently made at the State level. It is recommended that some of the approving powers should be delegated to the Nodal Officer at the District level or to the inter-departmental team/ committee (as recommended under R11) so that implementation process is expedited.	WDC – F36
WDC – R28	At present, the end line impact evaluations are sanctioned by the SLNA for the projects undertaken in their respective states. This leaves the issue of transparency and objectivity in question.	WDC – F37

Sl.no	Recommendation	Finding
	There should be an arms-length relationship between the implementing agency and evaluating agency. Hence, the studies must be commissioned by independent agencies/departments at the state level (such as the Department of Statistics and Program Implementation in some states).	

2.2.6 Irrigation Census

With the changes in groundwater scenario and shift to mechanized mode of water lifting, more efficient water distribution practices like drip, sprinkler irrigation, sub-surface piped irrigation has been adapted over the years. The share of different types of Minor Irrigation (MI) schemes has been changing over time. In order to study the composition of the minor irrigation schemes, Irrigation Potential Created (IPC), Irrigation Potential Utilized (IPU) by minor irrigation schemes and to assess the factors contributing to the gap between IPC & IPU, a sound database need to be in place which would provide meaningful insights to provide a strong foundation for planning and policy formulation. The definitions of minor irrigation types have been refined and new categories like Medium tube well has been introduced to capture the rapid changes in groundwater sector. New items of data collection like number of lifting devices, more than one sources of energy, more than one sources of finance, subsidy etc were added in the scheme schedules in order to capture the diversities in the types of lifting devices, funding pattern and sources of energy utilised by the owners of minor irrigation schemes.

One of the main objectives of "Rationalization of Minor Irrigation Statistics (RMIS)" a sub-scheme under the Centrally Sponsored Scheme 'Irrigation Census' is to conduct Census of Minor Irrigation structures in the country on quinquennial basis. Till date, five MI Censuses have been successfully carried out and the data analyses are used by Ministry of Agriculture and Farmers Welfare to provide financial support to farmers for development of MI through commercialized banks, regional rural banks, cooperative banks and NABARD. The data is further used by Ministry of Rural Development under Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) for providing financial support for development of Surface Water Schemes, de-

silting of ponds, defunct water bodies to improve storage capacity and creating scope for water availability for irrigation.

2.2.6.1 Background

Water being a critical input and keeping in view the importance of assured supply of water for agriculture, the number of major, medium and minor irrigation has increased substantially in India over the years. On account of introduction of a large number of minor irrigation schemes in particular, the area under irrigation has also increased significantly.

Minor irrigation schemes are defined as those irrigation schemes or structures, in either groundwater or surface water category, which have Culturable Command Area (CCA) up to 2000 ha. Owing to low capital investment, short gestation period and widespread coverage, they deliver irrigation benefits to millions of farmers and account for a major share (> 60 %) of the total irrigation economy of the country.

The Ministry of Water Resources, River Development and Ganga Rejuvenation (MoWR) conducts a census of minor irrigation structures to obtain detailed information on their existence, ownership, working condition, cost of construction, operational expenses and related issues. The census provides a clear picture of the distribution and utilization of different types of minor irrigation schemes and is the only available data at the national scale on minor irrigation. So far, five minor irrigation censuses (MIC) have been completed with reference years 1986-87 (GoI 1993), 1993-94 (GoI 2001), 2000-01 (GoI 2005), 2006-07 (Go 2014) and 2013-14 (GoI 2017).

Objectives of Minor Irrigation Census and Census of Water Bodies

The main objective of the census is to build up a comprehensive and reliable database in Minor Irrigation (MI) sector for effective planning and policy making. The Census throws light on important aspects like IPC and IPU through minor irrigation structures (both ground and surface water), water distribution practices employed by owners of these schemes and also sources used for energisation of these MI schemes.

The other purpose of MI census is also to study he changes in utilization pattern of these schemes across time and regions. As of now, the Minor irrigation Census provides a

comprehensive and reliable source of data at the national, regional, state and local scale on minor irrigation schemes.

Methodology

- The methodology adopted for conducting MI Census involves canvassing paper-based enumeration schedules for collecting village level and MI scheme-wise data in the rural areas.
- The village schedules are usually canvassed by *Patwaries* (field enumerators) through enquiries with the scheme owners. In case of institutional schemes, the information is collected through available records.
- Most of the States / UTs conduct field work (canvassing of Village and Scheme level Schedules) through the Nodal Department and offices of the concerned Department at District, Block and Village level. Some States entrust the work to private / third party agencies.
- Steering committees are formed in every State headed by Secretary of the Nodal Department and members of various departments like Revenue, Irrigation, PRI, State Planning, NSSO provide technical inputs.
- State Statistical Cell are formed in every State, headed by the Census Commissioner selected by the States. The State Statistical Cell is responsible for managing the operations on daily basis pertaining to the Survey. The State Statistical Cell is supported by the MI Stat Wing of MoWR, RD & GR.
- The enumerators visit the villages and collects information on MI Structures from the scheme owners. Certain information relating to the scheme is collected by the enumerators by physical examination of the scheme.
- After filling up the schedules, the enumerators are required to deposit all completed schedules with the Block development Officer/Officer-in-charge at the block level.
- The overall quality of field work was monitored by Block/District/State level officers, who in order to ensure the correctness of data conducted frequent site visits of the schemes as per prescribed norms and checked the entries made by primary enumerators. In addition, Central team along with the State Statistical Cell officials conducted field visits in the States/UTs and checked the quality of field work.

- Block level officers visit at least 5 villages in their respective blocks and scrutinize at least 10% or 300 schedules whichever is maximum, submits Supervisors Report form to the District level officer. At least 1% or 100 Schedules are randomly checked by the District level Officer. The District level Officer visits at least 5 villages in 5 blocks and physically verify the quality of data and coverage of MI schemes. The District Officer submits Supervisor's report to the State Nodal Officer. An additional item of scrutiny of 25% of MI Scheme Schedules and 100% Village Schedules has been introduced in 6th round of Census for ensuring better data quality which is carried out by the immediate supervisory officer of the enumerator. This in addition to the 10% scrutiny of Scheme Schedules.
- For census of Water Bodies, 25% of the schedules are being scrutinized by the immediate supervisor and 10% of the Water Body schedules to be scrutinized by the Block level officer.
- Data contained in the Schedules are then entered at State level through an application by a State Department or by an agency selected for data entry.
- Monthly reports are submitted by the States to MI Stat Wing. In addition, video conferences are organized from the end of MI stat wing to assess the field level challenges and provide corrective measures.
- The online web-based software developed by NIC for data entry and validation has assisted in eliminating the errors and enabling real-time progress monitoring of data entry thus reducing delays.
- The web-based MI census data are stored in a Central database server maintained by NIC. The real-time tabulated Census data are again scrutinized at Central level and referred back to the States for comments and corrections by the States as the case may be.
- The Census Commissioners at State level can use the software for generating micro-level tables / reports.
- A national level training is conducted involving all States / UTs where officials from each State / UTs participate. Six regional level trainings are organised for Northern, Southern, Eastern, Western, Central and North-Eastern States. Further trainings are organised at State levels by the Census Commissioners for District level officers. Block level officers and the enumerators are also trained. The State level trainings are attended by District level Officers from all districts, State level NIC officers, officials of State Agriculture Statistical Agency, officials of Directorate of Economics and Statistics.

Apart from training on concepts, definitions, schedules and instruction manual, field training is also imparted. The details of the methodology adopted for the census, its procedure, concepts and definitions etc. are discussed thoroughly and necessary clarifications are also given in such trainings.

2.2.6.2 Performance

Performance on REESI+E framework

Table 101: IC - performance evaluation using REESIE framework

Parameter	Findings from research
Relevance	**Secondary**: • The Centrally Sponsored Plan Scheme "Rationalisation of Minor Irrigation Statistics (RMIS)" was initiated in 1987 – 88 with 100% Central assistance to the States / UTs. During XIth Five Year Plan, RMIS was a part of Central Sector Scheme "Development of Water Resources Information System (DWRIS)". In XIIth Plan RMIS was taken as a subcomponent under "Irrigation Census" and currently Minor Irrigation Census is a standalone component under umbrella scheme "Pradhan Mantri Krishi Sinchai Yojana". • The necessity of MI Census is to generate and establish a robust database and analysis on Minor Irrigation Schemes to formulate policies on water resources planning. • The gap between IPC and IPU in 5th MI Census has reduced as compared to that in 4th MI census. The IPC-IPU gap in 4th MI census was 20.5 mha and that in 5th MI Census was 18.2 mha. Hence there was reduction of 2.3 mha of IPC-IPU Gap. In such scenario Irrigation Census is relevant in identifying the IPC-IPU gap and reasons therein and developing policies to reverse the same. • Identification of all Minor Irrigation sources is undertaken through the census as all rural and urban water bodies are covered after taking into account existing data available from Wetland Atlas and other such

Parameter	Findings from research
	secondary sources. Thus, adequate geographical coverage is also ensured. • A report of the Committee for third party evaluation of the scheme ("Committee to conduct critical evaluation of the Centrally Sponsored Plan Scheme component "Rationalisation of Minor Irrigation Statistics (RMIS))"clearly suggests that MI census provides useful information on critical parameters of Minor Irrigation aggregated at National and State level. There are no other schemes with similar objectives, and hence the possibility of duplication of effort in respect of the census does not arise vis-à-vis other schemes. • Minor Irrigation (MI) Census is intended to capture information on utilization pattern of MI Structures, their physical status, construction cost and operation expenses. The Census also captures the water distribution practices adopted by farmers and owners of the MI structure along with the energy consumption pattern.
	Primary: • The data of Minor Irrigation Census is used by a large number of Institutions like Central Ground Water Board (CGWB), Central Water Commission (CWC), Niti Aayog, NABARD, State/UT Governments, independent researchers etc. Central Ground Water Board (CGWB) uses the Minor Irrigation Census data for Dynamic Groundwater Resources estimation. While the CWC, Niti Aayog, State/UT Government and NABARD use the data of Minor Irrigation Census for policy formulation. o Various examples of use of MI data by government and other agencies are listed below: o Some states like Gujarat, Jharkhand and Tamil Nadu being water scarce states, the MI census have helped in assessing the current scenario of Minor Irrigation Schemes and Water Bodies. The Irrigation wing of Water Resources Department, Uttar Pradesh uses the data to assess block wise IPU; based on which IPU augmentation plans are prepared.

Parameter	Findings from research
	○ The Urban Local Bodies use the Water Bodies data to assess the status of surface water and accordingly plan activities for Urban water supply. Jharkhand has used the MI census data to identify illegal encroachments on water bodies and this has helped the authorities to deal with such cases legally. ○ As deliberated by stakeholders from Bihar, Assam and Sikkim, the MI census process has created demand for new Minor Irrigation schemes amongst the villagers. The villagers themselves help the district officials in identifying potential spots for groundwater sources. ○ Gujarat practises Participatory Irrigation Management and hence the census data and the analyses have helped the Irrigation Department to plan for water distribution system amongst the farmers using Minor Irrigation sources. States like Rajasthan use the data to monitor the status of the deep tubewells. Planning for costing of the repair of the tubewells is done based on the status of the tubewells. ○ "Kaleshwaram Project", a state sponsored scheme by Govt. of Telangana is using the MI census data for renovating the MI Schemes. ○ Independent researchers use the data collected through Minor Irrigation Census for research purposes.
	Inference: • Data from the latest minor irrigation census coupled with data collected through selective sample studies will help to identify the factors influencing delivery efficiency of minor irrigation systems at the state level and help estimate the supply of water for minor irrigation. • These reports provide state-wise data not only on IPC and IPU of groundwater and surface water systems, but also the potential of the systems that are in use. Analysis of primary data collected alone can help identify the reasons behind the changes in supply side and demand gaps and their respective contributions.

Parameter	Findings from research
	• Independent researchers have used the MI census data and provided important insights in relation to growth of groundwater structures, energy crisis, regional variations in India's groundwater economy amongst several others. • Therefore, the scheme has been rated as 'satisfactory' on this parameter.
Effectiveness	**Secondary**: • The process of MI census has evolved over years. Till date five MI censuses has been completed and it is observed that each MI census had unique components included. o The first census of MI works was conducted with 1986-87 as the reference year in all states and union territories except Rajasthan o The second MI census was conducted with 1993-94 as the reference year, and it provided district-wise and scheme-wise information for 21 states and four union territories, excluding Gujarat and Maharashtra, and the union territories of Chandigarh, Daman and Diu, and Lakshadweep. Additional information on sprinkler & drip irrigation were collected. Information on use of non-conventional energy sources was included for the first time and data was computerized with assistance from NIC for the first time. o The third MI census was conducted with 2000-01 as the reference year. It covered 33 states and union territories, excluding Daman and Diu, and Lakshadweep. o The fourth MI census covered 33 states and union territories, excluding Daman and Diu, and Lakshadweep. Information on use of non-conventional energy sources was included for the first time. Information on use of non-conventional energy sources was included for the first time o In fifth MI census, data entry and validation were done online for the first time in the portal developed by NIC. Real-time progress monitoring of data entry and validation was also made available

Parameter	Findings from research

through the portal. The fifth MI Census was conducted with reference year 2013-14 across the country in 33 States/ UTs except Daman and Diu, Dadra and Nagar Haveli and Lakshadweep.

- First Census of Water Bodies as a part of sixth MI census covering all Rural and Urban Local Bodies was considered along with census of sixth MI Census.

- It is also seen that with MI census over the years, the coverage has increased which reflects the effectivity of Irrigation Census

Irrigation Census	Total Groundwater schemes covered	Total Surface water schemes covered
First (1987)	1,21,97,471	9,17,511
Second (1993-94)	96,51,992	7,71,500
Third (2000-01)	1,85,03,268	12,48,931
Fourth (2006-07)	1,97,57,820	12,48,853
Fifth (2013-14)	2,05,20,305	11,92,249

- As Minor Irrigation Census continued over the years from 1986-87, data tabulation and presentation has improved. The tables contained State-wise aggregate data viz., number of MI Schemes, IPC, IPU, crop-wise irrigation, sources of finance for construction of schemes, distribution of schemes as per social category, type of farmers and many other parameters.
- Also, the MI Census contained State / UT wise detailed tables separately thus providing an assessment of state specific situation. District level data is available on the website of the Ministry while details below district level can be obtained through NIC unit in the Ministry after a request is made to the Ministry indicating the purpose for which data is being sought and due approval of the request.
- New items of data collection like number of lifting devices, types of energy sources, financial sources, subsidy etc. were added in the scheme schedules.

	Primary: o Data validation checks have been inbuilt in the data entry process through software. For the first time, online web-based software was developed for computerisation of data of the 5th MI census by the National Informatics Centre (NIC). This eliminated the need for separate installation of software in States/UTs, as in previous Census. The Progress Monitoring tool provides real-time progress updates during data collection and allows for timely corrective actions both at the Central as well as State/UT level, thereby reducing delays and improving data accuracy. o The data of Minor Irrigation Census is used by a large number of Institutions like Central Ground Water Board (CGWB), Central Water Commission (CWC), Niti Aayog, NABARD, State/UT Governments, Researchers etc. o CGWB uses the Minor Irrigation Census data for Dynamic Groundwater Resources estimation. Block wise number of dug well, shallow tube well and deep tube well have been utilized. Data on type of lifting device and source of energy are also utilized by CGWB. o Data on Culturable Command Area (CCA) is utilized for comparison and rationalization of unit draft in the context of Dynamic GW Resource estimation. o CWC, Niti Aayog and State/UT Government use the data of Minor Irrigation Census for policy formulation. o Data collected under Minor Irrigation Census especially information on source of finance, lifting device, source of energy etc are used by NABARD. o Independent researchers use the data collected under Minor Irrigation census to understand how minor irrigation has evolved over years. o Irrigation Census data and its analyses are available up to the district level. In addition, the data upto village level of the censuses conducted so far are available in the public domain https://data.gov.in/

	In addition, the schedules of enquiry, published reports and guidelines for data collection of the previous censuses are available at http://micensus.gov.in/ along with a dashboard which facilitates easy dissemination of 5th MI census data. The inferences from the data and its analyses however do not reach the blocks and villages, particularly in areas with limited or no internet connection. As a result, the issues and challenges pertaining to groundwater and surface water minor irrigation structures remain unavailable to the farming community in such areas. o Census of Water Bodies is done by using GIS application through mobiles, which has been included as new module in 6th Irrigation Census. Most of the States have conducted the census of water bodies without much difficulty by virtue of extensive capacity building and handholding. Significant capacity building measures have helped the enumerators to capture data and supervisors in minimizing the errors. All States agreed to the fact that Irrigation Census helps in identifying villages having scarcity of water resources. After publishing of the results, such issues are discussed and the fund availability for augmenting irrigation schemes in such villages are elaborately discussed by the district authorities. Such meetings are attended by all departments. Decisions are taken in such meetings for preparing DPRs specific to those villages. o At State level, revenue department contributes enormously towards MI census, providing land use statistics to the Statistical Cells. This has been acknowledged by all the States. The officials of revenue department also extend their support towards training of the enumerators as well as in monitoring of the data collected. o The Principal Secretary of the nodal department or Chief Engineer is the Census Commissioner for the State. The responsibility of implementing the Census in a State lies with the Census Commissioner. He is assisted by a Statistical Cell headed by a Joint

	Director or Assistant Director supported by five other officials in a large State or two other officials in a small State. o The nodal department has its structure at the district and below levels which undertake the Census work under the overall guidance and supervision of the State Statistical Cell. o In states like Bihar, community involvement is ensured through panchayat. The validation of the enumerated data is done by the Ward members and ensures the completeness and coverage of Minor Irrigation schemes and Water Bodies. The analyses of the Irrigation Census data particularly for Ground Water Irrigation are communicated to the villagers. Issues like depletion of groundwater level are communicated to concerned villages in form of alerts. o States like Andhra Pradesh, Telangana and Tamil Nadu have gone ahead with geo-tagging of all minor irrigation sources. Thus, a database for minor irrigation is in place, which is being used by Agriculture departments for planning. o Although the MI census reports has elaborated on major key performance indicators like IPC, IPU, gap between IPC & IPU, CCA, state-wise ground and surface water scheme performances, power supply and discharge of water, etc. but does not covers socio-economic parameters like livelihood generated from operationalisation of minor iriigation, change in income level of farmers, spending on health, education, etc.

Parameter	Findings from research
	Inference: • It is understood from the previous Irrigation Census Reports and deliberations by the National and State Stakeholders that, adequate analyses are done for minor irrigation viz., IPC, IPU, IPC-IPU gap, CCA, source of finance for private MI scheme development, utilisation potential of ground and surface water etc. However, no analyses are done for socio-economic parameters like cost-benefit analysis of MI schemes, livelihood change, spending on education and health and migration. • It is apparent that detailed tabulation of data is done for usage by key stakeholders in minor irrigation like CGWB, CWC, Water Resources Department at States, NITI Aayog for policy formulation and preparing master plans. No evidence for data dissemination or usage at the grassroot level (viz. block, panchayat and village) was made available during the KIIs. Varied level of sharing is seen across the states. While in some states, the findings on groundwater sources are shared and discussed with the farmers, in other states, the data is used for planning by the district level officials only. • Extensive application of GIS for census of Water Bodies has been done in the 6th MI census which has helped the ULBs and the Zilla Parishads in identifying these Water Bodies and identifying administrative issues like encroachments, garbage disposal, etc. • Major issues like scarcity of groundwater have been effectively identified on account of Minor Irrigation Census. Area specific groundwater level data has been captured and proposals for augmentation of groundwater are being prepared by the respective authorities. • Therefore, the scheme has been rated as 'satisfactory' on this parameter.
Efficiency	**Secondary**: • Prior to initiation of Irrigation Census, states need to collect data from various departments. At times, states faced many challenges in

collecting these data due to lack of coordination between various departments. The main data sources and related challenges faced in respect of the census are:

Source	Nature of information	Challenges
Land Use Statistics (LUS)	Area irrigated, Sources of irrigation	- The *Khasra* form in few states does not include information on sources of irrigation - Gross Irrigated Area as per MI sources are not compiled in LUS by most States - LUS does not provide number of MI structures
Periodical Progress Reports	Irrigation potential of Groundwater Schemes	- Absence of single nodal department for entire State - Private MI structures are usually recorded - Irrigation Potential is determined based on rules-of-thumb in respect of duties / water allowances
Annual Administrative Reports	Statistics pertaining to Minor Irrigation works undertaken by departments concerned	- No field agencies in Minor Irrigation Department of the States to collect data - Minor Irrigation programmes are dealt by separate departments in the States and data provided on works maintained by the concerned Department

Parameter	Findings from research		
	Ad-hoc Reports	These reports are intended to focus on socio-economic impact	- Priorities and weightage given to irrigation data for minor irrigation statistics suffer from several deficiencies
	• The Patwaris who are primarily responsible for data collection generally are not able to devote enough time required for collection of LUS data, leading to inefficiencies in Census process.		
	Primary: • Extensive support is provided by Secretary, Department of Water Resources, RD & GR, Ministry of Jal Shakti with the representatives from NITI Aayog, Ministry of Agriculture, Ministry of Panchayati Raj, National Statistics Office, Registrar General Office, Ministry of Rural Development, Ministry of Housing and Urban Affairs, Central Water Commission, Central Ground Water Board. • For the first time, a dedicated online portal for 5th Minor Irrigation (MI) Census has been developed which facilitated online data entry, updation, validation and tabulation. Since data can be accessed by both Central level and State level users in real-time, the bottlenecks in data entry and validation were removed instantaneously which resulted in quick processing /verification of data and finalization of results. • The tools for data collection and validation have changed from manual process to digital, resulting in less errors and quicker turnaround and dissemination of results. However, as per the KII with the State counterparts (Nodal Officers and Census Commissioners), five out of six states with whom KIIs were conducted so far, are still continuing with manual filling up of Village and Scheme Schedules, although		

	data tabulation and validation is done by all states through software developed by NIC. • In addition, a Steering Committee for conduct of 6th Minor Irrigation Census and Census of Water Bodies under the Centrally Sponsored Scheme "Irrigation Census" has been constituted under the Chairmanship of Secretary, (WR, RD & GR) with Chairman, Central Water Commission (CWC), Chairman Central Ground Water Board (CGWB), Director General, National Sample Survey Organization, Director General, Economic Statistics Division, Ministry of Statistics and Programme Implementation (MoSPI), Advisor (Water Resources), NITI Aayog, Joint Secretary (Governance), Ministry of Panchayati Raj, Joint Secretary (Swatch Bharat Mission), Ministry of Housing & Urban Affairs, JS & FA, Department of WR, RD & GR, Additional Registrar General and Deputy Director General (Census), O/o Registrar General India, Deputy Director General (Agriculture Census), Ministry of Agriculture , Cooperation and Farmers Welfare, Joint Secretary (MGNREGA), Department of Rural Development, Secretary (Revenue), Government of Rajasthan, Member Secretary, Minor Irrigation and Ground Water Department, Government of Uttar Pradesh, Special Chief Secretary, Planning Department, Government of Telangana, Additional Chief Secretary and Financial Commissioner (Revenue), Government of Haryana, Additional Chief Secretary, Water Resources Investigation and Development Department, Government of West Bengal, Secretary, Water Resources and River Development Department, Government of Sikkim, Commissioner (SPR), Ministry of Jal Shakti, DDG, National Informatics Centre (NIC) as Members and Wing in-charge, Minor Irrigation Statistics Wing, Ministry of Jal Shakti as Member Secretary to guide and advise the conduct of the Census. • Each State has identified a nodal department for the implementation of the Census. Depending on the State, it is either Revenue or

Parameter	Findings from research
	Agriculture or Minor Irrigation or Directorate of Economics and Statistics. • A structured monitoring system is in place thus ensuring timely submission of data and ensuring desired data quality. All States follow the workflow as directed by MI Stat Wing. On account of the monitoring system, 4 Sates have completed the field work and another 9 States have completed more than 80% of the field work. These States were on track to complete the field survey at the time of writing this report but were delayed due to the current pandemic situation. • In states of Tamil Nadu, Andhra Pradesh and Telangana the data collected during MI Census are compared with the MI data available with departments like Panchayat and Rural Development, Municipalities, Agricultural Department, Water Resources Department, etc. The gaps are identified thereof, and corrective actions are taken by the State Statistical Cell. • For MI census, Revenue Village is the basic unit, which helps in assessing the water resources in a village, enabling village specific proposals and not source specific. This approach helps in identifying issues on water resources for a geographically defined area. The authorities are also able to prioritize the area based on the severity of the problems. • A case study of Andhra Pradesh is deliberated below which elaborates on the "paperless" approach adopted by the State thus replacing the manual canvassing of minor irrigation schedules. ***CASE STUDY – ENUMERATION OF MI DATA IN ANDHRA PRADESH*** Andhra Pradesh is one of the few States that have conducted "Paperless" 6th Minor Irrigation Census. During the State Level Coordination Committee (SLCC) meeting prior to execution of 6th MI census it was decided to conduct the survey through tab/mobile

Parameter	Findings from research
	app without canvassing the schedules to save time and avoid data entry errors. Accordingly, customized software was developed in house. Tab / mobile app was developed with android version for canvassing all schedules of 6th Minor Irrigation Census and Census of Water Bodies. All the 5 schedules (Ground Water, Surface Water, Census of Water Bodies in Rural and Urban areas and Village schedule) as designed by GoI were integrated into 3 schedules covering all the information. "Postgre SQL" is used for storing the captured data through tab/mobile application. Trainings were conducted to the field and supervisory functionaries at State, District and Mandal level before commencement of the census. Pilot survey was done to test the application covering all the schedules of groundwater, surface water schemes and water bodies @ 2 schemes each in all 13 districts both in Rural and Urban areas. All the table scrutiny checks have been incorporated in the app as per instructions of GoI. Photographs along with latitudes and longitudes of water bodies are captured in the Census of Water Bodies. The app has been developed with provision to upload the canvassed data automatically in the NIC software structure in one go through back end bulk data entry. Exclusive Web portal (http://aproms.ap.gov.in/mic6/dashboard) was established for day to day monitoring of the fieldwork of 6th MIC & CWB featuring different MIS Reports viz., (1) Survey progress (2) Schemes covered and pace (3) Supervision status and (4) Other reports. WhatsApp group was formed to resolve the field level issues and to share the clarifications. Senior Officers from DE&S were allotted districts for monitoring and supervision. Core Group Team was Constituted with group of officials. The team visited all districts and explained the process of rectification of

Parameter	Findings from research
	errors in the portal at mandal level as part of validation of the enumerated data.
	Inference: • From the above facts it is evident that, Minor Irrigation Census is a well-coordinated event at National level. However, during KIIs, states (Nodal Officers and Census Commissioners) reported a lack of coordination with other departments (except for Revenue Department). As per the secondary sources, challenges are faced by the Nodal department and the State Statistical Cell in obtaining relevant ground level information from other State departments. • Except Andhra Pradesh and West Bengal, all States are still continuing data collection through canvassing of paper-based Village and Scheme Schedules. This approach is time consuming and even on-spot validation cannot ensure that data collected are error free. • Online data tabulation and data validation modules developed by NIC has helped in reducing time-lag and cost of survey. The web-based approach has also helped the State Statistical Cell in checking data quality and referring back to the Districts for necessary clarifications with minimum time lag. • The data is uploaded to a designated website, data tables are easily accessed by all officials at State, District and Block level. • The Key Informant Interviews (KIIs) with State and district level stakeholders reveal that contribution of departments like revenue, panchayat and rural development, agriculture, municipal affairs and water resources have significantly contributed towards providing base data and monitoring of the data. In most of the States, these departments have actively participated in the process and contributed to the technical aspects of minor irrigation. • Most of the States have ensured full coverage of Minor Irrigation schemes and water bodies both in rural and urban areas. In some states

Parameter	Findings from research
	like Uttar Pradesh, Bihar, Karnataka, Jharkhand, the panchayat samitis also extend their support in ensuring that no sources are left out. • Steering Committee has been formed in every state, which extends support in resource mobilization for the survey. The Steering Committee has provided technical support to the State Statistical Cell. • Hand holding measures on data collection and canvassing of schedules is done through Intensive field visits undertaken by the supervisors. Need for refresher training for selected enumerators is ascertained and trainings are conducted based on the observations made during such visits. • Therefore, the scheme has been rated as 'satisfactory' on this parameter.
Sustainability	**Secondary**: • With the existing institutional and operational framework at National, State, District, Block and Village level, since 4th Minor Irrigation Census, there has been no disruption of MI census. • Minor Irrigation Census being Centrally Sponsored Scheme with 100 per cent Central Funding and hence the States do not have any financial burden of executing MI Census activities or part of the activities. • As per the SFC, the report of the Committee, on third party evaluation(Committee for evaluation of Centrally Sponsored Plan Scheme component "Rationalisation of Minor Irrigation Statistics (RMIS)") has clearly stated that MI Census is the only comprehensive and reliable data set and provides useful information on regular basis to National level, State level and District level stakeholders apart from other institutions, agencies. Strong recommendations have been given for continuance of the Minor Irrigation Census. • Minor Irrigation Census is the only scheme for collecting and analysing data on various parameters of Minor Irrigation Schemes and there are no overlapping schemes or sub schemes having similar objectives.
	Primary:

Parameter	Findings from research
	• States have confirmed that there are no financial resource gaps (100% provided by the Ministry) or manpower resource gaps (provided by State governments). These two factors have helped in continuing Minor Irrigation Census since 1986-87. • Strong institutional set up established for Minor Irrigation Census at National and State level makes the census activity sustainable. The institutional arrangement established at the State level, over the years, has ensured data quality, completeness and data validation process. Though the previous five MI Census have contributed to ensuring data completeness and correctness but the process has also evolved in terms of scientific approach towards data collection and validation. • However, the state officials have expressed their dependence on the central government for continuation of MI census surveys as most of the states do not have adequate manpower/ resources to identify new parameters for such surveys, statistical analysis, etc. The states have expressed their inability to fund the statistical cells to carry out all the activities required under MI Census.
	Inference: • Instituional set up: At Central level, MI Stat wing plans the operations of the census with technical support rom the NIC. For the implementation of the scheme, each State/UT has identified a Nodal Department for compilation of Minor Irrigation Statistics. State Statistical Cells are generally created within the Nodal Department so identified. These Cells assist the Head of the Nodal Department or Census Commissioner in organising, coordinating and supervising the Minor Irrigation Census. • Minor irrigation being extremely critical to agriculture, the changing nature of minor irrigation needs to be understood and disseminated. The data is being utilized at both central and state levels. Usefulness of MI Census is expected to lead to its continued sustenance. • The States have however expressed the fact that, the MI census cannot be conducted with their own capacities, particularly tabulating, analysing

Parameter	Findings from research
	the enumerated data and publishing the same in form of a comprehensive report. Overall guidance from the end of Govt. Of India with respect to schedule designing, tabulation and analyses is necessary for continuation. Moreover, the states do not have the financial support to continue the functioning o State Statistical Cells as they are guided by MI stat wing, MoWR, RD & GR, Govt. of India. These State Statistical Cells act as coordinating office between the State and the Centre.
Impact	**Secondary**: • Important insights were developed on account of the data available through five MI Irrigation Census conducted between 1986 – 87 and 2013 – 14: o Groundwater schemes continue to dominate MI schemes while the usage of Surface water schemes have gone down o Minor Irrigation schemes are planned by Govt. of India and State Governments based on the findings from MI Census. Schemes for Surface Minor Irrigation has been developed based on the findings on Surface water minor irrigation through MI census. • Policy thrust on tube well electrification is to be planned by Govt. of West Bengal on account of findings on increased usage of electric pumps.
	Primary: • As deliberated by the Deputy Director General, MI Stat wing, MoWR, RD & GR, Govt. of India, a major scheme Atal Bhujal Yojana for Groundwater is largely based on the 5th Minor Irrigation Census data. • Also, the data enumerated for surface water schemes, have provided a significant basis towards framing the scheme Repair, Renovation and Restoration (RRR) of water bodies.Further, Minor Irrigation census is also conducted for collection of details of tanks providing irrigation, which is adequately provided through MI census. • The Fisheries Department of Govt. of Kerala has expressed their keen interest in MI Census data as the information and analyses of surface

Parameter	Findings from research

	water irrigation and water bodies will help them in developing measures pertaining to pisciculture.
	• Fisheries department, Govt. of West Bengal has also expressed their interest in using the data on Water Bodies as to be enumerated during 6th MI census for augmenting measures in pisciculture.
	• Other uses of MI Census data:
	  ○ CGWB uses the MI census data for dynamic groundwater resources estimation.
	  ○ Data on type of lifting device and source of energy is also used by the CGWB
	• MI census has provided access to adequate data on MI schemes and water bodies to the panchayat, district and state authorities on area specific current status of groundwater and surface water sources. This has helped in addressing immediate and overall issues.
	• In some states like Kerala, Tamil Nadu, Bihar and Uttar Pradesh, the villagers were made aware of the groundwater problems after data analysis. However, there are no evidences of addressing such issues at village level, through framing policies and regulations pertaining to usage of groundwater for specific blocks and districts.
	• MI census has helped in strengthening intra-departmental coordination at State and District levels. Evidences of coordination between State Statistical Cell and Revenue department were narrated by State and District stakeholders from all States during KIIs. It was mentioned that support was extended by other departments like panchayat, agriculture and irrigation for providing baseline data prior to initiation of survey and also towards monitoring during the survey.
	• Computerization of Irrigation Census have led to generation of a comprehensive database and analysis of the Minor Irrigation scheme performace across the country. Adoption of IT based techniques and tools for MI Census has led to:

Parameter	Findings from research
	○ Efficient planning and decision making for development of Water Resources through consistent and consolidated information. ○ Empower end users to perform in-depth Analysis. ○ Prediction of irrigation potential/utilization and segmentation of areas through OLAP models. • NABARD has proposed investment of Rs. 2,700 Cr. for surface water minor irrigation schemes, based on the analysis of MI Census data such as revenue generated by individual farmers, their savings and their investments in Minor Irrigation schemes. • Although the analyses of MI Census has been significantly used by stakeholders at national for new schemes like Atal Bhujal Yojana and RRR and at State level for schemes like "Kaleshwaram Lift Irrigation scheme", but the area specific findings on ground and surface water are not communicated to the farmers in form of key messages.
	Inference: • As per the secondary sources and KIIs with State Stakeholders, it is evident that the policy makers at National level and State levels use MI census data for programme formulation, planning of interventions for agriculture, pisciculture, horticulture etc. • Atal Bhujal Yojana has been designed with the principal objective of strengthening the institutional framework for participatory groundwater management and bringing about behavioral changes at the community level for sustainable groundwater resources management in seven States, viz. Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh. The data and the analyses of groundwater scenario which have been derived from the Minor Irrigation Census, have been significantly used for the scheme. • MI Census data has contributed towards development of new irrigation schemes and modification of components under existing schemes. Repair, Renovation and Restoration (RRR) of water bodies was designed in 2005, based on inputs from MI census data.

Parameter	Findings from research
	• MI Census has resulted in problem identification pertaining to irrigation water sources. The dissemination of the results has helped the major stakeholders involved in irrigation to have an understanding of issues in each area. • MI census have helped in accessibility of loans from institutions like NABARD for minor irrigation to the scheme owners and farmers. • The census findings are not converted into usable knowledge for the benefit of the farming community and MI scheme owners to enable water resources planning, water budgeting, optimal usage of water resources, recycling of water, etc. • Therefore, the scheme has been rated as 'average' on this parameter.
Equity	**Secondary**: • The data tables in the MI Census report indicate that a detailed study has been made wherein the following aspects have been covered: o Ownership of MI Sources by type of farmers o Ownership of MI Sources according to land holding size o Ownership of MI sources according to caste • No gender specific analyses as well as analyses of socio-economic factors like livelihood change, migration, increased investment on health and education, etc. are included within the scope of MI census.
	Primary: • As per the responses from stakeholders, inclusion of socio-economic parameters would make the questionnaire lengthy, and therefore, it will not be advisable to include the same within the scope of MI census • Most of the state level stakeholders agreed that the issue of gender and caste / class wise interpretation of data were not considered in any MI census but suggested that the parameters can be included in the next census. • Involvement of *Patwaris* (enumerators) who are the village level revenue or agriculture field officers for MI census survey, has ensured coverage of all villages. From KIIs with district authorities of north-eastern states

Parameter	Findings from research
	like Assam, Manipur, Nagaland and Sikkim, it was understood that even hard-to-reach villages are adequately covered.
	Inference: • The MI Census captures substantial information on ownership of MI schemes by class of farmers, land holding capacities and caste. Such data provides a comprehensive picture of ownership of MI schemes as per social and economic categories. • Owing to the operational and human resource deployment plan, all villages in all states are covered. Inclusion of left out areas is ensured by comparing the baseline village list available with other departments in each state. • Impact of minor irrigation on socio-economic aspects is currently not included in MI Census. The inclusion of such parameters shall enrich the overall context of Minor Irrigation and agricultural practices. • Analyses like distribution of MI schemes as per number of MI schemes managed by WUAs, gram sabhas, local farmers' association, etc. are not being done. • Therefore, the scheme has been rated as 'average' on this parameter.

A summary analysis and performance of the scheme on the identified themes is presented below:

Table 102: IC - summary of performance evaluation using REESIE framework

Parameter	Performance
Relevance	🟢
Effectiveness	🟢
Efficiency	🟢
Sustainability	🟡
Impact	🟡
Equity	🟡

REESI+E performance infographics legend

Satisfactory Average Needs Improvement No information

Performance on cross-sectional themes

Table 103: IC - performance evaluation using cross-sectional themes

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
1.	Accountability & Transparency	• What data records are available for the scheme in public domain? • Does a robust monitoring mechanism exist and at what level? • What process / impact evaluation studies conducted in the last decade - frequency, quality, coverage, etc. • What funding mechanisms are being used? • What is the involvement of beneficiaries across the project lifecycle? • Are community institutions (e.g. WUAs) truly representative in the process?	The main objective of the Irrigation Census is to build a comprehensive and reliable database of the Minor Irrigation (MI) sector for effective planning and policy making. The major activity under the scheme is the census of Minor irrigation schemes conducted in the States/UTs covering all groundwater and surface water schemes (up to 2000 ha. command area). The Census throws light on important aspects like irrigation potential created and utilised through minor irrigation structures, water distribution practices employed by owners of these structures as well as sources used for energisation of these schemes.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			It is seen that the enumerators in most cases belong to the villages. The survey is conducted by the enumerators in consultation with the fellow farmers of the village. There are around 6.5 lakh villages in India which were covered in the 5th Irrigation Census. This indicates the massive involvement of village representatives in the enumeration process.
Summary Analysis: On account of the vastness of the Irrigation Census, a comprehensive database is developed. Reports containing various data tables throw light on major indicators pertaining to irrigation. The 5th MI census covered around 6.5 lakh villages and at least an equal number of enumerators who are the residents of the respective villages. The inclusiveness of local participation is thus significantly addressed. The entire array of data and analyses starting from the national perspective to the village level are published and shared with other departments like Water Resources, Agriculture, Forest etc. The data of 5th MI census has been used for initiating water sector schemes both at National and State levels.			
2.	Use of IT/Technology in driving efficiency	• To what extent the data collection was done through electronic data transfer? • Challenges faced in adopting new IT techniques for Irrigation Census	For the first time, online web-based software was developed for computerisation of data of the 5th MI Census by the National Informatics Centre (NIC). The real-time Progress Monitoring module enables to view the progress at the time

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			of data entry and thus help to take timely corrective action both at the Central as well as State/ UT level, thereby reducing delays. In addition, the software has different modules for data entry, data validation and data update by States/ UTs apart from tabulation and other useful reports. Integration of GIS with all MI schemes can be a challenge in terms of execution of the modules since significant capacity building of the functionaries at all levels involved in Irrigation Census will be required. There are also certain issues pertaining to data accuracy vis-a-vis location and mapping of the MI schemes. As the MI Census involves significant data collection and data mining, hence, there are instances of application of Information Technologies at National and State levels. At National level, software for

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			data tabulation and validation was introduced in 5th Minor Irrigation Census. A module was developed by MI stat wing, MoWR with support from NIC and the State Statistical Cells for all states were trained. In addition, states like Andhra Pradesh and West Bengal has developed mobile/ tab applications for data entry, wherein validation mechanisms were inbuilt. This has reduced time lag in data validation and made the tabulation process easier.

Summary Analysis:

Use of IT in MI census have evolved over time. From 4th MI census onwards, inclusion of IT applications like data entry modules and data validation modules was introduced. Remote sensing techniques and GIS was used for 5th MI census for identifying Water Bodies. Some states like Andhra Pradesh and West Bengal has applied with new IT applications. Similar initiatives may be rolled out for rest of the States to ensure error free enumeration and faster analysis.

However, there is a scope to reduce the data checking at field level, thereby introducing computer based schedules in place of paper schedules.

In addition, options of geo-tagging of all Minor Irrigation schemes may be actively considered in the forthcoming censuses. This shall ensure further data accuracy for MI schemes viz., location of the schemes and exact count.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
3.	Stakeholder and Beneficiary behavioural change	• What percent of total allocation is directed towards Awareness generation or sensitization? What is the utilization rate? and How much impact has it been able to generate in terms of behaviour change?	The scheme guidelines do not have any provision for earmarking funds for awareness generation/ sensitization. The total fund support goes not only for survey works but also for strengthening of State Statistical Cells. No state has any mechanism of disseminating the findings obtained from the analysis of Irrigation Census data. Although every state publishes state specific tabulation of data, but such representation is not shared at the grassroot level in form of key issues. The information/ issues identified through MI Census may be communicated to the communities through mediums like TV, Radio, web-based advertisements. Apart from the above, group meetings may be adopted as an effective means for disseminating the identified issues pertaining to Surface water and groundwater.
Summary Analysis:			

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
There is no earmarked fund for awareness generation and sensitization. The aspect of stakeholder and beneficiary behavioural change has remained unaddressed till date. The mechanisms for dissemination of MI Census results to the grassroot level are not available and therefore, the findings and insights from the MI Census are not able to reach the intended beneficiaries.			
4.	Development, dissemination & adoption of innovative practices, technology & know-how	• What is the impact of innovative technologies and practices on scheme and sectoral outcomes?	So far as data enumeration is concerned few states like Andhra Pradesh has shown adoption of newer techniques leading to time based enumeration and ensuring error free raw data. However, there is a scope for adoption of new techniques pertaining to data anlysis and development of insights, which as reiterated earlier can be done by involving research agencies.
Summary Analysis Adoption of new techniques in the area of data collection, validation, tabulation, analysis, report generation and dissemination (as evidenced in Andhra Pradesh and few other states) can also be replicated by other states and in other major censuses like agricultural census, population census, SECC, etc. to name a few. On the other hand, the techniques adopted for surveys like NSSO for survey planning, drawing survey schedules, fileld instructions, validation and tabulation techniques and release of reports may be referred to in case of MI Census.			
5.	Research & Development	• What percentage of total allocation (Sector as well as Scheme specific) is directed	Premiere institutes like IWMI-Tata Water Policy Programme and IASRI have strongly recommended assessment of the MI Censuses completed so

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		towards R&D? How much of that percent is being utilized? • What is status of availability of any Institute or centre or department dedicated for R&D in the Sector?	far and provided recommendations to strengthen the usability of data for future research, planning and policy making. Several researchers suggested collection of data on additional parameters like post monsoon groundwater level in the villages, energy consumption data to identify constraints for low groundwater development in Eastern and North Eastern India. In some states like Bihar and Uttar Pradesh, IITs have used the Irrigation Census data.
Summary Analysis: Premiere institutes like IWMI-Tata Water Policy Programme and IASRI have strongly recommended assessment of the MI Censuses completed so far and provided recommendations to strengthen the usability of data for future research, planning and policy making. However, not much information is available on the R&D activities that can be undertaken to improve the MI Census.			
6.	Unlocking Synergies with other Government Program	• What activities are undertaken to ensure convergence at community level? Are there any Action Plans prepared at	It has been recommended that the Agriculture Census may be dovetailed with Irrigation Census to have correlated

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		State/District/Block level to ensure the same? • What are the areas for potential convergence / synergy across govt. programs?	views on irrigation and agriculture. Agriculture Census provides detailed information on basic characteristics of operational holdings such as land-use, cropping pattern, irrigation status, tenancy and dispersal of holdings etc. The information is tabulated by different economic classes and social groups and serves as an input for development planning, socio-economic policy formulation and establishment of national priorities. The Census also provides basis for development of a comprehensive integrated national system of agricultural statistics. Agriculture Census are conducted wherein 20% of the villages are selected based on random sampling for timely reporting system. Based on the data obtained from 20 percent of the villages, tables are generated at the Taluk/District/State levels after adopting suitable estimation procedure. The estimations

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			derived out of the census can be correlated with the similar parameters / indicators as in MI census. Such analysis will lead to better insights for the policy makers and for the end users at village level.
Summary Analysis: MI census can incorporate the estimations made out of the agriculture census and come with better insights pertaining to certain common parameters like estimated irrigated and unirrigated area by size classes under different crops, estimated number of wells and tubewells by classes, estimated number of operational holdings by size classes receiving irrigation and area irrigated by different sources.			

It may be note that Minor Irrigation Census scheme being a census study, some of the CST themes viz 'Direct/Indirect Employment Generation', 'Gender mainstreaming/Inclusiveness', 'Building resilience to climate change & ensuring sustainability', 'Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population', 'Water sharing treaties/agreements & diplomacy', 'Conjunctive use of water - surface versus groundwater usage optimizations', 'Reforms, Regulations" are found to be 'not relevant' while for the themes 'Research & Development' and 'Impact on and role of private sector, community and civil society in the scheme', no information is available and hence these themes are not evaluated for this scheme.

A summary analysis and performance of the scheme on the identified themes is presented below:

Table 104: IC - summary of performance evaluation using cross-sectional themes

Parameter	Performance
Accountability & Transparency	

Parameter	Performance
Direct/Indirect Employment Generation	●
Gender mainstreaming/Inclusiveness	●
Building resilience to climate change (including but not limited to developing water disaster preparedness) & ensuring sustainability	●
Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population	●
Use of IT/Technology in driving efficiency	●
Stakeholder and Beneficiary behavioural change	●
Development, dissemination & adoption	●
Research & Development	●
Water sharing treaties/agreements & diplomacy	●
Conjunctive use of water - surface versus groundwater usage optimizations	●
Unlocking Synergies with other Government Program	●
Reforms, Regulations	●
Impact on and role of private sector, community and civil society in the scheme	●

Cross-sectional themes performance infographics legend

● High ● Medium ● Low ● Not relevant ● No information

2.2.6.3 Issues and challenges

This sub-section describes the scheme issues and challenges and their mapping with the source of information viz. primary source, secondary source and household survey (if applicable).

Table 105: IC – Issues and challenges

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
Scheme Design					
IC – F1	**Data source**	• Currently, the main sources of Minor Irrigation data are Land Use Statistics, Periodical Progress from State departments, Annual Administrative			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		Reports and Ad-hoc reports prepared by various agencies. • However, the 5th Irrigation Census Report specifies issues pertaining to collection of above-mentioned reports. Currently, the census data has use for a limited set of users. • There is scope to improve utility of the survey. The MI census scheme can be easily extended to address the needs of a larger set of stakeholders such as departments like Fisheries, Tribal Welfare (survey the MI practices prevalent in tribal areas), etc. • Key messages on area specific issues on groundwater and surface water are not disseminated to the villagers. Issues like excessive use of groundwater, depletion of groundwater table and optimisation in usage are not discussed with the farmers.			
IC – F2	**Methodology**	• As reiterated above, on one hand in some of the States the enumeration is done through canvassing of paper schedules and on the other hand there are few States who have gone "paperless" in terms of data collection. • Enumeration by manually filling up Village and Scheme schedules leaves			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		room for errors (viz., one of the states mentioned during KII that in many occasions IPC and IPU figures were mistakenly swapped while filling up the schedules, which consumes considerable time in identification and correction). • Geo-tagging of minor irrigation sources may also be done along with water bodies. This will help in identifying all such schemes and data can be digitized through uploading of all requisite details.			
IC – F3	**Data Analysis**	• Significant analyses of MI data are done and micro tables specific to even villages are available on the website for reference. • However, the analyses are limited to technical aspects of Minor Irrigation. related socio-economic parameters like migration, livelihood change, expenditure on education especially girls' education etc. can be included in the census to provide a richer contextualization of the findings from the census. • In addition, data analyses are also not done for parameters related to climate change and environment. Currently, there are no related data points in the			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		schedules designed for Irrigation Census.			
IC – F4	**Scheme integration**	• Although the scope of Agriculture Census and Minor Irrigation are quite different in many aspects with each other but there is some overlap particularly in respect of irrigation. • Also, there are no censuses for major and medium irrigation schemes. A single database having all details of Major, Medium and Minor irrigation schemes needs to be in place to provide a comprehensive assessment of the irrigation situation.			
IC – F5	**Data management**	• There exists a large body of census data on the basis of the five MI censuses that have been completed so far. • However, restoration of historical data and ability to access them is a challenge especially at district level, if data restoration, segregation and retrieving policies are not made and practised at State, District and Block level. • Village wise data sharing currently doesn't exist. Gram Panchayat wise handbooks should be made available which may contain MI scheme wise details. Individual farmers or MI scheme owners can thus get access to			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		requisite data. Such data availability at grassroot level will help in local level planning.			
IC – F7	**Dissemination of data**	• The website https://data.gov.in/ provides data and tables from MI Census. However, considering the quantum of data available pertaining to MI census, a more functional dashboard that allows for preliminary data analysis (e.g. filtering, sorting, etc.) is required. • Given that each MI Census is a time taking process that spans more than a year and data from various states comes in at different points in time, there exists a significant delay in making the census data available publicly.			
IC –F8	**Participatory Planning**	• Participatory planning process using techniques like Participatory Rural Appraisal (PRA) has proved to be a useful tool for identifying resources at village level. The scheme currently does not provide the opportunity for such exercises at village level for identifying the type and location of MI structures. • Currently, data access at panchayat samiti and village level doesn't exist. Mechanisms for availability of data at gram panchayat and village level will			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		encourage participatory planning process.			
Scheme implementation					
IC – F9	**Knowledge dissemination to grassroot level**	• Although the MI census results are being extensively used by various scheme owners of MoWR, RD & GR at National level, Water Resources Departments, Agriculture Department, Panchayat & Rural Development Department etc. at State level and district counterparts of these departments for policy formulation, scheme designing, gap analysis etc. as the census reports are widely disseminated through web, dissemination of the survey results to the village level does not happen. • A knowledge base emerging out of the survey does not percolate to the population engaged in agriculture, particularly using MI sources. • Based on the issues identified during survey, capacity building measures like hand-holding sessions with farmers on issues like cost-effective channelization and distribution of water from the source, groundwater recharge mechanisms, etc, are sufficiently not conducted at block, panchayat and village level. Transfer			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		and exchange of technology also has not happened sufficiently.			
IC – F10	**Inter-Departmental Coordination**	• Strong involvement of the Revenue department in the Irrigation Census process is evident based on the KIIs with State level stakeholders; however, departments like finance, tribal welfare, forest etc, are not usually involved. • As understood from the KIIs at State level, lack of coordination between key departments at State level exists. • The Nodal Officer and Census Commissioner face difficulties in obtaining information about MI structures existing in villages as well as other details pertaining to MI schemes like land details, ownership, source, channel details etc.			
IC– F11	**Role / Responsibility modification**	• The role of State Statistical Cell remains limited to managing day-to-day activities like monitoring of data entry progress, validation, and operational and logistical issues. • The role of the State Statistical cell is not thought beyond the current scopes. The State Statistical Cell should perform data analysis for district, block and village level. • The enumerators are considered for data collection only. The enumerators			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		are not considered for dissemination of results of the census, given the fact that they are extensively trained on the technical aspects of minor irrigation prior to the census survey.			
IC – F12	**Management of Records**	• The village schedules are normally canvassed by Patwaries through enquires from village level workers/gram pradhans and the information available from revenue or land records maintained in the office of Government authorities. • In case of institutional schemes, the information is collected through available records. • Securing access to such records to the field enumerators is a challenge and causes serious delays in data collection. • In many states, it is understood that the land records are not maintained, and the relevant details cannot be filled up in the village and scheme schedule.			
IC– F13	**Capacity Building**	• Trainings for supervisors and enumerators are organized and are imparted on the technical aspects of Minor Irrigation. • As the scope of irrigation census does not include environmental issues, the enumerators are not trained on basic aspects like vegetation, rainfall and			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		temperature and their effect on ground and surface water availability. • The trainings primarily focus on the nuances of filling up the Village and Scheme Schedules. The trainings lack on imparting knowledge on soft skills required during enumeration viz., communication skills, time management, crisis management etc.			
Monitoring and evaluation					
IC – F14	**Supervision Mechanisms**	• Significant time is spent on monitoring and supervision of the enumerations at field level. • Sample manual checking of filled up schedules and subsequent submission of supervisors' reports at Block and District level consumes time but remain prone to errors. • Some States like Tamil Nadu, Karnataka, Kerala and Assam do have mechanism of involving the panchayat samiti members in identifying coverage gaps, but other states do not have similar mechanisms.			
IC – F15	**Community involvement**	• Enumerators (Patwaris) collect data on Minor Irrigation in consultation with the local people. Usually the enumerators are the residents of the locality and hence know the presence of MI schemes in the area.			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		• The presence of local person as enumerators on one hand provides support in identification of MI sources but on the other hand leads to casual / non-systematic approach. • In such cases, involvement of villagers become less, and the ownership of such information also reduces on part of the villagers and validation of the information on MI schemes by the villagers also is not done.			
IC – F16	**Inter-Departmental Coordination**	• Baseline information on land, minor irrigation source, water bodies are provided to the State Statistical Cell by the respective departments of the states. • Coordination between various departments like Water Resources Department, Agriculture Department with State Statistical Cell during the survey does not happen at the desired level. • In some states, the technical issues pertaining to MI schemes viz., classification of MI schemes as per discharge rate, IPU, inclusion of MI schemes as per its coverage, irrigated area etc, remains unresolved which surfaces out during enumeration due to lack of coordination between the Departments.			

Issue relevance legend

	Supported		Partially supported		Not supported		Not applicable

A summary analysis of issues & challenges for the scheme is presented in the tables below.

Table 106: IC – Area-wise issues and challenges

Area	Summary of Issues and Challenges
Institutional Mechanism & Governance	The Nodal Officer and Census Commissioner face difficulties in obtaining information about MI structures existing in villages as well as other details pertaining to MI schemes like land details, ownership, source, channel details etc. The role of State Statistical Cell remains limited to managing day-to-day activities like monitoring of data entry progress, validation, and operational and logistical issues. Steering Committee at the State level provides technical guidance to the State Statistical Cell for operationalization of the survey. Apart from approval of the operational plan, issues like field visits, data dissemination to the grassroot level and agrarian population, deployment of manpower for enumeration and supervision are not sufficiently supported by the Steering Committees. In some states, such initiatives have been taken up at Block and Panchayat level but are not replicated to rest of the districts.
Fund Flow Efficiency and utilisation	As understood from the KIIs, the scheme is being supported 100% by Government of India, along with support to State Statistical Cells. Mobility support for supervisors and enumerators are also fully supported by MoWR, Govt. of India. The hilly area states have deliberated that the fund provided for enumeration is insufficient as in many cases, transport to certain areas are difficult and expensive. Further, in few cases, delayed fund flow within the State remains as an issue and is one of the causes for time lag in enumeration.

Area	Summary of Issues and Challenges
Unavailability of resource persons	The role of the State Statistical cell is not thought beyond the current scopes. The State Statistical Cell should perform data analysis for district, block and village level.
Monitoring and evaluation	The presence of local person as enumerators on one hand provides support in identification of MI sources but on the other hand leads to casual / non-systematic approach. Less involvement of panchayat samiti, Water Users Association, local CBOs is noted as evident from the KIIs. In some cases it is felt that, lack of involvement of NGOs and CBOs hampered the process with respect to time and coverage. The issues generating out of the survey analysis are also not discussed in a widespread manner. GIS-based applications are already being used for census of water bodies, which has immensely helped in correct identification of sources as well as capturing physical attributes like location, area, etc. On the other hand, except Andhra Pradesh and West Bengal, none of the states has adopted web-based application for Census of minor irrigation sources. Software based monitoring will lead to less error and will save time and generate more accurate analyses.
Capacity building	The trainings primarily focus on the nuances of filling up the Village and Scheme Schedules. The trainings lack on imparting knowledge on soft skills required during enumeration viz., communication skills, time management, crisis management etc. A knowledge base emerging out of the survey does not percolate to the population engaged in agriculture, particularly using MI sources. Given the fact that the enumerators have been extensively trained on the technical aspects of minor irrigation sources, their enhanced capacities are not used for knowledge transfer to farmers and minor irrigation (MI) scheme owners, leading to better management of MI schemes.
Operational efficiency	A single database having all details of Major, Medium and Minor irrigation schemes needs to be in place to provide a comprehensive assessment of the irrigation situation.

Area	Summary of Issues and Challenges
	Unavailability of key records during enumeration. and the relevant details cannot be collected thus resulting in information gap. The chain of interventions undertaken in course of Irrigation Census do not include dissemination of key messages to the farmers on local issues identified pertaining to ground and surface water. There is a need for publishing area-specific analysis starting from district till village level issues.

Table 107: IC - summary of issues and challenges

Parameter	Performance
Institutional Mechanism & Governance	🟢
Fund Flow Efficiency and utilisation	🟡
Unavailability of resource persons	🟡
Monitoring and evaluation	🟢
Capacity building	🟢
Operational efficiency	🟡

Performance infographics legend

🟢 Satisfactory 🟡 Average 🔴 Needs Improvement

2.2.6.4 Recommendations and solutions

This sub-section describes the scheme recommendation and solutions from the perspective of scheme design, scheme implementation and monitoring & evaluation, along with their mapping with the issues and challenges described in the preceding sub-section.

Table 108: IC – recommendations and solutions

Sl.no	Recommendations	Finding
Scheme design		

Sl.no	Recommendations	Finding
IC -R1	• The MI census should be designed to include newer parameters that cover the needs of other departments like Fisheries, Tribal Welfare, MSME, etc. The data tabulation modules should also enable other such users to customize fields and view micro-tables as per their requirement**.**	IC -F1
IC -R2	• The enumeration process for MI census should be mandatorily computerized with validation modules integrated with the Village and Scheme Schedules. This would help enumeration process data error free and in addition shall save time in validation of numeric fields. Errors pertaining to other fields such as village name, location can be avoided entry if geo-tagging is adopted. • Integration of MI schemes with GIS applications as done for census of water bodies, will help in correct identification of such sources and collation of area-wise MI schemes can be automated, thereby saving time on checking.	IC-F2
IC-R3	• Although significant analyses are done on technical parameters of Minor Irrigation, but analysis of socio-economic parameters likes migration, livelihood change, cost benefit analysis of the MI schemes, expenditure on education etc. should be included in the next Census Report. Such additional reports would help social scientists, researchers, Welfare departments to design schemes or include components pertaining to above-mentioned aspects into the existing schemes.	IC-F3
IC-R4	• The scope of Irrigation Census should be expanded to cover Major, Medium, Minor and especially Micro-irrigation. Such a comprehensive census of all types of irrigation schemes in India would provide a better scenario of irrigation status as whole. Data points like IPC, IPU, CCA, etc. would provide the macro picture. In such scenario the schedule designing, database and table modules need to be modified appropriately.	IC-F4

Sl.no	Recommendations	Finding
IC- R5	• A dashboard should be developed to present the census data that is currently available on the website of MI Stat Wing. The dashboard should contain real-time progress of enumeration and supervision process, newer initiatives by the States, infographics on major indicators and indexes and basic data analyses facility.	IC – F7
IC – R6	• Assessment of number of MI schemes by types should be done before initiation of the survey. The assessment should be done by the villagers through PRA techniques like resource mapping, transect walk and should provide a basis for updating of Village and Block level records available for MI schemes. Alternatively, independent agencies may be engaged to conduct pre-survey assessments. Such initiatives can ensure complete coverage of the schemes.	IC – F8
Scheme implementation		
IC – R7	• The enumeration process can be mandatorily be done electronically with help of applications on mobiles and tabs. This will help in reducing data losses, data capturing errors and reducing time in transmitting data from village level to subsequent higher levels. Such practice has already been adopted by states like Andhra Pradesh (Ref: case study of Andhra Pradesh – Primary findings under effectiveness of Irrigation Census) • Dissemination of MI census results to block and village level should be ensured. It is understood that although village level analyses are made and tables are made available on websites, but dissemination of findings for major indicators viz., net cropped area for the current MI census in comparison to net cropped area during previous MI census to the farming community is important. The dissemination of the findings may be done through multiple channel (e.g. GP notice board, mobile phones, public advisory, etc.). Strategy for IEC on Minor Irrigation should be developed and disseminated to the	IC – F9

Sl.no	Recommendations	Finding
	village level. Village level meetings should mandatorily discuss the usage of groundwater and ways to replenish the same.	
IC –R8	• The State Statistical Cell should be empowered to perform customized tabulation of data and Statistical analyses at the level of Blocks and Villages. This would help in reducing the overload of analyses at National level. The local level analyses to be collated at District level and analysis of major indicators, display of results should be made available at that level and subsequent below that level.	IC – F11
Monitoring and evaluation		
IC –R9	Formation of village level committee for monitoring the collected data and supporting the Patwaris should be considered. A village level committee may be constituted in each village having representatives of local panchayat samitis, water users' associations, local clubs, CBOs. The village committee will help the enumerators to identify each MI schemes and water bodies and also may verify the schedules and the information collected therein. Upon approval by the village committees the enumerator can submit the schedules to subsequent higher level for further validation and data entry.	IC – F15

Case Study -I

Title: Web based application for Irrigation Census data collection and data validation

Context: Sound database is extremely significant for effective execution of irrigation policies and planning. Insufficient and disaggregated data had caused impediment in carrying out requisite analyses. Minor Irrigation schemes in India are large in number and the data generated at field level are collected through manual canvassing of paper schedules. As a result, it was realized that, inadvertent delays and errors are caused during validation and tabulation of data. On account of the massive importance of MI census data in terms of its applicability by various important government agencies like MoWR, CWC, CGWB, Water Resources Departments at State level for framing policies pertaining to appropriate usage of groundwater and rejuvenation of the

sources, a need for having web-based application for accuracy and quick processing of data was understood by the MI Stat wing, MoWR. After adopting the system, certain advantages like elimination of duplicate entries, timeliness, need based generation of tabulated data, archiving of historical data were realized.

Implementation Details: National Informatics Centre (NIC) was requested to develop a software meeting the above-mentioned requirements. The work was adequately taken up by all States and extended to the districts, wherein manpower and/or agencies were appointed for data entry. In 5th MI census, a web-based software was created for the first time wherein, three different schedules for data entry namely, village schedule, groundwater schedule and surface water schedule were introduced. For 6th MI census and 1st Census of Water Bodies, five schedules viz., village schedule, groundwater schedule, surface water schedule, urban schedule and the water body schedule, were incorporated for web-based data entry. The reliability of the data was checked through sample checks by the supervisors. In order to ensure data accuracy, timely tabulation of data and analysis, the software that was developed had following features:

- User friendliness
- Data verification ability
- Modules for data tabulation
- Data dissemination through websites
- Inbuilt models for identifying trends like pattern
- Decision Support System with Query Module

The overall objective of the project was to gather the correct data and process for different purposes. The databases collected from all States/UTs have been merged for making a National level database and several reports have been generated. The application has been divided into three modules based on their functionality i.e. Data Entry Module, Abstract Creation and Decision Support System (DSS). The objective of Data Entry Module is to gather the validated base/enumerated data. Abstract Creation Module will process these data (base/enumerated data) for generating a database that will be used by Decision Support System. DSS Module will generate all types of reports, queries and provide useful information.

Impact: Minor Irrigation Schemes are environment friendly and provide gainful employment opportunities to the rural population, resulting in optimum utilization of resources. This also contributes to rural economic growth and plays an important role in increasing agricultural production to meet the needs of the growing population. In the States these schemes are being

implemented by many departments/organizations like Agriculture, Rural Development, Irrigation, and Social Welfare. At the Central level also, several departments have been implementing programmes on minor irrigation. The government has been instrumental in providing credit to farmers for the development of minor irrigation through Commercial Banks, Regional Rural Banks, Co-operatives and National Bank for Agriculture & Rural Development (NABARD).

The major impacts that has happened due to wide application of the web-based software are:

- Efficient planning and decision making for development of Water Resources through consistent and consolidated information.
- Empowerment of end users to perform in-depth analysis
- Prediction of irrigation potential utilization and segmentation of areas through Online Analytical Processing (OLAP) models.

2.2.7 Servicing of Loans from NABARD under PMKSY

The Long Term Irrigation Fund (LTIF) was announced in 2016-17 for financing 99 projects undertaken under Accelerated Irrigation Benefits Program (AIBP) including Command Area Development and Water Management (CADWM). Subsequently, funding for other projects such as the Polavaram project in Andhra Pradesh, North Koel project in Bihar and Jharkhand, Relining of Sirhind Feeder and Rajasthan Feeder Canal in Punjab and Rajasthan and Shahpur Kandi Dam was taken up under LTIF.

Under the scheme, National Bank for Agriculture and Rural Development (NABARD) provides loans towards Central and State shares for AIBP with a tenure of 15 years. The Central Share is provided to National Water Development Agency (NWDA) whereas the loan towards State Share is availed by the State Governments.

Loans towards Central share are entirely funded through Extra Budgetary Resources in the form of Government of India fully serviced bonds. The State shares are funded through borrowings from the market. The loans are extended to State Governments at 6% per annum and the difference between the cost of fund for NABARD and 6% is compensated by Government of India through interest subvention.

The total amount of loan sanctioned until March 2020 was Rs. 81,865 Cr. (53% for central share, while remaining for state share) while the total disbursement was Rs. 44,719 Cr. (52% for central share while remaining for stare share). During 2019-20, the GoI allotted Rs. 1,994 Cr. for servicing of loans from NABARD under PMKSY.

2.2.7.1 Background

The key objective of the AIBP schemes was to provide additional funds in the form of CA to states implementing Major and Medium Irrigation projects to expedite the completion of the project works. Since its inception in October 1996, the government has adopted various funding arrangements for AIBP in the form of Central Loan Assistance and grants. However, a large number of projects taken up under AIBP have witnessed slow progress or were stalled owing to financial constraints. Large amount of investments in the projects were lying idle.

In view of this, in 2016-17 the government announced creation of dedicated Long Term Irrigation Fund (LTIF) in NABARD with an initial corpus of Rs. 20,000 Cr. to bridge the resource gaps in identified projects under PMKSY-AIBP (including CADWM). To make the loans under LTIF attractive for states, it was envisaged to extend funds to both Centre and States at 6% (inclusive of 0.6% margin to NABARD) during the entire borrowing period. Interest on Central share is to be paid in quarterly instalments over 15 years, whereas the principal amount is to be repaid at the end of 15 years as a bullet repayment; the interest during moratorium period shall also be serviced by NWDA.

During 2016-17 and 2017-18, loans were extended to both Centre and State at 6% per annum, which were funded through resources raised directly by NABARD and Extra Budgetary Resources (EBRs) serviced by GoI. While from April'18 onwards, loans extended to Centre was entirely funded through EBRs by GoI through fully serviced bonds while for loans extended to States, the GoI compensated NABARD the difference between actual cost of mobilizing funds and the lending cost of 6% per annum through Interest Subvention scheme.

2.2.7.2 Performance

The 99 AIBP projects were initially conceived to be completed by December 2019 at an estimated balance cost of Rs. 48,546 Cr. (as on March.2016), which was revised to Rs. 73,348 Cr. (as on

March 2016). It may be noted here that the aforementioned cost is exclusive of the cost for CADWM works of these projects, which was initially estimated to be Rs. 29,049 Cr. (as on March 2016). As on March 2020, for the 99 AIBP projects (along with CADWM projects), loan to the tune of Rs. 70,943 Cr. (Rs. 32,588 towards Central Share and Rs. 38,355 Cr. towards State Share) has been sanctioned. Out of which around Rs. 36,335 Cr. (51% of the sanctioned amount) has been released (Rs. 13,209 towards Central Share and Rs. 23,126 Cr. towards State Share).

State-wise details of loan sanctioned and disbursed under NABARD for PMKSY-AIBP and the other four projects is stated below.

Table 109: LTIF – loans sanctioned and released till March 2020[232]

State	Loan Sanctioned (in Rs.Cr.)		Loan released as percentage of sanctioned	
	Central share	State Share	Central share	State Share
Andhra Pradesh	425	514	22%	95%
Assam	195	0	2%	0%
Bihar	240	0	55%	0%
Chhattisgarh	166	80	34%	0%
Goa	18	0	0%	0%
Gujarat	8159	3611	67%	100%
Jammu & Kashmir	57	0	59%	0%
Jharkhand	1847	518	41%	100%
Karnataka	1837	0	51%	0%
Kerala	49	0	0%	0%
Madhya Pradesh	3538	2863	21%	35%
Maharashtra	4628	18021	31%	57%
Manipur	310	390	66%	54%
Odisha	1752	5612	70%	48%
Punjab	144	0	36%	0%
Rajasthan	1085	314	36%	74%
Telangana	3479	0	15%	0%
Uttar Pradesh	4662	6431	25%	64%
Sub-Total	**32588**	**38355**	**41%**	**60%**
Polavaram	8232	0	93%	0%
North Koel Reservoir	1379	0	48%	0%

[232] https://www.nabard.org/content1.aspx?id=655&catid=8&mid=488 (accessed on 11th July 2020)

Shahpurkandi Dam	485	0	12%	0%
Relining of Sirhind Feeder and Rajasthan Feeder	826	0	0%	0%
Gross-total	**43510**	**38355**	**50%**	**60%**

Performance on REESI+E framework

Table 110: LTIF – performance evaluation using REESIE framework

Parameter	Findings from research
Relevance	**Secondary:** • The scheme's objectives indirectly aim to address the following Sustainable Development Goals: o SDG Goal 2 – hunger o SDG Goal 6 – clean water and sanitation o SDG Goal 10 – reduced inequalities • The scheme aims at faster completion of ongoing MMI projects through financing of prioritized projects which in turn is expected to address the below challenges: o Food security challenges – food grain production in 2016 stood at 255 MMT against estimated requirement of 291 MMT in 2025 and 450 MMT in 2050 o Inaccessibility to assured irrigation: in 2016, Ultimate Irrigation Potential (UIP) was 140 mha while Irrigation Potential Created (IPC) is 113 mha[233]. The 99 Priority AIBP projects on completion shall help in creating 76.03 lakh ha of irrigation potential o Doubling of farmers' income by 2022 in line with the Central government target • Large number of major and medium irrigation projects under AIBP were stalled due to inadequate provision of funds leading to locking up of

[233] Data shared by DoWR,RD&GR

Parameter	Findings from research
	funds already invested in the stalled projects. Since its inception in 1996-97, 297 irrigation/multipurpose projects were included under AIBP, out of which only 143 projects (48%) got completed leading to an irrigation potential creation of 24.39 lakh ha only under AIBP up to March 2014, while the overall potential creation through all AIBP schemes up to March 2014 is 80.6 Lakh Ha. Total CA/ grants to the states for these projects was Rs. 56,068 Cr.[233] up to March 2016. • In 2016-17, 99 AIBP projects were incorporated under PMKSY to expedite their completion. The Ultimate Irrigation Potential (UIP) of 99 projects prioritized during 2016-17 is 76 Lakh Ha out of which 41.39 lakh Ha was created up to March 2016 and target balance potential was 34.63 Lakh Ha. All the projects were expected to be completed by December 2019 (currently extended to March 2023) at an estimated balance cost of Rs. 48,546 Cr. (as on March 2016) (out of which balance CA admissible was Rs. 16,818 Cr. while the state share was Rs. 31,728 Cr.). Rs. 73,348 Cr. is the revised balance cost of these projects (as on March 2016). It may be noted here that the above-mentioned cost is exclusive of the cost for CADWM works of these projects which was initially estimated to be Rs. 29,049 Cr. (as on March 2016). • Thus, the budget requirement of Rs. 73,348 Cr. over 5 years translates into around Rs. 14,700 Cr. per year which is roughly four times the expenditure incurred of Rs. 3,650 Cr. per year[234] during the last two decades (1996-2016).
	Primary: Discussions with the key informants like Directors (Monitoring & Appraisal) CWC regional offices, Chief Engineers, Superintending Engineers and equivalents from State Government departments provided the following insights in relation to relevance:

[234] https://archive.indiaspend.com

Parameter	Findings from research
	• Many of the projects were languishing owing to inability of the states to match the Centre's share, particularly in states with higher number of ongoing irrigation projects like Maharashtra (where, as on May 2020, 313 irrigation projects are going on with fund requirement to the tune of Rs. 1.09 lakh Cr., of which the state government allotted Rs. 10,235 Cr. to the water resources department[235]) and north-eastern states like Assam and Manipur. • Thus, extra-budgetary resources become necessary for timely completion of these projects.
	Inference: • Introduction of additional financing scheme like LTIF is a well-conceived and much-needed step by the Ministry to resolve the chronic issue of funding constraints affecting completion of MMI projects.
Effectiveness	**Secondary:** **Scheme design** • Central share financed through NABARD loan is 15 year tenor loans - interest on Central share is to be paid in quarterly instalments over 15 years, whereas the principal amount is to be repaid at the end of 15 years as a bullet repayment; the loans are funded by extra budgetary resources raised by fully serviced GOI bonds • State share financed through NABARD loan entails 15 years tenor at 6% interest; loans are funded through market borrowings by NABARD. Ministry of Finance bridges the interest gap between actual cost and borrowing rate. • Proposals from NWDA are sent to 'Sanctioning Committee for loans under LTIF' for sanction; the sanctioning details are generally communicated to NWDA with copies to DoWR/ Mission

[235] https://indianexpress.com

Parameter	Findings from research
	• NWDA executes Demand Promissory Note (DPN) in favour of NABARD for each loan disbursement separately **Scheme implementation** • As on March 2020, for the 99 AIBP projects, loan to the tune of Rs. 70,943 Cr. has been sanctioned. Out of which around Rs. 36,335 Cr. (51% of the sanctioned amount) has been released (Rs. 13,209 towards Central Share and Rs. 23,126 Cr. towards State Share). • These loans were instrumental in completing 44 projects out of the 99 projects resulting in additional irrigation potential creation of 4 lakh ha, during the period from 2016-17 to March 2020. Out of the Rs. 6,230 Cr. expenditure during 2016-20 for these 44 completed projects, around Rs. 3,259 Cr. was released as state share through NABARD loans. In addition to these funds, NABARD financing was drawn upon for the Centre share released. • 9 out the 18 states availed loans through NABARD during the period 2016-2020. Notably, these 9 states together account for more than 80% the target balance potential of around 35 lakh ha; thus all the states with higher targets and higher budget requirements have availed this fund (total estimated cost of balance cost of projects in these 9 states as on March 2016 was Rs.60,866 Cr.) **Monitoring and evaluation** • On Dec'19, the finance ministry (GoI) announced a proposal to create a high-level committee to monitor the funds allotted to projects under LTIF • As part of social monitoring, state government needs to put up engraved plaques at critical sites across project indicating physical and financial details of the project financed • Soon after a project is sanctioned by NABARD, NWDA shall submit to NABARD a PERT/BAR/CPM Chart to facilitate proper monitoring and review • NWDA shall also furnish information to NABARD half-yearly on physical progress of projects

Parameter	Findings from research
	• NABARD has a right to inspect projects on a random basis; in case NABARD finds non-satisfactory project progress it may stipulate appropriate conditions in consultation with DoWR
	Primary: **Scheme implementation** • Most of the informants across selected states (particularly Andhra Pradesh, Maharashtra and Manipur) confirmed that loans through NABARD has been a life-line and has greatly streamlined the fund flow. This funding mechanism has greatly resolved the issue of states' inabilities to match central's releases. **Monitoring and evaluation** • A rigorous monitoring mechanism has been set up through NWDA, CWC, online MIS portal and third-party monitoring through WAPCOS. Monitoring mechanisms may be further improved through continuous monitoring of the expenditure incurred by the states out of the funds disbursed through NABARD. A real-time view of the fund utilization will help to ensure better planning and allocation of resources (currently, Ministry is apprised of the unspent balance lying with the states, only when the states send proposals for second instalment). • Most of the informants from states (selected on random basis) like Andhra Pradesh (Gundlakamma, Musurumulli and Pushkara LIS projects), Assam (Borolia and Champamati projects), Maharashtra (Dhom Balkaawadi project) when enquired about social audit replied in the negative.
	Inference: • The LTIF fund (through NABARD loan) has been instrumental in expediting many of the projects particularly in states with higher targets and financial burden (like Maharashtra, north-eastern states, etc.) • Social monitoring is found to be inadequate in most of the states (selected on a random basis); though its needs to be further validated at other states before generalization.

Parameter	Findings from research
	Therefore, the performance of the scheme in terms of effectiveness is 'satisfactory', with scope for improvement in monitoring and evaluation (particularly in fund utilization and social audit).
Efficiency	**Secondary:** • Loans are extended under LTIF at interest rate of 6% per annum during 2016-17 including 0.6% margin of NABARD • LTIF Interest Fluctuation Reserve Fund has been created to credit/ reimburse the difference between actual weighted average cost of mobilization of funds and actual lending rate • In case of delayed receipts of budgetary commitments into LTIF, central government has to compensate NABARD depending on the cost of market borrowings by NABARD • In the event of default by NWDA in honouring payment obligations, central government has to pay NABARD the same on a priority basis within 15 days from receipt of requisition • In case of default in payment of principal on respective due date, NWDA has to pay an additional interest of 1%.
	Primary: • Most of the informants validated timely availability of funds through NABARD, which expedited the project completion. It is being reported that funds for both central and state shares under LTIF have been made readily available, where proposals are approved. (It may also be noted that timely availability of funds was one of the main factors that facilitated the faster completion of projects and potential creation under PMKSY-AIBP compared to previous years; annually 11 projects have been completed and around 5.3 lakh ha of irrigation potential created since 2016-17, compared to previous records of 7 projects and 4.5 lakh ha.) However, in some states, due to certain externalities, mainly land acquisition and R&R issues, a few of the projects got stalled/ delayed. In such cases, as reported, a significant sum (disbursed through

Parameter	Findings from research
	NABARD) may be lying unspent. As on March 2019, a total of Rs. 1,847 Cr. was lying unspent with 6 states viz Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh, out of which three projects viz Tarakaram Teertha Sagaram project in Andhra Pradesh (with unspent balance of Rs. 218 Cr.), Gosikhurd in Maharashtra (with unspent balance of Rs. 288 Cr.) and Madhya Ganga Canal Ph-II project in Uttar Pradesh (with unspent balance of Rs. 735 Cr.) account for Rs. 1,241 Cr. i.e. 67% of the total unspent funds across states.
	Inference: • Most of the informants confirmed timely availability of funds through NABARD, which facilitated timely execution of project works. However, in a few cases where execution got stalled/ significantly delayed, a re-think on utilization of the funds (disbursed through NABARD) lying unutilized is warranted. • Based, on the above finding on timely availability of funds, the performance of the scheme is termed as 'satisfactory'.
Sustainability	**Primary:** • As reported during KIIs, sustainability of the scheme is not an issue, considering irrigation has been a priority sector for the government and as on March 2020, a total of Rs. 70,943 Cr. has already been sanctioned under LTIF for AIBP and CADWM schemes; out of which the withdrawal has been Rs. 36,335 Cr. only (i.e. 51% of the sanctioned amount.). Thus, availability of funds for disbursal is not an issue. • Also, serving of loan by states is not an issue considering the interest rate payments (at the subsidized rate of 6%) have to be made quarterly while the principal may be re-paid as a bullet payment at the end of 15 years.
	Inference: • Sustainability of the scheme in terms of fund availability and servicing of loans, is not as issue. Considering that irrigation is a priority sector, Rs. 70,943 Cr. has already been sanctioned under LTIF, out of which the

Parameter	Findings from research
	withdrawal has been 51% only. Also, loan servicing needs to be done through quarterly financial payments and principal as bullet payment at the end of 15 years; the interest rate at 6% is a cheaper option for the states compared to many other fund sources. Therefore, the performance of the scheme under sustainability has been termed as 'satisfactory'.
Impact	• Since the main objective of the scheme is to expedite the completion of the PMKSY-AIBP projects, performance of the scheme under 'impact' has been rated same as that of AIBP in one of the earlier sections..
Equity	• Since the main objective of the scheme is to expedite the completion of the PMKSY-AIBP projects, performance of the scheme under 'equity' has been rated same as that of AIBP in one of the earlier sections.

Table 111: LTIF – summary of performance evaluation using REESIE framework

Parameter	Performance
Relevance	●
Effectiveness	●
Efficiency	●
Sustainability	●
Impact	●
Equity	●

REESI+E performance infographics legend

● Satisfactory ● Average ● Needs Improvement ● No information

Performance on cross-sectional themes

Table 112: LTIF – performance evaluation using cross-sectional themes

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
1.	Accountability & Transparency	Availability of Data Records and Reports in public domain • What data records are available for the scheme in public domain?	• Figures for loans sanctioned and loan disbursed for Central and State shares are available in the NABARD portal • There is a scope for publicly disclosing the figures for funds lying unutilized with the states for greater accountability.
		Monitoring Mechanisms • Does a robust monitoring mechanism exist and at what level?	• On Dec'19, the finance ministry (GoI) announced proposal to create a high-level committee to monitor the funds allotted to projects under LTIF • As part of social monitoring, state government needs to put up engraved plaques at critical sites across project indicating physical and financial details of the project financed • Soon after a project is sanctioned by NABARD, NWDA shall submit to NABARD a PERT/BAR/CPM Chart to facilitate proper monitoring and review • NWDA shall also furnish information to NABARD half-yearly on physical progress of project • NABARD has a right to inspect projects on a random basis; in case NABARD finds non-satisfactory project progress it may stipulate

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			appropriate conditions in consultation with DoWR
		Financial Accountability • What funding mechanisms are being used?	• Central share through NABARD loan comprises 15 years tenor loans - interest on Central share is to be paid in quarterly instalments over 15 years, whereas the principal amount is to be repaid at the end of 15 years as a bullet repayment; the loans are funded by extra budgetary resources raised by fully serviced GOI bonds • State share through NABARD loan entails 15 years tenor at 6% interest; loans are funded through market borrowings by NABARD. Ministry of Finance bridges the interest gap between actual cost and borrowing rate. • LTIF Interest Fluctuation Reserve Fund has been created to credit/ reimburse the difference between actual weighted average cost of mobilization of funds and actual lending rate • In case of delayed receipts of budgetary commitments into LTIF, central government has to compensate NABARD depending on the cost of market borrowings by NABARD

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			• In the event of default by NWDA in honouring payment obligations, central government has to pay NABARD the same on a priority basis within 15 days from receipt of requisition • In case of default in payment of principal on respective due date, NWDA has to pay an additional interest of 1%
Summary Analysis: • Figures for loans sanctioned and disbursed under LTIF (for both Central and State shares) are publicly available. There is a scope for further improving accountability and transparency through public disclosure of utilization rate of the funds already disbursed to states. • In respect to monitoring, during primary survey practice of social monitoring (/ audit) was found to be non-existent at many of the sampled states.			

It may be noted that main objective of LTIF is to provide adequate funds for the PMKSY AIBP and CADWM projects; hence except for 'accountability and transparency' the other CST themes are found to be 'not relevant'.

A summary analysis and performance of the scheme on the identified themes is presented below:

Table 113: LTIF – summary of performance evaluation using cross-sectional themes

Parameter	Performance
Accountability & Transparency	●
Direct/Indirect Employment Generation	●
Gender mainstreaming/Inclusiveness	●

Parameter	Performance
Building resilience to climate change (including but not limited to developing water disaster preparedness) & ensuring sustainability	●
Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population	●
Use of IT/Technology in driving efficiency	●
Stakeholder and Beneficiary behavioural change	●
Development, dissemination & adoption	●
Research & Development	●
Water sharing treaties/agreements & diplomacy	●
Conjunctive use of water - surface versus groundwater usage optimizations	●
Unlocking Synergies with other Government Program	●
Reforms, Regulations	●
Impact on and role of private sector, community and civil society in the scheme	●

Cross-sectional themes performance infographics legend

● High ● Medium ● Low ● Not relevant ● No information

2.2.7.3 Issues and challenges

This sub-section describes the scheme issues and challenges and their mapping with the source of information viz. primary source, secondary source and household survey (if applicable).

Table 114: LTIF – issues and challenges

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
Scheme design					
LTIF -F1	**Coverage**	• Current loans under LTIF are sanctioned and disbursed for all the projects (out of the 99 Priority Projects) for which			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH
		proposals are received for the AIBP and CADWM components. However, though there is a rigorous monitoring mechanism to expedite project execution, yet a considerable sum to the tune of Rs. 1,847 Cr. (which has been disbursed to states) is lying unspent with the states owing to stalling/delay of projects due to mainly issues like land acquisition and R&R. Notably, Rs. 1,241 Cr. (i.e. 67% of the total unspent amount across states) is lying unspent in three of the projects.			
Scheme implementation					
LTIF -F2	**Monitoring and evaluation**	• Figures for 'utilization of funds disbursed under LTIF to the states' are not publicly disclosed.			
LTIF -F3		• The provisions of social monitoring were found to be not adequately implemented in many of the states (selected on random sampling basis). As part of social monitoring, the scheme guidelines mandate public disclosure of the basic details of the project, awareness generation among beneficiaries and putting up of 'engraved plaques' at critical sites indicating physical and financial progresses.			

Issue relevance legend

	Supported		Partially supported		Not supported		Not applicable

A summary analysis of issues & challenges for the scheme is presented below:

Table 115: LTIF – summary of issues and challenges

Parameter	Performance
Institutional Mechanism and governance	●
Fund flow efficiency and utilization	●
Monitoring and evaluation	●

Performance infographics legend

● Satisfactory ● Average ● Needs Improvement

2.2.7.4 Recommendations and solutions

This sub-section describes the scheme recommendation and solutions from the perspective of scheme design, scheme implementation and monitoring & evaluation, along with their mapping with the issues and challenges described in the preceding sub-section.

Table 116: LTIF – recommendations and solutions

Sl.no	Recommendations	Finding
Scheme design		
LTIF -R1	**Provisions for ensuring optimal utilization of unspent balances lying in some projects** • Provisions under LTIF can be introduced to optimally utilize the unspent funds (already disbursed through LTIF) lying idle in projects stalled/ significantly delayed due to externalities like land acquisition, R&R and other chronic issues. Some of the suggested approaches are listed below: o To reduce the exposure risks to externalities, guidelines may be developed to disburse the funds to states in	LTIF -F1

Sl.no	Recommendations	Finding
	several tranches (instead of a single lump sum) based on utilization of previous tranche; however in such cases adequate provisions need to be built in so as to streamline the procedure between proposal/ application (by state) and release of funds (from NABARD) to avoid any inadvertent delays ○ In case of funds lying unspent in a particular project for more than a defined time period, the amount should be returned to NWDA/ NABARD who may then disburse it to another PMKSY-AIBP project in that or other states	
Monitoring and evaluation		
LTIF -R2	Figures for disbursal and utilization of funds under LTIF to states is proposed to be made available in public domain to bring in more transparency and accountability; it may be linked to the AIBP MIS Dashboard	LTIF -F2
LTIF -R3	**Include stricter norms for social monitoring** • Stricter norms may be introduced to ensure social monitoring by linking subsequent disbursals with performance of social monitoring	LTIF -F3

2.2.8 National River Conservation Plan

Water pollution is one of the biggest issues facing India right now. As may be evident, untreated sewage is the biggest source osf such form of pollution in India due to rapid urbanization, industrialization and increase in population. There are other sources of pollution such as runoff from the agricultural sector as well as unregulated unit that belongs to small scale as well as large scale industries. The situation is so serious that perhaps there is no waterbody in India that is not polluted to some extent or the other. In fact, it is said that almost 80% waterbodies in India are highly polluted. The Comptroller and Audit General (CAG) in India has expressed deep concerns over the high pollution levels in river water and noted that almost all rivers are fed with huge waste from industries as well as urban local bodies (Source: The Hindu, 15th Feb 2015).

Rivers may be polluted from both point and non-point sources. Among the total measurable pollution in the rivers from point sources, 75% can be attributed to municipal sewage generated from towns situated along riverbanks and remaining 25% from industrial effluents. Major point sources of pollution include:

- Domestic sewage: In urban areas, about 70-80% of water supplied for domestic purpose drains out to nearby water bodies through municipality drain or nallah without treatment which causes pollution.
- Industrial effluents: This is an area of concern for river water and other water bodies due to the higher concentration of the pollutants and complex profile owing to the presence of chemical, metals and other toxic materials. Industrial effluent contains heavy metals like lead, zinc, mercury etc. and harmful bacteria and virus which contaminates the river water.
- Agricultural effluents: The use of various types of fertilizers, pesticides and insecticides in agriculture causes water pollution and these effluents are directly discharged without treatment into water bodies causing river water pollution.

Apart from the above-mentioned sources, there are other non-point sources of pollution such as runoff from solid waste dumps, agricultural run-off, areas used for open defecation, dumping of un-burnt/ half burnt bodies, animal carcasses, dhobi ghats, cattle wallowing etc.

There are 12 major river basins and 46 medium river basins in India. The Central Pollution Control Board (CPCB) in association with the State Pollution Control Board (SPCB) monitors the water

quality of rivers, lakes, ponds, tanks and other water bodies across the country through a network of monitoring stations under the National Water Quality Monitoring Programme. A survey was carried out by CPCB on the sewage generation of Class I & Class II towns of the country and the capacity required for treatment of the generated sewage. As per the CPCB report published in March 2015, it was estimated that around 61,948 million litre per day (MLD) sewage is being generated from these towns and the treatment capacity available against this was only 23,277 MLD from 816 STPs. The CPCB also has been carrying out studies on the status of pollution of the rivers and as per the latest study, 351 polluted river stretches have been identified on 275 rivers across the country.

2.2.8.1 Background

The Central Government started the river pollution abatement programme with the launching of the Ganga Action Plan (GAP) Phase I in the year 1985 as a 100% centrally funded scheme with the objective to improve the water quality of river Ganga to acceptable standards as set by CPCB. Under GAP Phase I, pollution abatement works were taken up for 21 Class I towns of Uttar Pradesh, Bihar & West Bengal. The Phase I was completed on 31st March 2000 at a cost of Rs. 451.70 Cr.

The Ganga Action Plan (Phase II) was launched in 1993 and the scheme was extended to river Yamuna, Gomti & Damodar, the major tributaries of river Ganga. This action plan covered the pollution abatement works of 95 towns along the polluted stretches of 4 rivers spread over 7 states with an approved cost of Rs. 1498.96 Cr. on a 50:50 cost sharing basis between Centre & State Government.

Later, it was felt that the river pollution abatement programme needs to be expanded to the other major rivers of the country and hence, in 1995 all river conservation works were carried out under the aegis of the National River Conservation Plan (NRCP) with an approved cost of Rs. 772.08 Cr. on a 50:50 cost sharing between Centre & State Government. Accordingly, the then Ganga Project Directorate was converted to National River Conservation Directorate (NRCD) for servicing the National River Conservation Authority and Steering Committee. Initially the mission covered 46 towns along the polluted stretches of 18 rivers spread over 10 states. Finally, in

December 1996, GAP Phase II was merged with NRCP and all projects for river cleaning in the country was brought under one umbrella scheme of NRCP.

From August 2014 onwards, all works related to Ganga and its tributaries was transferred to Ministry of Water Resources, River Development and Ganga Rejuvenation (MoWR, RD & GR). The National Mission for Clean Ganga (NMCG) has been formed to act as the implementation arm of the National Ganga River Basin Authority (NGRBA). Currently NRCP (excluding Ganga & its tributaries) covers polluted stretches of 34 rivers in 77 towns spread across 16 states. The NRCD was previously under the Ministry of Environment, Forest and Climate Change (MoEF&CC) but currently, NRCD has been brought under the aegis of the newly formed Ministry of Jal Shakti.

Stated Objectives of the Scheme

The objective of NRCP is to reduce the pollution load in rivers by implementing the various pollution abatement programmes and thereby improving the quality of river water which in turn helps to improve the biodiversity and ecosystem of the river and the environmental condition of the town. Various activities have been included under NRCP related to pollution abatement works such as:

- Interception and diversion work to capture the raw sewage flowing into the rivers through open drains and diverting them for treatment
- Construction of sewage treatment plants for treatment of diverted sewage
- Construction of low-cost sanitation works to prevent open defecation on riverbanks
- Construction of electric crematoria and improved wood crematoria to conserve the use of wood and ensure proper cremation of body brought to burning Ghats
- Construction of bathing ghats
- Riverfront development works
- Public awareness and public participation
- Capacity building, training & research in the area of river conservation

Funding Pattern of the Scheme

The National River Conservation Plan (NRCP) scheme was launched in 1995 to reduce the pollution load on major rivers in India on a cost sharing basis of 50:50 between Centre & State Government. Since its inception the funding pattern has changed several times.

- In November 1998 the funding pattern was changed to 100% centrally funded
- In 2001, the funding pattern became 70:30 between Central & State Government
- In 2015, the funding pattern changed to 50:50 between Central and State Government and for North-Eastern states it became 80:20
- Since 2016, the funding pattern for North-Eastern states is 90:10 and for other states it is 60:40
- The funding pattern for the JICA assisted Mula-Mutha Action Plan under Pune Municipal Corporation is 85:15 between the Central & State Government

According to the NRCP scheme guidelines, funding is provided for construction of STPs and the O&M for the commissioned STPs is the sole responsibility of the State Government and Project Implementing Agency (PIA). Therefore, the O&M costs shall be borne by the State Government and PIAs. In this regard, a tripartite agreement is also signed between State Government, PIA and NRCD as a condition for sanction of the projects. The local bodies may take loan from any financial institution such as HUDCO for their share. Any additional expense or cost overrun of the project due to delay, inflation or any other reasons shall be borne by State Government and PIAs.

List of Projects and Beneficiary States

Currently the NRCP has covered polluted stretches of 34 rivers in 77 towns spread across 16 states in the country at a sanctioned cost of Rs. 5,870.54 Cr. A central share of Rs. 2,452.35 Cr. was released to the State Governments for implementation of various pollution abatement works. The state-wise and town wise constructed STP details along with the DPR cost are presented in the table below.

Table 117: Detailed allocation of Budget State-wise & Project-wise

State	Town	Name of River	Sanctioned Cost (DPR)	Expenditure by State	STP Capacity Sanctioned	STP Capacity Created
			(Rs. Lakh)	(Rs. Lakh)	(MLD)	(MLD)
	1. Rajamundry	1. Godavari	2,178.60	1,958.84	30.04	30.00

State	Town	Name of River	Sanctioned Cost (DPR)	Expenditure by State	STP Capacity Sanctioned	STP Capacity Created
			(Rs. Lakh)	(Rs. Lakh)	(MLD)	(MLD)
1. Andhra Pradesh		**Sub Total**	**2,178.60**	**1,958.84**	**30.04**	**30.00**
2. Goa	2. Panaji	2. Mandovi	1,409.52	1,349.93	12.50	12.50
		Sub Total	**1,409.52**	**1,349.93**	**12.50**	**12.50**
3. Gujarat	3. Ahmedabad	3. Sabarmati	54,639.87	28,743.42	442.60	280.00
	4. Surat	4. Mindhola	26,213.14	37,188.98	53.00	53.00
	4. Surat	19. Tapi	97,125.00			
		Sub Total	**177,978.01**	**65,932.40**	**495.60**	**333.00**
4. Jharkhand	5. Ghatshila	5. Subarnarekha	65.43	23.71	0.00	0.00
	6. Jamshedpur		174.52	37.83	0.00	0.00
	7. Ranchi		74.21	36.11	0.00	0.00
		Sub Total	**314.16**	**97.65**	**0.00**	**0.00**
5. Jammu & Kashmir	8. Udhampur	6. Devika & 7. Tawi	18,674.00	1,300.00	13.06	0.00
		Sub Total	**18,674.00**	**1,300.00**	**13.06**	**0.00**
6. Karnataka	9. Bangalore	8. Pennar	4,627.00	3,593.78	0.00	0.00
	10. Bhadravati	9. Bhadra	376.98	413.95	5.83	5.83
	11. Davangere	10. Tungabhadra	466.05	405.34	19.45	19.45
	12. Harihara		249.94	216.54	8.84	8.84
	13. K.R.Nagar	11. Cauvery	57.80	72.53	1.45	1.45
	14. Kollegal		108.65	107.64	3.34	3.34
	15. Nanjangud		223.86	114.67	1.47	1.37
	16. Shimoga	12. Tunga Cauvery	370.38	260.30	18.16	0.00
	17. Srirangapatna		144.01	173.79	1.36	1.36
		Sub Total	**6,624.67**	**5,358.54**	**59.90**	**41.64**
7. Kerala	18. Pamba	13. Pamba	1,844.98	3,369.00	4.50	4.50
		Sub Total	**1,844.98**	**3,369.00**	**4.50**	**4.50**
8. Madhya Pradesh	19. Burhanpur	14. Tapti	481.47	387.81	10.00	6.00
	20. Chapara	15. Wainganga	39.85	36.83	1.20	1.20
	21. Hoshangabad	16. Narmada	1,299.07	367.34	16.00	0.00
	22. Jabalpur		133.85	118.19	0.00	0.00
	23. Keolari	15. Wainganga	36.16	32.59	0.75	0.75
	24. Seoni		25.10	24.25	0.00	0.00
		Sub Total	**2,015.50**	**967.01**	**27.95**	**7.95**
	25. Karad	17. Krishna	318.72	313.94	28.00	28.00

State	Town	Name of River	Sanctioned Cost (DPR)	Expenditure by State	STP Capacity Sanctioned	STP Capacity Created
			(Rs. Lakh)	(Rs. Lakh)	(MLD)	(MLD)
9. Maharashtra	26. Kolhapur	18. Panchganga	7,429.00	5,537.42	76.00	78.00
	27. Nanded	1. Godavari	1,346.76	1,241.88	26.00	26.00
	28. Nashik		6,201.76	6,128.16	100.00	100.00
	29. Prakkasha	19. Tapi	244.43	96.11	0.00	0.00
	30. Sangli	17. Krishna	2,555.27	3,063.52	27.00	27.00
	31. Trimbakeshwar	1. Godavari	1,164.00	1,152.50	1.00	1.00
	32. Pune	20. Mula Mutha	99,026.00	3,869.00	396.00	0.00
		Sub Total	**118,285.94**	**21,402.53**	**654.00**	**260.00**
10. Nagaland	33. Dimapur	21. Diphu & Dhansir	8,280.09	3,500.00	25.43	0.00
		Sub Total	**8,280.09**	**3,500.00**	**25.43**	**0.00**
11. Odisha	34. Chandbali	22. Brahamini	34.90	34.90	0.00	0.00
	35. Cuttack	23. Mahanadi	804.30	804.30	33.00	33.00
	36. Dharamsala	22. Brahamini	19.63	19.63	0.00	0.00
	37. Puri	Coastal Area	8,044.86	7,945.74	15.00	15.00
	38. Talcher	22. Brahamini	370.20	220.76	2.00	2.00
		Sub Total	**9,273.89**	**9,025.33**	**50.00**	**50.00**
12. Punjab	39. Banga	24. Satluj	1,198.35	1,264.09	3.00	3.00
	40. Bholath	25. Beas & Satluj	1,541.78	1,723.33	4.00	4.00
	41. Dasuya		899.68	1,155.89	4.00	4.00
	42. Hoshiyarpur		9,405.00	8,256.34	30.00	30.00
	43. Jalandhar	24. Satluj	26,428.78	26,527.29	185.00	185.00
	44. Kapurthala		1,256.26	1,278.75	19.30	25.00
	45. Ludhiana		13,351.21	18,445.30	311.00	311.00
	46. Moga	25. Beas & Satluj	5,909.00	5,909.42	27.00	27.00
	47. Mukerian		1,467.09	1,513.24	5.00	5.00
	48. Nawanshehar	24. Satluj	1,707.22	1,633.42	6.00	6.00
	49. Phagwara		4,975.40	4,256.78	36.00	36.00
	50. Philaur		1,063.10	901.14	5.60	5.60
	51. Sultanpur Lodhi		240.74	164.49	2.60	2.60
	52. Tanda	25. Beas & Satluj	2,288.62	2,246.80	4.00	4.00
	53. Khanauri	26. Ghaggar	1,345.86	946.82	4.00	4.00

State	Town	Name of River	Sanctioned Cost (DPR)	Expenditure by State	STP Capacity Sanctioned	STP Capacity Created
			(Rs. Lakh)	(Rs. Lakh)	(MLD)	(MLD)
	54. Moonak		1,496.43	1,254.87	3.00	3.00
	55. Patran		815.85	817.89	4.00	4.00
	56. Lehragaga		2,052.40	1,445.14	4.00	4.00
	Sub Total		**77,442.77**	**79,741.00**	**657.50**	**663.20**
13. Sikkim	57. Gangtok	27. Rani Chu	26,352.18	13,950.56	21.44	18.19
	58. Ranipool		590.24	590.24	1.27	1.27
	59. Singtom		632.82	632.82	0.66	0.66
	Sub Total		**27,575.24**	**15,173.62**	**23.37**	**20.12**
14. Tamil Nadu	60. Biwani	11. Cauvery	392.84	254.57	3.94	3.94
	61. Chennai	28, 29 Adyar & Cooum	40,660.21	39,581.89	264.00	264.00
	62. Erode	11. Cauvery	1,472.13	1093.31	25.17	25.17
	63. Karur		3,105.32	3200.17	15.00	15.00
	64. Kumarapalayam		232.14	431.40	6.00	6.00
	65. Kumbakonam		4,410.45	5,458.83	17.00	17.00
	66. Madurai	30. Vaigai	12,009.40	11,439.30	0.00	0.00
	67. Mayiladuthurai	11. Cauvery	4,481.04	4,093.34	8.30	8.30
	68. Pallipalayam		184.67	66.38	0.00	0.00
	69. Thanjavur	31. Vennar	6,274.76	6,803.70	28.05	28.05
	70. Tirunelveli	32. Tamrabarani	5,492.90	5,555.02	24.20	24.20
	71. Trichirapalli	11. Cauvery	11,667.00	11,716.00	58.00	58.00
	72. Trichy		430.05	423.08	28.00	28.00
	Sub Total		**90,812.91**	**90,116.99**	**477.66**	**477.66**
15. Telangana	73. Bhadrachalam	1. Godavari	200.70	225.77	4.00	4.00
	74. Hyderabad	33. Musi	33,565.53	33,684.83	592.00	593.00
	75. Mancherial	1. Godavari	231.30	305.17	6.46	6.46
	76. Ramagundam		574.55	467.69	32.00	18.00
	Sub Total		**34,572.08**	**34,683.46**	**634.46**	**621.46**
16. Manipur	77. Imphal	34.Nambul	9,772.21			
	Sub Total		**9,772.21**	**0.00**	**0.00**	**0.00**

State	Town	Name of River	Sanctioned Cost (DPR)	Expenditure by State	STP Capacity Sanctioned	STP Capacity Created
			(Rs. Lakh)	(Rs. Lakh)	(MLD)	(MLD)
		Total	**587,054.57**	**333,976.30**	**3,165.97**	**2,522.03**

Physical Progress Achieved

Physical progress of NRCP scheme can be evaluated in terms of the creation of STPs. Till September 2019, 85 Sewage Treatment Plants (STPs) with a total capacity of 2,522.03 MLD has been created under NRCP. From 2014-15 till 2018-19, 25 STPs with a total treatment capacity of 359.62 MLD has been created against a target of 566 MLD. It has been observed that, Punjab has created the maximum STPs of capacity 663.20 MLD out of targeted 657. 50 MLD followed by Telangana (621.46 MLD out of 634.46 MLD), Tamil Nadu (477.66 MLD out of 477.66 MLD) and Gujarat (333.00 MLD out of 495.60 MLD) respectively.

Table 118: STP Capacity targeted vs created during FY 2014-15 to 2018-19 under NRCP

#	Financial Year	Physical Target (STP capacity to be created in MLD)	Achievement (STP capacity created in MLD)
1	2014-15	134.00	134.00
2	2015-16	117.00	77.00
3	2016-17	75.00	72.83
4	2017-18	53.00	26.19
5	2018-19	187.00	49.60
	Total	**566.00**	**359.62**

Financial Progress Achieved

Budget allocation and actual expenditure for river conservation works under NRCP during FY 2014-15 to 2018-19 is as follows:

Table 119: Financial Progress of the Scheme during FY 2014-15 to 2018-19

#	Financial Year	Budget Allocation (Rs. Cr.)	Revised Allocation (Rs. Cr.)	Actual Expenditure (Rs. Cr.)
1	2014-15	80.00	77.80	77.58
2	2015-16	40.00	66.73	66.72
3	2016-17	95.00	101.00	98.99

#	Financial Year	Budget Allocation (Rs. Cr.)	Revised Allocation (Rs. Cr.)	Actual Expenditure (Rs. Cr.)
4	2017-18	173.50	173.50	173.34
5	2018-19	173.50	150.50	150.32
6	2019-20	196.00	196.00	75.00 (Sept 2019)
	Total	**758.00**	**765.53**	**641.95**

The financial progress of the states has been measured in terms of expenditure by the states against the sanctioned cost or DPR cost. It has been observed that till September 2019, Tamil Nadu has utilized its maximum allocation (Rs. 901.17 Cr. out of Rs. 908.13 Cr.) followed by Punjab (Rs. 797.41 Cr. out of 774.43 Cr.) and Telangana (Rs. 345.72 Cr. out of Rs. 346.83 Cr.) respectively.

For laying of sewerage network and installation of sewage treatment plants to meet the gap in sewage treatment capacity of 61,948 MLD (as per Report of CPCB 2015) expenditure of around Rs. 200,000 – 300,000 Cr. is expected. The budgetary allocation at Centre, State and local body level for the sewage sector are highly inadequate vis-a-vis the requirement and would need to be substantially increased if the pollution in the river from untreated sewage generated in towns is to be controlled.

Project Sanction Mechanism by NRCD

The process of submission of proposals by State Governments for consideration under NRCP scheme and final approval by NRCD with subsequent release of funds for implementation is presented in the schematic diagram on the next page

Figure 41: Project Sanction Mechanism by NRCD

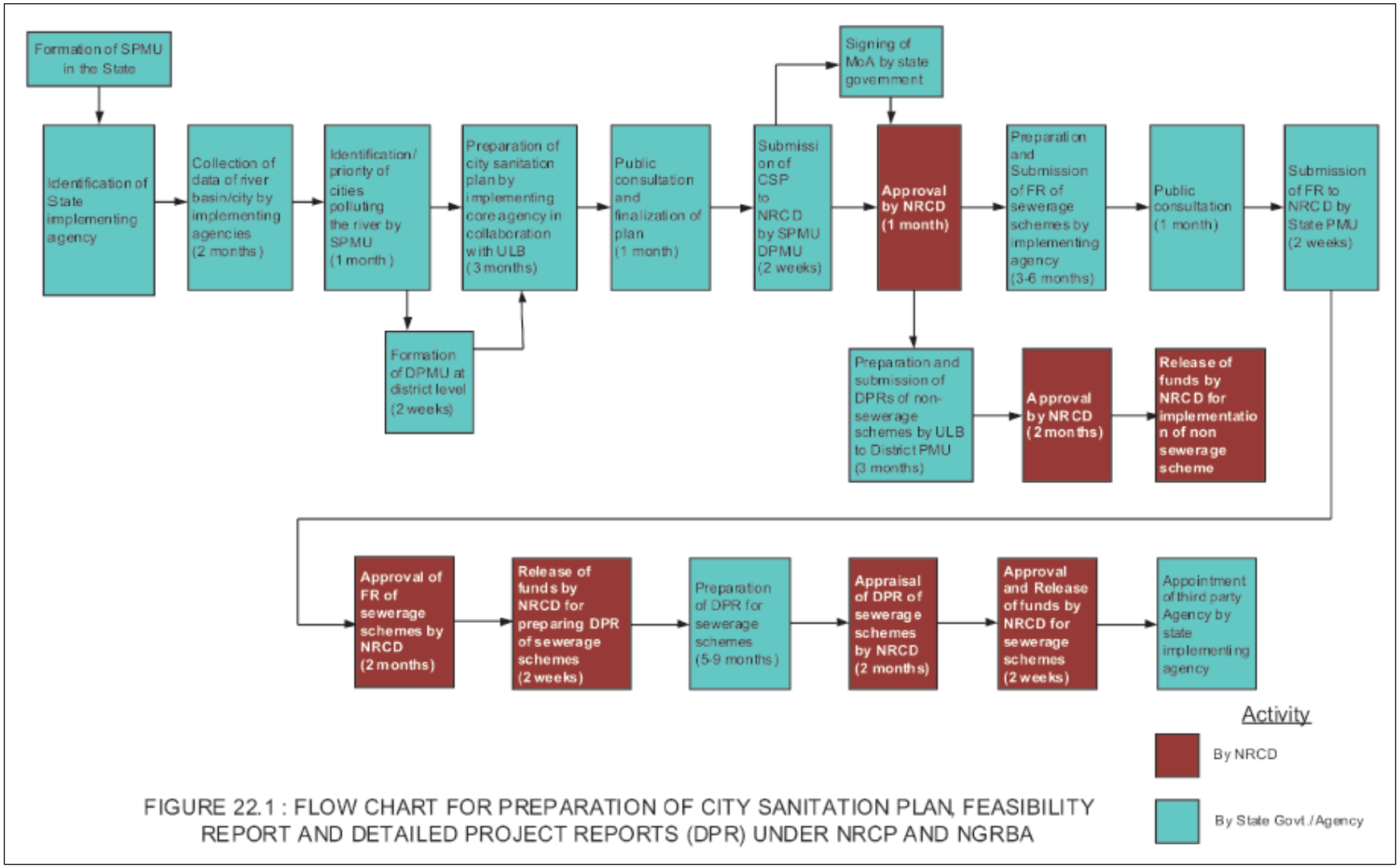


FIGURE 22.1 : FLOW CHART FOR PREPARATION OF CITY SANITATION PLAN, FEASIBILITY REPORT AND DETAILED PROJECT REPORTS (DPR) UNDER NRCP AND NGRBA

2.2.8.2 Performance

Performance on REESI+E framework

The scheme has been assessed on the REESI+E framework based on available secondary research and primary data collected through Key Informant Interviews (KIIs). The findings from the assessment are presented in the table below:

Table 120: NRCP - performance evaluation using REESIE framework

Parameter	Findings from research
Relevance	**Secondary:** • The principal objective of the NRCP scheme is abatement of pollution of the river basins in India through treatment of domestic and municipal sewage generated by Class I and Class II towns situated on polluted river stretches. • Hon'ble President of India in his Presidential Speech in Parliament in June 2019 has mentioned the need for conservation of rivers other than Ganga basin, namely, Godavari, Kaveri, Mahanadi and Narmada. • Almost 70% of our country's surface water resources are affected by biological, toxic, inorganic and organic pollutants. • As per a study conducted by CPCB in March 2015, an estimated 61,948 MLD sewage is generated by Class I and Class II towns and the available sewage treatment capacity is 23,277 MLD, which is a mere 37% of the total requirement. • In addition, analysis of data from Composite Water Management Index published by Niti Aayog indicates that nearly 15% of the existing sewage treatment plants are not operating resulting in untreated waste being dumped into the river bodies. • Pollution of downstream river stretches results in approximately 9% reduction in agricultural revenues and 16% drop in agricultural production.

<table>
<tr><th>Parameter</th><th>Findings from research</th></tr>
<tr><td></td><td>

Therefore, collection and treatment of domestic as well as industrial sewage is necessary before discharging them into the surface water sources to reduce water pollution.
The honourable NGT has recently ordered to revise norms of discharge standards. The revised discharge standards have been compared with erstwhile standards in the table below:

<table>
<tr><th>Parameter</th><th>Unit</th><th>Old Standards</th><th>New Standards</th></tr>
<tr><td>pH</td><td></td><td>6.50 - 9.0</td><td>5.50 - 9.0</td></tr>
<tr><td>BOD</td><td>mg/L</td><td>30</td><td>10</td></tr>
<tr><td>TSS</td><td>mg/L</td><td>100</td><td>20</td></tr>
<tr><td>COD</td><td>mg/L</td><td>100</td><td>50</td></tr>
<tr><td>Nitrogen Total</td><td>mg/L</td><td>-</td><td>10</td></tr>
<tr><td>Phosphorus Total</td><td>mg/L</td><td>-</td><td>1.0</td></tr>
<tr><td>Faecal Coliform</td><td>MPN/100 mL</td><td>1000</td><td>230</td></tr>
</table>

Although, these revised norms have not yet been notified by MoEF&CC, once these become notified, it will necessitate advanced sewage treatment technologies and renovation of the commissioned STPs to meet the revised standards.
Treatment of sewage before flowing into the river is also required to improve the biodiversity and ecosystem in the river and the environmental condition of the towns situated on the riverbanks.

</td></tr>
<tr><td></td><td>
Primary:

Central Pollution Control Board (CPCB) has identified 351 polluted river stretches on 275 rivers in the country at present, out of which 45 river stretches are under Priority 1 (BOD>30mg/l) and 16 river stretches are under Priority 2 (BOD between 20-30 mg/l)

</td></tr>
</table>

Parameter	Findings from research
	• Discussions held with the National River Conservation Directorate (NRCD) clearly emphasize the growing awareness about depolluting river stretches both from environmental, hygienic as well as religious perspectives. Proposals for rejuvenation of major river basins such as Namami Kaveri, Mission Clean Krishna and Godavari are being submitted by states to the centre, particularly after the advent and success of the National Mission for Clean Ganga (NMCG). • Discussions with key informants including Punjab Water Supply and Sewerage Board (PWSSB), Bangalore Water Supply and Sewerage Board (BWSSB), Water Resources Department of Andhra Pradesh and Tamil Nadu along with State Pollution Control Boards of Karnataka, Punjab, Andhra Pradesh and Maharashtra as well as municipal corporations provided the following insights with respect to relevance of the scheme. o Most rivers have major cities situated on their banks such as Rajamundry and Vijayawada on Rivers Krishna and Godavari, Ludhiana and Jalandhar on the banks of Rivers Sutlej and Beas, Trichy and Erode on River Kaveri. Large quantities of municipal and industrial sewage seep in at specific pockets into the rivers. o Existing treatment capacities are insufficient to treat the incoming domestic sewage. Some instances are mentioned below- ▪ Vijayawada Municipality with a population of 20 Lakh has a treatment capacity of only 30 MLD and a major proportion of generated municipal sewage goes untreated into the river. ▪ Rajamundry, situated on River Godavari generates 60 MLD sewage but has a treatment capacity of only 30 MLD. ▪ Maharashtra Pollution Control Board noted that out of 2700 MLD sewage generated, only 50% is currently being treated. ▪ As mentioned by Jharkhand SPCB during the KII, some industries have themselves established STPs in the colonies for treatment of domestic and industrial sewage. But the treatment capacity is

Parameter	Findings from research
	far less than that required and a lot of untreated sewage flows into Subarnarekha river. No STP for treatment of domestic sewage has been set up in Jharkhand. ▪ In Chennai, the current 264 MLD treatment capacity is not enough and some untreated sewage still flows into the River Cooum. This is being taken up separately by Chennai River Restoration Trust (CRRT). ▪ In Surat, some STPs are present under Surat Municipal Corporation, but in the urban and rural areas beyond the corporation's purview, there are no STPs and a significant quantity of untreated sewage flows into the river Tapi. ▪ It was noted by UEED, J&K that the current treatment capacity in the state is not enough to treat the sewage generated and more treatment plants, sewerage networks and sewage collection infrastructure is needed. ▪ It was noted by Odisha State Pollution Control Board that more STP creation is required in other cities in the state to be able to treat the generated municipal sewage. o There are other sources of pollution of river water such as that noted by Andhra Pradesh Water Resources Department (APWRD) wherein silt from the Eastern Ghats accumulates in River Krishna deteriorating the quality of river water and reducing river capacity.
	Inference: • Lack of sewage treatment infrastructure in the Class I and Class II towns make NRCP scheme highly significant. • The scheme will continue to aid in the abatement of pollution level in the river basins in India, thereby improving the river water quality, surrounding environmental condition and river ecology. • There has been a growing need for conservation of major river basins in the country.

Parameter	Findings from research
	• Hence, assessment of the findings from secondary and primary research indicates that the NRCP scheme is highly relevant.
Effectiveness	**Secondary:** **Physical progress:** • Since the scheme inception, a total of 85 Sewage Treatment Plants in 77 towns over 34 rivers (excluding Ganga & its tributaries) spread across 16 states have been constructed till September 2019 at a total sanctioned cost of Rs. 5,870.54 Cr. • As on September 2019, 347 projects have been sanctioned among which 340 projects have already been completed • STPs designed for treatment of 3166 MLD domestic sewage have been sanctioned, out of which only 2522.03 MLD STP capacity has been created • This includes one of the biggest STPs in India – a 339 MLD Upflow Anaerobic Sludge Blanket (UASB) technology based STP on River Musi in Hyderabad, which is currently being operated by the Hyderabad Metropolitan Water Supply and Sewerage Board (HMWSSB) • From FY 2014-15 to 2018-19, 359.62 MLD STP capacity (only 63%) has been constructed against a target of 566 MLD. • Along with construction of STPs, works such as interception and diversion of sewage, laying of sewer lines, rehabilitation of sewer mains, solid waste management facilities, new pumping station for STPs, renovation of existing intermediate pumping stations have also been taken up under NRCP. • Construction of community based low cost toilets (especially in slum and fringe areas), bathing ghats, electric crematoria, riverfront development activities, cleaning and fencing of riverbanks, afforestation have been undertaken to take care of other factors causing pollution.

Parameter	Findings from research

	• This has also been corroborated in the impact evaluation studies of schemes in 10 identified towns in Region 1,2,3 in India submitted to NRCD in 2014 which indicates -
	  o Construction of core structures - Interception & Diversion (I&D) works, STPs were completed.
	  o Construction of non-core structures such as Community Toilet Facilities, Electric/ Improved Crematoria, River front development as well as construction of washer's platform, afforestation and solid waste disposal were undertaken under the scheme.
	Performance of states:
	• Till September 2019, Punjab has created the maximum STPs of capacity (663.20 MLD out of targeted 657. 50 MLD), followed by Telangana (621.46 MLD out of 634.46 MLD), Tamil Nadu (477.66 MLD out of 477.66 MLD) and Gujarat (333.00 MLD out of 495.60 MLD) respectively.
	• Andhra Pradesh, Goa, Kerala, Odisha, Punjab, Sikkim, Tamil Nadu and Telangana have performed better than average performing states both in terms of physical and financial progress.
	• Maximum STP capacity yet to be created as against the target is in Maharashtra (394 MLD) and Madhya Pradesh (20 MLD)
	• There has been very little progress in states like Nagaland and Jammu & Kashmir
	• Jharkhand has not shown any progress in creation of STPs. There has been around Rs. 300 Cr. projects sanctioned and Rs. 100 Cr. has been spent by State Government, but all works are in pending phase.
	Improvement in river water quality:
	• Water quality standards from STPs discharging into rivers has improved and is currently well below the 30 mg/l BOD level.

Parameter	Findings from research

Primary:

Physical progress:

- During discussion with NRCD, it was noted that since 2014-15, 7 projects have been sanctioned by NRCD for construction of STPs with a total capacity of 914 MLD at a sanctioned cost of Rs. 2,867 Cr. The project details are given in the table below.

Project	Sanctioned Cost (Rs. Cr.)	Sanction Date	STP Capacity (MLD)
Pollution Abatement of River Mula Mutha	990.26	Jan 2016	396
Pollution Abatement of River Tapi	971.25	Mar 2019	250
Pollution Abatement of River Sabarmati	444.44	Oct 2014	210.5
Pollution Abatement of Rivers Devika and Tawi	186.74	Sept 2018	13.6
Pollution Abatement of River Nambul	97.72	Jan 2019	17
Pollution Abatement of River Rani Chu	94.66	July 2018	3.25
Pollution Abatement of Rivers Diphu & Dhansari	82.8	Mar 2019	25.43
Total	**2867.87**		

- Among the projects sanctioned since 2014-15, none of the projects has been commissioned yet. There has been significant progress in only 2 projects – namely Sabarmati and Dimapur projects where 75% and 47% of the works has been completed. The works phase is yet to be started for 4 of the projects. The status of the ongoing projects is given in the table below.

#	Project	Town/ State	Present Status
1.	Pollution Abatement of River Mula Mutha	Pune, Maharashtra	Contractor yet to be appointed

Parameter	Findings from research			
	2.	Pollution Abatement of River Tapi	Surat, Gujarat	Tenders awarded for 2 STPs, work not yet started
	3.	Pollution Abatement of River Sabarmati	Ahmedabad, Gujarat	Physical Progress 75%
	4.	Pollution Abatement of Rivers Devika and Tawi	Udhampur, Jammu & Kashmir	Physical Progress 10%
	5.	Pollution Abatement of River Nambul	Imphal, Manipur	Physical Progress 4%
	6.	Pollution Abatement of River Rani Chu	Gangtok, Sikkim	Physical Progress 2.8%
	7.	Pollution Abatement of Rivers Diphu & Dhansari	Dimapur, Nagaland	Physical Progress 47.08%

- As noted during secondary research, it was verified during KIIs also, that civil structures such as bathing ghats, low cost public toilets, sewer lines, crematoria, pumping stations have been created which are functional and people are being encouraged to use the facilities.

Improvement in river water quality:

- Discussions with stakeholders highlighted that there has been an improvement in river water quality in many states such as Andhra Pradesh, Maharashtra, Punjab, Tamil Nadu, Odisha etc.
  - In Punjab, pollutant levels which were 200-300 mg/l BOD prior to treatment have been reduced to 30 mg/l BOD.
  - In Tamil Nadu, 2 polluted river stretches – Tamrabarani and Bhavani have been proposed to be delisted and River Kaveri has been proposed to be downgraded in pollution ranking.
  - In Chennai, as mentioned by CMWSSB, the commissioned STP under NRCP scheme has been operational since last 10 years and

Parameter	Findings from research
	there has been around 30% reduction in pollution level on Rivers Adyar and Cooum. o Also, in Maharashtra, previously there were 9 polluted river stretches of Priority 1 but currently there is only 1 polluted river stretch of Priority 1. o In Kolhapur, Maharashtra, 90-95% reduction in pollution level on River Panchganga has been achieved due to the construction of the 76 MLD STP under NRCP scheme. o In Odisha, the project interventions have helped develop sewerage network for the entire town of Puri and helped reduce pollution in the sea and beaches in Puri. The river water quality of Mahanadi has improved in the last few years and is meeting extant discharge norms. o In Rajamundry in Andhra Pradesh, to a large extent, flow of untreated sewage into the River Godavari has been checked and quality of river water has improved o In Surat in Gujarat, 50 Sewage Pumping Stations and 37 STPs are being constructed as part of the Tapi River project which is expected to treat all incoming domestic sewage before being discharged into the river. o In Sikkim, as noted during the KII with Sikkim Pollution Control Board, there has been an improvement in river water quality in the River Rani Chu. o Further, in Sikkim, 4 polluted river stretches in Category V had been identified by CPCB, but current reports indicate significant improvement in BOD levels and hence Sikkim Pollution Control Board has proposed CPCB to delist those polluted river stretches. o In addition, it was noted by PHED Sikkim, that many projects for construction of STPs, rehabilitation of STPs, laying of sewerage networks have been taken up under NRCP scheme in and around Gangtok on different tributaries of River Teesta, most of which have

Parameter	Findings from research
	been successfully completed. These STPs are all operational and have helped improve the river water quality significantly. • In some projects such as the Tapi River Project, treatment of domestic sewage flowing into small creeks has also been brought under the purview of NRCP project. Under the Tapi River project, 23 small STPs at 23 locations on small water bodies, creeks are being constructed in rural areas. • As part of the NRCP project on River Devika and Tawi in Udhampur, Jammu & Kashmir, construction of 3 STPs of 13.61 MLD capacity, 128 km sewer lines, 7 pumping stations, 3 solar power plant and 2 hydel power plants have been taken up which the respondent from Urban Environmental Engineering Department (UEED), J&K believes will help in significantly improving the condition in Udhampur town and surrounding areas of River Devika. As part of the ongoing works, 700 manholes and 690 IC chambers have also been built for collection of municipal sewage. In addition, works for installation of bio-remediation plant is also being proposed. • However, as noted by the informant from Odisha State Pollution Control Board, some activities such as septage treatment is not being taken up under the NRCP scheme. Hence, untreated faecal sludge gets discharged into drains which eventually flows into the rivers. **Operational effectiveness:** • It was noted during the KIIs, that in some cases, the designed capacity of the treatment plants was much less than the actual sewage generated and hence a large portion of untreated sewage is being discharged into the rivers. For instance, o In Ludhiana in Punjab, the sewage generated is 650 MLD against an existing treatment capacity of 325 MLD. o In Trichy in Tamil Nadu, sewage generated in 128 MLD and the current treatment facilities include only an 88 MLD oxidation pond and 30 MLD pumping station

Parameter	Findings from research
	Impeding Factors: • In areas where large cities and towns are situated on the banks of the rivers, industrial sewage along with domestic sewage is being dumped into the river but since only treatment of domestic sewage is taken up, the industrial sewage from smaller auxiliary plants (which do not have their own ETPs) are left untreated. This was mentioned during KIIs with Punjab Water Supply and Sewerage Board (PWSSB) and Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB). • Some untreated domestic sewage as well as industrial effluents are often discharged into nearby lakes, ponds and small water bodies which flows into the rivers downstream. • Also, in many areas all the lateral and branch lines and house connections are not connected to main sewer lines. • Most rivers in India except the northern rivers have become seasonal with flows only between June to February and no flow in the rest of the year to help in dilution of the pollutants. Hence the pollution levels measured are often higher in the off-season. • Most rivers in South India frequently experience floods which cause soil erosion on the riverbanks and negatively impact river conservation. **Monitoring and Evaluation** • Although there is a provision in the scheme guideline for appointment of 3rd party independent agency for monitoring, most PIAs sample treated sewage manually twice a month and test it in their internal laboratories. • Even in projects, where a private party has been appointed for O&M, the PIA relies on SPCB reports, internal lab testing and no 3rd party testing agency is appointed for testing quality of treated sewage before being discharged into the river. • Although NRCD has a dedicated MIS for monitoring physical and financial progress of projects and expenditures, the state level bodies

Parameter	Findings from research
	and PIAs do not have any dedicated MIS for regular monitoring and evaluation of the projects. • In ongoing projects, Online Continuous Monitoring (OCM) is being implemented. For instance, o In the Mula Mutha river project, SCADA system is being implemented for centralized monitoring of functioning of STPs. GIS mapping of sewerage facilities for better asset management is also being done. o In the ongoing Udhampur project on River Devika and Tawi in J&K, SCADA system is being proposed for online monitoring. • In some cases where STP has already been commissioned, SCADA and OCM is being proposed, but has not been implemented yet. ***Case Study:*** *Odisha State Pollution Control Board regularly does biomonitoring of rivers. Samples of micro invertebrates are collected and based on the number of types of samples, a diversity index is calculated. The higher the index, the more diversity of bio-organisms in the river and hence it indicates cleaner river water.*
	Inference: • The scheme has been effective in significantly improving the level of pollution in river water in most of the areas. • Secondary research and KIIs with national and state level stakeholders indicate that there has been creation of assets and non-core infrastructure under the scheme to tackle the issue of rising river pollution levels. • Independent monitoring and evaluation are not being done for the projects regularly through appointment of 3rd party monitoring agencies and MIS by PIAs. • However, there are some challenges due to which the scheme has not been able to fully achieve reduction in pollution level in the rivers such as o Designed capacity of STPs being less than actual sewage generated

Parameter	Findings from research
	○ Mixing of industrial effluents with domestic sewage at certain pockets ○ All house connections not being connected to sewer lines ○ Seasonal rivers having very little flow in lean season • Hence, assessment of the findings from secondary and primary research indicates that the effectiveness of the NRCP scheme is average.
Efficiency	**Secondary**: **Financial Progress:** • Between 2014-15 to 2018-19, funds of Rs. 765.53 Cr. was allocated, and utilization was Rs. 641.95 Cr. which is around 84% of the total sanctioned funds. • Till September 2019, sanctioned cost of projects under the NRCP scheme was Rs. 5,870.54 cr and funds released by NRCD was Rs. 2,510.63 Cr. • Till September 2019, actual expenditure on NRCP projects has been Rs. 3,339.96 Cr. • Tamil Nadu has utilized its maximum allocation (Rs. 901.17 Cr. out of Rs. 908.13 Cr.), followed by Punjab (Rs. 797.41 Cr. out of 774.43 Cr.) and Telangana (Rs. 345.72 Cr. out of Rs. 346.83 Cr.) respectively. **Project Time and Cost Overrun:** • Till September 2019, STPs with capacity of 3,166 MLD has been sanctioned against which a treatment capacity of only 2,522 MLD has been created. Remaining capacity is yet to be created on ground. • Since 2014-15, only 7 projects have been sanctioned by NRCD, none of which have been completed yet. • Since transfer of funds to PIAs requires fund release by both central and State Government, most of the projects were delayed due to delay in release of matching state share of funds.

Parameter	Findings from research
	• Recently, the Ministry of Jal Shakti has written to Gujarat Government noting the inordinate delay in completion of the NRCP projects on River Sabarmati and River Tapi. • However, it was mentioned, that projects which had been commissioned in the early years (before 2009-10) had been completed on time and there had been no delay in funds transfers. This includes projects under Rajamundry Municipal Corporation and CMWSSB. **Operational Efficiency:** • Performance Evaluation of STPs under NRCD (Aug 2013) shows that only 97 STPs out of 153 STPs, constructed under this scheme were meeting the prevalent NGT standards for discharging of environmental pollutants into water bodies in terms of BOD & COD levels. • Although, ongoing projects are implementing latest treatment technologies, most of the STPs under the scheme which were commissioned previously have not been upgraded to modern technologies which sometimes reduces the efficiency of the scheme. • According to a CPCB report published in March 2015, 10% of STPs in India were non-operational, i.e. out of 816 STPs in the country, 79 STPs with a total capacity of 1,237.13 MLD were non-operational. **Inter-departmental Coordination:** • There is good coordination between state level departments and central ministry.
	Primary: **Financial progress:** • Most key informants noted that although there has been delay in receipt of funds, but there was timely utilization of the funds available. • However, it was noted by NRCD that, in some cases, there have been delays in submission of utilization certificates by the PIAs to the centre. **Project time and cost overrun:**

Parameter	Findings from research
	• From FY 2014-15 to 2018-19, 359.62 MLD STP capacity (only 63%) has been constructed against a target of 566 MLD. • Among the 2,522 MLD STP capacity created under NRCP schemes, 2,162 MLD STP capacity has been created before 2014-15. Clearly, this indicates that there has not been much progress and STP capacity creation during the recent years. • Some informants noted that impending monsoons sometimes affected the project implementation timeline leading to project execution being delayed • The Mula Mutha River project was sanctioned in January 2016 but is still in tendering phase for appointment of contractor for constructing the STPs. The primary reasons for delay in project timelines as noted by NRCD and Pune Municipal Corporation are: - o Delay in appointment of consultant for review of works due to O.M. issued by the DEA o Issues in land acquisition o Delay in conducting the study by JICA (funding agency) o Multi-stage tendering process along with delay in finalization of tenders by the PIAs o Currently the process is stalled since the bids received by PMC have been rejected due to high quotes • The project proposal for Tapi River in Surat was prepared by Surat Municipal Corporation during submission to NRCD. However, during implementation, the work in the rural areas was given to the Gujarat Water Supply and Sewerage Board (GWSSB). As noted by the informant from GWSSB, during the KII, the DPR and cost estimates again needed to be revised by GWSSB before beginning work which caused some delay in project timelines. • It was mentioned by UEED, Jammu & Kashmir, (the implementing agency for the River Devika and Tawi project in Udhampur, Jammu &

Parameter	Findings from research
	Kashmir), that unavailability of local labourers post revocation of Article 370 in J&K was one major reason for delay of the project works. **Delays in fund transfer** • It has been noted that there have been delays in fund flows primarily because of the funding pattern. Funds for 60% of the project cost are first released by the centre to which 40% of funds are added by State Government which is then transferred to the implementing agencies. This often causes delays in receipt of funds and hence in payments, due to state government's inability to provide matching state share. For instance, o In Jharkhand, as noted by Jharkhand State Pollution Control Board, 3 projects with a total cost of Rs. 314 Cr. has been sanctioned but no fund has been released by the centre, only state funds amounting to Rs. 97 Cr. has been released. Hence, there has been no progress o The pollution abatement work for Rivers Diphu and Dhansari in Nagaland being implemented by PHED Nagaland was initially sanctioned in August 2005 and central share of funds was released in Oct 2005. However, the state could not release matching fund share and the project was stalled for 10 years. Revised DPR was submitted which was later sanctioned in 2014 and work on the project has been restarted. o In addition to the above, the funding pattern of NRCP projects in Nagaland in 2005 was 70:30 share between centre and state and hence the sanctioned project on Rivers Diphu and Dhansari follows this funding pattern. However, currently, the funding pattern for north-eastern states has become 90:10 between centre and state and PHED Nagaland has submitted proposal to NRCD for change in the funding pattern for the remaining works. o For the pollution abatement works on River Devika and Tawi, central share of funds was released in Oct 2018 to the state government,

Parameter	Findings from research
	but the fund was transferred to the PIA with matching state share only in August 2019, after a year. ○ PWSSB particularly noted that arbitration with contractors are ongoing due to delayed payments on account of delay in fund release. ○ The informant from Surat Municipal Corporation noted that although central share of funds had been released to the state, it took another year for them to receive the funds because of state not being able to provide the matching share of funds. Moreover, it was noted that the central share of funds (in this case Rs. 13 Cr.) was lying idle with the state government with no interest being accrued. **Delays due to land acquisition** • Issues and ongoing litigations due to land acquisition in some cases have led to projects being stalled for 3-4 years resulting in project time and cost overruns. For instance, ○ Pollution abatement works in Sikkim on River Rani Chu is yet to start due to issues with land acquisition ○ Project on River Sabarmati which started in 2014 is also not expected to be completed by scheduled completion date due to land acquisition problems. The scheduled completion date was September 2018 which was later extended to March 2020 and has again been extended to March 2021. ○ The works for the ongoing project in Surat on River Tapi has stopped due to land acquisition problems. Nearly 70-80% of the land required for construction of STP has still not been acquired for the project which was sanctioned in March 2019. Further, in this case, the project is proposed on Gauchar land and as per the directive of Supreme Court, alternative land needs to be given before Gauchar land can be acquired. There is huge technical risk envisaged since tenders have already been awarded for the project even though the

Parameter	Findings from research
	land has still not been acquired. The land acquisition is still resting with the State Government and has not been approved. ○ The project on River Mahanadi in Cuttack and in Puri was delayed due to ongoing litigations relating to land acquisition. ○ Similarly, it was noted by the informant from PHED Sikkim that land acquisition issues caused major delays in project completion primarily because residents were reluctant to give NOC on their private land for laying sewerage networks. ○ The informant from Kolhapur Municipal Corporation in Maharashtra noted that land acquisition problems delayed project completion by 2-3 years. **Operational efficiency:** • During KIIs with PIAs where STPs have already been commissioned before 2014-15, it was noted that the STPs are operating upto 85-90% capacity. These include 30 MLD STP on River Godavari in Rajamundry in Andhra Pradesh, 264 MLD STP on River Adyar and Cooum in Chennai in Tamil Nadu and 76 MLD STP on River Panchganga in Kolhapur in Maharashtra. • It was noted by Odisha Water Supply and Sewerage Board (OWSSB) that the 15 MLD STP constructed in Puri was not operating to full capacity because maximum 11 MLD sewage can be collected with existing sewerage networks. Although 750 commercial sewerage connections have been built, all houses are not connected to a sewerage network because of old city planning. • In Sikkim, as mentioned by the informant from PHED Sikkim, the STPs are operating upto 85% capacity. • Discussions with PIAs such as Nasik Municipal Corporation and Pune Municipal Corporation indicate that the STPs are constructed using latest treatment technologies such as UABS, MBBR, SBR and are efficiently treating the effluents.

Parameter	Findings from research
	• Both national and state level key informants noted that although STPs have been constructed, many treatment plants have become defunct or are not functioning up to the capacity and level of treatment required. One reason cited by the informants was that since the STPs were designed for treatment of domestic sewage, they do not function properly when industrial effluents mixes with the domestic sewage. For instance, o In Ludhiana 1-2 STPs with a treatment capacity of 48 MLD are not functioning o In Odisha, the 33 MLD STP built in Cuttack over River Mahanadi is currently under renovation and is not working which is causing a lot of untreated waste being discharged into the river. Since, it is under renovation, it is also not being monitored by Odisha State Pollution Control Board (OSPCB). • In addition, few informants such as Punjab Pollution Control Board and Nasik Municipal Corporation also noted that lack of O&M and lack of funds for upgradation and retrofitting of the assets has resulted in reduction of efficiencies of the treatment plants. **Cost Efficiency:** • In some cases, lower cost treatment plants are being set up where lower quality treated water is being used. For instance, o Low cost plant for treating water up to 100 mg/l BOD can be used for irrigation purposes in agriculture. o Treatment of sewage upto 30 mg/l BOD can only be done for potable uses **Adequacy of fund:** • Inadequacy of fund has also been noted by NRCD because of which many projects could not be sanctioned. Since 2014-15, only 7 projects with a total sanctioned cost of Rs. 2,867 Cr. has been approved whereas proposals amounting to nearly Rs. 5,400 Cr. was returned by NRCD to the State Government due to lack of funds.

Parameter	Findings from research
	• It was noted during the KII with PHED Sikkim that submission of proposals to NRCD requires lot of effort, expenses for the PIA to prepare feasibility report, DPR, conduct studies etc. and these are often rejected by NRCD citing unavailability of funds. This causes a lot of effort, time and cost to be spent without result. • Similarly, the informant from Ahmedabad Municipal Corporation noted that due to lack in clarity on sanction of new projects, there is often a big gap in execution between subsequent projects. For instance, the first NRCP project on River Sabarmati was completed in 2004 and the second, ongoing project was sanctioned and approved in 2014. • It has been estimated by NRCD that to bridge the present gap in sewage treatment capacity, funds ranging from Rs. 2,00,000 – Rs. 3,00,000 Cr. would be required. • Due to lack of funds, many components of the schemes are being taken up under convergence with other schemes such as AMRUT or also being funded by IFIs such as JICA. • Some associated works with STP construction for the Panchganga River Project in Kolhapur has been taken up under Maharashtra Suvarna Jayanti Nagarotthan Abhiyan. ***Case Study:*** *The Mula Mutha River Project in Pune being implemented by the Pune Municipal Corporation has a loan assistance of 19.064 billion Yen from JICA. The project cost is being shared between Government of India and Pune Municipal Corporation in the ratio of 85:15.* **Inter-departmental coordination:** • Coordination between NRCD, State Government and PIAs are satisfactory. • In some states such as Gujarat, there is a River Rejuvenation Committee (RRC) which coordinates all STP/ ETP works on river bodies in the state and has members from other state departments. However, due to lack

Parameter	Findings from research
	of coordination between RRC and other departments such as land, revenue, finance, the existing issues in implementation of projects (land acquisition, funding delays) are not resolved in a timely manner.
	Inference: • Most of the STPs commissioned before 2014-15 are functional and operating upto 85-90% of their treatment capacity. • Nearly 10-15% of the STPs are defunct due to lack of O&M. • Delay in fund transfer to the PIAs and issues due to land acquisition have primarily led to project time and cost overruns. • STPs constructed after 2014-15 are equipped with latest sewage treatment technologies, but STPs commissioned previously need upgradation • Fund with NRCP is not adequate and proposals by State Governments are being rejected due to fund constraints. • Hence, assessment of the findings from secondary and primary research indicates that the efficiency of the NRCP scheme is average.
Sustainability	**Secondary**: **Performance of STPs:** • Due to lack in focus towards O&M, post completion of construction of STP, some STPs created have become idle after initial years of operation. • Nearly 10-15% of the STPs are defunct or not operating with latest treatment technologies due to lack of O&M. **Financial Sustainability:** • Impact evaluation studies of schemes in 10 identified towns in Region 1,2,3 in India submitted to NRCD in 2014 indicates o For O&M of STPs, ULBs were still dependent on state departments like PHED for technical and financial assistance. o There is limited revenue generation during O&M phase through approaches such as reuse of treated wastewater, reuse of treated sludge etc. **Capacity Building and Public Awareness**

Parameter	Findings from research
	• Some activities such as Shivirs, Padyatras, Shramdans, Exhibitions and Ghat cleaning have been undertaken to create awareness among the people residing in town on riverbanks. • A Communication Advisory Committee has been set up with Ministry officials to identify communication requirements, identification of target groups and media communication to generate awareness.
	Primary: **Performance of STPs:** • Some PIAs such as Rajamundry Municipal Corporation, CMWSSB, Surat Municipal Corporation, UEED J&K, OWSSB and Kolhapur Municipal Corporation noted that a private operator has been appointed for O&M activities post construction for a period of 5-10 years through a tendering process. These PIAs are self-sufficient and are capable of funding the O&M activities through internal finances. • Some PIAs such as OWSSB, Ahmedabad Municipal Corporation are operating and maintaining the assets created themselves and it is being funded by the State Government. • In some cases, as noted by PWSSB, due to lack of availability of funds, proper O&M activities such as upgradation and retrofitting of STPs with newer technologies, repair and maintenance is not being taken up. Hence structures are becoming defunct or obsolete after a few years of operation or STPs are not able to operate upto full capacity. • It was also noted by the informant from Odisha State Pollution Control Board that, more focus and interventions are needed for efficient O&M of the commissioned STPs so that they can operate to full capacity and meet extant discharge norms. • In addition, CPCB noted during the KII that, the norms and measures of level of pollutants for meeting quality standards keeps changing and hence the treatment process and treatment standards of the STPs needs to be upgraded accordingly. For instance,

Parameter	Findings from research
	○ Standards notified 15 years back when the STP was created has changed over the years as per directives of NGT and CPCB. ○ According to the recent directives published by the National Green Tribunal (NGT), there is proposed revision of discharge standards. It is proposed that the treated sewage should have BOD level of 10 mg/L, COD level of 50 mg/l and TSS should be less than 20 mg/l. Although these have not yet been notified by MoEF&CC but once it gets notified, it will necessitate upgradation of STPs to comply with stringent discharge norms. ***Case Study:*** *In the ongoing Tapi River Project, a private contractor is being appointed for construction and 7 years O&M which shall be funded by the State Government and Panchayat department.* ***Case Study:*** *For the Panchganga River project in Kolhapur, the Kolhapur Municipal Corporation has appointed a private contractor for a period of 15 years on DBOT mode. The contractor is made quarterly payments for O&M activities. There is no fixed construction period. The contractor is incentivized to complete construction early and start operation so that they can get paid early.* **Financial Sustainability:** • Most informants including the Punjab Pollution Control Board, PIAs such as Pune Municipal Corporation, Directorate of Environment of Manipur and Punjab Water Supply and Sewerage Board noted that the current procurement model and funding pattern under the scheme gives limited importance to O&M and does not include any O&M costs. The PIAs in many cases are unable to bear the financial burden of O&M activities. • It was mentioned during the KIIs that even though large municipal corporations may be able to financially sustain O&M activities, projects in smaller towns are unable to do so and need funding support from centre and state. • In Sikkim, it was particularly noted that due to the hilly terrain and unavailability of large pieces of land, small STPs are built which have very high energy consumption necessitating high O&M costs. Although, a

Parameter	Findings from research
	minimum user charge is levied for sewerage connection, the entire O&M cost cannot be loaded onto the residents. Also, in Sikkim revenue generation through selling of treated wastewater is not an option because of the high elevation of houses at of 5,500 ft. in Gangtok and the STP being situated at a lower elevation of 2,000 ft. Hence, funding support from state and centre is required for effective O&M. • Proposals for upgradation of STPs to latest treatment standards are being submitted by the PIAs to NRCD for funding as new projects. • There is limited focus on revenue generation during O&M phase under the scheme guidelines through approaches such as reuse of treated wastewater, reuse of treated sludge etc. Although, most projects completed before 2014-15, have no such revenue generation mechanism, there are few cases which deserve mention: - o In some recent ongoing projects such as the Tapi River project, it is proposed that treated wastewater will be sold to the industries. Revenue generation from agriculture department through reuse of treated wastewater for irrigation purposes is also envisaged. o Some ULBs are coming up with innovative revenue generation models to sustain O&M expenditures such as BWSSB which sells the treated wastewater for use to airports and corporates such as BHEL, Arvind Mills, for gardening and landscaping, irrigation purposes in neighbouring Kolar district etc. o Some PIAs such as Rajamundry Municipal Corporation are currently using treated wastewater for beautification and gardening in municipal parks. In recently submitted proposals to NRCD, revenue generation options have been proposed including selling of treated wastewater for use in power plants, railways good sheds and bus stations.

Parameter	Findings from research
	○ During the KII with PHED Nagaland, it was noted that a sewerage tariff is proposed to be levied for household connections along with selling of treated sludge as manure, selling of treated wastewater for irrigation to fund O&M activities. ***Case Study:*** *OWSSB collects charges for sewerage connections for 8000 connections among which 750 connections are commercial connections. This revenue source partially funds the O&M.* ***Case Study:*** *Ahmedabad Municipal Corporation collects sewerage tax* **Capacity Building and Public Awareness** • Some informants noted the that there is no trained manpower for O&M of the created assets since no trainings or workshops are conducted to increase awareness about extant discharge norms, latest treatment technologies, cost efficient treatment etc. • In line with the above, the Additional Chief Secretary, UEED, J&K and OWSSB noted that there is lack of expertise in PIAs for undertaking such projects. The staff does not have the required technical knowhow for designing and operating the assets created, particularly, in terms of treatment technology, waste disposal mechanism etc. Long term workshops and training programs are needed for building technical expertise of the PIAs. • It was also noted both by PHED Sikkim and Sikkim Pollution Control Board that training and capacity building workshops are required so that the STPs can be properly maintained, retrofitted, upgraded to latest treatment technologies to operate efficiently and meet extant discharge standards. For instance, the STPs in Gangtok were commissioned by a private contractor from Pune, Maharashtra. Hence, whenever there is a breakdown, local staff is unable to repair it and depend on the contractor from Pune for repair and maintenance. • It was mentioned during the KII with Surat Municipal Corporation that although a budget has been allocated for IEC campaigns to increase

Parameter	Findings from research
	public awareness about the Tapi River project, such campaigns are yet to be designed and launched. • During KIIs, it was also noted that there was lack of community awareness about the NRCP scheme, projects and objectives and hence, the community structures created such as bathing ghats and low-cost public toilets created have not been maintained properly. ***Case Study:*** *An organization "Love Tapi, Care Tapi" has been formed headed by SHGs. The organization comprises technical experts, doctors, politicians, local people, ULB and is involved in project activities, creating awareness about the program and taking suggestions for improving river health. Every year, birthday of River Tapi is celebrated on 27th July by the organization.* ***Case Study:*** *Under the Godavari River project in Rajamundry, 14 low cost public toilets were constructed under NRCP scheme. These have been given to Sulabh International for operations and maintenance and for encouraging public usage.*
	Inference: • O&M is the sole responsibility of the state government and the PIA. • Many PIAs have appointed private contractors for O&M and the activities are being funded by the ULBs themselves. • Some PIAs noted that they did not have adequate funds to sustain in the O&M phase and there was limited focus on revenue generating activities in the post-construction phase. • In few of the recent ongoing projects, options for revenue generation through reuse of treated sludge and treated wastewater, levy of sewerage cess etc. are being explored. • Lack of skilled manpower and public awareness has also impacted the upkeep of assets created in the post-construction phase.

Parameter	Findings from research
	• Hence, assessment of the findings from secondary and primary research indicates that the sustainability aspect of the NRCP scheme is average.
Impact	**Secondary**: **Improvement in river water quality:** • At present 76 towns have been selected over 34 rivers spread across 16 states to reduce the pollution level of water being discharged into rivers. • It is difficult to quantify the benefits derived from the NRCP scheme in physical terms • Impact evaluation studies of schemes in 10 identified towns in Region 1,2,3 in India submitted to NRCD in 2014 indicates that construction of I&D works has helped improve the quality of river water, biodiversity and ecosystem of the river. **Improvement in social condition:** • Construction of public toilets and bathing ghats has given access to the marginalized section to clean sanitation and bathing facilities.
	Primary: **Improvement in river water quality:** • Key regulators such as Maharashtra Pollution Control Board, Punjab Pollution Control Board and Tamil Nadu Pollution Control Board noted that ensuring no untreated water flowing into the rivers has helped improve the quality of the river water. For instance, o In Punjab, Beas river has been downgraded to Category B o In Tamil Nadu, 2 polluted river stretches – Tamrabarani and Bhavani have been proposed to be delisted and River Kaveri has been proposed to be downgraded in pollution ranking. o In Chennai, as mentioned by CMWSSB, the commissioned STP under NRCP scheme has been operational since last 10 years and there has been around 30% reduction in pollution level on Rivers Adyar and Cooum.

Parameter	Findings from research
	○ Also, in Maharashtra, previously there were 9 polluted river stretches of Priority 1 but currently there is only 1 polluted river stretch of Priority 1. ○ In Kolhapur, Maharashtra, 90-95% reduction in pollution level on River Panchganga has been achieved due to the construction of the 76 MLD STP under NRCP scheme. ○ In Odisha, the project interventions have helped develop sewerage network for the entire town of Puri and helped reduce pollution in the sea and beaches in Puri. The river water quality of Mahanadi has improved in the last few years and is meeting extant discharge norms. ○ In Rajamundry in Andhra Pradesh, to a large extent, flow of untreated sewage into the River Godavari has been checked and quality of river water has improved **Improvement in environmental condition:** • Discussions with key informants noted that river front development and afforestation activities has helped improve the environmental condition along the river. • Construction of public toilets has minimized open defecation along riverbanks and related health hazards. • Policies for wastewater reuse by some state water supply and sewerage boards such as BWSSB and PWSSB for use by corporates, usage in garden beautification, irrigation and construction purposes has helped improve environmental conditions. • Some water bodies due to improved treatment facilities have also developed into recreational spots for boating and other activities such as Jakkur Lake in Karnataka • As part of the Tapi River project, plantation of 1 lakh trees along with installation of an imported vermi-compost plant is envisaged which will hugely benefit the surrounding environmental condition.

Parameter	Findings from research
	• However, as part of impact analysis under the NRCP scheme, bio-impact analysis or physico-chemical analysis to gauge the impact on bio-organisms (flora and fauna) in the river water is not being carried out. • Only, Odisha State Pollution Control Board regularly does biomonitoring of rivers. Samples of micro invertebrates are collected and based on the number of types of samples, a diversity index is calculated. The higher the index, the more diversity of bio-organisms in the river and hence it indicates cleaner river water. • It was also noted by UEED, J&K that the interventions being done on River Devika and Tawi under the NRCP project will help preserve the natural beauty of the region and the River Tawi, religiously worshipped as GuptGanga by the locals. • OWSSB noted during the KII that the NRCP projects have had a significant impact on sea beach environmental condition. ***Case Study:*** *Rajamundry Municipal Corporation has employed a team of Sanitary Inspectors who monitors activities such as throwing of garbage, construction debris etc. by riverbank residents into the rivers.* ***Case Study:*** *Surat Municipal Corporation has banned religious activities such as Ganesh Visarjan on River Tapi since 2017 and small artificial ponds have been built for the immersion activities.* ***rivers.*** **Improvement in social condition:** • Improvement in water quality has taken care of issues such as mosquito breeding • Incidence of water borne diseases due to inadequate water quality has been reduced. • Issues such as waterlogging due to absence of sewer lines to houses has been mitigated leading to improved quality of lives. • There has been improvement in social and hygienic conditions of the slum areas located on the riverbanks.

Parameter	Findings from research
	• Some informants also noted that there were issues with overflow of septic tank in households and flow of faecal sludge into the fields leading to contamination which have been overcome. • Bathing ghats allows many residents to take bath and reduce groundwater usage for bathing purposes. • Improvement in river water quality has also had a positive impact on livelihood and local employment generation through - o pisciculture and fishing activities o income generation through local employment for O&M of STPs o components such as river front development also offers tourism opportunities and support local employment generation
	Inference: • Various reports, KIIs at the state and district level show that the scheme has led to positive impacts in improving the river water quality in many polluted rivers stretches. • Project components such as treatment facilities, riverfront development and afforestation has helped in marked improvement in the environmental condition surrounding the river bodies. • Moreover, opportunities for employment generation through O&M of STPs, pisciculture, recreation etc. has also helped improve the livelihood of the project region. • Hence, assessment of the findings from secondary and primary research indicates that the impact of the NRCP scheme has been satisfactory.
Equity	**Secondary**: • One of the scheme components include construction of low-cost sanitation structures and bathing ghats especially in the slum and fringe

Parameter	Findings from research
	areas which can be used by marginalized and weaker sections of the society. • The funding pattern under the scheme favours equity. The funding pattern of North Eastern states including Sikkim is 90:10% and for the remaining states and UTs, the funding pattern in 60:40.
	Primary: • During the discussion with NRCD, it was noted that there is a separate budget ~18% of the project costs for undertaking actions targeted for the SC/ST population • As part of the projects, some targeted actions to ensure equity in the project include –

Parameter	Findings from research
	○ construction of low-cost sanitation structures and bathing ghats for use by the marginalized and weaker section ○ construction of sewer lines and sewage connections for slum areas free of cost ○ some portion of the land on the riverbanks being reclaimed as biodiversity land and the marginalized section residing in the area being shifted to a better place ○ small STPs for rural areas are being constructed under the Tapi River project in Surat • Women involvement is being ensured in some projects such as: - ○ The Directorate of Environment in Manipur noted that women are being involved in public awareness campaigns. ○ In Rajamundry in Andhra Pradesh, 50% women are being employed for O&M of the public toilets created under the project and 40% women are employed as Sanitary Inspectors ○ In CMWSSB, some women are also employed in O&M of the STP
	Inference: • Although, there is not much scope for actions targeted specifically for the vulnerable, marginalized and weaker section of the society under this scheme, the guidelines have ensured that some low cost public toilets,

Parameter	Findings from research
	bathing ghats, sewer lines for slum areas have been constructed to ensure equity. • In some states such as Manipur, Andhra Pradesh, Tamil Nadu women participation is also being ensured in O&M of STPs, maintenance of assets, awareness campaigns etc. • Hence, assessment of the findings from secondary and primary research indicates that the equity aspect of the NRCP scheme is satisfactory.

A summary analysis and performance of the scheme on the identified themes is presented below:

Table 121: NRCP - summary of performance evaluation using REESIE framework

Parameter	Performance
Relevance	🟢
Effectiveness	🟡
Efficiency	🟡
Sustainability	🟡
Impact	🟢
Equity	🟢

REESI+E performance infographics legend

🟢 Satisfactory 🟡 Average 🔴 Needs Improvement ⚪ No information

Performance on cross-sectional themes

Table 122: NRCP - performance evaluation using cross-sectional themes

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
1.	Accountability & Transparency	Availability of Data Records and Reports in public domain	• River water quality is monitored by CPCB and SPCB on a regular basis as part of

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		• What are the measures undertaken for capturing water quality data related to the scheme performance? • Do you have any dedicated MIS system for recording & updating the database of the scheme?	National Water Quality Monitoring Programme • NRCD has a dedicated MIS for tracking physical and financial progress of sanctioned projects, actual expenditures etc. • In ongoing projects, Online Continuous Monitoring (OCM) is being implemented. For instance, in the Mula Mutha river project, SCADA system is being implemented for centralized monitoring of functioning of STPs. GIS mapping of sewerage facilities for better asset management is also being done.
		Monitoring Mechanisms • How robust is the monitoring mechanism? Is there any mechanism to independently verify the progress reported by the supervising entity through audits or other methods? • How does your state collect and manage the data?	• River water quality is monitored by CPCB and SPCB on a regular basis • In all ongoing projects, OCM is being implemented for monitoring quality of treated sewage • However, for projects already commissioned, there is no dedicated MIS system being used by PIAs for monitoring

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		• Do you face any challenges in current data management system?	performance. PIAs monitor the treated sewage before discharging into the river by manually sampling treated sewage and testing in internal laboratories • As per the scheme guidelines, there is a provision for 3rd party inspection, however most projects do not have any 3rd party monitoring agency involved
		Evaluation Mechanisms • Is there any evaluation study conducted on NRCP (from 2015 to till date)? • As per the guidelines, do the states carryout a third-party evaluation study regarding the performance of the scheme?	• No impact evaluation study on NRCP by centre or states conducted after 2015 was found from secondary and primary research
		Financial Accountability • Are the demands for fund from State on regular basis? • As per the guidelines, do all the states conduct inspection of the scheme	• Demand for funds from states are on regular basis as per requirement • There have been multiple instances of delay in project implementation due to delay in fund flows to PIAs primarily

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		for their states by 3rd party? • Is the fund flow at each level (of the scheme execution org) adequate and released in the timely manner?	because states were not able to provide matching share of funds
Summary Analysis: • The pollution level of the river water which is the key outcome of the NRCP scheme is monitored by CPCB and SPCB on a regular basis. • NRCD has a dedicated MIS for tracking project physical and financial progress and expenditures. • In all ongoing projects, OCM is being implemented for monitoring quality of treated sewage. However, for projects already commissioned, there is no independent testing agency for monitoring water quality. The quality of treated sewage is manually sampled and tested in internal laboratories by PIAs. • There have been delays in project implementation because of delay in states releasing matching share of funds.			
2.	Direct/Indirect Employment Generation	• To what extent employment has generated, for skilled as well as unskilled jobs, on account of the scheme? • To what extent income level of people engaged in post construction stage?	• There has been some employment generation of local people engaged in O&M in STPs or in pisciculture activities • Component of river front development also has created tourism opportunities which can be maintained, and income earned by locals.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			• This has led to increase in income levels and newer sources of income generation through tourism activities on beautified river fronts.
Summary Analysis: • There has been some employment generation among the locals being employed in STPs and in pisciculture • This has led to increase in income levels and newer sources of income generation through tourism activities on beautified river fronts.			
3.	Gender Mainstreaming/ Inclusiveness	• Is there a specific mention of gender equality and equity considerations in the scheme guidelines/objectives, i.e. has the scheme been designed keeping gender considerations in mind? • Mention how the project contributed to increase women empowerment (say higher income, literacy, better decision taking roles, etc.) • What is the women participation (%) in the scheme at your state?	• The NRCP scheme is aimed at pollution abatement on rivers. Hence, the scheme guidelines also do not include any gender specific provisions. • Women are sometimes involved in awareness campaigns, O&M of STP, O&M of public toilets etc. • For instance, in Rajamundry, Andhra Pradesh, women are being employed as Sanitary Inspectors to check the dumping of garbage, plastics etc. into the river bodies.
Summary Analysis:			

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
• The NRCP scheme is aimed at pollution abatement on rivers. Hence, the scheme guidelines also do not include any gender specific provisions. • In some cases, women are consciously being involved during scheme implementation. Women are being employed wherever possible in awareness campaigns, O&M of STP, O&M of public toilets etc.. • However, even though there is involvement of women in some cases, there is scope for improvement in consciously ensuring gender mainstreaming during scheme design, scheme implementation and monitoring and evaluation.			
4.	Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population	• What is the fund allocated under TSP & SCSP for each scheme? • Have the TSP & SCSP funds been able to improve equity? • Are you facing any challenges in this regard? • What are the interventions implemented for specific vulnerable groups?	• 18% of the project costs are mandated for undertaking actions targeted for the SC/ST population • Beneficiaries under Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan are identified, and actions are taken targeting them such as construction of public toilets and bathing ghats
Summary Analysis: • Beneficiaries under Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan are identified, and actions are taken targeting them such as construction of public toilets and bathing ghats.			
5.	Building resilience to climate change	• Is there any component of the scheme which target	• There are currently no scheme components which targets this aspect. • This project component is not included under prevalent scheme guidelines.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			○ There is need for inclusion of measures for holistic river conservation due to climate change such as nson-structural approaches for protection of river basins through construction of alternatives to embankments for flood management such as floodplain zoning, catchment area treatment and other
Summary Analysis: • There are currently no scheme components which target this aspect.			
6.	Use of IT/Technology in driving efficiency	• Is geotagging and use of geotagged photographs being done? Mention what are the benefits accrued due to geo-tagging and what are the challenges. • Which states are leading in terms of technology use and which are lagging behind? • How is technology being used for on-ground data collection? • Do you envisage any other advanced technologies for	• NRCD has a dedicated MIS for tracking physical and financial progress of sanctioned projects, actual expenditures • In ongoing projects, Online Continuous Monitoring (OCM) is being implemented. For instance, in the Mula Mutha river project, SCADA system is being implemented for centralized monitoring of functioning of STPs. GIS mapping of sewerage facilities for better asset management is also being done.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		data collection and monitoring purposes? • What are the technologies being used in project implementation, service delivery? • What is the impact of innovative technologies and practices on scheme outcomes?	• Online Continuous Monitoring is being implemented in states such as Tamil Nadu, Gujarat • Some PIAs mentioned that geotagging is being done during construction of I&D works and STPs • PWSSB is planning to roll out Online Continuous Monitoring system for data collection and monitoring • However, there is no central dashboard available in the public domain which tracks the progress of the projects • Also, there is no Real-time Water Quality Monitoring System (RTWQMS) for real-time monitoring of river health. • RTWQMS is important for measurement of biodiversity index and assimilative capacities, which are critical indicators of river health. • Convergence with other central schemes such as National Water Mission, Atal Innovation Mission can be explored in this aspect

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
Summary Analysis: • OCM is being used by some states and is currently being implemented in all ongoing projects • Some PIAs use geotagging during construction phase but data collection is done manually by most. • However, there is no central dashboard available in the public domain which tracks the progress of the projects. • Also, there is no Real-time Water Quality Monitoring System (RTWQMS) for real-time monitoring of river health. • Convergence with other central schemes such as National Water Mission, Atal Innovation Mission can be explored in this aspect.			
7.	Stakeholder and Beneficiary behavioural change	• What percent of total allocation is directed towards Awareness generation or sensitization? What is the utilization rate? How much impact has it been able to generate in terms of behaviour change?	• There is a component of capacity building under the scheme, which is the responsibility of the state government, but awareness generation activities are not being undertaken • Some activities such as Shivirs, Padyatras, Shramdans, Exhibitions and Ghat cleaning have been undertaken by NRCD to create awareness among the people residing in town on riverbanks. • A Communication Advisory Committee has been set up

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			with Ministry officials to identify communication requirements, identification of target groups and media communication to generate awareness.
Summary Analysis: • There is a component of capacity building under the scheme, but awareness generation activities are not being undertaken			
8.	Development, dissemination & adoption	• What percent of total allocation is directed towards development, dissemination and adoption of innovative practices and technology? How much of it is utilized?	• There is no such component under the scheme • In ongoing projects, latest treatment technologies are being proposed • For instance, waste stabilization ponds are being built as an alternative to STPs in small towns
Summary Analysis: • There is no such component under the scheme. • In ongoing projects, latest treatment technologies are being proposed.			
9.	Research & Development	• Is there any percentage of total allocation is directed towards R&D in the field of river conservation?	• There is no such component under the scheme. Scheme guidelines does not mention any R&D efforts or any earmarked funds for R&D. • In some cases, NRCD funds R&D activities on case to case basis.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			• However, with respect to NRCP scheme, it is important to have streamlined research and development efforts in the areas of latest technologies for sewage treatment, options for usage of treated wastewater, treated sludge, advanced river-health monitoring mechanisms, bio-diversity mapping, measurement of e-flow etc. • Ongoing, continuous tie-ups with academia (such as IITs), Industry experts needs to be taken up for R&D on cost effective treatment, latest sewage treatment technology, innovative methods for bio-impact analysis - biodiversity index, assimilative capacities, options for usage of treated wastewater, treated sludge, maintaining min e-flow in rivers etc.
Summary Analysis: • There is no such component under the scheme. • In some cases, NRCD funds R&D activities on case to case basis.			

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
• However, with respect to NRCP scheme, it is important to have streamlined research and development efforts. • Ongoing, continuous tie-ups with academia (such as IITs), Industry experts needs to be taken up for R&D			
10.	Unlocking Synergies with other Government Program	• What are the areas for potential convergence / synergy across govt. programs?	• Convergence with AMRUT, erstwhile JNNURM for financial support on the projects. • Also, to improve capacity utilization of STPs, convergence of NRCP with AMRUT such that STP design will be in tandem with sewer network planning is important.
Summary Analysis: • Convergence with AMRUT for improved capacity utilization of STPs and resolving issue of absence of backend sewer network.			
11.	Reforms, Regulations	• What measures are being taken to ensure effective implementation and compliance of adopted acts/rule/regulations?	• CPCB, SPCB and NGT monitor the river water quality to ensure compliance with prevalent standards of water quality in terms of BOD, COD and TSS levels
Summary Analysis: • CPCB, SPCB and NGT monitors the river water quality to ensure compliance with prevalent standards of water quality in terms of BOD, COD and TSS levels.			
12.	Impact on and role of private sector,	• Is there scope for private sector to be involved at any stage (e.g. during O&M	• Private sector is being currently involved under EPC mode in the construction phase

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
	community and civil society in the scheme	phase) with a view to increase employment opportunities? • Is there any private investment in any states for this program? • Is there any PPP model prevalent in this area? • Are there any private sector, community/collectives/cooperatives and civil society involved in any activities under this Scheme?	• In some of the commissioned projects, private sector has been involved for O&M activities of the STP. • In some projects such as Mula Mutha River project, a consultant has been hired to monitor and review the project • No private sector investment in any state in this program • No PPP model is prevalent • No private sector communities are involved in any activities
Summary Analysis: • There is a need for private sector to be involved through PPP or HAM and adopt a lifecycle based participatory procurement model to ensure technical and financial sustainability during O&M phase.			

Apart from the above, other cross-sectional themes such as Water sharing treaties and Conjuctive Use of Water have not been evaluated from NRCP scheme since these are not relevant. Accordingly, these have been marked "Not Relevant" in the table below. A summary analysis and performance of the scheme on the identified themes is presented below:

Table 123: NRCP - summary of performance evaluation using cross-sectional themes

Parameter	Performance
Accountability & Transparency	🟡
Direct/Indirect Employment Generation	🟢
Gender mainstreaming/Inclusiveness	🟡

Parameter	Performance
Building resilience to climate change (including but not limited to developing water disaster preparedness) & ensuring sustainability	
Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population	
Use of IT/Technology in driving efficiency	
Stakeholder and Beneficiary behavioural change	
Development, dissemination & adoption	
Research & Development	
Water sharing treaties/agreements & diplomacy	
Conjunctive use of water - surface versus groundwater usage optimizations	
Unlocking Synergies with other Government Program	
Reforms, Regulations	
Impact on and role of private sector, community and civil society in the scheme	

Cross-sectional themes performance infographics legend

High Medium Low Not relevant No information

2.2.8.3 Issues and challenges

This sub-section describes the scheme issues and challenges and their mapping with the source of information viz. primary source and secondary source.

Table 124: NRCP – issues and challenges

Sl.no	Area	Issues & Challenges	Secondary	KII
Scheme Design				
NRCP – F1	**Lack of measures for abatement of other sources**	• In many states, untreated municipal sewage is often discharged into canals, lakes, ponds and water bodies which flows downstream into the rivers thereby polluting them.		

Sl.no	Area	Issues & Challenges	Secondary	KII
	of river water pollution	• Some cities and towns situated on riverbanks do not have exhaustive branch and lateral sewer lines for all house connections and hence some portion of untreated domestic sewage flows into the rivers. • NRCP scheme currently does not include treatment of these ponds, lakes, drains and small water bodies or even run off from agricultural fields. • Some states such as Andhra Pradesh are taking up separate missions for pollution abatement in canals on Rivers Godavari and Krishna since these are not included under NRCP. • Agricultural run-off is another source of river water pollution and the NRCP scheme guidelines does not cover this aspect • Septage treatment is also not under the purview of the scheme but is an important source of river water pollution.		
NRCP – F2	**Mixing of industrial effluents with domestic sewage**	• In some states such as Punjab and Andhra Pradesh there is mixing of domestic and industrial sewage in some pockets due to which proper treatment is not feasible under the currently installed technology • Small auxiliary industrial units situated on riverbanks do not comply with CPCB/ SPCB norms for treatment of industrial effluents and release untreated effluents		

Sl.no	Area	Issues & Challenges	Secondary	KII
		into the canals and nallahs which eventually flow into the river. • Treatment of industrial effluent is currently not under the purview of the NRCP scheme		
NRCP – F3	**Non-compliance with revisions in NGT norms and standards for sewage treatment**	• Many STPs which were constructed have been designed following the erstwhile NGT orders for discharge standards • However, recently NGT has ordered to revise discharge standards of treated sewage. These have not been notified yet by MoEF&CC. However, once these are notified, it will necessitate modernization and renovation of the commissioned STPs to be compliant.		
NRCP – F4	**No minimum environmental / ecological flow in rivers**	• Most of the rivers in India except the northern rivers have now become seasonal rivers. They only have flow in them during the months of June-February. In the lean season, they almost have no flow. • As discussed with the SPCBs, pollutants have an assimilative property and river water dilutes the pollutants. Hence, when there are very low levels of surface water, the pollution level measured in terms of BOD and COD will be high. • It is important to maintain a minimum environmental or ecological flow in the rivers to dissipate the pollutants. This is		

Sl.no	Area	Issues & Challenges	Secondary	KII
		currently not under the purview of NRCP scheme.		
NRCP – F5	**No flood embankment and catchment area treatment**	• During discussions with some key informants particularly in the states of Andhra Pradesh and Tamil Nadu, it was noted that floods during the monsoon is a prevalent issue on the riverbanks. For instance, o River Krishna in Andhra Pradesh got flooded for 80 days last year and almost 800 TMC was washed away into the sea. It is also expected that River Krishna will have floods once every 3 years • Regular floods affect the structures created on the riverbanks, habitations and cause soil erosion in adjacent lands • Hence, catchment area treatment and flood management activities are required for conservation of the river. However, this is currently not included under the NRCP scheme.		
NRCP – F6	**Focus not on major rivers in recent years**	• Prior to 2014-15, projects had been undertaken on major river basins. However, after 2014-15, there are no ongoing projects on these rivers such as Krishna, Kaveri, Mahanadi, Narmada and Godavari under NRCP. Separate proposals are being conceptualized for river conservation for these such as Namami		

Sl.no	Area	Issues & Challenges	Secondary	KII
		Kaveri, Mission Clean Krishna and Godavari. • Some works are being carried out for reducing pollution on these rivers by the ULBs but due to lack of funds, major work for improving water quality of the rivers are not being taken up.		
NRCP – F7	**Low convergence with related schemes**	• There is currently minimal convergence between NRCP and other related schemes such as AMRUT • Such convergence will help to ensure that the STPs along with I&D structures being developed under NRCP are in conjunction with house connections and sewerage networks to be developed under AMRUT. • For instance, in the Tapi River project in Surat, STP construction in Mandavi location was being taken up both under NRCP and SGMMY schemes and there was duplication of work. Later, it was removed from NRCP scope and brought under SGMMY.		
Scheme implementation				
NRCP – F8	**Inadequate fund allocation for NRCP scheme**	• At present, there is an increasing awareness about depolluting river stretches across India and many states are submitting proposals for the same. • It has been estimated by NRCD that to bridge the present gap in sewage treatment capacity, funds ranging from		

Sl.no	Area	Issues & Challenges	Secondary	KII
		Rs. 2,00,000 – Rs. 3,00,000 Cr. would be required. • Since 2014-15, among the proposals received by NRCD from the states, only 7 projects at a total sanctioned cost of Rs. 2,867 Cr. has been approved whereas projects amounting to a total cost of Rs. 5,400 Cr. have been rejected due to shortage of funds. • Lack of clarity with the PIAs and ULBs regarding availability of fund with NRCD, often results in wastage of effort, time and money being spent on preparation of proposals, feasibility reports, DPRs for new projects by the states, which eventually cannot be sanctioned due to unavailability of funds with NRCD. • There is uncertainty about year wise fund allocation which makes it difficult to take up more projects.		
NRCP – F9	**Delay in planning phase of the projects**	• Since 2014-15, among the 7 projects sanctioned, none has been commissioned yet. • There has been significant progress in only 2 projects – namely Sabarmati and Dimapur projects where 75% and nearly 47% of the works has been completed respectively. • The works phase is yet to be started for the remaining • For instance,		

Sl.no	Area	Issues & Challenges	Secondary	KII
		○ The Mula Mutha River project under Pune Municipal Corporation, was sanctioned in January 2016 but no contractor has yet been appointed. Delays in appointment of consultant, delay in finalization of tender documents for the multistage tendering process have contributed to the delay ○ The Rani Chu River project in Sikkim was sanctioned in July 2018, but tenders were awarded last year only and only 2% work has been done ○ The Sabarmati River project which was sanctioned in October 2014 is still not complete due to delay in tendering, approval of tenders etc. ○ In case of the Tapi River Project, the DPR was initially prepared by Surat Municipal Corporation. However, the implementation of the project in rural areas was given to GWSSB. During implementation, the project design needed to be changed to include 40 smaller STPs (~0.11 MLD capacity), underground drainage network for some villages due to terrain and technical issues. Such changes in DPRs, project design has caused delays in project timelines.		

Sl.no	Area	Issues & Challenges	Secondary	KII
NRCP – F10	**Issues in land acquisition**	• One of the key issues noted was land acquisition along the riverbanks for construction of the treatment plants. For instance, o PWSSB noted that litigations due to land acquisition issues caused project delays o The Sabarmati River project which was sanctioned in October 2014 is still not complete due to delay in land acquisition o Pollution abatement works in Sikkim on River Rani Chu is yet to start due to issues with land acquisition o The works for the ongoing project in Surat on River Tapi has stopped due to land acquisition problems. o The informant from Kolhapur Municipal Corporation noted that project completion was delayed by 2-3 years due to land acquisition issues.		
NRCP – F11	**Insufficient capacity design of STPs**	• In some instances, the actual discharge is much more than that envisaged and hence, the STP is unable to treat the entire collected sewage and a part of the sewage flows untreated into the river. For instance, o In Punjab the treatment capacity is only 325 MLD but sewage generated is 650 MLD		

Sl.no	Area	Issues & Challenges	Secondary	KII
		○ In Trichy in Tamil Nadu, sewage generated in 128 MLD and the current treatment facilities include only an 88 MLD oxidation pond and 30 MLD pumping station • In some instances, the STP cannot be operated to full capacity due to absence of sufficient I&D network to tap the entire sewage generated. Construction of I&D and sewerage networks which are the responsibilities of the state government are often delayed resulting in lack estimated sewage inflow to the STPs resulting in lack of capacity utilization. For instance, ○ In Puri, Odisha, 15 MLD STP constructed is not operating to full capacity because maximum 11 MLD sewage can be collected with existing sewerage networks. Although 750 commercial sewerage connections have been built, all houses are not connected to a sewerage network because of lack of coherency with the old city planning.		
NRCP – F12	**Delay in fund transfer to PIAs**	• Delay in release of matching state share against the funds released by the centre has caused implementation delays in many projects. For instance, ○ The project on Rivers Diphu and Dhansari in Nagaland being		

Sl.no	Area	Issues & Challenges	Secondary	KII
		implemented by PHED Nagaland was initially sanctioned in August 2005 and central share of funds was released in Oct 2005. However, the state could not release matching fund share and the project was stalled for 10 years. Revised DPR was submitted which was later sanctioned in 2014 and work on the project has been restarted. o For the project on River Devika and Tawi, central share of funds was released in Oct 2018 to the state government, but the fund was transferred to the PIA with matching state share of funds only in August 2019 o The Rani Chu River project in Sikkim was sanctioned in July 2018, but only 2% work has been done because state has not release matching share o PWSSB noted, that the delay in receipt of funds and subsequent payment to contractors led to litigations being filed by the contractor which are still ongoing, and the costs must be borne by the state government. o In case of Tapi River project, it was noted that the central share of funds (in this case Rs. 13 Cr.) was lying idle with the state government with no interest being accrued and was transferred to		

Sl.no	Area	Issues & Challenges	Secondary	KII
		PIA with matching state share after a year.		
NRCP – F13	**Unavailability of funds for O&M**	• The NRCP scheme focuses on sewage treatment infrastructure only and the full responsibility of the O&M of the STPs created rests with the state government and PIAs. • Most of the informants noted that State Government is unable to provide adequate funds and hence limited maintenance activities are being undertaken on the assets created such as upgradation to new technologies, retrofitting, cleaning etc. This has led to some STPs becoming defunct and not functioning to full capacity • There is limited focus on revenue generation activities during O&M. In some ongoing projects such as Tapi River Project, options for reuse of treated wastewater, treated sludge are being explored. However, these activities are not being taken up in most cases.		
NRCP – F14	**Unavailability of skilled manpower for O&M**	• Technical knowledge of Departmental staff and staff of the executing agency are not updated on the modern sewerage treatment methods. • Hence, the O&M of the commissioned STPs cannot be carried out efficiently		
NRCP – F15	**Low public awareness**	• There is very low public awareness about the projects.		

Sl.no	Area	Issues & Challenges	Secondary	KII
		• During our KIIs, many state water resources departments and bodies were not aware of the projects and scheme objectives • Because of lack of awareness, private participation is also low in using and maintaining the facilities created under the scheme		
Monitoring and evaluation				
NRCP – F16	**Non-involvement of 3rd party monitoring agency**	• As per NRCP guidelines involvement of a 3rd party monitoring agency to evaluate the treatment efficacy is mandated • However, most PIAs do not appoint any external agency for testing and rely on SPCB monitoring reports. • The PIAs manually collect samples and test them in their internal laboratories once or twice a month.		
NRCP – F17	**Absence of central dashboard for real-time monitoring**	• NRCD has a dedicated MIS system for tracking physical and financial progress of projects • Currently, continuous monitoring system is being implemented in few ongoing projects and some PIAs use geotagging during construction of STPs • However, there is no central dashboard for tracking progress of projects, sanction of funds, latest norms and guidelines, status of projects, etc.		

Sl.no	Area	Issues & Challenges	Secondary	KII
NRCP – F18	**Absence of bio-impact analysis**	• Bio-impact analysis or physico-chemical analysis of bio-organisms (flora and fauna) in the rivers is currently not under the purview of the NRCP scheme • This is important for evaluation of river ecology and river health.		

Issue relevance legend

	Supported		Partially supported		Not supported		Not applicable

A summary analysis of issues & challenges for the scheme is presented below:

Table 125: NRCP - summary of issues and challenges

Parameter	Performance
Institutional Mechanism and governance	●
Fund flow efficiency and utilization	●
Unavailability of resource persons	●
Capacity building	●
Monitoring and evaluation	●
Operational Efficiency	●

Performance infographics legend

● Satisfactory ● Average ● Needs Improvement

2.2.8.4 Recommendations and solutions

This sub-section describes the scheme recommendations and solutions from the perspective of scheme design, scheme implementation and monitoring & evaluation, along with their mapping with the issues and challenges described in the preceding sub-section.

Table 126: NRCP – recommendations and solutions

Sl.no	Recommendation	Finding
Scheme design		
NRCP – R1	**Revision in scheme guidelines and earmarking funds for inclusion of additional project components to take care of holistic conservation of rivers** • The following components should also be included under the purview of NRCP scheme to ensure holistic conservation of the river. o Maintaining ecological and environmental flow of rivers throughout the year through: o Construction of checked dams and barrages on the rivers, deconcretisation of riverbeds, to maintain minimum environmental or ecological flow in the rivers during the lean season of February to June. • *Examples: NMCG has similar provisions for Aviral Dhara or Wholesome River. Environmental water requirement (EWR) assessment methods, for ascertaining how much water should be retained in rivers to sustain ecological functioning and desired levels of biodiversity, have been developed under Aviral Dhara. Under NMCG, there is special focus on increasing base flow and aquifer recharge. Minimum environmental flows have been notified for different sections of the Ganga and violation of the e-flow norms would lead to closure of respective water-consuming*	NRCP-F1 NRCP-F4 NRCP-F5 NRCP-F10

Sl.no	Recommendation	Finding
	projects such as hydroelectric projects and/ or imposing heavy penalties. • *For non-perennial rivers it is often difficult to get data on hydrology, and ecological functioning. However, many tributaries of Ganga like the Damodar, Hindon, Kali etc are non-perennial. Hence the learnings from "Aviral Dhara" programme remains applicable.* • *For non-perennial rivers a case study through a method known as "DRIFT-ARID"[236] was adopted in South Africa which needs to be looked upon in the case of NRCP as well. This method explores refining the normal technique of EWR measurements over a period, through different types of non-perennial rivers. Many non-perennial rivers have enough water even during the dry season to carry out EWR measurements to be extrapolated using the DRIFT model data of perennial rivers. The fundamental requirement of such method is availability of enough data. Hence this needs to be adopted initially in select non-perennial rivers with a minimum e-*	

[236] Environmental Water Requirements of Non-Perennial Rivers, Michael C Grenfell

Sl.no	Recommendation	Finding
	flow and be replicated to others over time. • *Nashik Municipal Corporation has recently deconcretised the riverbed of River Godavari to improve river flow* o Riverfront development projects such as: o Engineering works to reduce river width, construction of embankments, encroachment on floodplains and transforming them into commercial spaces. • *Examples: Sabarmati riverfront project in Ahmedabad. Few positive impacts of this project include:* o *Protection of riverbank and retention of water flow* o *The abandoned land of riverbed and nuisance at the centre of the City was converted into people's attraction; tourist destination; creation of infrastructural and recreational facilities* o *The capex spent could be recovered through direct revenue collected via tourist footfalls and indirect revenue in the form of taxes.* • *Upcoming Mula and Mutha riverfront project in Pune* o Non-structural approaches for protection of river basins - Construction of alternatives to embankments for flood	

Sl.no	Recommendation	Finding
	management such as floodplain zoning, catchment area treatment and other • *Examples: NMCG has similar provisions and emphasizes on "living with the floods." In an effort to reduce soil erosion, NMCG also promotes afforestation measures and sustainable agricultural practices such as zero budget farming, planting of fruit trees and plant nurseries on the riverbanks. Further, NMCG has also proposed the development of an organic farming corridor along River Ganga.* o Other methods to holistically treat sewages from all sources including agricultural run-offs through methods such as: o Promoting organic farming and afforestation across riverbanks • *Example: NMCG currently working with Department of agriculture for 5-7 km belt along Ganga to undertake organic riverbed farming along the rivers in Uttarakhand* • *A pilot research is being undertaken on Agri-run off and promotion of organic farming along the Ganges. MoEF&CC is also taking this up to extend to other 13 rivers and looking at convergence with CAMPA funds*	

Sl.no	Recommendation	Finding
	○ In areas of land constraints approvals could be granted by NRCP for construction of small capacities of phyto-remediation and bio-remediation plants (~10-20 KLD) or fabricated STPs (~0.1 MLD) This could also be relevant for areas where there are many small canals, creeks which are discharging untreated sewage into the rivers like in Jharkhand, Gujarat ○ construction of septage treatment plants to ensure that faecal sludge collected from the municipalities will be first treated in septage treatment plants and only the treated water will be discharged into the nearby rivers.	
NRCP – R2	**Earmarked fund for modernization of commissioned STPs after the notification of the NGT order by MoEF&CC** • Inventorisation of STPs by state government by river basins • Identification of STPs commissioned before 2019 which are not operating to their full capacity and/ or the treated sewage is not compliant with current NGT norms of water quality and sewage treatment standards of BOD, COD and TSS levels. The main reasons and associated solutions for lack of capacity utilization includes: ○ Lack of back-end sewer network. - Can be solved by constructing suitable I&D network and diverting the untreated sewage from open drains to the STPs ○ Lack of adequate demand – Demand projection is done keeping a horizon of 30 years. If population growth does not happen in sync with projection, then capacity utilization remains low. This can be solved by developing STPs in a phased manner and avoiding adding of full capacity at one go. ○ Lack of trained manpower – many STPs created under EPC mode using new technologies remain	NRCP-F3

Sl.no	Recommendation	Finding
	underutilized because of inadequate knowledge transfer or capacity building to the ULB engineers. This can be solved through long term O&M (at least 10 years) by the contractor/ concessionaire. Also, imparting training and capacity building to the ULB engineers could be a part of the responsibility of the contractor prior to handover. o Lack of regular monitoring of capacity utilization: This can be achieved through performance linked O&M contracts wherein payments to the contractor/ concessionaire is linked to capacity utilization parameter as one of the KPI. • Formation of a commensurate fund earmarked for renovation and modernization of these identified STPs. Renovation and modernisation of existing STPs will be cost effective compared to setting up of new STPs. E.g. Renovating an existing Activated Sludge Process technology based STP to meet the revised norms will cost around Rs. 0.75 - 1 Cr./MLD. However, if we set up a new STP to meet the revised norms it will cost around Rs. 1.75-2 Cr./MLD. Additionally, the undepreciated cost of the old STP will be lost as well.	
NRCP – R3	**Revision in scheme guidelines – convergence with other schemes** • Opportunities for convergence with other schemes should be explored for effective implementation of the scheme components and holistic conservation of the river basin. This may include – o Convergence with AMRUT – to ensure that the STPs and the I&D structures that are being constructed under NRCP scheme are in conjunction with future planning of sewerage	NRCP-F1 NRCP-F5 NRCP-F7 NRCP-F11

Sl.no	Recommendation	Finding
	networks and household connections under AMRUT considering correct population figures o Convergence with FMBAP – to ensure protection of river from floods o Convergence with RRR – to ensure that no untreated domestic or industrial sewage flows into lakes, ponds or small adjoining water bodies which flow into the river downstream o Convergence with Swachh Bharat Mission – for construction of bathing ghats and low-cost public toilets o Convergence with state level schemes/ activities	
NRCP – R4	**Close coordination and periodic knowledge sharing with NMCG** • Since NMCG also functions with the overarching objective of pollution abatement on River Ganga and its tributaries, close coordination between the schemes can be looked at. In particular, periodic review meetings between officials for knowledge sharing of learnings, best practices, project progress etc. can prove to be helpful for improving the implementation efficiency of NRCP scheme. • In the long term, NMCG can play an advisory role in river rejuvenation programs undertaken across the country. Also, involvement of a central authority will raise private investor's confidence in NRCP projects. • Lastly, administrative and functional restructuring of NRCD is required to expand mandates to include components which will lead to a more holistic river rejuvenation programme similar to NMCG.	NRCP-F1 NRCP-F6 NRCP-F8 NRCP-F9
NRCP – R5	**Prioritization of rivers and targeting river basins**	NRCP-F6

Sl.no	Recommendation	Finding
	• Since the fund available with NRCP is limited, projects for conservation and sewage treatment along major river basins should be prioritized to be taken up under the scheme • For each performance year, there should be targets for pollution abatement on most polluted river stretches on major river basins such as Krishna, Godavari, Kaveri, Narmada, Mahanadi etc. and funds should be allocated for the same • There are currently proposals being submitted for this under separate schemes such as Namami Kaveri, Mission Clean Krishna and Godavari. All these separate schemes should be brought under the umbrella of NRCP. • Learnings from international case studies of river basin conservation needs to be inculcated as well. One noteworthy being: o The Rhine river: The river flows across Switzerland, France, Germany and the Netherlands to reach the North Sea. During the rapid industrialization of 1800s, there was rampant river pollution where untreated chemicals from industries as well as untreated sewage was thrown into the river much like in India today. Multiple actions and international cooperation were targeted through the Rhine Action Programme. However, results only started being visible in the 1980s. Restoration of river water quality to drinking standards, ecological rehabilitation, restoring salmon population were few of the key success indicators. Currently, Rhine 2020 programme is ongoing to continuously monitor and maintain the river health including flood prevention and groundwater protection. This entire programme wouldn't have been successful without intense trans-boundary	

Sl.no	Recommendation	Finding
	cooperation between multiple governments and citizens. ○ A key learning from the Rhine Action programme is that a river basin conservation effort is not a one-time effort but a continuous process and spans decades and requires immense collaboration and stakeholder engagement throughout the process. • Currently, a cabinet note is being worked upon to have a similar institutional structure like NMCG and expand/ scale up NRCP scheme since other iconic rivers of India are also important along with River Ganga.	
NRCP – R6	**Eliminating mixing of domestic and industrial sewage** • Inventorisation of grossly polluting units which are not complying with CPCB/SPCB/ NGT effluent treatment norms and discharging untreated effluents into the nallahs/ canals/ water bodies/ rivers thereby mixing domestic and industrial sewage is required. • Notifying CBCB/ SPCB and NGT through listing of such non-compliant industrial units and requesting immediate interventions. Educational institutions such as IITs/ NITs can be roped in this similar to the way NMCG has done. • Similar to NGRBA under CPCB, a cell may be proposed to be set up under CPCB for more focused monitoring of ETPs. • Extant norms such as Zero Liquid Discharge Norms for industries or Ministry of Power guidelines for mandatory reuse of wastewater within 50 km of a thermal power plant should be evoked and non-compliant entities should be reported. • Thermal Power Plants should be encouraged to collaboratively adopt wastewater treatment technologies and wastewater reuse.	NRCP-F2

Sl.no	Recommendation	Finding

	• CETPs may be set up for small scale industries or charters should be developed on how to set up and upgrade ETPs for small industries such as paper, pulp etc.
	  o *E.g.: NMCG has set up a CETP at Kanpur for the tannery sector and CETPs are proposed for tanneries at Unnao and Banther and for textile industries*
	• Treatment of industrial effluents separately or treatment of mixed sewage should be taken up
	  o *E.g.: NMCG has set up STPs at Bhagalpur, Farukkabad which treats mixed sewage (domestic + industrial sewage)*
	• Treated Wastewater (TWW) Reuse can ensure self-regulation and control by industries as well as STP operators. Properly treated effluent / sewage can be reused within industries and/ or be sold to other users. This can encourage industries/ STP operators to treat the effluent/ sewage to the acceptable quality level. An enabling policy to make TWW use across the country is being developed by Ministry of Jal Shakti. This policy will guide the states (those which doesn't have a TWW policy yet) to prepare state level policies ensuring increase in compliance and self-regulation by industries and ULBs.	

Scheme implementation		
NRCP – R7	**Exploring funding options for NRCP** • The funding for NRCP needs to be increased considering the existing sewage treatment gap and the funds required to bridge the gap • NRCD should explore funding options with bilateral/ multilateral funding agencies such as World Bank, ADB, JICA, USAID, DFID • Explore PPP procurement models such as Hybrid Annuity Models will help in bringing private sector funding through capex sharing with private players. Under such model, government benefits from staggered and distributed capital payments over a	NRCP-F8 NRCP-F12

Sl.no	Recommendation	Finding
	longer period. This will also enable the authority to have additional funds for taking up more projects • Create an enabling structure to get into long term tripartite agreements which are essential for developing and maintaining PPP projects (similar to the arrangement in NMCG projects where NMCG is a party to the PPP contracts with the state government and concessionaire). This can be enabled through creating a society or corporation or SPVs backed by Government of India which can enter long term contract and provide cushion to the private players investing in the projects. • Explore funding options from leading NGOs, large philanthropic organizations such as Bill and Melinda Gates Foundation (BMGF) need to be explored (similar to Clean Ganga Fund) • Private players can also be roped in through their CSR funds, especially in river front development and beautification activities leveraging the local aesthetic appeal many rivers may be having to the community. • Innovative financing instruments such as Municipal Bonds, Green Bonds and alternate funding options including microfinance, private finance etc. can be explored. • Finally, the scheme requires operational and institutional independence like NMCG and a dedicated year wise funding allocation such that more projects can be taken up. •	
NRCP – R8	**Additions to the current scheme guidelines for fund release – Conditions Precedent** • The NRCP scheme should add certain time bound "Conditions Precedent" which needs to be satisfied prior to approval of projects and sanction of funds by NRCD. . The Conditions Precedent should include the following in addition to the prevalent terms and conditions:	NRCP-F9 NRCP-F10 NRCP-F12

Sl.no	Recommendation	Finding
	○ Submission of Certificate of Possession of the land to be used for construction of STP by the PIA ○ Consent of state and Panchayat departments for usage of the land for construction of STP ○ Testing of influent parameters by NABL accredited laboratory and reporting of industrial contaminants (if any) ○ Identification of fund by state govt. for contribution to state matching share of the project ○ Identification of PIAs for implementation of the project along with approval of project design by the PIA as per DPR. No further changes in the project design shall be permitted during implementation phase except written approval from NRCD.	
NRCP – R9	**Adoption of lifecycle-based procurement model** • To tackle the challenge of unavailability of funds and manpower during O&M phase, a lifecycle-based procurement model with private sector participation such as Hybrid Annuity Model and/ or EPC with long term O&M should be explored. Standard bid documents for these models should be prepared gathering learnings from NMCG projects. • Under these models, the contractor is appointed for construction of the STP and shall also have O&M responsibility for a period of10-15 year. • In addition, execution of a performance-based contract throughout the project lifecycle shall ensure that the concessionaire is performing well, and discharge parameters shall always comply with extant norms. • Further, technology neutral contracts should be explored where the concessionaire can choose the best suited treatment technology among centralized STP/ decentralized STP/ FSTP/ co-	NRCP-F8 NRCP-F13 NRCP-F14 NRCP-F15

Sl.no	Recommendation	Finding
	treatment etc. based on STP location, existing conditions and treatment gap. • Concepts like one city-one operator model wherein one private operator will be responsible for development and O&M of all the sewerage networks and STPs in the city can also be explored especially in the larger towns. • The concessionaire shall also have an option to generate revenue in post-construction phase through innovative ways such as – o Selling of treated wastewater for use in nearby industries o Selling of treated wastewater for horticulture, gardening and beautification, irrigation etc. as per prevalent wastewater reuse policies o Selling of treated sludge as manure after stabilization o Generating power in the plant from biogas produced from sewage for running mechanical and electrical equipment in the STP or can also set up solar power plants. o *E.g.: Learning can be derived from the case study of River Nag and Pili in Nagpur on wastewater treatment and reuse.* ▪ *In April 2020, pollution abatement works on Rivers Nag and Pili in Nagpur has been approved at a total cost of Rs. 2,324 Cr. to be funded by JICA and partially (15%) by Nagpur Municipal Corporation. The project includes construction of 2 STPs (48 MLD and 43 MLD respectively) and laying of 1,362 km of sewage lines for diversion of sewage from 100 small streams that flow into River Nag/ Pili downstream.* *An arrangement of water swap has been undertaken for wastewater reuse. Raw water sent in bulk to the industries under Nagpur Municipal Authority is diverted to water treatment plants for the city, thus increasing availability of potable water for Nagpur residents. In turn,*	

Sl.no	Recommendation	Finding
	recycled water from the city is again being diverted for industrial use. This water swap arrangement, operational since 2015, is additionally using municipal treated wastewater from Nagpur for cooling purposes in the power plants at Koradi, Khaparkheda and Mauda.	
NRCP – R10	**Increasing public awareness about NRCP** • The concessionaire should also take up awareness campaigns for sensitizing the local populace and encouraging use of the project structures created. NGOs and voluntary organizations should be engaged for this purpose. • More activities such as Shivirs, Padyatras, Shramdans, Exhibitions and Ghat cleaning should be undertaken by the states to create awareness among the people residing in towns situated on riverbanks. The Communication Advisory Committee should closely coordinate with State Governments to oversee this • Social media footprint should be enhanced by creating Facebook page, Instagram profile, Twitter handles to make people more aware of the projects being undertaken. *Related schemes such as National Mission for Clean Ganga, AMRUT have such social media presence.* • Rivers have a local appeal and often have religious connects with the people. This people-river connect needs to be strengthened by building more organizations in line with "Love Tapi Care Tapi" group and involving more grass-root level people and SHGs. • There should be a dedicated component and budget allocation for IEC campaigns in the NRCP scheme guideline to increase public awareness about the program. • Increasing public awareness about NRCP should be monitored by public perception surveys that can also act as feedback to implementing agency and be helpful in outcome monitoring.	NRCP-F15

Sl.no	Recommendation	Finding
NRCP-R11	**Training and Capacity Building Workshops by NRCD** • Ensure engagement of technically accredited bodies to conduct these periodic trainings and impart knowledge sharing via industry experts. • NRCD should conduct training sessions and workshops for the PIAs to impart knowledge on the following: - o latest sewage treatment technologies o latest cost-efficient treatment methods o revised discharge standards notified by NGT o River quality monitoring o TWW recycling o latest notifications from CPCB and SPCBs o standard procurement process and model tender document o exploring revenue generation options from reuse of treated wastewater and treated sludge o modalities for public awareness campaigns • Training sessions can also be conducted by Indian Council of Agricultural Research (ICAR) on novel models for biological wastewater treatment. The Indian Agricultural Research Institute (IARI) is also currently working on developing environmentally sustainable de-centralized wastewater treatment technologies with low Capex/ Opex and can impart knowledge to the PIAs.	NRCP-F14
NRCP – R12	**Change in funding and fund transfer mechanism to PIA** • There should be a mechanism of providing in-principle approval for a project based on pre-feasibility report submitted by the state/ PIA. A detailed project assessment, DPR can be submitted post the in-principle approval and before fund sanction. This would save effort, cost and time of the PIAs submitting detailed proposals for projects which might get rejected later. • Alternatively, budget allocation for river basins for a financial year can be made under NRCP scheme to give more clarity to PIAs.	NRCP-F8 NRCP-F12

Sl.no	Recommendation	Finding
	• It is proposed that central share of funds be released directly to the PIA in tranches through creation of an SPV. The fund can be transferred to an escrow account. For instance, a token 25% of central share of funds can be transferred to the PIA at the start of the project. Once the PIA submits the Utilization Certificates and raises request for subsequent funds, NRCD can release the central share in tranches. • The state government may release their share in tranches as per availability and requirement.	
Monitoring and evaluation		
NRCP – R13	**Revision in scheme guidelines – Guidelines for project monitoring** • Appointment of a 3rd party independent agency for regular monitoring and evaluation (who shall conduct monthly verification of the quality of the treated sewage) should be completed before release of last tranche of funds. • Appointment of an Environmental Officer at the SPMU who shall submit bi-monthly reports on the quality of the treated sewage. • Coordination with the Central Monitoring Committee set up by NGT (to enforce national plan to make polluted river stretches pollution free) and River Rejuvenation Committees in the states is important to ensure improvement in river water quality. • A special cell for water quality monitoring of rivers along with monitoring of sewage and river health should be proposed to be set up under CPCB (similar to the cell set up for River Ganga) ○ Learning can be drawn from NMCG. For example: Under the NMCG programme, Central Pollution Control Board (CPCB) is carrying out the water quality monitoring of River Ganga at 97 locations in five States viz. Uttarakhand, Uttar Pradesh, Bihar, Jharkhand and West Bengal in association with State	NRCP-F16 NRCP-F18

Sl.no	Recommendation	Finding
	Pollution Control Boards. The objective of monitoring is to assess the fitness of water for bathing water quality criteria. There are 63 water quality parameters which are currently being monitored comprising - Field Parameters (9); Bio Monitoring (3); Core Parameters (7); General Parameters (19); Micro-pollutants - Heavy Metals (10) and Pesticides (15). • Inclusion of bio-diversity monitoring of rivers including calculation of bio-diversity index in the river body, hygienic surveys with respect to Fecal coliform, Fecal streptococci in bathing waters should be undertaken. o Learning can be drawn from NMCG- Biomonitoring of river Ganga at various locations (Haridwar to Diamond Harbour in West Bengal) has been carried out to study the Benthic Macro Invertebrates, which reflects the biological health of river. It has been observed that water quality of Ganga supports diversified community structure and there is an improvement in biological water quality from moderate to good which indicates that river environment is having tendency towards enhancing its ecological health. • Create provision of water quality monitoring on a real-time basis through setting up Real-time Water Quality Monitoring Stations (RTWQMS) on the main stem of the river much like in the River Ganges. o E.g.: Twenty Real-time Water Quality Monitoring Stations (RTWQMS) were installed on main stem of river Ganga; nine on the tributaries. These real-time stations measure water quality of river Ganga on 24x 7 basis for 17 parameters through sensors.	

Sl.no	Recommendation	Finding
	• River health monitoring should be done based on monitoring stations placed at different points on the river and not only in the vicinity of STPs. STPs discharge will anyway be monitored by flow meters and sensors measuring parameters like BOD, COD, TDS, TSS, etc. • The National Green Tribunal, in an order dated 20.09.2018 has ordered the state environmental agencies to tackle the pollution of identified critically polluted and highly polluted river stretches in the states. The Action Plan will be directed to address the monitoring and control of sources of pollution. Rivers have assimilative capacity to respond to any upset of equilibrium in water quality or sediment load through self-adjusting processes of erosion and sedimentation. "*Assimilative capacity is the relationship between water quality and quantity, land use (not only urban development, but also activities such as agriculture, aggregate extraction, and recreational activities), and the ability of a watercourse or river to resist the effects of these disturbances without the impairment of water quality below levels set by provincial standards.*"[237] A mass balance approach along with empirical relationships can be used to compute the assimilative capacity. However, the prerequisite is the availability of sufficient water quality data. Hence presence of Real-time Water Quality Monitoring Stations (RTWQMS) becomes critical. The calculation of assimilative capacity with proper monitoring instrumentations helps in identifying the pollution hotspots in	

[237] Lake Simcoe Region Conservation Authority, Assimilative Capacity Study, 2006. Retrieved from http://www.lsrca.on.ca/watershed-health/reports/assimilative-capacity-study

Sl.no	Recommendation	Finding
	a riverbed and accordingly interventions can be planned to maintain the assimilative capacity	

NRCP – R14	**Development of a central dashboard for Monitoring**
	• A central dashboard needs to be developed by NRCD which shall give regular progress updates on the following parameters –
	  ○ Planning Phase–
	  ▪ Projects under consideration for sanction
	  ▪ Proposals submitted and their evaluation status
	  ○ Works Phase **-**
	  ▪ Project physical progress - STPs, bathing ghats created etc.
	  ▪ Project financial progress - sanctioned versus actual expenditure
	  ▪ STP capacity in MLD – target vs achieved
	  ▪ I&D works in km - target vs achieved
	  ▪ Project progress - status of each project in each state and activity tracker
	  ▪ Ongoing tenders
	  ○ Post-construction phase
	  ▪ Real-time monitoring of STP performance – inlet & outlet BOD, COD and TSS level
	  ▪ River water quality parameters from the Real-time Water Quality Monitoring Stations
	  ▪ Monitoring reports submitted by ULBs
	• Installation of real-time monitoring instrumentation systems should be done during the construction of the STPs. The contractors should be entrusted with the responsibility of installing the real-time monitoring systems along with the assets and the related bid documents for hiring contractors should have the detailed technical specifications of the meters, sensors and instrumentation systems.
		NRCP-F17

2.2.9 Flood Management and Border Area Programmes

The projects for flood management and flood control are formulated and implemented by respective state governments/Union Territories from their own resources and as per their priority. Central Government provides financial assistance and technical assistance to states/UTs for implementing some projects in critical areas. Central Government has been providing financial assistance through a scheme called Flood Management Programme (FMP) since XI Plan. The scheme since its inception has undergone several changes as per demands of states/UTs and also on account of various directions and policies of Govt. of India.

2.2.9.1 Background

During X Plan, following four schemes were sanctioned to provide central assistance to the flood prone states to take up flood control and river management works in critical areas:

a) Critical Anti-erosion works in Ganga Basin States (a Centrally Sponsored Scheme)
b) Critical Flood Control and Anti Erosion Schemes in Brahmaputra and Barak Valley States (a State Sector Scheme),
c) Improvement of Drainage in critical areas in the country (a State Sector Scheme) and
d) Critical Anti-erosion Works in Coastal and other than Ganga Basin States (a State Sector Scheme)

Flood Management Programme:

The Flood Management Programme (FMP) was implemented during XI Plan with an outlay of Rs. 8,000 Cr. after subsuming above four schemes. Under the Programme, central assistance was provided to State Governments for taking up works related to river management, flood control, anti-erosion, drainage development, flood proofing, restoration of damaged flood management works and anti-sea erosion. The pattern of funding was 90 % (Centre):10 % (State) for Special Category States and 75 % (Centre): 25 % (State) for General/ Non-Special Category States.

During XI Plan, 420 works with a total estimated cost of Rs.7,857.08 Cr. was approved under FMP. Central assistance to the States/UTs to the tune of Rs. 3566.00 Cr. was released during this plan period. During XII Plan, the Government of India approved continuation of "Flood Management Programme" with an outlay of Rs.10,000 Cr. The funding pattern under the

Scheme for the special Category States covering the North Eastern States, Sikkim, Himachal Pradesh, Jammu & Kashmir and Uttarakhand was 70% (Centre) :30% (State) and General States – 50% (Centre) : 50% (State). The project eligibility criteria for inclusion under the Scheme in respect of special Category States was project with estimated cost of Rs. 10 Cr. or above with Benefit Cost ratio of more than 1.0; and in respect of General States was Rs. 40 Cr. or above with Benefit Cost ratio of more than 1.0. The inclusion of projects, inter-se priority of the works, etc. were decided through an Inter-Ministerial Committee headed by Secretary (Water Resources), Government of India. During XII Plan (up to 31-03-2017), 102 works with a total estimated cost of Rs.5,381.28 Cr. were approved under FMP. Central assistance to the States/UTs to the tune of Rs. 1307.07 Cr. was released during this plan period. Thus, total release during XI & XII Plan under FMP was Rs. 4,873.07 Cr.

River Management Activities and Works Related to Border Areas (RMBA):

During XI Plan, Government of India had approved implementation of the Central Sector Scheme "River Management Activities and Works related to Border Areas" with a total outlay of Rs. 820 Cr. for taking up non-structural measures such as Hydrological Observation and Flood Forecasting works on common border rivers, payment to neighbouring countries (China) for supplying HO data on common rivers, investigation of WR projects in neighbouring countries, activities of GFCC and Pancheswar Development Authority (PDA) was funded through this scheme. In addition to above activities, 100% Central Assistance was also provided for taking up structural measures such as Anti Erosion/Flood Management schemes on rivers on international borders and Union Territories.

The Scheme was continued during XII Plan, with a total outlay of Rs. 740.0 Cr. to cover the following continuing and new activities.

i. Hydrological observations and flood forecasting on common border rivers with neighbouring countries
ii. Investigations & Pre-construction activities for WR projects on common border rivers
iii. Pancheshwar Development Authority (PDA)
iv. Grant in Aid to States/UTs for flood management/anti –sea erosion works
v. Maintenance of flood protection works of Kosi & Gandak projects (in Nepal)

vi. Flood Protection/anti-erosion works in the border areas with Bangladesh and Pakistan by States and Flood Management/anti-erosion works/anti- sea erosion works in UTs

vii. Activities of Ganga Flood Control Commission (GFCC)

The RMBA being specific to activities in border areas with neighbouring countries viz. Bangladesh, Nepal, China, Pakistan and Bhutan and for taking up Anti Erosion/Flood Management schemes on rivers on international borders and Union Territories, the projects/ works are funded with 100% central assistance. A Grant-in-Aid of Rs. 563.61 Cr. (Rs. 340.41 Cr.-XI Plan & Rs. 223.20 Cr.-XII Plan) were released to various states under this Scheme.

Flood Management and Border Areas Programme (FMBAP)

The Outcome review/Third party evaluation of the two Plan Schemes 'Flood Management Programme (FMP)' and 'River Management Activities & Works related to Border Areas (RMBA)' implemented during XII Plan was carried out by a Committee constituted under the chairmanship of Director, National Institute of Hydrology, Roorkee. The Outcome Review/Third Party Evaluation Committee recommended that only those schemes which are very critical for long-term protection against floods, costing above Rs. 40 Cr., may be considered for funding by Union Government under Flood Management Programme. Other schemes / works may be taken up by the concerned State Governments through State Plan allocation. Since the FMP and RMBA schemes have common nature to some extent, the modalities for merging the two schemes in a hybrid/umbrella scheme may be explored and both the schemes may be merged into a single scheme.

For the period 2017-18 to 2019-20, a comprehensive scheme titled "Flood Management and Border Areas Programme (FMBAP)" with an outlay of Rs. 3342.00 Cr. (FMP-Rs. 2642 Cr. & RMBA-Rs. 700 Cr.) with merged components from the XII Plan Schemes viz. Flood Management Programme (FMP) and River Management Activities & Works related to Border Areas (RMBA) schemes was approved by the Union Cabinet.

The funding pattern for works in general category states under FMP component remained as 50 % (Centre): 50 % (State) and for projects of 8 North Eastern States, J&K, Himachal Pradesh and Uttarakhand, the funding pattern continued to be 70 % (Centre):30 % (State). Whereas, RMBA

component being specific to activities in border areas with neighbouring countries viz. Bangladesh, Nepal, China, Pakistan and Bhutan the funding pattern continued as 100% central assistance.

During the period 2017-18 to 2019-20 Rs. 1536.95 Cr. has been released as Grant-in Aid to the States under FMP component and Rs. 485.33 Cr. has been spent under RMBA component of FMBAP, thereby making a total of Rs. 2022.28 Cr.

The projects completed so far under the Scheme have provided flood protection to an area of 4.987 mha and benefitted population of 51.97 million. This protected area also includes restoration of earlier protected area (damaged due to force majeure like conditions) by means of works like raising & strengthening of embankments etc.

Some of the salient features of FMBAP Scheme as approved by Union Cabinet for the period 2017-18 to 2019-20 are-

i. FMBAP Scheme is for completion of the spill over works in respect of 83 ongoing projects as well as for the works which are completed and included earlier under FMP during XI & XII Plan. Also, as assessed/required and dropping 16 ongoing projects in which the current work progress is less than 50 percent.
ii. The Scheme has a provision only for clearing the committed liabilities of ongoing and completed projects as per extant XI/ XII Plan guidelines and that no new project to be included under FM component of FMBAP Scheme till then.
iii. In this Scheme, Administrative Ministry has been authorized to decide the inter-sub-component and inter-item redistribution of provisions within the overall cost of the respective components of FM (Rs. 2642 Cr.) and RMBA (Rs. 700 Cr.) under the Scheme.
iv. The techno-economic Appraisal and Investment Clearance of flood management works under FMBAP continued to be done as per the procedures laid down by Department of Water Resources, River Development & Ganga Rejuvenation.
v. The Inter-Ministerial Committee (IMC) headed by Secretary (WR, RD & GR) with members drawn from Ministry of Finance (Department of Expenditure), Planning Commission (Now NITI Aayog) and other line Ministries / Departments/Organisations constituted during XII Plan to be continued under the scheme for FMP component. For the works under RMBA

component, the procedure is proposed to be in accordance with the bilateral mechanism with neighbouring countries.

vi. For release of Central assistance to State Government for Projects included under FMP, detailed guidelines of DoWR, RD & GR of October,2013 describing procedures about submission of documents, budget provisions, Utilisation Certificates, monitoring reports, Concurrent Report, instalments for release of central share to States, etc is followed.

State / UT Wise Status

Table 127: State-Wise Works Approved, Works Completed and Funds Released under Flood Management Programme (FMP) during XI Plan, XII Plan, 2017-18, 2018-19 & 2019-20

Rs. in Cr.

Sl. No.	State	XI Plan			XII Plan			Total (XI + XII Plan) Status				Under FMP component of FMBAP			
		Works Approved		Funds Released (XI Plan)	Works Approved		Funds Released (XII Plan)	Works Approved		Number of Works Completed	Total Funds Released (XI + XII Plan)	2017-18	2018-19	2019-20	Total funds released
		Nos.	Estimated Cost		Nos.	Estimated Cost		Nos.	Estimated Cost						
1	Arunachal Pradesh	21	224.69	81.69	0	0.00	87.91	21	224.69	**11**	169.60	21.18			190.78
2	Assam	100	996.14	748.86	41	1386.97	64.89	141	2383.11	**95**	813.75	245.49	142.12	85.03	1286.39
3	Bihar	48	1370.42	723.18	4	447.63	184.64	52	1818.05	**41**	907.82		16.58		924.41
4	Chhattisgarh	3	31.13	15.57	0	0.00	3.75	3	31.13	**0**	19.32				19.32
5	Goa	2	22.73	9.98	0	0.00	2.00	2	22.73	**2**	11.98				11.98
6	Gujarat	2	19.79	2.00	0	0.00	0.00	2	19.79	**1**	2.00				2.00
7	Haryana	1	173.75	46.91	0	0.00	0.00	1	173.75	**0**	46.91				46.91
8	Himachal Pradesh	3	225.32	165.98	4	1139.62	221.87	7	1364.94	**1**	387.85	87.50	162.60	176.41	814.36
9	Jammu & Kashmir	28	408.22	252.57	15	562.47	169.95	43	970.69	**8**	422.52	110.40	52.20	92.74	677.85
10	Jharkhand	3	39.30	18.44	0	0.00	4.27	3	39.30	**2**	22.71				22.71
11	Karnataka	3	59.46	23.80	0	0.00	0.00	3	59.46	**0**	23.80				23.80

Table 128: State-Wise Grant in Aid Released under RMBA during XII Plan, 2017-18, 2018-19 & 2019-20

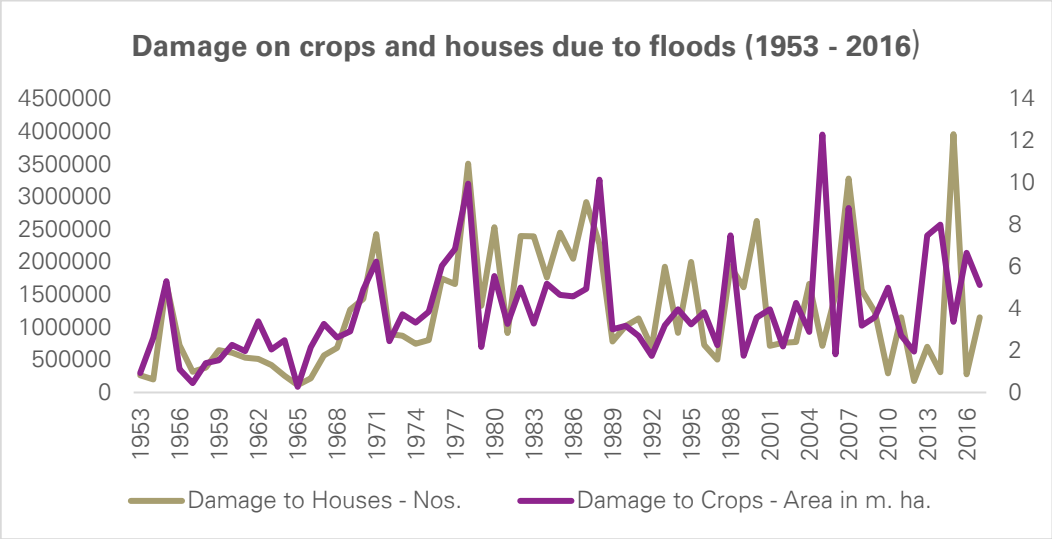
Rs. in lakh

SN	State	2012-13	2013-14	2014-15	2015-16	2016-17	Total in XII Plan	2017-18	2018-19	2019-20	Total releases
1	Assam	0.00	0.00	0.00	0.00	0.00	0.00				0.00
2	Bihar	924.20	0.00	5127.33	4784.24	0.00	**10835.77**	**5257.07**	**11569.70**	**6529.00**	34191.54
3	UP	0.00	0.00	0.00	2664.09	0.00	**2664.09**	**9043.18**	**7229.20**		18936.47
4	Tripura	0.00	0.00	0.00	1402.45	0.00	**1402.45**				1402.45
5	West Bengal	0.00	630.91	0.00	2969.09	0.00	**3600**		**6565.54**		10165.54
6	J&K	0.00	997.76	0.00	0.00	0.00	**997.76**	**877.50**	**283.25**	**431.80**	2590.31
7	Punjab	0.00	0.00	0.00	1494.50	0.00	**1494.5**	**747.25**			2241.75
8	Puducherry	0.00	0.00	1325.63	0.00	0.00	**1325.63**				1325.63
9	Lakshadweep	0.00	0.00	0.00	0.00	0.00	**0.00**				0,00
	Total	**924.20**	**1628.67**	**6452.96**	**13314.37**	**0.00**	**22320.20**	**15925.00**	**25647.69**	**6960.80**	**70853.69**

2.2.9.2 Performance

Performance on REESI+E framework

Table 129: FMBAP – performance evaluation using REESIE framework

Parameter	Findings from research
Relevance	**Secondary**: • As per flood data available from 1953- 2016, the average area affected per year is 7 mha and mean population affected every year is around 32 million[238]. State-wise  • The objective of FMBAP is to minimize damages from the floods and protect establishments in towns and villages, communication links, agriculture fields. • The prime purpose in flood management is to provide a reasonable degree of protection against flood damages and economic loss through a combination of structural and non-structural measures. • FMBAP undertakes short and long term measures in respect of flood management. The emphasis is on the following areas: o Basin wise integrated flood management approach o Construction of reservoirs and diversion of flood water to water scarce areas o Use of new construction materials

Parameter	Findings from research
	○ Modernisation of flood forecasting network and its extension to other areas and reservoirs ○ Automatic reservoir release information system • The general approach about flood management has been in the form of physical measure to prevent the flood water from reaching potential damage centres. The main thrust of the flood protection programme undertaken in India, so far has been of structural measures like: ○ Embankment / Flood Walls ○ Dams & Reservoirs ○ Natural Detention Basin ○ Channel improvement ○ Drainage improvement ○ Diversion of flood water • In addition to above, non-structural components to mitigate the flood damages are taken up such as: ○ Facilitating timely evacuation of the people and moving their movable property to safer grounds by having advance warning of incoming flood i.e. flood forecasting, flood warning in case of threatened inundation ○ Discouraging creation of assets/settlement of the people in the areas prone to frequent flooding i.e. enforcing flood plain zoning regulation
	Primary: • Between 1953 and 2016, the average area affected (in mha), population affected, and value of crops, houses and public utilities damaged by state is provided below[238].

State	Average Area Affected (in mha)	Average Population affected (in lakh)	Average value of damages (in Rs. Cr.)
Assam	0.81	26	123
Bihar	1.30	60	235

[238] Flood Forecasting Monitoring Directorate, Central Water Commission, "State wise flood damage statistics"

Parameter	Findings from research			
	Himachal Pradesh	0.33	15	349
	Uttar Pradesh	1.70	65	303

- There are 20 river basins (12 major and 8 composite) in India, out of which three major river systems, namely Ganga, Brahmaputra and Indus are shared with neighbouring countries i.e. Nepal, Bhutan, China, Bangladesh and Pakistan. These three river systems alone drain a total of 42 % of geographical area in India.
- As per stakeholders from GFFC, the Koshi River system has its sources in the territory of Tibet and flows through an old channel near the border with Nepal and the Indian city of Bihar. The frequent floods are a constant threat to the livelihoods of the local population in the northern Indian state of Bihar. Areas like Sharsa in Bihar and Sunsari in Nepal are generally severly affected. Similarly, areas in North 24 Parganas district of West Bengal bordering Bangladesh are severely affected by flood from the rivers Teesta, Torsa, Jaldhaka, Raidak I & II. Ferozpur in Punjab is affected due to water coming from Sutlej River due to heavy flow of water from Pakistan due opening of headwork gates in Kasur area.
- Considering the above facts, hydrological observations and flood forecasting of border rivers are included as an important scope of FMBAP.
- Various Monitoring Agencies (like CWC, GFCC & BB) have been set up to provide technical support to the States in respect of techno-economic appraisal of Flood Management schemes, generating flood forecasts, and monitoring and coordinating flood management schemes across border areas of Nepal, Bhutan, Bangladesh, China and Pakistan.
- The Monitoring Agencies also support the states by providing data modelling and forecasting through damage statistics by means of 199 Flood Forecasting stations. The percentage accuracy is around 95%. Currently, there are around 878 Hydro-meteorological sites covering the 20 River Basins in India[239].
- The states coming under Ganga river basin viz., Uttarakhand, Himachal Pradesh, Haryana, Delhi, Uttar Pradesh, Rajasthan, Madhya Pradesh, Chhattisgarh, Bihar,

[239] Data shared by Central Water Commission

Parameter	Findings from research
	Jharkhand and West Bengal, are monitored by GFCC. While, the States coming under Brahmaputra river basin viz., Arunachal Pradesh, Assam, Nagaland, Meghalaya, Sikkim and West Bengal are monitored and supported by Brahmaputra Board. The Brahmaputra river drains an area of 5,80, 000 sq. km., which is shared by six states namely Arunachal Pradesh (41.88%), Assam (36.33%), Nagaland (5.57%), Meghalaya (6.10%), Sikkim (3.75%) and West Bengal (6.47%)[240]. • The rest of the States are monitored and technically supported by CWC. However, CWC is the only agency monitoring the Flood Forecasting and Hydro-meteorological stations. • Wireless Communication system installed in almost 550 stations is the backbone of the communication system required for flood forecasting activities. • States like Bihar, Assam, Himachal Pradesh, Jammu & Kashmir have effectively implemented structural measures, as a result of which problems like erosion and inundations have been reduced to a considerable extent. • Structural measures like embankments, porcupines, spurs have proven effective in flood control. In Himachal Pradesh, around 10,000 hectares of land could be brought under protection through channelization of Swan river. Additionally, treatment of catchment area of tributaries falling from Jhalera bridge, as the Swan River flows from Jhalera Bridge to Sanktogarh Bridge in District Una of Himachal Pradesh and Bata river channelization works have protected around 107 hectares of land[241]. • In Jammu & Kashmir, as erosion due to flash floods and cloud bursts is a major problem, the emphasis is on erosion control and drainage development. Amongst water sector schemes, maximum investment is made for flood control schemes (Rs. 55 Cr. in comparison to major and medium irrigation schemes (Rs. 52 Cr.) and Minor Irrigation (Rs. 2 Cr.)[242]. • Bihar, on the other hand, experiences the problem of inundation due to flood, resulting insignificant damage to life and property. As on date, a total of around 3,500 km of embankment across 12 river basins have been constructed. Approximately,

[240] Data shared by Brahmaputra Board

[241] Data shared by Jalshakti Bivag, Himachal Pradesh

[242] Data shared by Water Resources and Flood Control department, Jammu & Kashmir

Parameter	Findings from research
	294 mha of area is protected[243]. Amongst the states under Ganga river basin, Bihar is implementing the maximum number of projects (29), followed by Uttar Pradesh (10) and West Bengal (2). • The total length of Brahmaputra river in Assam is 640 km and hence Assam had the requirement of most structural measures like construction of embankments and flood walls, river training and bank protection works, anti-erosion and town protection works, river channelization, drainage improvement/ sluices and raised platforms. However, no long-term measures have been implemented so far to mitigate the flood and erosion problems of the state. Till date, only immediate and short-term measures have been implemented by the state Water Resources Department.
	Inference: • FMBAP is considered relevant as far as flood protection is concerned as it provides the flexibility of implementing area specific and problem specific structural measures. The benefits of such measures have increased over the years. • FMBAP undertakes flood protection measures through financial assistance for construction of structural components. The scheme intends to protect valuable land and assets such as housing, public infrastructures, livestock, crops from erosion and flooding. The structural measures are meant to reduce flood flows by artificially creating reservoir across a river, by diversion of a part of the peak flow to another river or basin, by constructing a parallel channel bypassing an area, by raising the effective river bank through embankments and through channel and drainage improvement works. • The non-structural measures endeavor to mitigate the flood damage by facilitating timely evacuation of the people and shifting of their movable property to safer grounds by generating warnings of incoming flood i.e. through flood forecasting, flood warning in case of threatened inundation and discouraging creation of valuable assets/ settlement of the people in the areas subject to frequent flooding i.e. enforcing flood plain zoning regulation.

[243] Data shared by GFCC

<table>
<tr><th>Parameter</th><th>Findings from research</th></tr>
<tr><td></td><td>
• To address the bilateral issues with neighboring countries like Nepal, Bhutan, China, Bangladesh and Pakistan, a number of activities are carried out e.g., flood forecasts for rivers flowing from Nepal, Bhutan and China are obtained on a regular basis. Similarily, anti-erosion works are undertaken along the international borders with Bangladesh. Further, efforts have been made to finalize the DPR for Pancheshwar Multipurpose Project jointly and coordinated field investigations for Sapta Koshi Dam in Nepal are being undertaken.
• Flood forecasting mechanism has strong applicability in terms of generating and disseminating warnings. Generally, the community residing in the flood prone areas is provided with warnings 7 days prior to the expected date of flood. Increasing the number of flood forecasting stations and Hydro-meteorological stations has helped in timely dissemination of these warnings.
• Technical support and monitoring by respective monitoring agencies towards planning and implementation of the flood management schemes have helped the States.
• Therefore, the performance of the scheme on this parameter is ‘satisfactory’.
</td></tr>
<tr><td>Effectiveness</td><td>
Secondary:
• The Flood Management (FM) and the River Management and Works related to Border Areas (RMBA) under FMBAP include construction of embankments, check dams, anti-erosion structures and investigation of Water Resources Projects in neighbouring countries. This is shown below for various states[244]:
<table>
<tr><th>Region / State</th><th>Embankment built (km)</th><th>Drainage development (km)</th><th>No. of towns / villages protected</th><th>Area benefitted (mha)</th></tr>
<tr><td>Assam</td><td>4459</td><td>851</td><td>681</td><td>1.64</td></tr>
<tr><td>Manipur</td><td>500</td><td>126</td><td>1</td><td>0.13</td></tr>
<tr><td>Meghalaya</td><td>116</td><td>-</td><td>8</td><td>0.001</td></tr>
</table>
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</table>

[244] Memorandum for Expenditure Finance Committee (EFC) on “Flood Management and Border Area Programme (FMBAP)” during 2017-18 to 2019-20

Parameter	Findings from research				
	Tripura	140	11	11	0.026
	West Bengal	101406	7140	48	2.57
	Uttar Pradesh	2810	13357	65	1.60
	Bihar	3554	364	47	2.95

- The total protection provided through completed works during the XI & XII Plan was 34.66 lakh Ha of land and this has benefitted a population of around 266 lakh. FMBAP has been effective in protecting 20 mha of land area and a population of 197 lakh during XI Plan and 15 mha of land area and a population of 69 lakh during XII Plan[244]. As on date, a total of more than 37,000 km of embankment and 40,000 km of drainage development have been completed which has protected more than 10,000 towns and villages protected. As a result, more than 34 mha of land area and a population of 266 lakh have been protected.[244] It was estimated that 298 completed schemes (252 during XI plan and 46 during XII Plan) provided protection against floods in 3.47 mha of flood affected area & around 26.58 million population was benefitted. As per latest status, 414 schemes are completed; 64 schemes have been foreclosed and shifted & 44 schemes are ongoing. It has been estimated that these 414 completed schemes provided flood protection to an area of 4.987 mha & around 51.97 million population has been benefitted.[244]
    - Dams and Reservoirs: Dams and Reservoirs can moderate the intensity and timing of the incoming flood. They store the water during periods of high discharges in the river and release it after the critical high flow condition is over, so as to be ready to receive the next wave. Their effectiveness in moderating floods would depend on the reservoir capacity available at that time for absorbing the flood runoff and their proximity to the likely damage centre. The Design & Research wing of CWC supports the states in technical appraisal of safety aspects of existing dams and its monitoring. The Dam

9. Memorandum for Expenditure Finance Committee (EFC) on "Flood Management and Border Area Programme (FMBAP)" during 2017-18 to 2019-20

	Safety Organization of CWC looks after issues related to Dam Safety which can be broadly categorized as under: o Maintenance of National Register of Large Dams. o Convening meeting of National Committee on dam safety and National Committee on Seismic Design Parameters. o Instrumentation in Dams and Powerhouse Caverns, besides other hydraulic structures. o Special Analysis like Dam Break Modelling and foundation problems. Additionally, the Ministry of Water Resources constituted a Standing Committee in 1982 to review the existing practices and to evolve unified procedures of dam safety for all dams in India, under the Chairmanship of Chairman, Central Water Commission. Subsequently Government of India, Ministry of Water Resources reconstituted the Standing Committee in 1987 as the National committee on dam Safety to: o Monitor the follow-up action on the report on Dam safety Procedures both at the Centre and at the State level, o Oversee dam safety activities in various states and suggest improvements/ remedial measures to bring dam safety practices in line with state-of the art practices consistent with Indian conditions, o Act as a forum for exchange of views on techniques adopted for remedial measures to relieve distress in dams. Dam Rehabilitation & Improvement Project (DRIP): o Ministry of Water Resources, Government of India is implementing Dam Rehabilitation and Improvement Project (DRIP) with financial assistance from the World Bank. DRIP involves rehabilitation of about 225 large dams in seven States i.e. Madhya Pradesh, Orissa, Kerala, Tamil Nadu Karnataka, Jharkhand (DVC) and Uttarakhand (UJVNL) at an estimated cost of Rs. 2,100 Cr. In addition, DRIP also involves institutional strengthening (for dam safety) of all participating States as well as central level organizations like the Central Water Commission. The main implementation agencies for DRIP are the owners of dams viz. the Water Resources Departments and State Electricity Boards in the participating States.

	○ Embankments: Embankments (including ring bunds and town protection works) confine the flood flows and prevent spilling, thereby reducing the damage. These are generally cheap, quick and most popular method of flood protection and have been constructed extensively in the past. These are reported to have given considerable protection at comparatively lower costs, particularly in the lower reaches of large rivers. The total length of embankment constructed so far is around 37073 Kms till 2017. ○ Channelization of Rivers: Channelization of rivers, is effective, in the context of tackling the extensive meandering problems of the rivers, activating navigational channels and training these rivers into their original courses. ○ Channel improvement: The method of improving the channel by improving the hydraulic conditions of the river channels by desilting, dredging, lining etc., to enable the river to carry its discharges at lower levels or within its banks has been often advocated but adopted on a very limited extent because of its high cost and other problems. ○ Drainage improvement: Stress has been laid on improving the existing natural drainage system in the flood plains so that what should essentially be flooding of a few days should not get prolonged for months. In this context, the importance of the system of 'dhars' or 'old channels', which efficiently served the function of draining away the spillage and surface flows generated by local rains, are recognised. Till date, a total of 39727 km of drainage has been built. • As per CWC's Annual Report (2019-2020), under non-structural measures of FMBAP, 325 Flood Forecasting stations are installed through which, on an average 7,000 flood forecasts are issued every year (which have accuracy of around 98%). The flood forecasts are categorized as "Above Normal", "Severe Flood Situation" and "Extreme Flood Sitiation". During flood season of 2019, 9,754 flood forecasts were issued out of which around 87% of the forecasts were found within the accuracy limit. During this year, 245 daily bulletins, 768 orange bulletins for Severe Flood Situations and 113 Red Bulletins for Extereme Flood were issued. There are around 1,569 Hydrological Observation Stations in different river basins of the country to collect data on water level, discharge, water quality and siltation. Also, 75 exclusive meteorological observation stations are operational.

	• Information systems on flood management are maintained by the individual states whose coverage is currently limited to the number of schemes and the physical and financial progress data only. Also, MIS is being maintained by the Flood Management wing, DoWR. However, augmenting the MIS so as to include key performance indicators (KPIs) may be considered. A detailed Flood Management Information System (FMIS),as piloted in states of Bihar and Uttar Pradesh, may be rolled out in more states in a phased manner. The FMIS covers improved hydrologic observations and telemetry, more reliable and longer term rainfall forecasts, enhanced flood forecast and inundation prediction with better models, airborne Synthetic Aperture Radar (ASAR) surveys for real-time inundation information during floods, close-contour surveys of the flood plain using LIDAR Technology, mapping floodplain geomorphology including micro-relief to understand and improve drainage, improved communication links and information flow, risk and vulnerability analysis, institutional and community outreach mechanisms and real-time flood data dissemination. The fully upgraded FMIS would support preparation of master plan for flood control and drainage, irrigation improvement and overall water sector development in Bihar and Uttar Pradesh. • Institutional structure: At the national level FMBAP is overseen by Flood Management Wing of DoWR, RD & GR. The major functions of Flood Management wing are: o Examination and implementation of FMBAP o Monitoring of flood situation in the country o Support in formation of expert committees / task forces / working groups on flood management o All matters relating to India-Bangladesh and India – Nepal water resources development/ projects on common / border rivers o Technical matters related to Ganga Flood Control Commission o At the regional level, there are three monitoring agencies namely Central Water Commission (CWC), Ganga Flood Control Commission (GFCC) and Brahmaputra Board (BB). While GFCC monitors the flood management measures implemented by the States in Ganga River Basin and BB does so in

	Brahmaputra – Barak river basin, CWC monitors the flood management measures implemented by the states in rest of the country. • Monitoring and Evaluation: Monitoring of the scheme/projects under FMP are carried out by the Central Water Commission (CWC), Ganga Flood Control Commission (GFCC) and Brahmaputra Board (BB) in their respective jurisdictions. For the schemes costing less than Rs. 12.50 Cr., the performance is evaluated after the schemes are completed. The Performance evaluation of the completed works are conducted by independent specialized/ professional agencies having expertise in related fields in consultation with CWC/ GFCC/ BB as the case may be. Monitoring teams of CWC/GFCC/BB are entrusted with the monitoring of the physical and financial progress of the schemes. They are to conduct sample checks on the quality of construction materials and quality of works during their field visits. The samples taken/ witnessed at site by the teams are tested for quality checks and results thereof are reflected in the monitoring reports. • Training: Apart from approval of schemes, monitoring and fund management, FM wing of DoWR, RD & GR and the monitoring agencies impart training on techno-economic aspects of flood management. In addition, trainings on flood management measures are imparted by National Water Academy (NWA), Pune. The trainings mainly cover preparation of DPRs, Master Plans, Flood Warning System, River Management and Basin Planning, customized state specific training modules on Dam Break models, record management. During 2019-20, NWA organized 29 training programmes training programmes on hydrological aspects in project planning and preparation of DPR, GIS, Design Flood Estimation and Hydrological Modelling, DRIP implementation, Also, trainings on STAAD Pro and other design and analysis softwares like FLAC 2D have been imparted. • Flood Plain Zoning: Flood-plain zoning measures aim at demarcating zones or areas likely to be affected by floods of different magnitudes or frequencies and specify the types of permissible developments in these zones, so that whenever floods actually occur, the damage can be minimised, if not avoided. Unfortunately, while this approach was endorsed in principle by many, yet not adequate scant attention has been given to it in practice, leading to increased flood damages. The Central Water Commission (CWC) has been continuously impressing upon the states the need to take follow-up action to implement the flood plain zoning

Parameter	Findings from research
	approach. A model draft bill for flood plain zoning legislation was also circulated by the union government in 1975 to all the states. • Formation of River Basin Organizations: It has been recognised that comprehensive management of river basin can be promoted through setting up of River Basin Organisation (RBO). To enable the development of other rivers in the country, the River Boards Act was enacted in 1956. The Act spells out the need to regulate and develop the inter-state rivers and river valleys or any specified projects, by setting up a River Board under the consent of the respective state governments. Several River Basin Authorities like Tungabhadra Board, Bhakra-Beas Management Board, Cauvery River Authority, Narmada Control Authority has been formed but, these boards do not play any role in implementing flood management measures. The major functions of these River Basin Boards are limited to preparation of basin level and regional plans, generation of hydroelectric power, maintenance of multi-purpose projects and monitoring of water resources projects. • Although there are technical guidelines for FMP and flood forecasting (prepared by CWC), no scheme guidelines are available which specify the overview, objectives, components and fund management for FMBAP. Such guidelines will help the States in following uniform regulations for implementation of schemes as well as facilitate proper fund management. • Fund sharing: The fund sharing pattern for structural measures is 50:50 for all states except states in Hilly Areas like Uttarakhand, J&K and Himachal Pradesh and 8 North Eastern States. For Hilly Areas, the fund sharing pattern is 70:30 i.e., 70% of the total project cost is provided as Central Share and the residual 30% is contributed by the State. No additional cost towards cost escalation for structural measures are supported by the DoWR, RD & GR. Any such cost escalations have to be met by the States. • No fund is allocated for operations and maintenance of the completed Flood Management schemes. Once the scheme is completed, the same becomes the asset of the State and hence the responsibility of maintaining the structures becomes State's responsibility.

	Primary: • FMBAP Scheme encompasses completion of the spill over works of 83 ongoing projects as well as the works which are completed and included earlier under FMP during XI & XII Plan. As per FMP guidelines of XII plan for release of Central Assistance, restoration of flood control/ management works damaged due to force majeure like conditions are only taken up. During the KIIs with regional level stakeholders it was reported that some projects were dropped due to land acquisition problems, non-contribution of states' share and morphological changes in rivers. • The projects completed so far under the Scheme have provided flood protection to an area of 4.987 mha and benefitted population of 51.97 million.[245] This protected area also includes restoration of earlier protected area by means of works like raising and strengthening of embankments etc. • It may be noted that, most of the States adopt specific and short-term structural measures such as construction of embankments, permeable and impermeable spurs, revetments, anti-erosion and town protection measures, river channelization and pro-siltation works, etc. but long-term measures like improving river connectivity, planned urban development, graded development plan near the sea are not undertaken. Better effectiveness in terms of flood management can be achieved through adoption of long-term measures having far-reaching impact. • At State level, FMBAP is managed by state departments – mostly the Water Resources Department, headed by Chief Engineer with Superintending Engineers at sub-divisional level and Executive Engineers/Assistant Engineers at district level. At block level, the scheme is being implemented and monitored by Junior Engineers. Apart from the above structure, each state has a State Technical Advisory Committee (STAC) and a State Flood Control Board. The members of the STAC are engineer representatives of State departments and their prime responsibility is to examine and approve flood control schemes forwarded by the State nodal department. DPRs after examination from CWC/GFCC are considered by Advisory Committee of DoWR, RD&GR for techno-economic approval. The committee is chaired by Secretary, DOWR and members of the committee are from CWC, GFCC, State/UT Government representative and other Ministries representatives. The DPRs prepared by the Water Resources/Irrigation and Flood

[245] Data shared by FM wing, DoWR,RD&GR

	Control department with value between Rs. 12.5 Cr. and Rs. 25 Cr. are approved by State Technical Advisory Committee and then by Flood Control Board. The DPRs of value more than Rs. 25 Cr. are approved by the respective monitoring agencies. All states have monthly and quarterly reporting system in place as per requirement of the respective monitoring agencies which was confirmed by the states of Bihar, Uttar Pradesh, West Bengal and Jammu & Kashmir. • In terms of the number of FMP schemes approved as well as completed schemes so far, the states of Himachal Pradesh, Chhattisgarh, Goa, Odisha, Gujarat, Jharkhand, Tamil Nadu, Arunachal Pradesh, Manipur, Tripura have performed well. There are some States like Assam, J&K, Bihar, West Bengal, UP, Uttarakhand etc where some schemes are still ongoing. Further some States like Assam, Sikkim foreclosed many schemes due to various issues like litigations, land acquisition and non-starter projects. A significant number of anti-erosion works are taken up in Bihar and Uttar Pradesh on account of the flood problems caused by Kosi and Gandak rivers. In Bihar, around 300 anti-erosion structures have been completed, which have reduced the damage caused by flood over the years. States like Bihar have allocations ready for the state's share, as the problem of inundation and erosion is quite significant. The States like Bihar, Jammu & Kashmir, and Uttar Pradesh have several state sponsored flood management schemes as well. • States like Bihar and Uttar Pradesh are in process of developing a Flood Management Information System (FMIS). FMIS is in the process of preparing a database of natural resource profile, hydrological and hydro-meteorological data for the state of Bihar. The FMIS of Uttar Pradesh on the other hand has components like Real-time data acquisition system, embankment asset management system and flood forecasting model. • Trainings are imparted to the states primarily by CWC and by National Water Academy, Pune. Trainings are given on advanced technologies applicable for structural measures to the state representatives. Basic trainings on DPR preparation and preparing mathematical models for feasibility studies of schemes are also organized for the states by CWC. However, as reported during KIIs with State level officials, generally no trainings are given to the district and block levels officials. The State nodal departments also do not have any training plan in place

Parameter	Findings from research
	for building the capacity of district officials, block officials, panchayat members and village level functionaries.
	Inference: • It is evident both from the secondary sources and interactions with the stakeholders that adequate structural measures have been undertaken which has effectively protected assets like land, crops, infrastructures and most importantly human lives. Also, follow ups with the river basin authorities of the neighbouring countries (Nepal, Bangladesh, Bhutan, Pakistan and China) have helped in addressing the issues like flood forecasting, inflow forecasts in an effective manner. • Additionally, initiatives like DRIP, have strengthened the institutional set up at State levels. This has improved the monitoring mechanism of the Dams and has resulted in regular maintenance. However, DRIP is limited to few states and may be extended to other States affected by flood. • In addition, Hydrological observations are also carried out under RMBA component of FMBAP, which involve investigation and pre-construction activities of Water Resources projects in neighbouring countries. Such measures have increased the effectiveness of the robust flood forecast mechanisms already existing, thereby assising in regular dissemination of the flood forecasts and warnings. • Involvement of departments like PWD, water resources department, etc. for flood management at State level is evident from both secondary and primary reaearch findings. With respect to construction of structural measures at the State level, various departments like Water Resources Department, PWD provide support in cost estimation, monitoring, etc. Additionally, Department of Space/NRSC is reported to be associated in monitoring of physical progress of the schemes through Remote Sensing Techniques. Thus, involvement of various departments at Central and State level has helped the States in successfully implementing the flood management measures. The institutional set up at State levels is adequately supported by the monitoring agencies i.e., CWC, BB and GFCC apart from the FM wing at central level. The states are provided support with respect to

	implementation of FMBAP projects, monitoring of the mesaures, technical support and international border area related flood issues. Such support has increased the effectiveness of FMBAP measures at the State level thereby identifying immediate issues and the remedial measures. Regular communications through notifications, issuance of guidelines from the end of FM wing, DoWR,RD&GR and their updation have helped the States in effectively planning flood management measures (both structural and non-structural). As for instance, detailed guidelines on flood forecasting have augmented the flood forecast system and their dissemination mechanism. • Initiatives like Flood Management Information System (FMIS) have helped in predicting flood situations and adopting protective measures prior to the floods. Such activities have increased the effectiveness of the scheme. Such information dissemination tools are expected to enhance the capacity of the implementing agencies from disaster response to improved disaster preparedness and to effectively support flood control and management in the focus area. • The monitoring agencies viz. the CWC, GFCC and BB have been effectively extending support to the states by providing techno-economic inputs on preparation of DPRs, assessment of the DPRs, concurrent and end-term evaluation of the flood management schemes. Involvement of technical institutes like IITs and NITs also has been made for evaluation of the completed projects. Such inputs have helped the states in identifying the correct nature of structural measures as per the area and nature of flooding. • Trainings are mainly imparted to the State Officials on techno-economic aspects of flood management by National Water Academy (NWA), Pune and Central Water Commission (CWC). However, trainings on parameters like assessment of livelihood, migration and disease control may also be included. • Construction of embankments results in increasing the silt charge in the flow due to prevention of spill of silt laden water. Huge volume of silt, entrapped into the river water, gets deposited in the riverbed. Consequently, the depth of the channel is reduced. Therefore, while constructing embankments, factors like river channel geometry, longitudinal profile, river morphology, etc. should be considered. River dredging can also be adopted as one of the key activities under FMBAP.

Parameter	Findings from research
	• Parameters like area under protection, human lives protected, cattle protected, protection of public infrastructure and utilities are measured on regular basis but aspects like incidence of diseases, loss of livelihood, availability of safe drinking water, sanitation and hygiene may additionally be considered for assessing the effectiveness of the schemes. • Setting up of River Basin Organization at Central level and at the level of the River Basins has been long pending. The RBOs will boost the preparation of basin level flood plans and monitoring of flood management measures. • Long term reform measures like implementation of Flood Plain Zoning Bill will help Govt. of india and the States in managing the flood situations more effectively. Issues like encroachments and human activities on flood plains will be dealt specifically in a way that will reduce incidences of flood. • Therefore, FMBAP has been effective in its execution of structural measures and rolling out the non-structural measues across the flood affected areas in our country and performance against this parameter is 'satisfactory'.
Efficiency	**Secondary**: • During the XI plan the total central assistance released was Rs. 3,566.00 Cr. Central Assistance released during XII Plan was Rs. 1,307 Cr. During 2017-18, 2018-19 & 2019-20, the Central Assistances released in FMP component of FMBAP is Rs. 563 Cr., Rs.428 Cr. and Rs. 546 Cr. respectively[244] • In most cases as evident from the CAG reports (like "Report No. of 10 of 2017 (Performance Audit) Flood Control and Flood Forecasting"), the time lag between DPR submission and fund release is 2 – 5 months on an average. The FMP guidelines stipulate that the first instalment is to be released immediately on approval of the scheme by the Empowered Committee. Also, the corresponding State Shares are to be released to the project authorities within 15 days of receipt of CA. • As per constitutional provisions," Flood Management" falls within the purview of the States. The flood control and management schemes are planned, investigated and implemented by the State Governments with its own resources as per priority within the State. The Union Government renders assistance to States which is

technical, advisory, catalytic and promotional in nature. Therefore, a two-tier system of flood management exists in India. State Level Mechanism - It includes the Water Resources Departments, State Technical Advisory Committee and Flood Control Board. In some States, the Irrigation Department and Public Works Department look after flood related issues. Central Level Mechanism – The Union Government has set up following organizations and various expert committees to enable the State Governments in addressing flood problems in a comprehensive manner.

- National Disaster Management Authority (NDMA) - For prevention and mitigation of effects of disasters including floods and for undertaking a holistic, coordinated and prompt response to any disaster situation, the Government of India has set up a National Disaster Management Authority (NDMA) in 2005 under the Chairmanship of Hon'ble Prime Minister of India.
- Central Water Commission (CWC) – The Government of India has set up the Central Water Commission in 1945 for achieving the goal of furthering and promoting measures of flood control andconservation and utilization of water resources throughout the country. The CWC plays direct role in real-time collection of flood data, flood forecasting and dissemination of flood forecasts to the local administration for planning suitable administrative measures including evacuation of people from flood affected areas to the safer locations.
- Brahmaputra Board – The Government of India has set up the Brahmaputra Board under Brahmaputra Board Act, 1980 (46 of 1980) under the then Ministry of Irrigation (now Ministry of Water Resources) Its jurisdiction includes all NE States including Sikkim and North Bengal.
- Ganga Flood Control Commission - The Ganga Flood Control Commission (GFCC) was set up by Government of India in 1972 for preparation of comprehensive plan of flood control for Ganga Basin and to draw out a phased coordinated programme of implementation of

works and monitoring & appraisal of flood management schemes of Ganga basin States.

- During XI Plan, the approval of the individual schemes was given by an Empowered Committee headed by the Secretary (Expenditure), Ministry of Finance, Government of India after taking into consideration the critical and emergent situation and availability of annual budget/plan outlay and provision of State share and Central share by the respective State Govts. From XII Plan onwards, approval for inclusion under FMP is given by Inter-Ministerial Committee for Flood Management Plan (IMC-FMP) chaired by Secretary DoWR, RD&GR. Further prior to that, Investment Clearance was accorded by Planning Commission. Now, the Government has approved the transfer of powers for according Investment clearance to major, medium irrigation, Extension, Renovation & Modernisation (ERM) of projects, Flood Control and Multi-purpose projects from the erstwhile Planning Commission to DoWR, RD & GR.
- In order to enable the States to take up major works of urgent nature expeditiously, it was recommended during the XII Plan that only critical flood management works with Benefit Cost Ratio of more than 1.0 and costing Rs. 10 Cr. for special category states and Rs. 40 Cr. for general states, may be funded under Central Sector Scheme FMBAP and flood management /anti sea erosion works below above criteria may be undertaken by the State Governments through their State plans244.
- The Model Bill for Flood Plain Zoning (MBFPZ) is a key policy document that reflects Government of India's position on floodplain zoning and captures the governance mechanism that it has tried to impress upon on the states. The MBFPZ is the only policy document that lays down the procedural and operative aspects of floodplain zoning in India.
    - Manipur enacted the floodplain zoning legislation in 1978 and has made concerted efforts to implement it fully. By 1988, the flood zoning area had been published. The most recent activity undertaken in this aspect includes an eviction campaign to free the banks of the Imphal river.
    - Uttarakhand has issued two floodplain zoning notifications for two tehsils of the state — Haridwar and Uttarkashi for zones extending horizontally by 50 kms and 10 kms, respectively. These contain

Parameter	Findings from research
	elaborate information on landholdings that lie within the restricted zones. o Tamil Nadu had proposed forming a committee to provide recommendations on how to enact a floodplain zoning law. o While Uttar Pradesh has taken measures to regulate the economic and development activities in the floodplains in the state. o West Bengal has made some progress by preparing a draft bill on floodplain zoning. o Madhya Pradesh has demarcated 36 towns affected by floods and has carried out the necessary administrative work towards the demarcation of flood zones.
	Primary: • Flood Management projects under FMBAP scheme are planned by State Governments and appraised by CWC and GFCC. The schemes are accepted by Advisory Committee of DoWR, RD&GR after appraisal is completed. After that the project is cleared by Investment Clearance Committee of DoWR, RD&GR and included in FMBAP by Inter Ministerial Committee subsequently. Inter-Ministerial Committee (IMC) is the competent authority for approval of FMP projects during XII Plan and is chaired by Secretary MoWR, RD&GR and includes Member (RM) CWC, Chairman GFCC, Chairman BB and Advisor, Planning Commission. The committee was formed during XII Plan. The IMC approves the spill over projects at various stages of completion. Also, the feasibility with respect to criterion for critical and long term protection measures of the works proposed to be included under FMBAP would be taken care of by a Committee to be constituted headed by Secretary (WR, RD & GR) in line with the Inter Ministerial Committee on Flood Management Programme (IMC-FMP) of XII Plan. Thus, there exists a mechanism to efficiently handle approval of the projects for flood management. • Central Assistance proposals along with requisite documents are prepared by the concerned State Govts as per FMP guidelines. These proposals are submitted to FM Wing of DoWR, RD&GR though CWC (except Ganga basin states & North Eastern States), GFCC (Ganga basin States) & Brahmaputra Board (North Eastern

Parameter	Findings from research
	States). The monitoring agencies and the States maintain a regular communication amongst them during preparation, incorporating additional technical inputs into the DPRs, which are finally reviewed by the monitoring agencies prior to submission to FM Wing. Also, regular communications between the monitoring agencies and the States are maintained for performing mid-term assessments of the ongoing schemes and final evaluation of the completed projects. • Concurrent Evaluation and Performance Evaluation of the project are third party evaluation of the project and is done by any reputed government institutes like IITs, NITs or any State Engineering College. Concurrent Evaluation Study is carried out to check/ monitor the progress of ongoing project on various construction parameters. Performance Evaluation of the project is carried out to examine the performance of a completed and operational project in relation to its desired benefits/ outcome. Such evaluation mechanisms help in assessment of the outcomes achieved viz., number of human lives protected, land protecred, number of houses protected, crops protected, reduction in incidences of health hazards, etc. These mechanisms also help in deciding the fund allocation for the ongoing projects, terminating the stagnant projects and fund requirement for new schemes. • The planning process for a structural measure in States starts from the villages. In states like Himachal Pradesh, Bihar and Uttar Pradesh, the district officials interact with the villagers and visit the sites. The plan is shared and discussed with a group of villagers and suggestions are noted. • At the local level, some convergences with MGNREGA scheme has been reported. E.g. during the Focus Group Discussions (FGDs) with villagers in Assam, it was reported that at the local level, repairment works of flood management structures like check dams, channels and drainage repairment works are undertaken through the MGNREGA scheme. Also, reclaimation of waterlogged lands, repair of the sluice gates, culverts etc. are also carried out by the villagers through MGNREGA.
	Inference:

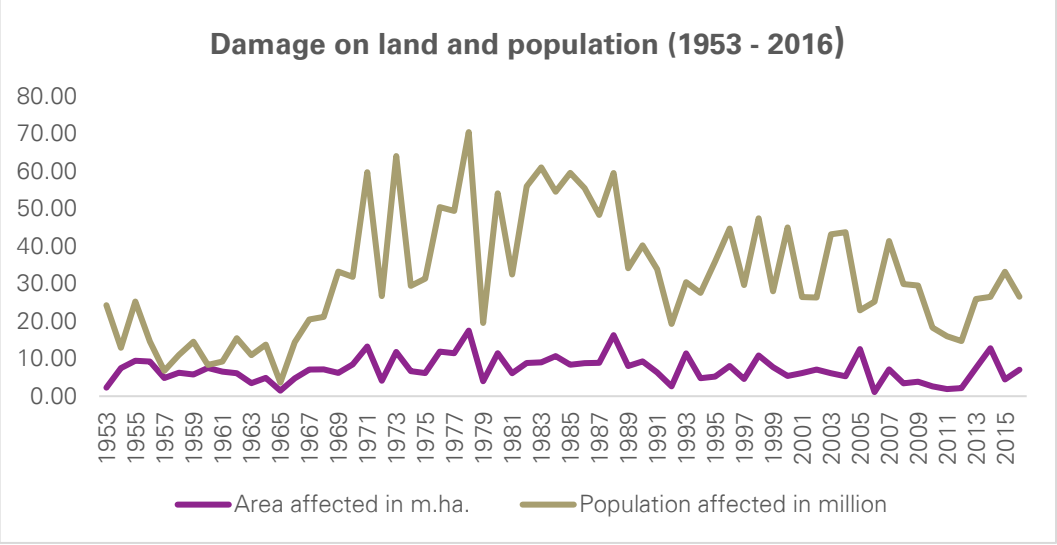
Parameter	Findings from research
	• As on date, a total of 522 schemes under FMBAP have been sanctioned out of which 414 Schemes have been completed; 64 schemes have been foreclosed and balance 44 schemes are onoing. The above facts signify the efficiency of the institutional structure, funding and operational mechanisms. • An amount of Rs. 2022.22 Cr. has been released to various States/ UTs towards FMBAP activities, out of which Rs. 615.61 Cr. has been released to various states in 2019-20. The release of funds is as per Ministry of Finance, Govt. of India and are adequate and without any time lag, which have ensured timely implementation of the scheme. With the monitoring agencies providing support to the States in preparation and validation of DPRs, the time lag between submission of DPRs and fund release has reduced. In most cases as evident from the CAG reports, the time lag between DPR submission and fund release is 2 – 5 months on an average. • In order to efficiently manage floods, which is recurrent in nature, both the Central and State governments have established institutional structure at their respective levels. At central level, the Flood Management wing is supported by CWC, GFCC and Brahmaputra Board. At the State level, the flood management is looked after by State Technical Advisory Committee, supported by Water Resources Department and Flood Control Board. Under FMBAP, guidance is provided regularly to the States by circulation of guidelines and other communications, thereby, updating the States on the change in policies. Further, queries raised are regularly responded to. The monitoring agencies have issued detailed guidelines on DPR preparation, prepared handbooks on technologies required for structural measures, prepared handbooks on flood forecasting, etc. In addition to these, site visits and publication of newsletters are taken up regularly by CWC, BB & GFCC for the States. • In the Flood Management component, the projects/ works of non-special category States, within the scope of Flood Management Programme, costing Rs. 40 Cr. and above and having Benefit Cost Ratio more than 1.0, were included for funding under Flood Management Programme during 2017-20.

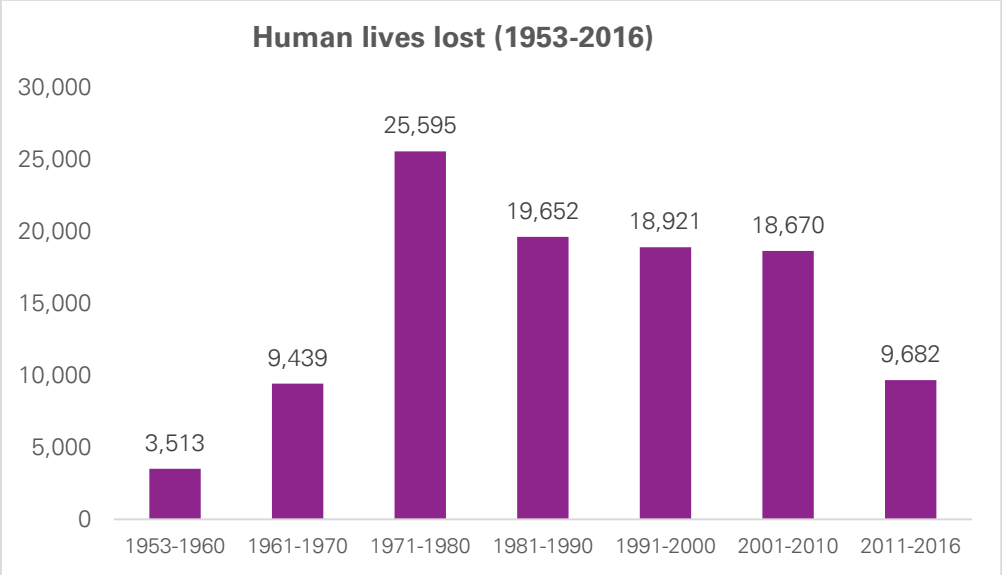
Parameter	Findings from research
	However, in case of Special Category States, which consists of North Eastern States, Sikkim, J&K, Himachal Pradesh and Uttarakhand, all projects/ works within the scope of Flood Management Programme, costing Rs. 25 Cr. and above and having Benefit Cost Ratio more than 1.0 were included for funding during 2017-20. Such criteria ensure efficiency of the scheme in terms of cost and the components that are planned to provide intended benefits. • It is understood that adoption of Flood Plain Zoning at State level will further expedite the execution of structural measures as issues like encroachments, resettlements need to be dealt by the States resulting in delays. • Therefore, on this parameter, the performance of the scheme is 'satisfactory'.
Sustainability	**Secondary:** • As per the CAG Report (Report 10 of 2017 on Flood Control and Flood Forecasting), most of the States do not adopt any integrated approach (covering entire stretch of river and flood plain zones). • The issues of land encroachment, acquisition of land by the State Governments and re-settlement of the population are huge impediments to proper site selection and ensuring correct technical execution, thereby causing risks to sustainability of the structures. • The current scope of FMBAP does not includes any Central Assistance for maintenance of existing structural measures. Funds for O&M of existing structures are solely borne by states, which burden the States with additional allocation of funds. • The O&M of the flood management structures are lagging to some extent because of inadequate fund allocation by the States. Also, involving the local people in maintaining the structures was reported to be lacking. Various organizations like the World Meteorological Organization and Global Water Partnership have suggested involvement of the local community in O&M to instill a sense of ownership among them. • With regard to upkeep and maintenance of the existing FMP projects, the project authority at State level need to plan for maintenance of works after their completion for effective utilisation of investment on the project. Most of

Parameter	Findings from research
	the States have not planned for upkeep and maintenance of the completed projects. • The NDMA has been mandated with laying down policies on disaster management and guidelines which would be followed by different Ministries, Departments of the Government of India and State Government in taking measures for disaster risk reduction. • Mainstreaming DRR into the developmental plans is an important mandate of the Disaster Management Act 2005. Integration of disaster risk reduction measures into ongoing flagship programmes of Government of India is being used as an entry point for mainstreaming DRR in development plans. However, currently the DRRs are not prepated by the states as part of the overall Master Plans. Few states like Assam and Bihar although have disaster management plans but are heavily focussed on crisis management rather than on integrated approach which includes infrastructures, service delivery, addressing emerging risks and recovery strategy.[246]
	Primary: • Currently, FMBAP scheme guidelines have no provisions for O&M activities. However, as per FMP guidelines of XII plan, if restoration of flood control/ management works damaged due to force majeure like conditions are taken up, then Central Assistance is to be released. • Many States do not prepare the Master Plan at State level. The Master Plan typically involves detailed study of the river basins in a State along with identification of vulnerable zones and areas susceptible to flood. GFCC has already issued a guideline for preparation of comprehensive plan for Flood Management. A Master Plan should include details of topography, soil conditions, river course, drainage details, rainfall trends, land use pattern, socio-econ omic pattern, hydrology, river morphology to name a few. Master plan provides adequate guidance to the States towards framing strategies for sustenance of structural measures.

[246] Strengthening disaster risk management in India: A review of five state disaster management plans – Climate Development Knowledge Network (CDKN), Overseas Development Institute (ODI), All India Disaster Mitigation Institute (AIDMI), Kul 2016

Parameter	Findings from research
	• Disaster Risk Reduction (DRR) is a part of sustainable development, and calls for involvement of society, government, non-governmental organizations and the professional and private sectors. It therefore requires a people-centred and multi-sector approach, building resilience to multiple, cascading and interacting hazards and creating a culture of prevention and resilience. • As indicated in the PDNA – Kerala, National Action Plan for Climate change is existing and need to be linked with the Master Plans. Also, Govt. of India alongwith UNDP has prepared and circulated a manual for districts on mainstreaming Disaster Risk Reduction and Climate Change Adaptations (CCA) into district plans in 2017 but , no evidences through the Key Informant Interviews (KII) have been found wherein such plans are prepared at the state or district level.
	Inference: • Although States prepare O&M plan for the completed schemes through State Share; but they being inadequate in most of the cases, adequate O&M activities are not carried out, thereby reducing the effectiveness and sustainability of the structures. Also, current allocation towards O&M of flood control/ management structures addresses only the immediate issues with the structures, rather than addressing long-term sustainability of those structures. • Activities like preparation of Disaster Risk Reduction (DRR) plan, incorporation of Climate Change Adaptations and preparation of Master Plans by the States with support from the monitoring agencies are not done. Consequently, the planning is not integrated and risks the effectiveness and sustainability of the works. • The Master Plans or the River Basin Plans do not address the risk to the communities due to floods or identify the root cause for vulnerability in detail. FMBAP schemes appears to be stand alone in their approach as inter-sectoral approach leading to sustainability and equity dimensions are not addressed. • Involvement of community in sustaining the structures and reform measures planned for sustaining the projects need to be considered. Community level trainings on flood management are also not conducted, which otherwise are

Parameter	Findings from research
	expected to instil a sense of ownership and build a technical pool of skilled workforce for maintenance of the flood management structures. Absence of trained person at local level make the flood protection structures unsustainable. Involvement of such persons at panchayat and/ or village level will help in identifying long-term measures for massive structures like embankments, porcupines, revetments, etc. • Therefore, on sustainability the performance of the scheme is rated as "Average".
Impact	**Secondary**: • The direct impacts of flood protection measures have been adequately documented, which shows that substantial quantum of land and number of houses, human lives are being protected against the damages. • The impact of FMBAP measures is evident from the fact that, population affected, and damage to crops and houses have reduced considerably over the years. The quantum of damage to public properties has also reduced significantly, as illustrated in the two graphs below (data source: CWC's 'State-wise flood damage statistics – regarding' dated 10th May 2018)  The decadal loss of human lives due to flood has also reduced from 18,670 (2001-2010) to 11,697 (2010-2017).

Parameter	Findings from research
	 • In addition to the structural flood protection measures, non-structural measures like flood forecasting and warnings of incoming floods have played a significant role in reducing the loss of life and movable property apart from alerting authorities in-charge to take appropriate measures to deal with floods.
	Primary: • The short-term measures have successfully contributed to reducing the damages to houses, agricultural land, public infrastructure. • Active people's participation is evident as from the case study of Channelization of Swan River in Una district of Himachal Pradesh. As per the FGDs with the villagers and KIIs with the officials, it was evident that the local people donated land and also free labour for the construction of the project. However, such participation did not happen overnight but through continuous meetings, interactions have helped in mobilizing the local people. As a result of the project, the overall economy of the locality, which is primarily based on vegetable cultivation, got a boost. From the FGDs with the villagers, it is understood that not only the cultivation but also transportation of the vegetables to the markets of the neighbouring districts was possible due to following improvement of the infrastructure, particularly roads.

Parameter	Findings from research
	• Also, as reported by the state authorities in Jammu & Kashmir, the flood management measures have mitigated the the stagnation of water in low lying areas, which also resulted in reduction in water borne disesaes during and after flood incdences. • KII with the stakeholders in Bihar revealed that FMIS has been a successful initiative with Embankment Asset Management System (EAMS) been successfully executed for Bagmati and Kosi river basins. Also, works are in progress in relation to enhancement of the community participation for embankment surveillance and maintenance in the Kosi basin. As reported, FMIS in its first phase, has been successful in assessing the breach in the Kusaha and Kosi embankments. Also, development of spatial database, planning and monitoring of River Training work using RS/GIS and dissemination of daily flood bulletins have been undertaken with the help of FMIS. • Capacity building of gram sabhas on the micro-level interconnectedness of flood risk factors viz., local agricultural and animal husbandry practices, local practices adopted for improving housing, etc. is not undertaken, which has a deleterious effect.
	Inference: • Various reports and studies as well as KIIs with stakeholders at National, Regional and State level indicate that there has been substantial positive impact of the structural and non-structural measures like FMIS in Bihar, through which daily forecasts are disseminated to the flood prone areas of north Bihar. • It has been observed that flood management measures have played a positive role on socio-economic aspects. For example, owing to intervention under FMBAP have resulted in fewer incidence of diseases and lower migration of people due to protection against crop loss and better returns from farm activity. • Therefore, the performance of the scheme on this parameter is 'satisfactory'.
Equity	**Secondary**: • Equity refers to just and fair inclusion—a condition in which everyone has an opportunity to participate and prosper. Social equity in disaster recovery means that all people have full and equal access in resource distribution and opportunities

Parameter	Findings from research

	that enable them to meet their needs. It is observed that the FMBAP policy guidelines do not adequately address equity issues.
	• The budget document also has allocation only for Tribal Sub Plan for the year 2020-21 and the allocation is 6.5% of the total budget. It does not have any allocation for scheduled caste (SCSP).
	• However, in an indirect way there are quite a few equity issues observed in overall flood management and relief, as under:
	  • As flood affects a community as a whole, the flood management measures are not designed to separately target disadvantaged social groups including women. Still, principles of equity in beneficiary selection, benefit sharing and representation of all communities in decision making process may be considered.
	  • The Post Disaster Need Assessment conducted in Kerala suggests that while over 60% of the fatalities were among men, the differential and lasting effect of the disaster on women and girls needs to be underscored. Women and girls across social groups experience gender-based disadvantages and discrimination, which exacerbate in the aftermath of floods.

	Primary: • No structural or non-structural measures have been undertaken so far which address any components intended to benefit a particular social group. • The KIIs reveal that overall there are lesser involvement of communities in planning and implementation of flood management structures. Also, the role of NGOs as coordinating agencies is also not evident. • The FMP measures do not address gender sensitive issues with respect to health, livelihood as there is no scope for collecting and analysing such information. • The DPRs for structural measures also do not include construction of infrastructure like women's clinic, livelihood centers with facilities for women during and after floods.
	Inference: • Guidelines issued from the end of NDMA clearly indicate protective measures for women and children of the flood affected communities. However, the flood

Parameter	Findings from research
	management plans prepared under FMBAP do not consider any measure for women, children and aged people in particular. • The budget document has allocated funds only for tribals within the total release under FMBAP and it does not address other vulnerable sections. • Primary research reveals that although the need for involvement of NGOs has been charted out in many documents, but their involvement towards monitoring of the scheme implementation still remains very limited. • Therefore, the performance of the scheme on this parameter is termed as 'needs improvement'.

Summary analysis and performance of the scheme on the identified themes is presented below:

Table 130: FMBAP - summary of performance evaluation using REESIE framework

Parameter	Performance
Relevance	●
Effectiveness	●
Efficiency	●
Sustainability	●
Impact	●
Equity	●

REESI+E performance infographics legend

● Satisfactory ● Average ● Needs Improvement ● No information

Performance on cross-sectional themes

Table 131: FMBAP - performance evaluation using cross-sectional themes

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
1.	Accountability & Transparency	• What data records are available for the scheme in public domain? • Does a robust monitoring mechanism exist and at what level? • What process / impact evaluation studies conducted in the last decade - frequency, quality, coverage, etc. • What funding mechanisms are being used? • What is the involvement of beneficiaries across the project lifecycle? • Are community instiutions truly representative in the process?	• The schemes under Flood Management Programme is monitored by the Central Water Commission (CWC), Ganga Flood Control Commission (GFCC) and Brahmaputra Board (BB) in their respective jurisdictions. The Department of Space is also associated in monitoring of physical progress of the works through remote sensing techniques. • After the completion of works, performance evaluation studies are conducted by independent agencies in consultation with CWC/GFCC/Brahmaputra Board as the case may be. • Monitoring of flood management schemes under FMBAP is done by various Regional offices except for Ganga Basin States (which is done by GFCC) and North-Eastern States (which is done by Brahmaputra Board).

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			• Regular submission of progress reports: Most of the states do not follow the system of submitting monthly reports to the monitoring agencies and to Flood Management wing of DoWR. Also, the mechanism of regular report submission from district level to the state level is not clear. Further, no mechanism exists for reporting to the district by the circle, block or panchayats.

Summary Analysis:

Monitoring is primarily done by the the regional offices viz., CWC, GFCC and Brahnmaputra Board. However, there are no regular monitoring mechanisms in form of monthly reports submitted by the States on the physical and financial progress made for structural and non-structural measures. The monitoring dashboard currently maintained by DoWR, Govt, of India also does not track the current status of the ongoing and the performance of the completed project sunder FMBAP. The accountability of local people in planning and monitoring of flood management measures needs to be considered. Involvement of local community in monitoring the status of completed projects and the progress of ongoing projects is not in place. Apart from the monitoring agencies who perform techno-economical appraisal, other departments at National, State and District level need to be involved for assessing the projects from social benefit perspective. Dissemination of progress data of projects to local people will also ensure transparency pertaining to implementation. Presence of designated officials at Panchayat level for Flood Management Programmes for planning, supervision and monitoring is not evidenced.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
2.	Direct/Indirect Employment Generation	• What is the level of employment generation through schemes in the sector and overall sectoral contribution in National employment generation?	• Based on the collaborative efforts of Govt. of Kerala, Kerala State Disaster Management Authority, the United Nations agencies, the European Commission (and , Swiss Agency for Development and Cooperation (SDC) , European Union Civil Protection and Humanitarian Aid (ECHO) an assessment titled 'Post Disaster Need Assessment' was conducted in 2018 on livelihood impacts. As per the assessment, the reconstruction measures present a huge opportunity for employment generation and businesses for the local masons and those involved in construction materials supply. The Post Disaster Need Assessment report for Kerala highlighted that only works related to painting during reconstruction would generate 9 lakh working days for women artisans. Apart from that, 35 lakh working days of skilled masons and 171 lakh working days of unskilled workers job will be created in the reconstruction work.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
Summary Analysis: The FMBAP DPRs do not include any provision for employment generation and hence, employment generation aspects are not covered. Further, the STAC and Investment Clearance Committee also do not consider any opportunity for employment generation as a component for DPR appraisal. A few States like Kerala have adopted provisions for employment generation in construction of flood management structure. Focus Group Discussions (FGDs) with flood affected communities in Assam also reveal that the local people are involved in minor repair works of flood management structures through MGNREGA. However, KIIs with other state level stakeholders do not provide evidence of community involvement or engaging local NGOs for O & M works.			
3.	Gender mainstreaming	Inclusiveness in scheme design/ planning • Is there a specific mention of gender equality and equity considerations in the scheme guidelines/objectives, i.e. has the scheme been designed keeping gender considerations in mind? • How has empowerment of women improved?	• Women are particularly vulnerable given the risks of overreliance on unpaid work carried out especially by them, the risk of unequal access to essential services and resources, and emerging psycho-social needs. • As per Post-disaster Needs Assessment (PDNA) conducted in Kerala, disaster situations like flood are an opportunity to establish a robust human rights-based approach across all phases of the recovery cycle, based on the principles of non-discrimination, participation, and "leaving no one behind". • FMBAP addresses the flood affected communities and its approach does not focus on any

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			specific section of the community e.g. women. However, the guidelines of NDMA have required focus on women and gender issues and this may be adopted in the FMBAP scheme guidelines.
Summary Analysis: FMBAP does not have any intervention focussing on gender related issues. The scheme currently also does not have scope for creating or improving infrastructure pertaining to health or livelihood issues that may benefit women. States like Kerala have explicitly detailed out plans and strategies to address livelihood, health and hygiene related issues for women population of the flood affected communities, while rest of the States are yet to formulate strategies for addressing geneder related issues.			
4.	Climate change & sustainability including adoption of climate-change resilient practices & diversifications	Climate resilience • Are there appropriate climate resilient policies for mitigation and/or adaptation (or included as part of scheme objectives and design)?	• Disaster Risk Reduction (DRR) is a part of sustainable development, so it must involve every part of society, government, non-governmental organizations and the private sector. It therefore requires a people-centred and multi-sector approach, thereby, building resilience to multiple, cascading and interacting hazards and creating a culture of prevention and resilience. • Impact of climate change is getting reflected in frequent occurrence of floods in river with

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			increased water level. The design of various works proposed under flood management scheme is dependent upon the hydrological aspects of the area. Hydrological aspects take care of past flood experiences, increased flood peaks to account for extreme flood conditions (due to climate change) in design of various structures proposed under the flood management schemes. • The master plans prepared by some of the States under the guidance of the monitoring agencies do have scope to address climate change issues like flood frequency analysis, studies on typology of land, rainfall, temperature, waste management issues, etc. However, the DPRs rarely address the climate change issues specific to a State or District.
Summary Analysis: Most of the States do not include environment management or climate change mitigation as part of the overall planning for flood management. Adequate capacity building of State officials for preparation of DRR and Master Plans including training on inclusion of environment and climate change aspects into the scope of flood management is carried out. The Master Plans			

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
also do not include Climate Change Adaptability (CAA) although trainings are imparted to the state officials by institutes like NWA, Pune and CWC.			
5.	Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population	• What is the fund allocated under TSP & SCSP for each scheme? • What has been the effect of the TSP & SCSP funds on improving equity? • What are the interventions implemented for specific vulnerable groups? • %-ge fund allocation for TSP & SCSP • Amt. of fund allocated for TSP & SCSP for last 3 years	• The budget documents mention special allocation for TSP and allocation to States towards Scheduled Tribes is done accordingly. As per the budget of DoWR for FY 2020-21, Rs. 50 Cr. has been allocated towards Tribal Area Sub Plan (TSP). However, no allocation is made for SCSP.
Summary Analysis: As per the budget for 2020-21, a total of 5.6% of the total budget is allocated towards TSP. However, no allocation is made for Schedule caste sub plan (SCSP).			
6.	Use of IT/Technology in driving efficiency	• Range of use of GIS technology	• It may be observed that advancement in Information Technology in the form of

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		and Satellite data for flood control • Technologies that are used for flood forecasting and hydrological observations • Extent of coordination with expert agencies in using the technologies • Use of information collected through GIS and remote sensing	Internet, GIS, Remote Sensing, satellite communication, etc. can help a great deal in planning and implementation of hazards reduction measures. GIS can improve the quality and power of analysis of natural hazards assessments, guide development activities and assist planners in the selection of lessening measures and in the implementation of emergency preparedness and response action. Remote Sensing, on the other hand, as a tool can very effectively contribute towards identification of hazardous areas, monitor the planet for its changes on a real-time basis and give early warning to many impending disasters. • Venture with Google: India's Central Water Commission (CWC) has signed a Collaboration Agreement with Google that will help crisis management agencies deal with extreme hydrological events, such as floods, more effectively.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			The agreement allows CWC to make use of Google's artificial intelligence, machine learning and geospatial mapping expertise for effective water management and flood forecasting. The agreement will also help CWC to better disseminate flood related information through different platforms developed by Google. Under this Agreement, CWC and Google will share technical expertise in different fields related to flood management, including geospatial flood mapping and analysis of hydrological observation data. The agreement also facilitates collaboration on improving flood prediction systems, which will help to provide area specific flood warnings; a high priority research project utilizing Google Earth Engine to help visualize and improve flood management; and a cultural project to build online exhibitions on the Rivers of India. The collaboration aims to improve the flood disaster management in the country and ultimately reduce

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			the impact of flooding on the people's lives and properties. The initiative on flood forecasting is likely to help lessen the impact of floods on communities. The collaborative agreement commits Google to use their expertise in the realm of artificial intelligence as well as using their high-resolution Digital Elevation Model and vast computing resources to generate flood inundations with the level forecast input data provided by CWC. These maps can be used for disaster risk management and emergency response efforts by enabling the Government and disaster management organisations to effectively identify the locations and population that are at risk from floods and require warnings and information. This collaborative initiative is expected to be a milestone in flood management and in mitigating the flood losses in India. • Need for strengthening hydrological pattern, geographical data, inter-institutional

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			convergence: Central Water Commission (CWC), in association with India Space Research Organization (ISRO), has set up a web enabled Water Resources Information System in the Country (India-WRIS). The India-WRIS is a 'Single Window' solution for comprehensive, authoritative and consistent information and data of India's water resources along with allied natural resources in a standardized national GIS framework. It has tools to search, access, visualize, understand and analyze the data for assessment, monitoring, planning, development and Integrated Water Resources Management (IWRM). Following hydrological data related to surface water are collected at CWC Hydrological Observation (HO) sites: (i) River water level (Gauge, G) (ii) River discharge (Discharge, D), (iii) Sediment flow (Silt, S); and (iv) Water quality (Quality Q)

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			• Besides hydrological observation, CWC also monitors some selected sites, selected meteorological parameters such as rainfall, maximum-minimum temperature, humidity, pan-evaporation, solar radiation and wind velocity on some specific sites. • Flood Management Information System (FMIS): Currently a Web based FMIS is being adopted by Flood Management Improvement Support Centre, Bihar and Irrigation and Water Resources Department, Uttar Pradesh. The FMIS in both the States provides information on innovative concepts and technologies to improve flood management, develop databases, utilize analytical tools and information products, enable effective dissemination of the information, thus providing an interface between flood management stakeholders.
Summary Analysis: The FMIS is an important initiative with respect to management of information on floods and intends to build a common information platform across various stakeholders in the States.			

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
However, such an initiative is only being executed in the states of Bihar and Uttar Pradesh. Although the monitoring agencies are providing guidelines on flood management information system, such initiatives are awaited from other flood affected states. On the other hand, Information Technology is observed to be more used for non-structural measures. As a result of which, improvements in frequency and accurateness of flood forecasts have taken place. Initiatives in this regard such as partnership with Google Analytics on flood warning system using Artificial Intelligence and accurate predictions of floods has already been taken. Also, Central Water Commission (CWC) in collaboration with ISRO has set up web-based Water Resources Information System (WRIS) which will provide regular updates on river water level, river discharge, sediment flow and water quality. In addition, hydro-meteorological informations on rainfall, maximum – minimum rainfall, humidity, evaporation etc. are provided through hydro-meteorological stations.			
7.	Stakeholder and Beneficiary behavioural change	• What percent of total allocation is directed towards Awareness generation or sensitization? What is the utilization rate? and How much impact has it been able to generate in terms of behaviour change? • What activities are undertaken at District/Block level to promote	• Review of secondary sources reveals that, sporadic awareness generation activities like publishing reports in public domain are taken up by CWC for creating awareness about river valley projects and environmental issues in India. States like Jammu & Kashmir have recently initiated community awareness towards measures for minimizing flood damages. Overall, the involvement of local community for flood management at local level is lacking. The budgetary allocation for trainings and awareness generation as in the budget document for FMBAP is

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		adoption of good practices? • What are the major challenges? Are there any areas which needs more attention in terms of bringing behaviour change?	only Rs. 4.13 Cr., which is very minimal considering the total quantum of fund for FMBAP. Also, such funds are utilized by CWC and NWA, Pune for imparting trainings on flood managememnt to State and District officials. However, no evidences on fund utilization vis-à-vis the nature of trainings conducted is evident from any reports.
Summary Analysis: Under institutional reform measures taken up within the ambit of FMBAP, only Rs. 4.13 Cr. has been allotted for Capacity Building and Awareness Generation. However, details of such activities are not available and it is understood that initiatives like community awareness for responsible human activities to minimize flood events, capacity building of the community towards O&M of structural measures have not been taken up adequately.			
8.	Research & Development	• Nature of support sought from the institutes towards flood risk reduction • Types of research done on various aspects of flood management • Financial support towards R&D for last three years	• In order to deal with the specific hydrological problems of different regions of the country, a number of training, research and development institutes are in place:

			1. Centre of Flood Management Studies, National Institute of Hydrology, Roorkee 2. All India Disaster Mitigation Institute, Ahmedabad 3. National Institute of Disaster Management 4. Indian Institute of Remote Sensing • A research and design wing of CWC is in place which is responsible for providing guidance and support in planning, feasibility studies, standardization and designs of river valley projects in the country, safety aspects of major and medium dams, hydrological studies for the projects, coordination of research activities, etc. • Research by IITs: Under Rebuild Kerala Initiative, the Irrigation Department has entrusted the Indian Institute of Technology, Madras, (IIT-Madras), with the task of conducting hydrodynamics studies for implementing the 'Room for the River' concept in the flood-prone Kuttanad region. The study will look at multiple components that are integral to reducing flooding in low-lying Kuttanad. It will include

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			methods to improve the efficiency of the Thottapally spillway system, the feasibility of further extending the Alappuzha-Changanassery Canal (AC Canal) and possible solutions to the formation of sandbars at the estuary mouth beyond the spillway. As the name suggests, the concept hinges on managing flooding by giving rivers more 'room' to flow. In December 2019, the State government had given administrative sanction for preparing the detailed project report at a cost of Rs. 4.5 Cr. The money for carrying out hydrodynamics studies will be sourced from this amount. In a recent study, researchers from the Indian Institute of Technology Bombay (IIT Bombay) and the Indian Institute of Technology Kharagpur (IIT Kharagpur) have used a combination of global climate models along with local rainfall and river flow models to determine the odds of flood inundation of individual villages.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			They demonstrated their approach by predicting the flood risks for villages in Jagatsinghpur district of Odisha. The study, funded by the ISRO-IITB Space Technology Cell, and the Department of Science & Technology, Government of India (SPLICE-Climate Change Programme), was published in the journal Science of the Total Environment. The study highlights that climate change will only worsen the situation over time. State authorities are already taking long-term disaster planning measures, such as regulating the flood water using the Hirakud Dam on the Mahanadi, constructing embankments along the rivers, planting mangroves along the Bay of Bengal coastline, and resettlement of residents in the flood-prone areas to elevated areas. While such activities are indispensable, the study shows that they are not enough to mitigate potential damages to life and property.
Summary Analysis:			

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
Flood is a wide subject involving technology, environment, social development, international cooperation and many other such areas. Adequate funding for Research and development is required, so that a knowledge hub can be created and the results can be shared with various stakeholders at different levels leading to improvement in flood management plans. A few research activities pertaining to flood management have been taken up by the research wing of CWC; however, the detailed reports are not available in the public domains for the greater benefit of the stakeholders, reaserchers, academicians at large.			
9.	Water Sharing Diplomacy	• What are the range of issues covered in the water sharing agreements with neighbouring countries? How well are such agreements enforced?	• Under River Management Activities & Works related to Border Areas (RMBA) component of FMBAP, some initiatives been actively taken up and are monitored on regular basis; some of which are listed below: - Flood forecasting on rivers common to India and Nepal - Hydrological observations on rivers originating in Bhutan - Joint observations on rivers common to Bangladesh and neighbouring countries - Update of DPR for Pancheshwar Multipurpose Project - Surveys & investigation of Kosi High Dam located in Nepal

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			• A total of Rs.1,795.70 Cr. has been allotted for the aforesaid components under RMBA during the period 2017-2020. • Following activities have been taken up pertaining to international matters: 1. **India-Bangladesh Cooperation**: Government of India is providing necessary flood data of Ganga-Brahmaputra-Meghna basin at free of cost to Bangladesh during for flood forecasting, which has enabled Bangladesh to save property and lives of people. 2. **India-Bhutan Cooperation:** A scheme titled "Comprehensive Scheme for Establishment of Hydro- meteorological and Flood Forecasting Network on rivers common to India and Bhutan" is in operation. The network consists of 35 hydro-meteorological/ meteorological stations located in Bhutan and being maintained by the Royal Government of Bhutan with funding from India. The data

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			received from these stations are utilized in India by Central Water Commission for formulating flood forecasts. A Joint Expert Team (JET) consisting of officials from the Government of India and Royal Government of Bhutan continuously review the progress and other requirements of the scheme. 3. **India-China Cooperation**: The Government of India has signed MOUs with China for sharing of hydrological information of Chinese Stations on rivers Yaluzangbu/ Brahmaputra and Langquenzangbu/Sutlej during monsoon season. Both the countries have also set up an Expert Level Mechanism for addressing the issues pertaining to trans-boundary rivers. 4. **India-Nepal Cooperation**: To discuss various issues related to water resources between India and Nepal, a three-tier mechanism comprising:

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			- Joint Ministerial Level Commission on Water Resources (JMCWR) headed by Ministers of Water Resources of India and Nepal, - Joint Committee on Water Resources (JCWR) headed by Secretaries of Water Resources and - Joint Standing Technical Committee (JSTC) headed by the Chairman, Ganga Flood Control Commission, Patna from Indian side, exists. - A Treaty on Integrated Development of Mahakali (Sharda in India) river including Sharda Barrage, Tanakpur Barrage and Pancheshwar Multipurpose Project was signed between the Government of India and the Government of Nepal in February 1996. Treaty is valid for a period of 75 years. 5. **India-Pakistan Co-operation**: India and Pakistan signed Indus Waters Treaty in 1960, and two permanent posts of Commissioners

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			were created, one each in India and Pakistan. The two Commissioners together form the Permanent Indus Commission. In fulfilment of the requirements of Indus Water Treaty, the daily data of 280 hydrological sites in six basins namely Indus, Jhelum, Chenab, Ravi, Beas and Sutlej is regularly sent to Pakistan every month. Besides, Flood warnings are transmitted by India to Pakistan through Telegrams, Telephones and Radio Broadcasts during every monsoon for Indus River system.

Summary Analysis:

Around 25% of the total outlay for FMBAP (2017-20) has been allocated for Water Sharing Diplomacy component, from which it may be inferred that significant focus is being given on the international waterfront to fulfil the objective of FMBAP. The border states like Bihar have been benefitted through such measures. However, initiatives like expediting steps for construction of large storage dams in Nepal viz. Pancheshwar Multi-purpose Project and Sapta Kosi High Dam should be taken up and emphasis may be given on flood control measures apart from irrigation and hydropower generation. Also, the outstanding bilateral issues regarding mutual acceptance on the DPR of Pancheswar Multi-Purpose Project may be resolved with Nepal at the earliest.

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
10.	Unlocking Synergies with other government programmes	• What activities are undertaken to ensure convergence at community level? • Are there any Action Plans prepared at State/District/Block level to ensure the same?	• The aim of FMBAP is to assist the State Governments to provide reasonable degree of protection against floods in critical areas by adopting optimum combination of structural and non-structural measures and enhancing capabilities of State/ Central Government officials in related fields. Although the Flood Management wing of DoWR, Govt. of India has implemented substantial number of structural and non-structural measures, the linkage with other social aspects like livelihood generation, disease control, etc. is not evident. FMBAP is focussed towards flood management as a whole only and do not address long term measures such as afforestation in a significant way. • Ministry of Water Resources, River Development & Ganga Rejuvenation through Central Water Commission with an objective to improve safety and operational performance of selected dams, along with institutional strengthening with

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			system wide management approach, embarked upon the Dam Rehabilitation and Improvement Project (DRIP) with World Bank assistance at a cost of Rs. 2,100 Cr. DRIP has been successful in rehabilitation of dams, other important activities likle Design Flood Review, publication of important guidelines as well as manuals dealing with Dam Safety Management, preparation of O&M Manuals, Emergency Action Plans, development of web based asset management tool i.e. Dam Health And Rehabilitation Monitoring Application (DHARMA), Seismic Hazard Mapping along with development of Seismic Hazard Assessment Information System (SHAISYS).

Summary Analysis:

- FMBAP has been restricted to structural and non-structural measures at large and significant focus is made on the short-term measures than on the long-term measures like flood plain zoning, basin level planning, inter-linking of river basins, community awareness and capacity building. In order to implement such long-term measures coordination with land departments, river conservation schemes, urban development department etc. is required. Moreover, FMBAP does not have any provision for linkages with other schemes

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
	like livelihood mission, health programme, which otherwise could have activities within its scope addressed towards generation of livelihood and reducing incidences of diseases and health hazards in post flood situtaions. Also, coordination with financial institutions, funding agencies like World Bank, ADB etc for effective addressing of O&M of flood management structures like embankments has been taken up. However, not much progress is observed in this aspect.		
11.	Reforms Regulations	• What measures are being taken to ensure effective implementation and compliance of adopted acts/rule/regulations? (like in areas of safety, accountability, transparency etc.)	• As reiterated in previous portions of the report, long term measures like country wide implementation of flood plain zoning as suggested in Flood Plain Zoning Draft Bill (1975) has been implemented only in a few states. Formation of river basin organizations and community level involvement although been suggested for active consideration, yet no such measures have been taken up. Adopting such long-term reform measures will effectively reduce the flood incidences as well as damages caused by flood. • The Standing Committee on Water Resources (2016-17) has noted that the Ministry needs to coordinate with the State Governments to ensure that pending enactment of legislation in this regard should be taken up to prevent further encroachment

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			of areas located in the flood plain zone. • In addition, River Basin Organizations at National and river basin levels may be formed as apart of the reform activitiy. This would enable preparing basin level planning integrated into the state specific master plans.
Summary Analysis: • Flood Plain Zoning Draft Bill (1975) has still not been enacted in most of the flood prone states. This measure is critical in ensuring reduction in encroachments and human activities in the flood plains thereby reducing flood inciences and random meandering of rivers. • Formation of River Basin Organizations at National and Basin level needs to be integrated into the state specific master plans so as to have basin level plans.			
12.	Impact on and role of private sector, community	• What is the percentage of private investment in the clusters/programs run by the government? • How well have PPP functions in the Sector? What are the challenges faced?	• As suggested in various secondary sources like the report 'Public-private partnerships in emergency and disaster management: examples from the Queensland floods 2010-11' by Peter Hastings, et al. (2015), public private partnerships in flood management may be explored by the governments for maintaining critical infrastructure like power, logistical support like distribution mechanisms for consumable

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
		• How many private sector, community/collectives/cooperatives and civil society have availed the benefits under any Scheme?	goods, insurance at lower costs, etc. • Numerous international studies have corroborated the value of public–private sector partnerships in reducing vulnerability and building resilience to emergencies and disasters. An initiative in Australia towards Public-Private Partnerships in emergency and disaster management proposes a simple conceptual framework for public-private partnerships in emergency and disaster management that could be applied to research and policy analysis. The framework proposes three dimensions: sector types (public, business and community), partnership arrangements (legislated and formal to informal agreements), and partnership roles (strategic and resilience-building and response and recovery). Public–private partnerships during and after the Queensland floods of 2010–11 were used to illustrate the relationships presented in the framework and to give a snapshot

#	Cross-cutting theme	Indicative Areas of Enquiry and Key Questions	Findings from research
			of these partnerships in Queensland. • Community involvement in planning and monitoring of FMBAP measures are lacking and may need considerations. The flood affected communities may be involved in identification of problem areas, site selection, resource mobilization and regular monitoring of the progress of the ongoing projects and performance of the completed ones.
Summary Analysis: A number of studies have suggested the government to explore various PPP models in relation to flood management; but the adoption of same in India is limited. In relation to FMBAP, it is observed that community involvement in overall planning and monitoring of measures is limited.			

The CST theme 'Conjunctive use of water - surface versus groundwater usage optimizations' was found to be 'not relevant' for this scheme and hence it has not been evaluated. While, in absence of adequate information, the 'Development, dissemination & adoption' theme has been marked as 'no information'.

A summary analysis and performance of the scheme on the identified themes is presented below:

Table 132: FMBAP - summary of performance evaluation using cross-sectional themes

Parameter	Performance
Accountability & Transparency	🟡
Direct/Indirect Employment Generation	🟡
Gender mainstreaming/Inclusiveness	🔴
Building resilience to climate change (including but not limited to developing water disaster preparedness) & ensuring sustainability	🟡
Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population	🟡
Use of IT/Technology in driving efficiency	🟢
Stakeholder and Beneficiary behavioural change	🔴
Development, dissemination & adoption	⚪
Research & Development	🟡
Water sharing treaties/agreements & diplomacy	🟢
Conjunctive use of water - surface versus groundwater usage optimizations	⚫
Unlocking Synergies with other Government Program	🔴
Reforms, Regulations	🔴
Impact on and role of private sector, community and civil society in the scheme	🔴

Cross-sectional themes performance infographics legend

🟢 High 🟡 Medium 🔴 Low ⚫ Not relevant ⚪ No information

2.2.9.3 Issues and challenges

This sub-section describes the scheme issues and challenges and their mapping with the source of information viz. primary source, secondary source and household survey (if applicable).

Table 133: FMBAP – issues and challenges

Sl.no	Area	Issues & Challenges	Secondary	KII	HH / FGD
Scheme Design					

Sl.no	Area	Issues & Challenges	Secondary	KII	HH / FGD
FMBAP – F1	**Improvement in scope**	• FMBAP components has substantially included major flood issue like erosion, damages to land and crops, human settlements, human lives, cattle population, vegetation through its structural measures and warnings through non-structural measures. • FMBAP does not include local community as stakeholder for planning and execution of flood management. Areas like facilitating local economy, capacity building of local people, safe drinking water, sanitation and hygiene are not addressed in the scope. • FMP schemes do not actively consider improvement of individual housing in the flood prone areas. In addition, creating provisions for flood shelters and introduction of flood resilient public infrastructure are not considered.			
FMBAP – F2	**Reform measures**	• There is a need to set up, River Basin Organizations at National and Basin level, which will enable planning for respective flood zones and states coming under the zones. There is also immediate need to enact the Flood Plain Zoning in states. In			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH / FGD
		absence of the River Basin Organizations the interlinking of rivers has not been taken up as a priority issue. • The existing Interlinking of Rivers (ILR) programme is aimed at ensuring greater equity in distribution of water by enhancing the availability of water in drought prone and rain-fed area but the scope of FMBAP is not dovetailed with ILR. As of date, despite all measures taken under the ambit of FMBAP, appropriate distribution of water thus avoiding excess inflow of water is not taken care of. • Absolute or permanent immunity from flood damage is not physically attainable by known methods of flood control. Flood Plain Zoning like measures are not given due importance. • No planning for flood protection measures are made at Basin level. The Basin level planning should provide basis for Master Plans prepared by the States. • Reform measures pertaining to flood management programme do not consider awareness generation of			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH / FGD
		the community on practices that lead to reduction in incidences of flood like extraction of soil, sand from river beds and near river banks, removal of forest cover, drainage cleaning, etc.			
FMBAP – F3	**Addressing social issues**	• No activities have been planned to address social issues such as: o health and nutrition related issues of the population o drinking water, sanitation and hygiene o employment and livelihoods o community mobilization • The DPRs for structural measures in no way address improvement of health, drinking water and sanitation related infrastructures.			
FMBAP – F4	**Capacity Building**	• -Trainings are mainly given to the State Officials on techno-economic aspect of flood management. Trainings on managing parameters like livelihood, migration, disease control are not included in the existing training modules • Important issues like climate change are also not adequately addressed through trainings by institutions like National Water Academy, Pune.			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH / FGD
		• Apart from trainings, no evidences of exposure visits and on-site trainings have been found.			
FMBAP – F5	**Inclusiveness of all schemes**	• FMBAP includes projects approved only by Empowered Committee (XI Plan) or Inter-Ministerial Committee. In such a scenario, a holistic picture of flood management measures and their benefits remains unknown.			
Scheme implementation					
FMBAP – F6	**Protectiveness by the scheme**	• Sound technical support is provided to states by the monitoring agencies towards execution of structural measures. • Although there are adequate number of schemes, but some are still ongoing thus minimizing the protection against envisaged results. • The FMP schemes are limited to protection of habitations, agricultural fields in majority of cases. The schemes do not cover other vital infrastructure like hospitals, educational institutions, public offices and infrastructure related to power. • Although construction of embankments are taken up in a large scale as protection measures against floods, however, on account			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH / FGD
		of siltation on river beds, the inflow of water from the embankments causes floods. The embankments provide a false sense of security to people, but instead can worsen floods by not allowing releases of water. In fact, embankments have been broken down by people in some cases to allow flood waters to find their way. The problem of flood risk for lakh of people trapped between embankments needs urgent resolution by identifying solutions for better resettlement of affected families.			
FMBAP – F7	**Operations and Maintenance**	• -Most of the States lack in adequate O&M measures in place as funds for O&M are not supported by Government of India. However, with assistance World Bank financial support for Dam Safety for 220 Dams across Karnataka, Kerala, Madhya Pradesh, Odisha, Tamil Nadu and Uttarakhand has been provided by Government of India but it has not been extended to other states. Most of the States have expressed their difficulties in mobilizing fund for O & M, as a result of lack of policies in place for the			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH / FGD
		same. The role of State Technical Advisory Committee also does not focus about providing guidance to the state nodal department for mobilizing such funds.			
FMBAP – F8	**Need for a Database**	• No Database exists for assessing the physical and financial progress and regular scheme and State-wise report of physical and financial progress. Monthly and quarterly reports are also not regularly submitted which can adequately feed in regular progress related information into the Database.			
FMBAP – F9	**Community involvement**	• No evidences of involvement of NGOs / CBOs / Local clubs / Mahila Mandals in monitoring of structural measures or disseminating flood forecasts to the villages was found during the KIIs undertaken so far. • Formal Block/Panchayat level planning mechanisms do not exist for any states. No evidences were found where local planning was carried out through discussions or meetings. Involvement of specific groups like women was also not found.			
FMBAP – F10	**Integrating environment**	• -Activities like preparation of Disaster Risk Reduction (DRR) and			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH / FGD
	with flood management	Master Plans by the States with support from the monitoring agencies are not done. Consequently, the planning is not integrated and risks the effectiveness and sustainability of the works			
Monitoring and evaluation					
FMBAP – F11	**Inclusiveness of social development indicators**	• Parameters like area under protection, human lives protected, cattle protected, protection of public infrastructures and utilities are measured on regular basis but aspects like incidences of diseases, loss of livelihood, availability of safe drinking water, sanitation and hygiene are not considered for assessing the effectiveness of the schemes. • Some studies have been made on socio-economic feasibility of flood management schemes but they do not adequately emphasize on the need to address issues like health, livelihood, gender safety, hygiene, etc. while developing master plans and DPRs. • Impact evaluation studies also remain limited to techno-economic aspects only.			

Sl.no	Area	Issues & Challenges	Secondary	KII	HH / FGD
FMBAP – F12	**Research and evaluation studies**	• The evaluation studies conducted by technical institutes are not available for researchers. A compendium of the research findings needs to be uploaded in the website.			

Issue relevance legend

	Supported		Partially supported		Not supported		Not applicable

A summary analysis of issues & challenges for the scheme is presented in the tables below.

Table 134: FMBAP – area-wise issues and challenges

Area	Summary of Issues and Challenges
Institutional Mechanism & Governance	• Setting up of River Basin Organization at Central level and at the level of the River Basins has been long pending. The RBOs will provide boost to preparation of basin level flood plans and monitoring of flood management measures. • Despite the crucial need for floodplain zoning, several states have resisted such efforts. The two major constraints arising due to need to evacuate the people occupying floodplains and resettling them elsewhere given the paucity of land. • No evidences of involvement of NGOs / CBOs / Local clubs / Mahila Mandals in monitoring of structural measures or disseminating flood forecasts. • Lack of evidence of inputs from panchayat and village level in planning of schemes. DPRs do not have any documentation of local level participation and as a result, village specific issues and their solutions are not found.
Fund Flow Efficiency and utilisation	• A total of Rs.1,536.89 Cr. has been released as Central Assistance towards completion of Spill-over projects under FMP component of FMBAP.

Area	Summary of Issues and Challenges
	• Since FMBAP does not have the scope of supporting Operations and Maintenance of Flood Management structures, hence some states face difficulty in maintaining the structures due to paucity of funds
Monitoring and evaluation	• Although a sound monitoring system exists for assessing the progress of structural measures and the efficacy of non-structural measures, through officials at National. Regional, State & District. However, grass root level monitoring through beneficiaries / WUAs / Panchayat Samitis etc. does not exist. • Monitoring and supervision of structural measures are done by the district level officials. There are no village level or panchayat level committees involved in monitoring of the completed as well as ongoing schemes on a regular basis. • Few evaluation studies have been conducted to assess the efficiency of the scheme, but with the changing scenario like increased investments, Impact study of social and environmental impact on the flood affected population is of extreme necessity.
Capacity building	• Regular trainings are imparted to the State officials but primarily on Techno -economic aspect. The trainings are imparted by the monitoring agencies, i.e. CWC, GFCC & BB. Apart from these organizations, training on flood management is also imparted by National Water Academy, Pune. • No trainings on participatory planning and monitoring have been done so far.
Operational efficiency	• Although web-based Flood Management Information System (FMIS) exists in Uttar Pradesh and Bihar, requisite flood related data pertaining to structural measures, status of completed and ongoing schemes, monthly progress, etc. are not being uploaded in the corresponding state websites. • No Database exists for assessing the physical and financial progress and regular scheme and State-wise report of physical and financial progress.

Area	Summary of Issues and Challenges
	• Monthly and quarterly reports are also not regularly submitted which can adequately feed in regular progress related information into the Database.

Table 135: FMBAP – summary of issues and challenges

Parameter	Performance
Institutional Mechanism & Governance	🟡
Fund Flow Efficiency and utilisation	🟡
Unavailability of resource persons	🟡
Monitoring and evaluation	🟡
Capacity building	🟢
Operational efficiency	🟡

Performance infographics legend

🟢 Satisfactory 🟡 Average 🔴 Needs Improvement

2.2.9.4 Recommendations and solutions

This sub-section describes the scheme recommendation and solutions from the perspective of scheme design, scheme implementation and monitoring & evaluation, along with their mapping with the issues and challenges described in the preceding sub-section.

Table 136: FMBAP – recommendations and solutions

Sl. No.	Recommendations	Findings
Scheme design		
FMBAP – R1	• Form committees at district, block and village level with the objective of community participation in planning of projects and ensuring adequate O&M of structural measures built for flood control. Such committees at village	FMBAP – F1 and FMBAP – F9

Sl. No.	Recommendations	Findings
	and block level should include local NGO / CBO / SHG members, who will be coordinating and in communication with the local people. The action plans from the village level to be consolidated into block level plans and further into district plans. The committees also should have block level engineers, who will be support in preparing village and block action plans with design, estimates and other technical aspects. • An important prerequisite for FMP is the availability of sufficient and reliable data and state-of -the-art hydrological models to support environmental and social impact assessments including mitigating measures to arrest environmental deterioration. This needs to be accompanied by a process of citizen education and democratic dialogue, so that the need for decentralized flood management planning is communicated and appreciated at all levels.	
FMBAP – R2	• Scheme operational guidelines on FMBAP should be in place, which may contain overview of the scheme, components, institutional structure, implementation mechanisms and	FMBAP – F6

Sl. No.	Recommendations	Findings
	financial managements norms. Such guidelines shall help all states in following a uniform set of norms and also shall help the Department of Flood Management. DoWR in effective monitoring.	
FMBAP – R3	• Preparation of Master Plan at state level should be made mandatory and should be a prerequisite for granting approval of any new project proposed. Preparation of basin-wide master plans linking upstream, and downstream zones should be prioritised. The state specific master plans should contain demographic, morphological, environmental and social information so that it becomes a perspective plan and provides a basis for scheme wise DPR preparation.	FMBAP – F10
Scheme implementation		
FMBAP – R4	• Flood Plain Zoning: Flood Plain Zoning Act should be enacted immediately and necessary actions in keeping with the provisions of the Act should be implemented by the states. Flood-plain zoning demarcates zones or areas likely to be affected by floods of different magnitudes or frequencies and probability levels, and specify the types of permissible	FMBAP – F2

Sl. No.	Recommendations	Findings
	developments in these zones, so that whenever floods actually occur, the damage is minimised, if not avoided. Further, the states should share details of such zones with the Ministry to enable coordinated planning.	
FMBAP – R5	• River Basin Organization: With the growing perception of global environmental change and uncertain behaviour strategies of the river systems, RBO need to be formed to evolve strategies to prevent acceleration of man-made interventions, adapt and manage with the dynamic nature of the river systems. ○ RBOs can play a major role to facilitate the objectivity through consensus and cross-fertilisation of technological options with social actors for improved management of river. • Functions of the River Basin Organization: ○ Provide and disseminate information on the river system for evolving various options (social and technological), framework for transparent and accountable process of options assessment and	FMBAP – F2

Sl. No.	Recommendations	Findings
	management interventions pertaining to flood control ○ The RBO can then prioritise the complementary management intervention for implementation in a phased manner. This will enable the RBO to equip itself with various interest groups with a new kind of. professionalism for community participation and spreading river basin management particularly focussing on flood management.	
FMBAP – R6	• River dredging: Dredging of the river would dig out sediments from the riverbed and will increase the water retention capacity of the river. Consequently, the pressure on the banks would be reduced minimizing the chances of flood and erosion. An initiative taken by the Govt. of Assam as a solution to the mayhem of flood and erosion that has gobbled up huge mass of land on both bank of the mighty river Brahmaputra is the dredging of the river. This initiative will allow more water to stay in the river and reduce flooding. Selective desilting/dredging at outfalls/confluences or local reaches can, also can be adopted as a measure to tackle the problem locally.	FMBAP – F6

Sl. No.	Recommendations	Findings
Monitoring and Evaluation		
FMBAP – R7	• An online database and monitoring tool containing data pertaining to structural measures undertaken under FMBAP as well as real-time flood forecasting information should be created. This comprehensive database will be useful for integrated planning by states, monitoring of works by agencies such as CWC / GFCC & BB, states and districts, and for disaster response agencies in accessing timely information on floods. • The online database should be supported with a dashboard. Although a dashboard (http://pmksy-mowrnic.in/fmbap/) exists, but it primarily contains graphical representations of state-wise and year wise release of Central Shares for Flood Management Programmes (FMP) and River Management Activities and Works Related to Border Areas (RMBA). State-wise physical progress of ongoing FMBAP and State sponsored schemes need to be represented in the dashboard. • State specific FMIS as in case of Bihar and Uttar Pradesh need to be re-designed in a way so that it contains	FMBAP – F8

Sl. No.	Recommendations	Findings
	major monitoring indicators like year-wise human lives, agricultural lands, habitations saved and infrastructure protection undertaken. The FMIS should contain list of Centrally supported and state sponsored scheme details and their current status, so that decision making is made easier and timely. • Such web-based initiatives which helps in effective tracking of flood incidents and predicting flood in coming years should be rolled out across all flood prone states in our country. A dashboard at central level should be in place and connected to the states through a web server. Real-time data and predictions should be provided through the application on hourly basis.	
FMBAP – R8	• Project monitoring mechanisms like monthly and quarterly reporting should be initiated at block and village level. The reporting should include both physical and financial progress of the interventions. • Physical and financial progresses should be uploaded in an online public domain and updated on regular basis. Such online report tabulations coupled with dashboard should be	FMBAP – F8

Sl. No.	Recommendations	Findings
	based on the monthly / quarterly reports obtained from the States.	
FMBAP – R9	• The concurrent evaluation of the schemes should include scope of evaluating not only the techno-economic aspects of a flood control scheme but also the socio-economic aspects viz., livelihood status before and after completion of the structural measure. Additionally, it should also include environmental factors like salt intrusion of water, loss of vegetation, etc. A central database containing all concurrent evaluations should be in place for use by researches and policy makers. • Regular third-party evaluation should be mandatorily done by the States, wherein a holistic assessment of benefits is made at regular interval of time. Project-wise interim evaluation reports by third parties may be a pre-condition to fund release for subsequent instalments.	FMBAP – F8

Case Study I

1. **<u>Scheme details</u>**:
    a. Scheme Name: Channelization of Swan River
    b. Target Area: Swan River watershed, Una district, Himachal Pradesh
    c. Total Project Cost: Rs. 945.49 Cr.
    d. Scheme Outline:

i. Afforestation
ii. Civil works for soil and river management (check dams and embankments, etc.)
iii. Soil protection and land reclamation (terracing and soil addition, etc.)
iv. Livelihood improvement activities (agricultural development, small-scale infrastructure installation, income generating activities, etc.)
v. Institutional building (purchase of equipment, training, hiring of facilitators, etc.)

e. Implementing Agency: Forest Department and Irrigation and Flood Control Department, Government of Himachal Pradesh
f. Area covered: 95 Gram Panchayats of Una District, within which 61, 900 Ha of land were treated to protect the lands from soil erosion and floods, regenerate the forest cover and enhance agricultural productivity.

2. **Background**: District Una is situated on the bank of Swan River, which flows from North to West direction. This river during monsoon period creates devastating floods in District Una. Due to continuous silting, the bed of Swan River had risen constantly due to which meandering action took place. The width of the river had increased, and fertile land situated on both banks was turning barren due to silt deposits. Besides, some of the fertile land situated near the banks had been lost during the floods.

   Approximately, 10,000 Ha. of agriculture land was affected by floods and annually 2,000 Ha. of fertile land were not being cultivated due to fear of floods. During the past 10-12 years extensive damage to civil structures, properties, human life and livestock had happened. The estimated loss to crops and property was to the extent of Rs. 15 Cr. per annum.

3. **Project implementation**: The forest department was the nodal department for the project. The participating line departments were agriculture, horticulture and animal husbandry. The overall administration, planning and implementation of the project was with the Project Management Unit (PMU). The Chief Project Director was the overall in charge of the Project and responsible for all administration and financial matters and maintaining liaison with the government. He was assisted by a team of Additional Director, Joint Director (administration), Deputy Project Directors Agriculture, Horticulture, Animal Husbandry, Social Development Expert, Environment Education Expert and Training Expert. Three Project Implementation Units were established at Una,

Amb, and Gagret headed by the Deputy Directors. At Panchayat level Panchayat Development Committees (PDCs) were established in all the 96 Gram Panchayats of the Project area.

The Detailed Project Report for providing embankments on both banks of Swan River for a length of 16.67 km. from Jhalera bridge to Santokhgarh bridge in Phase-1 was prepared based on mathematical modelling studies carried out by Central Water Power Research Station (CWPRS), Pune. This project amounting to Rs. 102.71 Cr. was accepted by the Technical Advisory Committee of Ministry of Water Resources, Govt. of India. For integrated approach to the project it was proposed to treat entire catchment instead of just the sanctioned portion of 16.67 km. In all 42 most vulnerable points requiring emergent flood control works were identified and of these 40 have since been completed at a cost of Rs. 9.28 Cr. An additional amount of Rs. 24.57 Cr. has been approved under NABARD for phase-I.

Also, a provision has been made of Rs. 106.83 Cr. for treatment of catchment area of tributaries falling from Jhalera bridge to Santokhgarh bridge. The Forest Department has planted around 60,000 trees of different varieties, in 50 ha.,. In addition to this, check dams in the tributaries and planting of grass and bushes for bank protection have also been done.

4. **Community involvement:** People's participation was key to the success of this project and community participation was seen as an important aspect. No fund had to be allocated for land acquisition as the villagers had come forward and donated their land for the project. This saved around Rs. 500 Cr. The people donated their land with the expectation that the agriculture in the remaining portion of land after construction of the project would give them better returns. The report by JICA says that "The project will be implemented on national forests and on private land chosen through community participation. The project will not involve any land acquisition or involuntary resettlement."
5. **Impact**: The Swan River Project has benefitted the villages situated by the side of the river from the massive erosion and siltation caused by the flash floods. The villagers of Una, Amb and Gagret villages had contributed their land for construction of the embankment. The Focus Group Discussion with villagers of Una captured "*Since the Channelization of Swan River has been implemented by the Government, it changed our destiny for better as today, we are earning a reasonable money by producing seasonal*

vegetables and cash crops on the reclaimed land and have shifted back to our traditional vocation of farming".

a. The analysis of cropping pattern revealed that the total area under cereals decreased from 69% to 54%; however, with the increase in the irrigation facilities by the project interventions, the area under vegetable crops increased from 31% to 46 % of total cropped area. The cropping intensity increased from 193% to 199% after the project implementation.
b. During the project implementation period, the average size of livestock unit increased from 1.62 to 2.71. The share of milk to the total income from livestock was found to be highest among different livestock products.
c. As a result of proportionate increase in the income from agricultural crops, fruit crops and livestock by about 43%, 35%, and 55%, respectively, the overall farm income has increased by 50 per cent during the project implementation period.
d. The employment generation in field crops has increased with the implementation of the project. The annual per farm labour employment in horticulture and livestock, showed an increase of 213% and 65%, respectively on overall farms situation.
e. Commodity-based groups formed under the project were found to be facilitators for other members in arranging critical inputs. They were doing pioneering services with respect to production and marketing of produce.

Case Study II

1. **Project details**:
    a. Scheme Name: Flood Management Information System (FMIS)
    b. Target Area: Bihar
    c. Total Project Cost: Bihar – Rs. 10.86 Cr. funded by World Bank
    d. Scheme Outline:
        i. Development of technical and institutional capacity of the State for flood management
        ii. Improved flood forecasting in terms of lead time and accuracy
        iii. Prediction of expected inundation
        iv. Development of updated flood control manuals
        v. Upgrading hydrologic measurements

vi. Use of Online Analytical Processing (OLAP) and data mining tools for planning of schemes using forecasted data

vii. Preparation of a comprehensive Embankment Asset Management System: Embankment Asset Management System (EAMS) for Bagmati-Adhwara basin up to Dumri bridge intends to support flood management functions including maintenance and strengthening of existing embankment, anti-erosion works and flood-fighting measures etc. It would also assist in developing further flood management measures which may include planning of additional new flood control structures. The development of community participation for embankment surveillance and to update embankment safety information in the EAMS will be piloted.

e. Implementing Agency: Flood Management Information System Cell (FMISC), Government of Bihar

f. Area covered: Phase – I : Flood prone area in North Bihar, from Burhi Gandak river in the west to Kosi river in the east, including the districts of East Champaran, Muzaffarpur, Begusarai, Samastipur, Dharbanga, Sitamarhi, Sheohar, Madhubani, Supaul, Saharsa, and Khagaria covering about 26,000 sq. km. in area.

Phase – II: Entire North Bihar together with Patna, Bhagalpur and Munger district have been targeted to be developed.

2. **Background**: Flood Management Information System, Bihar finds its genesis in the brainstorming meeting on Jan 18, 2006 in which the Government of Bihar (GoB) and the World Bank agreed on a water sector partnership matrix and action plan in three-time horizons. In the short term, it was proposed to improve the technical and institutional capacity of the State of Bihar for flood management, introduce the extensive use of modern information technologies and develop and implement a comprehensive Flood Management Information System (FMIS) in priority areas. Flood Management Information System Cell (FMISC) was created under the overall supervision of Chief Engineer (CE), Monitoring and Planning, in Water Resources Department (WRD), GoB, and under Superintending Engineer (SE), Flood Monitoring Circle, to develop and operate the Flood Management Information System (FMIS) with technical assistance from the World Bank. Currently, one Executive Engineer as In-Charge, and six Assistant Engineers (and one peon) have been deputed to FMISC.

Major functions of FMISC are:

- To ensure operational readiness of FMIS prior to each flood season.
- To operate and disseminate information products as per plan and schedule.
- To respond to emergency data requirements through the use of FMIS.
- To follow-up on dissemination to enable effective utilization.
- To analyze feedback and experience of every flood season for improving FMIS.

3. **Scheme implementation:** The FMIS in the first stage covered the focus area from Burhi Gandak River in the west to Kosi River in the east in North Bihar that is most flood prone area in the State. This included 11 districts i.e. East Champaran, Sheohar, Sitamarhi, Muzaffarpur, Madhubani, Dharbanga, Samastipur, Supaul, Saharsa, Khagaria, and Begusarai covering 26,000 sq. km.

   The FMIS Phase I was initiated in August 2006 and was scheduled to be completed by 31.10.07. The extension to the project till 30.06.08 was granted by the World Bank and the project was completed and closed on this date. The project components included development of FMIS, improved flood forecasting, Bihar Flood Information Website, updated flood control manual, training and upgrading hydrologic measurements and telemetry.

   FMIS Phase-II started on 31-05-2010. In the meantime, the FMIS sustained itself on the internal resources of the Water Resources Department from 01-07-2008 to30-05-2010. The FMIS Phase II was scheduled to be completed by 31 December 2012, which was extended till 30 Nov. 2014.

4. **Impact:** As a result of FMIS in Bihar, following achievements have been realized:
   a. Flood modelling: Real-time Flood Forecasts are made using statistical and deterministic model.
   b. FMISC is coming out with monthly E-Bulletin since May-2007. This is an in-house production and gives a brief account of activities in FMISC.
   c. Flood Management Information System Cell, Bihar, Patna issues Daily Flood Information Bulletin during monsoon season generally from 15th June to 15th October. The bulletin carries information on observed rainfall in Nepal, Bihar and three days maximum rainfall forecast from IMD and river water level for all six sub-basins/rivers of North Bihar viz Gandak, Burhi Gandak, Bagmati (including Adhwara group of rivers), Kamala, Kosi and Mahananda.

d. Inundation Maps: These maps show a real extent of flood water spread. The inundation extent is derived from RADARSAT Layers/Imagery provided by NRSC in processed 1bit image format.
e. FMISC also supplements with regular embankment news, detailing the status of embankments in Bihar. Embankment Assets Management System for Bagmati and Kosi is currently functional and is providing up to date information on Embankment conditions by collecting information from department officials and select community members through field data collection application and SMS.
f. Following information products are regularly uploaded in the website for public viewing:
    i. Inundation map
    ii. Flood intensity map
    iii. Village level inundation map
    iv. River status map during flood
    v. Post flood River Status Map

2.2.10 Impact Assessment Studies

Impact Assessment Studies (IAS), a centrally sponsored scheme, aims to conduct monitoring and evaluation activities for AIBP projects under PMKSY.

The objectives of the scheme as available in the Monthly Newsletter of CWC (May 2019) are stated below:

- **Project analysis:** Reviewing the performance of the project vis-à-vis envisaged targets and evaluating the impact and outcomes of AIBP on irrigation projects.
- **Implementation and O&M:** It mainly involves the assessment of (i) extent of utilization of irrigation potential created; (ii) strength and weakness of projects; (iii) nature & effectiveness of procedures/modalities being used for equitable and effective distribution of water; and (iv) the nature & extent of activities taken up for promoting participation of grass root level stakeholder/local community in planning, implementation and maintenance of assets created under the project.
- **Impact evaluation**: It mainly involves evaluation of the nature & effectiveness of On-Farm Development (OFD) works; nature & extent of socio-economic development; changes in environment/ecology; extent of acceptability of project; purpose for which the acquired land is used; seek the perception, views and opinions of projects beneficiaries; and assess the nature & extent of rehabilitation of displaced families.

2.2.10.1 Background

The guidelines for PMSKY stipulate that Government of India may retain 1.5% of PMKSY provision for information, education and communication (IEC) activities and another 1.5% for administrative, monitoring, evaluation and any contingencies that may arise during the implementation of the scheme by each participating department. The IAS scheme was introduced in view of the substantial expenditure by the government towards creation of irrigation potential and the lack of assessment studies of the sub-components of PMKSY. Such analysis would also lead to identification of gaps and aid in overall streamlining of the PMKSY scheme. Since its inception, the IAS scheme has successfully conducted impact assessment for 10 completed AIBP projects.

The scope of issues to be covered under the impact assessment studies (conducted for 10 completed AIBP projects[247]), can be divided under the broad heads as follows:

- Procedural parameters:
  - Status of project at the time of inclusion under AIBP
  - Status of efforts made for equitable distribution of water, people's participation at different stages of the project
  - Number of projects out of total irrigation projects in the state have been included under AIBP
  - Status of funds received other than AIBP for completion
- Planning and execution:
  - Quality of construction of various components of the project
  - Review whether the work has been carried out following the original approved DPR or has been revised for completion
  - Status of people's participation in completion of the project
  - Status of monitoring mechanism available for resolving inter-departmental and inter-ministerial issues
  - Status of Command Area Development programme
- Financial aspects:
  - Status of the cost of the project whether completed as per the original estimation or revised in due course of time and effect of revision on cost escalation
  - Review whether the Ministry has released central assistance as per MoU on time
  - Review whether the states have released their share and central assistance to the implementing agencies on time
  - Status of financial management in project implementation
  - Cost benefit ratio
  - Reasons for cost escalation/ revision, time taken in releasing an adequacy of funds for physical works schedule
- Hydrological parameters:
  - Status of IPC and IPU before and after inclusion under AIBP

[247] MoWR, RD & GR (2016), RFP for Appointment of Consultant for Impact Assessment of AIBP on 10 Completed Projects Selected from Five Regions

- Status and efficacy of On-farm Development (OFD) works
- Increase in groundwater table in the project area before and after the project
- Status of drainage system in the area with and without the project
- Extent of water-logged area before and after the project

- Impact assessment parameters:
  - Coverage in terms of whether the scheme has reached the un-served areas, different classes of users and tail end users have been benefitted
  - Impact on agricultural yield and productivity in the project area as a result of implementation of the project
  - Whether sustainable practices, such as water-use efficiency, water footprint, conjunctive use of water etc, are followed
  - Extent to which cost recovery through user charges has been achieved from different classes of users
  - Use and promotion of innovation and technology in planning and implementation of scheme and managing operations
- Outcome of project:
  - Estimate social-cost benefit of implementation of the scheme and comparison of the projected vs actual benefits
  - Change in cropping pattern and crop rotation
  - Increase in irrigation intensity
  - Increase in groundwater
  - Change in economic status of the people residing in the area
  - Status of rehabilitated families in the project area
  - Overall impact of the project in the area

2.2.10.2 Performance

An impact assessment study of 10 completed AIBP projects was conducted by Academy of Management Studies (AMS), Lucknow at a cost of Rs.60 lakh.

Table 137: IAS – List of completed projects[248]

#	Project Name	Beneficiary state
1	Shahnehar Project	Himanchal Pradesh
2	Providing Kharif Channel in Hindon Krishni Doab (HK Doab) Project	Uttar Pradesh
3	Hawaipur Lift Irrigation Scheme	Assam
4	Upper Kolab Irrigation Project	Odisha
5	Jhuj Irrigation Project	Gujrat
6	Mahi Bajaj Sagar Project	Rajasthan
7	Priyadarshini Jurala Project	Telangana
8	Maskinala Medium Irrigation Project	Karnataka
9	Purna Medium irrigation	Maharashtra
10	Sindh Phase I Project	Madhya Pradesh

Table 138: IAS: Financial Progress[249]

(Rs. Cr.)

Scheme	2015-16		2016-17		2017-18		2018-19		2019-20	
	Budget est.	Actual exp.	Budget est.	Actual exp.	Budget est.	Actual exp.	Budget est.	Actual exp.	Budget est.	Exp up to Sep 2019
Impact Assessment Studies	5.00	0.04	1.00	0.07	1.00	0.14	1.00	0.28	1.00	0.25

Performance on REESI+E framework

Table 139: IAS – Performance evaluation based on REESIE framework

Parameter	Findings from research
Relevance	**Secondary**: • Considering that large volume of capital was invested in the AIBP projects, a need was felt to assess the impact created by AIBP projects

[248] Impact Assessment of Accelerated Irrigation Benefits Programme on 10 completed projects selected from five regions by AMS

[249] Data shared by Mo WR, RD & GR on 1 Nov 2019

Parameter	Findings from research
	against the benefits envisaged at the time of project approval. Therefore, Cabinet committee, in 2016, recommended for assessment of the existing gap between the irrigation potential created (IPC) and irrigation potential utilized (IPU) for all on-going and completed AIBP projects. • The objectives of the study conducted by Academy of Management Studies (AMS), Lucknow included analysis of scheme performance, implementation challenges, operations and maintenance and impact evaluation.[248]
	Primary: • It has emerged from the discussions with the stakeholders that impact assessment of the completed major and medium irrigation (MMI) projects is quite necessary because it helps to compare actual vs envisaged benefits of the projects and therefore, actual vs planned cost benefit ratio. Impact assessment of a completed MMI project can also help to take corrective actions for an ongoing MMI project because the issues in the projects are not very different.
	Inference: • Impact evaluation for large irrigation projects is extremely important because those projects provide irrigation facilities to huge number of beneficiary farmers. Since this scheme aims to assess impact of such large projects under AIBP scheme, it is quite relevant. Hence, it has been rated as 'satisfactory' with respect to relevance parameter.
Effectiveness	**Secondary**: • Govt. sanctioned a budget of 9 Cr. for these impact assessment studies during 2015-16 to 2019-20. • From 2015-16, total expenditure of Rs. 78 lakh was incurred till September 2019 against the allocated budget of Rs. 9 Cr.[249]

Parameter	Findings from research
	• Under the scheme, an impact assessment study of 10 completed AIBP projects by was completed by Academy of Management Studies (AMS), Lucknow at a cost of Rs. 60 lakh.[249]
	Primary: • Only a miniscule amount has been incurred so far on these studies vis-à-vis the allocated budget. • It has emerged from the discussions with the stakeholders that impact assessment of any MMI project is suitable only after 4-5 years post completion of that project because it takes around 4-5 years for the project to mature and start producing benefits, which were envisaged during project inception. The 99 projects under PMKSY-AIBP will be assessed after few years when these projects will reach their maturity stage and can be considered for impact assessment.
	Inference: • 143 AIBP projects were completed by March 2014. However, impact evaluation has been performed only for 10 projects during 2015-16 to 2019-20. It takes around 4-5 years for any MMI project to reap its benefits. Still, impact assessment of any other project has not been initiated despite substantial budget allocation for that. Hence, it can be concluded that the scheme has not been effectively implemented so far. Hence, the scheme has been rated as 'needs improvement' with respect to effectiveness parameter.
Efficiency	Data not available
Sustainability	Data not available
Impact	Data not available
Equity	Data not available

A summary analysis and performance of the scheme on the identified themes is presented below:

Table 140: IAS: Summary of performance evaluation based on REESIE

Parameter	Performance
Relevance	
Effectiveness	
Efficiency	
Sustainability	
Impact	
Equity	

REESI+E performance infographics legend

High Medium Low Not relevant No information

2.2.10.3 Issues and challenges

This sub-section describes the scheme issues and challenges.

Table 141: IAS – Issues and challenges

Sl.no	Issues & Challenges
IAS - F1	The scheme objectives are stated in the Monthly Newsletter of CWC (May 2019). However, no scheme related documents are available. Implementation guidelines, institutional arrangements etc. are not specified anywhere.
IAS – F2	The progress of this scheme, impact assessment study reports, etc. are not available in public domain.

2.2.10.4 Recommendations and solutions

This sub-section describes the scheme recommendations and solutions along with their mapping with the issues and challenges described in the preceding sub-section.

Table 142: IAS – Recommendations and solutions

Sl.no	Recommendation	Finding
IAS - R1	Operational Guidelines should be published for this scheme. That will help in understanding the implementation mechanism,	IAS-F1

Sl.no	Recommendation	Finding
	institutional arrangements, eligibility criteria, scope of assessment etc.	
IAS – R2	MIS of PMSKY-AIBP can be leveraged for tracking progress (physical as well as financial) of this scheme. Also, impact assessment study reports should be made available in PMKSY-AIBP portal.	IAS-F2

2.2.11 Other Schemes

In addition to the analysis of schemes presented above, two other schemes: viz. i) Atal Bhujal Yojana and ii) Assistance for Sutlej Yamuna Link Project were originally proposed to be included for analysis as per the terms of reference of this study. However, due to non-availability of scheme related documents for the above two schemes at the time of writing this report, these two schemes have not been taken up for further analysis. Brief summaries on these two schemes are provided below.

2.2.11.1 Atal Bhujal Yojana

Government of India has announced the Atal Bhujal Yojana, a Central Sector Scheme, with the aim to improve the situation of groundwater resources in India. The Union Cabinet gave approval on 24 December 2019 for implementation of this scheme to be implemented over a period of five years from 2020-21 to 2024-25 at a cost of Rs. 6,000 Cr. with assistance from World Bank.

This scheme has two major components:

Institutional Strengthening and Capacity Building: This component will work towards strengthening institutional arrangements for sustainable groundwater management in the selected states and improving monitoring networks, capacity building, strengthening of Water User Associations etc.

Incentive Component: This component will work towards incentivising the beneficiary states for achievements in improved groundwater management practices, such as data dissemination, preparation of water security plans, implementation of management interventions through convergence of ongoing schemes, adopting demand side management practices etc.

Background

Groundwater has significant contribution to irrigation (around 65% of total irrigated area) as well as rural drinking water supply (around 85%) in India. However, the groundwater resources are depleting due to the increasing demands of growing population, urbanization and industrialization. In addition to that, unregulated groundwater extraction in many areas has caused rapid and widespread decline in groundwater levels as well as hampered the sustainability of groundwater abstraction structures. The deteriorating groundwater quality in some parts of the country has

exacerbated the issues of low groundwater storage. Therefore, it is utmost necessary to take preventive / remedial measures; otherwise, the increasing stress on groundwater due to over-exploitation, contamination and associated environmental impacts will endanger the food security of the nation.

In this context, the Mo WR, RD and GR has undertaken an initiative for ensuring long term sustainability of groundwater resources through the Atal Bhujal Yojana (ATAL JAL) in identified groundwater stressed blocks in seven states, representing a range of geomorphic, climatic and hydrogeologic and cultural settings. The Central Groundwater Authority (CGWA) will be responsible for regulating groundwater development under this scheme.

Objective

The objective of this scheme is sustainable management of groundwater resources across priority areas in the country through strengthening the institutional framework for participatory groundwater management and bringing about behavioural changes at the community level. The identified over-exploited and water-stressed areas for the scheme fall across Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh.

The scheme aims to provide benefits to nearly 8,350 Gram Panchayats in 78 districts in the beneficiary states.

Funding

The funding for the scheme shall be shared equally (i.e. 50:50) between the Government of India and the World Bank. The funds will be made available to the participating states as grants.

Primary Activities

- Institutional strengthening for improving groundwater monitoring networks and capacity building of stakeholders at different levels which will enhance groundwater data storage, exchange, analysis and dissemination
- Improved and realistic water budgeting based on an improved database and preparation of community-led Water Security Plans at Panchayat level
- Implementation of Water Security Plans through convergence of various ongoing/new schemes of the Government of India and State Governments to facilitate judicious and effective utilization of funds for sustainable groundwater management

- Efficient use of available groundwater resources with emphasis on demand side measures such as micro-irrigation, crop diversification, electricity feeder separation, etc.

Benefit

- This scheme will help in achieving source sustainability for Jal Jeevan Mission in the project area with active participation of local communities
- This scheme will contribute towards the goal of doubling the farmers' income
- This scheme will promote participatory groundwater management
- This scheme will help in improving water use efficiency on a mass scale and cropping pattern
- This scheme will help in promoting efficient and equitable use of groundwater resources and behavioural change at the community level

Evaluation

Since the scheme was approved very recently in December 2019 and scheme guidelines are not available, evaluation of this scheme has not been taken up. However, considering the current context as outlined in the above, this scheme is quite relevant, and it is expected to play an important role in groundwater resource management.

2.2.11.2 Assistance for Sutlej Yamuna Link Project

Sutlej Yamuna Link (SYL) project is a proposed canal of more than 200 km with about 121 km in Punjab and 90 km in Haryana and is designed to convey 3.45 million acre feet (MAF) out of 3.5 MAF of Haryana's average annual share of surplus Ravi-Beas waters as per a 1981 agreement between the Governments Punjab, Haryana and Rajasthan. Once complete, the project will irrigate 4.46 lakh ha. in Haryana and 1.28 lakh ha. in Punjab and generate 50 MW of power. Construction of Haryana's portion of the canal is complete. Punjab's portion of the canal has not been completed and project is stalled due to differences between the Governments of Punjab and Haryana for the past several decades.

Since no information about this scheme was available, this scheme has not been evaluated.

2.3 Scheme Level Summary

2.3.1 Performance Summary on REESI+E Framework

Summary analysis of the performance of all the schemes based on the REESI+E framework is presented below:

Table 143: Performance Summary on REESI+E Framework

Scheme Name	Relevance	Effectiveness	Efficiency	Sustainability	Impact	Equity
AIBP	🟢	🟡	🟢	🔴	🟢	🟢
CADWM	🟢	🟡	🟢	🟡	🟢	🟢
RRR	🟢	🟡	🟡	🟡	🟢	🟡
SMI	🟢	🟡	🟢	🟡	🟢	🟢
GWI	🟢	🟡	⚪	⚪	⚪	⚪
SPFM	🟢	🟡	🟡	⚪	⚪	⚪
PDMC	🟢	🟡	🟡	🔴	🟢	🟡
WDC	🟢	🟢	🟡	🔴	🟡	🟢
IC	🟢	🟢	🟢	🟡	🟡	🟡
LTIF	🟢	🟢	🟢	🟢	🟢	🟢
NRCP	🟢	🟡	🟡	🟡	🟢	🟢
FMBAP	🟢	🟢	🟢	🟡	🟢	🔴
IAS	🟢	🔴	⚪	⚪	⚪	⚪

REESI+E performance infographics legend

🟢 Satisfactory 🟡 Average 🔴 Needs Improvement ⚫ Not applicable ⚪ No information

2.3.2 Performance Summary on Cross-sectional themes

Summary analysis of the performance of all the schemes based on the identified cross-sectional themes is presented below:

Table 144: Performance Summary on Cross-sectional themes

Cross sectional theme	AIBP	CADWM	RRR	SMI	GWI	SPFM	PDMC	WDC	IC	LTIF	NRCP	FMBAP
Accountability & Transparency	🟢	🟡	🟡	🟡	🟡	🟡	🟡	🟢	🟢	🟡	🟡	🟡
Direct/Indirect Employment Generation	🟢	🟢	🟢	🟢	⚪	⚪	🟡	🟢	⚫	⚫	🟢	🟡
Gender mainstreaming	⚫	🟡	🟡	🟡	⚪	⚪	🟡	🟢	⚫	⚫	🟡	🔴
Building resilience to climate change (including but not limited to developing water disaster preparedness) & ensuring sustainability	🟡	🟡	🔴	🟡	🟡	⚪	⚫	🔴	⚫	⚫	🔴	🟡
Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population	🟡	🟡	⚫	🟢	⚪	⚪	🟡	🟢	⚫	⚫	🟢	🟡
Use of IT/Technology in driving efficiency	🟡	🟡	🟡	🟡	🟡	🟡	🟢	🟢	🟢	⚫	🟡	🟢
Stakeholder and Beneficiary behavioural change	⚫	🔴	🟡	🔴	⚪	⚪	🟡	🟡	🔴	⚫	🔴	🔴
Development, dissemination & adoption of innovative practices,	⚪	🟡	⚪	⚪	⚪	⚪	⚪	⚪	🟡	⚫	🟡	⚪

Cross sectional theme	AIBP	CADWM	RRR	SMI	GWI	SPFM	PDMC	WDC	IC	LTIF	NRCP	FMBAP
technology & know-how												
Research & Development	●	●	●	●	●	●	●	●	●	●	●	●
Water sharing treatise / agreements and diplomacy	●	●	●	●	●	●	●	●	●	●	●	●
Conjunctive use of water	●	●	●	●	●	●	●	●	●	●	●	●
Unlocking Synergies with other Government Program	●	●	●	●	●	●	●	●	●	●	●	●
Reforms, Regulations	●	●	●	●	●	●	●	●	●	●	●	●
Impact on and role of private sector, community/ collectives/ cooperatives (e.g. Farmer cooperatives, FPOs, Water User Associations, etc.) and civil society in the scheme	●	●	●	●	●	●	●	●	●	●	●	●

Cross-sectional themes performance infographics legend

● High ● Medium ● Low ● Not relevant ● No information

2.3.3 Summary of Issues and Challenges

Summary analysis of the issues and challenges for all the schemes across the identified themes is presented below

Table 145: Summary of Issues and Challenges

Scheme Name	Institutional Mechanism & Governance	Fund Flow Efficiency and utilisation	Unavailability of resource persons	Capacity Building	Monitoring and Evaluation	Other issues*
AIBP	●	●	●	●	●	●
CADWM	●	●	●	●	●	●
RRR	●	●	●	●	●	●
SMI	●	●	●	●	●	●
SPFM	●	●	●	●	●	●
PDMC	●	●	●	●	●	●
WDC	●	●	●	●	●	●
IC	●	●	●	●	●	●
LTIF	●	●	●	●	●	●
NRCP	●	●	●	●	●	●
FMBAP	●	●	●	●	●	●

* The 'other issue' observed for each scheme is as follows:

- for AIBP,CADWM, IC, NRCP, FMBAP: operational efficiencies
- SMI: non-usage of surface water schemes
- RRR: encroachment of surface water bodies

Performance infographics legend

● Satisfactory ● Average ● Needs Improvement

3 Conclusions and recommendations: Water resources

3.1 Gap Analysis of Sectoral Issues

3.1.1 Interventions Gaps at Sector Level

As mentioned in the sector performance section, water resources are a vast sector comprising several important sub-sectors. Some of the key sub-sectors include groundwater, surface water, reservoirs and large irrigation projects, micro-irrigation, water consumption and demand management and wastewater. In addition to the Ministry of Jal Shakti (GoI), various other central government ministries as well as state line departments and MFIs have undertaken multiple interventions to address the varied issues facing the water resources sector. A brief overview of major central sector schemes (CS), centrally sponsored schemes (CSS), state schemes as well as IFI sponsored key initiatives currently active in the water resources sector is summarised in the table below. Only schemes having direct impact on the sector have been considered. The table below also indicates the gap map, i.e. the specific issues which are currently not being addressed by any major scheme or intervention. The list is indicative in nature and not exhaustive.

Table 146: Interventions gap at Sectoral level

Sectoral objective	Major Issues	CS	CSS	State Schemes	Policy, Legal, Regulatory interventions	Other Interventions (MFIs, Private, NGOs, Policy, Laws, etc)
Adequacy	Low overall water storage capacity as well as water storage capacity per capita in dams		PMKSY-RRR, AIBP	Multiple Major, Medium and Minor Irrigation projects across states, Mission Kakatiya-Telangana, Neeru Chettu-AP		Dam Rehabilitation and Improvement Programme (World Bank), Rengali Irrigation Project-Odisha
Access	IPC-IPU Gap		PMKSY-CADWM, SMI, GWI, SPFM, IC	Mukhyamantri Shashwat Krushi Sinchan Yojana-Maharashtra		Rajasthan Water Sector Livelihood Improvement Project

Sectoral objective	Major Issues	CS	CSS	State Schemes	Policy, Legal, Regulatory interventions	Other Interventions (MFIs, Private, NGOs, Policy, Laws, etc)
Access	Low Irrigation coverage status		PMKSY- AIBP, CADWM, RRR, SMI, GWI, SPFM,PDMC	Multiple Major, Medium and Minor Irrigation projects and LI across states, Mission Kakatiya-Telangana, Neeru Chettu-AP		Uttar Pradesh Water Sector Restructuring Project, Rengali Irrigation Project-Odisha
Equity	Spatial variance in surface water availability and River interlinking	The River Basin Management Scheme, Interlinking of River (ILR) programme		Multiple Lift Irrigation schemes across states		

Sectoral objective	Major Issues	CS	CSS	State Schemes	Policy, Legal, Regulatory interventions	Other Interventions (MFIs, Private, NGOs, Policy, Laws, etc)
Equity	Low efficiency of canal network		PMKSY- AIBP, CADWM, SPFM			
Sustainability	High extraction of groundwater and its regulation	Participatory Groundwater Management, Atal Bhujal Yojana	PMKSY- WDC, Jal Shakti Abhiyan		State GW Rules	
Sustainability	High Dependency on groundwater for irrigation		PMKSY- AIBP, SMI, WDC	Multiple Major , Medium and Minor Irrigation projects and LI across states, Mission Kakatiya-Telangana, Neeru Chettu-AP		

Sectoral objective	Major Issues	CS	CSS	State Schemes	Policy, Legal, Regulatory interventions	Other Interventions (MFIs, Private, NGOs, Policy, Laws, etc)
Sustainability	Cropping pattern and crop diversification	MIS- PSS, PM-AASHA, Promotion of 10,000 Farmer Producer Organizations (FPOs)	PMKSY-CADWM,PDMC, WDC SPFM, RKVY	Bundelkhand Increasing Plan-UP, State Micro-irrigation Scheme- MP		Andhra Pradesh Integrated Irrigation and Agriculture Transformation Project
Sustainability	High Water consumption in Thermal Power Plants				Tariff Policy 2016 (Power sector), ZLD Rule (EPA), MWRRA Act	
Sustainability	Low Efficiency in water use and pricing in Industrial sector				ZLD Rule (EPA), MWRRA Act	
Sustainability	Low Efficiency in water use and pricing in domestic sector		Jal Jeevan Mission,	Multiple State level Drinking	MWRRA Act	

Sectoral objective	Major Issues	CS	CSS	State Schemes	Policy, Legal, Regulatory interventions	Other Interventions (MFIs, Private, NGOs, Policy, Laws, etc)
			AMRUT, Smart Cities	Water schemes		
Sustainability	O&M and financing deficiencies		LTIF, PMKSY-WDC, NRCP			
Sustainability	Climate Change	Climate Change Action Plan	PMKSY- WDC, Jal Shakti Abhiyan			Maharashtra Project on Climate Resilient Agriculture
Sustainability	Lack of Micro level information on all depleted aquifers	NAQUIM				
Sustainability	Gap between demand and supply of water	Multiple Schemes	Multiple Schemes	Multiple Schemes		Uttarakhand Decentralized Watershed Development II Project

Sectoral objective	Major Issues	CS	CSS	State Schemes	Policy, Legal, Regulatory interventions	Other Interventions (MFIs, Private, NGOs, Policy, Laws, etc)
Sustainability	High Urban Water Consumption		AMRUT, Smart City			
Sustainability	O&M and lack of financing- rural water supply		Jal Jeevan Mission			Uttarakhand Rural Water Supply & Sanitation Project (World Bank), West Bengal Drinking Water Sector Improvement Project (ADB)
Water Security	Low water use efficiency in agriculture		PMKSY-CADWM, PDMC, WDC, RKVY	Bundelkhand Increasing Plan-UP, State		Uttar Pradesh Water Sector Restructuring Project,

Sectoral objective	Major Issues	CS	CSS	State Schemes	Policy, Legal, Regulatory interventions	Other Interventions (MFIs, Private, NGOs, Policy, Laws, etc)
				Micro-irrigation Scheme- MP		Andhra Pradesh Integrated Irrigation and Agriculture Transformation Project, Tamil Nadu Irrigated Agriculture Modernization Project
Water Security	Low Agriculture Sector Contribution to GDP	PM- KISAN, PM-AASHA, Promotion of 10,000 Farmer Producer Organizations				Uttar Pradesh Water Sector Restructuring Project

Sectoral objective	Major Issues	CS	CSS	State Schemes	Policy, Legal, Regulatory interventions	Other Interventions (MFIs, Private, NGOs, Policy, Laws, etc)
		(FPOs), Nutrient Based Subsidy, Transport and Marketing Assistance (TMA) Scheme for specified agriculture products, Pradhan Mantri Kisan Sampada Yojana				
Water Security	Using recycled water for agriculture		PMKSY- PDMC, Smart City, AMRUT, SBM			

Sectoral objective	Major Issues	CS	CSS	State Schemes	Policy, Legal, Regulatory interventions	Other Interventions (MFIs, Private, NGOs, Policy, Laws, etc)
Water Security	Effect of water stress on households- Socio Economic Impact		Jal Jeevan Mission	State level Drinking Water programs		Uttarakhand Rural Water Supply & Sanitation Project (World Bank), West Bengal Drinking Water Sector Improvement Project (ADB)
Water Security	Effect of water stress on households- Health Impact		Jal Jeevan Mission	State level Drinking Water programs		Uttarakhand Rural Water Supply & Sanitation Project (World Bank), West

Sectoral objective	Major Issues	CS	CSS	State Schemes	Policy, Legal, Regulatory interventions	Other Interventions (MFIs, Private, NGOs, Policy, Laws, etc)
						Bengal Drinking Water Sector Improvement Project (ADB)
Water Security	Water sharing treaties / agreements and diplomacy	The River Basin Management Scheme, Interlinking of River (ILR) programme	FMBAP		MWRRA Act, Indus Water Treaty, India-Bangladesh Treaty, Water Disputes Tribunal-Godavari, Krishna, Narmada, Ravi, Cauvery	

Sectoral objective	Major Issues	CS	CSS	State Schemes	Policy, Legal, Regulatory interventions	Other Interventions (MFIs, Private, NGOs, Policy, Laws, etc)
Overall nature and responsiveness of Water sector planning	Need for better Planning and data management in the sector	Water Resources Information System (WRIS), National Hydrology Project (NHP), National Water Mission	Irrigation Census, FMBAP	Reservoirs Water Level Monitoring System- Jharkhand, AP WRIMS		North East Water Resources Information Base
Overall nature and responsiveness of Water sector planning	Requirement for increase in coordination between the various central government level organisations and the state government departments			Multiple task forces		

Sectoral objective	Major Issues	CS	CSS	State Schemes	Policy, Legal, Regulatory interventions	Other Interventions (MFIs, Private, NGOs, Policy, Laws, etc)
Overall nature and responsiveness of Water sector planning	Groundwater Level Monitoring	NHP		APWRIMS		
Overall nature and responsiveness of Water sector planning	Conjunctive use of surface and groundwater	NHP				
Overall nature and responsiveness of Water sector planning	Water for environmental needs					

Sectoral objective	Major Issues	CS	CSS	State Schemes	Policy, Legal, Regulatory interventions	Other Interventions (MFIs, Private, NGOs, Policy, Laws, etc)
Quality	Wastewater reuse & pollution abatement measures	NMCG	NRCP, Smart City, AMRUT, SBM		Tariff Policy 2016 (Power sector), ZLD Rule (EPA), CPCB Acts	
Quality	Groundwater quality		Jal Shakti Abhiyan	Salinity Ingress Prevention Scheme- Gujarat, Holiyu Project- Gujarat	State GW rules	
Convergence	Scheme convergence		PMKSY- AIBP, CADWM, PDMC, WDC, NRCP, MGNREGA			
Gaps in broad sectoral outcomes	Efficient groundwater management and technologies	Atal Bhujal Yojana	Jal Shakti Abhiyan, MGNREGA	AP WRIMS		

Sectoral objective	Major Issues	CS	CSS	State Schemes	Policy, Legal, Regulatory interventions	Other Interventions (MFIs, Private, NGOs, Policy, Laws, etc)
Gaps in broad sectoral outcomes	Wastewater reuse policy				WW Reuse policy- Gujarat, Karnataka, Punjab, Rajasthan, etc.	
Gaps in broad sectoral outcomes	Need for water regulator for all states and /or central				MWRRA Act, Punjab Water Resources Ordinance- 2019, UP Water Management & Regulatory Commission Act- 2008, Jharkhand WRRA- 2014, J&K Water Resources	

Sectoral objective	Major Issues	CS	CSS	State Schemes	Policy, Legal, Regulatory interventions	Other Interventions (MFIs, Private, NGOs, Policy, Laws, etc)
					(Regulation and Management) Act 2010	
Gaps in broad sectoral outcomes	Capacity building of the organisations/utilities creating and managing Water Resources infrastructure and providing service	Multiple Capacity Building Programs	PMKSY-CADWM, SPFM, PDMC, IC, FMBAP	Multiple Capacity Building Programs		Multiple Capacity Building Programs
Gaps in broad sectoral outcomes	Staffing levels					
Gaps in broad sectoral outcomes	Financing in the sector	National Investment and	PMKSY- AIBP, CADWM, LTIF			

Sectoral objective	Major Issues	CS	CSS	State Schemes	Policy, Legal, Regulatory interventions	Other Interventions (MFIs, Private, NGOs, Policy, Laws, etc)
		Infrastructure Fund				
Gaps in broad sectoral outcomes	Project Management issues and Slow project execution		PMKSY- AIBP, SPFM, WDC			
Gaps in broad sectoral outcomes	Enforceable water entitlements					
Gaps in broad sectoral outcomes	R&D in the sector	CS under ICAR	PMKSY- PDMC, WDC			

3.1.2 Gap Map Synthesis of Sector and CSS Schemes

An analysis of nine CSS being evaluated as part of this study and their mapping with the key sector issues have been undertaken in the table below.

Table 147: Gap map synthesis of sector issues and CSS schemes

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
Adequacy	Low overall water storage capacity as well as water storage capacity per capita in dams	RRR	RRR	A total of 1,359 water bodies (i.e. 61% of target) and storage capacity of 504.85 MCM (i.e. 51% of target) has been restored, as on March 2020. Scheme is being implemented in 12 states across India	Encroachment of water bodies may be checked through active involvement of stakeholders at grassroot level from planning stage. To ensure there is no encroachment, domestic/ industrial discharge in treated water bodies, a certificate may be issued by the Gram Panchayat, while inclusion of water bodies under RRR.
		AIBP	AIBP	Specific data related to total storage capacity created was not available	
Access	IPC-IPU Gap	CADWM	CADWM	Pari-passu implementation of CADWM scheme (for the 99 Priority AIBP projects) resulted	Expeditious completion of the construction and lining of field channels (particularly in the

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				in 14.18 lakh ha utilization of irrigation potential in an additional CCA (against the targeted figure of 45.08 ha). This is complimented by non-structural interventions through creation of 6,981 WUAs (51% of targeted 13,734).	tail reaches). Ensure effective functioning of the registered WUAs through proper capacity building and devolution of authority
		GWI	GWI	This scheme aims to increase irrigation potential creation (IPC) through groundwater for small and marginal farmers across the safe groundwater areas (i.e. areas other than over-exploited, critical or semi-critical areas). Ground Water irrigation (65-70%) is more efficient than surface water irrigation (30-65%) due to low conveyance loss and proximity	

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				between availability of water source and place of its utilization in case of groundwater-based irrigation. Hence, the scheme helps to improve irrigation potential utilization (IPU); thus, reduce IPC-IPU gap. Since the scheme is operational post May 2019, it would be pre-mature to assess IPU by this scheme at this stage.	
		SMI	SMI	The performance of SMI in terms of reduction of IPC IPU gap was not tracked	
		Irrigation Census	Irrigation Census	IPC - IPU Gap is one of the major performance indicator that is measured through Irrigation Census. While gap	State, District, Block and Village wise IPC - IPU gap to be assessed and published

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				between IPC and IPU was almost double in 3rd Census (22Mha) as compared to 2nd Census, the gap was 20 mha in 4th. The gap was found to be further reduced in 5th Census (18Mha)	
Sustainability	High extraction of groundwater and its regulation	GWI	GWI	Unregulated extraction of groundwater is a major challenge in current water stressed situation in the country. As per the scheme guidelines, the criteria for an area to be eligible for this scheme: - The area should not be classified as over-exploited, critical or semi-critical in respect of groundwater resources	Convergence with other schemes, such as PMKSY-Watershed Component, MGNREGA, PMKSY-Per Drop More Crop etc., for supporting water harvesting and groundwater recharge interventions/ demand side interventions can be explored to achieve long-term sustainability of groundwater resources.

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				- Less than 60% of the annual replenishable ground water resources have been developed - Average annual rainfall should be 750 mm or more to ensure scope for groundwater recharge - Shallow ground water levels within a range of 15 m below ground level or less during pre-monsoon period Ground water development for irrigation is to be planned in such a way that after implementation of the project, stage of Ground Water Development (SOD) in an area should not exceed 70% at any	

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				time. Below steps are taken for achieving this: - In a potential assessment unit, the maximum probable wells, that can be drilled which can lead SOD beyond 70%, are identified. - The limit of admissible number of wells in each assessment unit has been kept 20% less than the wells required to lead SOD to 70%. - Further, number of wells proposed in State Government proposals are kept significantly less than the admissible	

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				wells in each unit and this comfortably covers the wells drilled under any other scheme. In view of the above, no risk is involved, as far as ground water resources availability is concerned. Marginal risk of failure of bore wells, especially in hard rock areas do exist and for that, site selection through hydrogeological and geophysical investigation is provisioned.	
		WDC	WDC	There have been cases of unregulated extraction of groundwater in watershed areas post groundwater recharge as was suggested by the state of Rajasthan. It was	Post-project management of natural resources requires focus to ensure the sustainability of benefits. Scheme guidelines should

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				also highlighted that SLNA does not monitor the same but such cases have been observed. It was also pointed out that there is a need to change the behaviour of the farmers towards sustainable practices. Although this is not covered under WDC-PMKSY at present.	specify objectives and strategies in this regard.
		Atal Bhujal Yojana	Atal Bhujal Yojana	This scheme is yet to be implemented and has not been evaluated as part of this study.	This scheme is yet to be implemented and has not been evaluated as part of this study.
Equity	Low Efficiency of canal network	AIBP	AIBP	No specific guidelines for canal lining; some states take up canal lining under AIBP (as ERM projects). To address low canal efficiency, 26 underground	Change in funding norms/ eligibility criteria to facilitate shift from construction to ERM projects - in view of existing low utilization/ below par utilization of many of the

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				piped distribution networks have been initiated among the 99 PMKSY-AIBP projects	MMI projects (widening IPC-IPU gap), it is proposed that government needs to bring in a paradigm shift in its priority selection; a shift towards ERM (encapsulating canal lining and canal automation projects) and maintenance of existing projects is desirable. Also, whereby possible, feasibility of construction of UGPL instead of conventional canals for branch and minors should be explored
		CADWM	CADWM	One of the objectives of CADWM is to ensure equitable water distribution among cultivators in head and tail reaches	Lining and maintenance of field water courses along with correction of system deficiencies; effective implementation of PIM to

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
					ensure equitable water distribution
		SPFM	SPFM	The major and medium irrigation (MMI) projects under this scheme involve construction of conventional open channels which are prone to huge seepage and evaporation losses, resulting into overall low conveyance efficiency. The use of underground pipelines (UGPL) in the projects wherever feasible, has been promoted by the GoI to improve water conveyance efficiency. Detailed guidelines on design and use of UGPL were issued by MoWR, RD &	The use of underground pipelines (UGPL) needs to be enhanced across more projects wherever feasible.

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				GR and Central Water Commission during July 2017.	
Access	Low Irrigation coverage status	AIBP	AIBP	Out of the Ultimate Irrigation Potential (UIP) of 76 lakh ha of the 99 Priority AIBP projects, 41 lakh ha was created as on March 2016; while out of the balance 35 lakh ha, around 21 lakh ha (i.e. 62% of the balance) have been created during 2016-2020	a. Mitigation of seepage losses through lining of canals b. Regulation of water flow through canal automation c. Shift from open canals to piped irrigation network to contain conveyance losses and unauthorized withdrawal d. Implementing agencies are suggested to critically explore the possibility of inclusion of lift irrigation proposals (particularly in project areas with high incidences of lifting) in the main irrigation system in their initial proposal. A national guideline in this aspect may be prepared to

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
					specify the eligibility criteria and other norms All the above efforts are expected to result in conveyance efficiency and irrigation coverage
		CADWM	CADWM	One of the outcome indicators for CADWM is creation of additional irrigation potential in 0.5 lakh ha as per Output Outcome framework - no data available in terms of achievement	a. Pro-active regulation of water flow by WUAs b. Increase in water efficiency by ensuring lining of water courses and expeditious adoption of MI in 10% of command area through convergence with PDMC b. Increase awareness and crop planning particularly in head reaches with assistance from empanelled social facilitators and effective co-

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
					ordination with agriculture department
		RRR	RRR	Irrigation potential of 0.99 lakh ha (i.e. 53% of target) has been created, as of March 2020.	RRR should be finalised in rainfed farm holding and most irrigation deprived districts.
		SMI	SMI	Scheme objectives and components are not mentioned for SMI. 5,838 SMI schemes with total irrigation potential of 10.5 lakh ha. have been taken up. Till March 2020- 3,354 schemes have been completed and an estimated irrigation potential of 6.77 lakh ha i.e. 64% of the targeted potential has been created.	The scheme design needs to be sequential in nature. Provisioning of conveyance system through creation of diversion structures like weirs should be considered only after there is adequate facility for water storage in the upstream.
		GWI	GWI	Groundwater irrigation conveys water more effectively to the	Govt. should encourage the states to adopt this scheme,

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				farms as it targets smaller area as compared to the major or medium irrigation schemes. So, the scheme is supposed to enhance irrigation productivity, thus reducing gap in irrigation coverage. Scheme is operational in Assam and Arunachal Pradesh since May 2019. Irrigation potential creation has been 14,216 ha (74% of target) and 1,072 ha (60% of target) respectively in Assam and Arunachal Pradesh.	wherever the project area qualifies the eligibility criteria as mandated in the scheme guidelines, for utilizing the available groundwater resources in sustainable way.
		SPFM	SPFM	Irrigation potential creation from 2018-19 to 2019-20 is around 90,410 ha (24% of target) under this scheme.	Recommendation will be like that of AIBP and SMI scheme since this scheme involves 83 SMI and 8 MMI projects

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
		PDMC	PDMC	This micro-irrigation scheme has enhanced irrigation productivity by 30% to 70%. Thus, the scheme has reduced gap in irrigation coverage	In 2004, the Task Force on Micro-irrigation (MI) had estimated a potential of 69 mha for micro-irrigation. Out of this, only 12.6 mha was covered till March 2020. Since MI is highly capable of increasing irrigation productivity, adoption of MI system should be encouraged
Sustainability	High Dependency on groundwater for irrigation	AIBP	AIBP	Objective of scheme is to expedite completion of selected AIBP projects - access to assured irrigation (however owing to shift towards high water intensive crops and increase in groundwater level owing to canal water, farmers are resorting to groundwater in	a. Expedite completion of branch canals to ensure reliability of water supply at outlets b. Ensure conjunctive use of surface and groundwater through construction of tanks/ decentralized storages at chak levels to act as buffer during dry and / rabi season(s). As

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				command area to supplement the canal water)	suggested in PIRC meetings, the MI funds under CADWM scheme may be utilized to facilitate conjunctive use of groundwater in places with 'safe' groundwater level
		RRR	RRR	Though objectives of RRR include groundwater recharge and conjunctive use of surface and groundwater; continued dependence on individual beneficiary-oriented groundwater-based structure has been observed in parts of Bihar, Telangana, Madhya Pradesh and Rajasthan due to quick creation, easy access to electricity and year-round assured water supply.	Conjunctive use of surface and groundwater resources may be ensured through participatory planning by the WUAs and Gram Panchayats.

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
		WDC	WDC	As per stakeholders given the prolonged availability of surface water in the monsoon, pressure on groundwater extraction has come down during this period. Groundwater is used mainly in the rabi season when surface water is scantly available. DoLR has issued advisories to the States, SLNA and Agriculture Ministry to ensure convergence with the scheme Per Drop More Crop (PDMC) to enhance water use efficiency.	The department needs to further promote the use of drip and sprinkler irrigation with water-saving crops for optimisation of water use efficiency. There is a need to promote convergence with schemes like Per Drop More Crop to enhance water use efficiency.
Sustainability	Cropping pattern and crop diversification	CADWM	CADWM	Non-structural interventions include trials and trainings by regional agricultural institutes	Strict implementation of the non-structural interventions like appointment of social facilitators, monitoring of its performances

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
		SPFM	SPFM	Maharashtra has adopted an approach called 'Volumetric Supply of Water' to manage sustainable water sources without curbing farmers' freedom of crop selection. In this approach, farmers are informed the amount of water they will receive in a period so that they can plan cropping pattern based on availability of water. Also, they are educated to save water during rabi season in order to compensate the water requirement of hot season	Participatory Irrigation Management (PIM) should be strengthened so that water use by farmers can be effectively monitored by the WUAs
		PDMC	PDMC	MI is used for water intensive crops, such as sugarcane, cotton, banana etc. across many states	MI system has very high-water use efficiency (80-90%). Hence, using MI for water intensive crops can

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
					reduce risks of water scarcity and become a sustainable solution for these crops. Therefore, extensive awareness should be created among farmers regarding benefits of MI adoption for water intensive crops
		WDC	WDC	Impact evaluation studies show that : Cropping intensity has gone up in intervention watershed over pre-project level. The area under horticulture crops have also gone up. Crop production has risen.	There is need to promote climate resilient cropping patterns. It is also required to avoid water intensive cropping pattern in these areas.
Water Security	Low Agriculture water use efficiency	CADWM	CADWM	Mandatory coverage of 10% CCA with micro-irrigation structures - only 3.1% of target has been achieved	a. Merging with 'Other Interventions' component under PDMC scheme to streamline the government

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
					subsidy flow for MI equipment and increased awareness generation by horticulture departments b. To ensure sustainability of the MI infrastructure during dry/ Rabi seasons, conjunctive use of groundwater through bore wells/ tube wells may be facilitated utilizing the funds earmarked for MI
		PDMC	PDMC	Micro-irrigation system has increased water use efficiency in the range of 30% to 100% across various states	There is an untapped potential of around 56.4 mha for MI in India. Hence, Govt. should enhance focus on MI through several measures including IEC activities, institutional strengthening etc.
		WDC	WDC	DoLR has issued advisories to the States, SLNA and	The department needs to further promote the use of

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				Agriculture Ministry to ensure convergence with the scheme Per Drop More Crop (PDMC) to enhance water use efficiency.	drip and sprinkler irrigation with water-saving crops for optimisation of water use efficiency.
Sustainability	O&M and financing deficiencies	AIBP	AIBP	No separate provisions for O&M; some ERM projects are financed through 99 AIBP Mostly state govts bear the O&M cost; collection of irrigation fees across states is limited 99 Priority AIBP projects is partly financed through NABARD loans at cheaper interest (under LTIF)	Explore Release of central grants to states for non-establishment component of maintenance expenditure. Additional incentives may be provided to states that have adopted various water sector reforms like increase in state maintenance budget, setting up water resources regulatory authority etc.

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
		CADWM	CADWM	O&M of assets below outlets is the sole responsibility of the WUAs	a. Ensure effective functioning of the WUAs through proper hand-holding and delegation of authority like fees collection b. States may be incentivized to share a substantial portion (say >50%) of the irrigation fees collected with the WUAs by enacting amendment in their respective PIM acts
		WDC	WDC	There is need for sensitization of the local community with proper handholding for appropriate maintenance of assets during the O&M phase.	There is a need for appropriate guidelines to ensure the utilization of Watershed Development Fund (WDF) for maintenance of assets during

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				Watershed Development Fund that is being generated through the Watershed Programs is on occasions not sufficiently utilised to manage, repair and maintain assets being created under the project.	the O&M period. Guidelines issued by Karnataka can be treated as model guidelines and can be modified by states as per their requirement. This is essential for the sustainability of watershed projects. There is a need for raising awareness of the local community with proper handholding for proper maintenance of assets during the O&M phase.

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
		RRR	RRR	The scheme guidelines mention WUAs to charge for its services and build up corpus for maintenance and management of water bodies. However, there are no details on its implementation structure and unavailability of funds for O&M has been cited as a major threat to scheme sustainability across Andhra Pradesh, Manipur, Meghalaya, Rajasthan and Telangana.	Revenue generation mechanism for WUA needs to be defined. Use of water bodies for economic benefits through activities like fisheries may be encouraged to inculcate feeling of ownership within the community.
		SMI	SMI	Though the guidelines mention O&M to be done by WUAs, states face challenges in this regard. Irrigation department has to intervene in states like Bihar, Meghalaya and	Roles and responsibilities of WUA, along with mechanism for revenue generation needs to be defined.

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				Uttarakhand since WUAs are technically and financially unequipped to take care of the maintenance work. Though water is a state subject, all states have pointed out inadequacy of funds for O&M as a major constraint.	Support from local NGOs/CSR may be taken for capacity building of WUAs towards overall management; including water availability assessment, water auditing and O&M.
		NRCP	O&M of created STPs along the river	O&M is currently being carried out by appointment of contractor in some cases and funded by state govt. But due to lack of funds for O&M activities and lack of skilled manpower, many created assets are not operating at full capacity and few are defunct.	State govt. needs revenue generation mechanisms for the O&M phase such as selling treated wastewater to industries, nearby thermal power plants, for irrigation purposes, beautification and gardening etc.

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				This often causes some untreated sewage to flow into the river bodies thus polluting the river water.	PPP model (HAM) as used in NMCG may be explored, where the concessionaire will be responsible both for construction and O&M for at least 5-10 year period.
Overall nature and responsiveness of Water sector planning	Need for better Planning and data management in the sector	Irrigation Census	Irrigation Census	Irrigation Census is conducted quinquennially which collects enormous quantum of data on Minor Irrigation Schemes and their performances. Based on MI Census data, Atal Bhujal Yojana was framed. At State and District level, new proposals for Minor Irrigation schemes are prepared based on MI census data and its analyses	Despite the fact that State level planning is done based on MI census data but the village level wise data should be used for participatory planning of Minor Irrigation involving the farmers and MI scheme owners.
		FMBAP	FMBAP	Although substantial measures has been undertaken in	Need to have performance database at State and Scheme

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				FMBAP both for Structural and non-Structural measures, but, physical and financial progress data are not obtained from the States on regular basis. As a result of which database on performance of the measures is lacking. Apart from Bihar and Uttar Pradesh, no comprehensive MIS is seen in any state which provides information on the nature and historical data of damages, status of structural measures (both completed and ongoing), hydrological and flood forecasting information.	level at least at Regional level i.e., at the level of CWC, GFCC & Brahmaputra Board. A dashboard containing the above-mentioned data need to be in place. Online database and dashboards depicting the details of the flood affected areas and the community residing therein, environmental status, details of the FMBAP as well as state sponsored schemes, their status, best practices, etc. may be considered, which will help in addressing cross sectional issues with respect to socio-economic and

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
					environmental features of flood affected areas.
Quality	Wastewater reuse & pollution abatement measures	NRCP	Creation of STPs along banks of polluted river stretches	There has definitely been improvement in the river water quality in the polluted river stretches due to the interventions under the NRCP schemed	Efficient design of STPs for treatment of both domestic and industrial sewage and adoption of latest technologies can lead to more efficient pollution abatement in the rivers. Additionally, one can explore performance-based contract where discharge parameters are clearly specified as per extant norms and private partner has to comply to such norms during entire lifecycle of the project.
Sustainability	Climate Change	WDC	WDC	In present times many extreme climatic events because of climate change are being	The design principles of watershed projects, especially production system, needs to

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				observed, climate change resilience has not been brought into the watershed scheme design.	be modified to embed resilience to risks posed by climate change. Necessary training to develop awareness and capacity in this regard should be planned.
		FMBAP	FMBAP	Improving climate literacy and promoting decentralised action for adaptation and mitigation are critical for building climate change resilience. While the floods cannot be exclusively attributed to climate change impact, climate change predictions do indeed forecast increases in rainfall intensity in the years to come. Furthermore, coastal areas are prone to waterlogging and flooding due to increased water	Requisite IEC and capacity building measures need to be planned within the ambit of FMBAP, wherein the community and population at large need to be educated on environmental protection measures and the impact of environmental degradation on flood. Also post disaster environmental assessment should be made part of the impact and concurrent evaluations currently

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				inflow as well as sea level rise. Alongside DPRs, not much corroborations are evident which focuses on improving climate literacy and promoting decentralised action for adaptation and mitigation are critical for building climate change resilience. In addition, the KIIs did not reveal that any post disaster environmental assessment has been done that addressed the underlying problems of environmental degradation and abuse that exacerbated the impact of the floods.	performed by third party institutions like IITs and NITs across the states.
Water Security	Using recycled water for agriculture	PDMC	PDMC	Government of India promotes the use of treated wastewater for MI. Micro-irrigation Fund	Further research is required in India for successful use of recycled wastewater in

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				(MIF) scheme started in 2017 encourages innovative MI projects including reuse of treated wastewater. In Karnataka, recycled wastewater is being used for vegetable cultivation at Kolar district. There are 2-3 pilot projects underway in Tamil Nadu as well	agriculture using MI. There is a risk that it might add harmful metals to the food chain, which might create genetic or mental disorder. Hence, it should be encouraged after thorough research
		NRCP	Treated wastewater used by farmers for irrigation	In some states such as Punjab, farmers are being encouraged to use treated wastewater for agriculture.	Should be included under wastewater reuse policy of the state water supply and sewerage board
Gaps in broad sectoral outcomes	Capacity building of the organisations/utilities creating and managing Water	CADWM	CADWM	Non-structural interventions encapsulate empanelment of social facilitators/ NGOs for handholding the WUAs -	Strict implementation of this component through mechanisms like linking release of CA for 2nd instalment with the

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
	Resources infrastructure and providing service			performance quite poor in these components	empanelment of social facilitators and their performance
		SPFM	SPFM	It is difficult for the govt. to manage the irrigation assets over entire lifetime. WUAs should be accountable for that. However, WUAs are currently not able to manage the assets effectively due to lack of knowledge. Therefore, training and capacity building activities should be enhanced.	Local NGOs or private organizations can be involved for training and capacity building activities
		PDMC	PDMC	Most of the states are running awareness creation and capacity building activities to demonstrate the benefits of MI, educate the farmers about how to use MI, perform maintenance activity etc.	• Govt. may mandate to enhance involvement of MI companies, educational institutes, KVKs for increasing scale of awareness campaign & capacity building activities.

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				through various mediums such as radio broadcasting (Akashvani), TV advertising (Doordarshan), wall painting, leaflet distribution, exposure visits, demo of best practices over workshops, user manual of MI system etc. along with the empanelled MI companies, educational institutes and Krishi Vigyan Kendra (KVK). However, the need to rapidly scale up such activities with a view to improve adoption rates has widely been acknowledged among stakeholders.	• Digital media platform (e.g. YouTube, Facebook) can be explored. This can increase the reach while reducing cost of the activities. e.g. Andhra Pradesh has started such activities through displaying small videos, audio-visual sessions (e.g. installation, maintenance, benefit of MI etc.) at village level kiosks of Rythu Bharosa Kendra (RBK). • Govt. may consider separate allocation for such activities which are currently expended from 5% fund allocated for admin expenses.

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
		Irrigation Census	Irrigation Census	Intensive trainings on technical aspects of Irrigation Census are imparted to officials at national level, State level and District level, where supervisors and enumerators are trained . However, socio-economic parameters like migration, livelihood, cost-benefit analysis, ability to spend on education and health etc. also need to be collated and analysed.	Evaluation studies on the socio-economic aspects of farmers using MI sources and MI Scheme owners should be conducted. An evaluation of such nature will provide a better picture.
		FMBAP	FMBAP	Trainings on techno-economic feasibility are imparted to officials of State Nodal Department by the Monitoring Agencies i.e., CWC, GFCC & BB. However, training on socio-economic parameters like	Social Welfare department may be coordinated with for assessing the socio-economic parameters as a result of structural and non-structural measures. Social development

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				community organization, gender involvement, migration, livelihood development etc. is lacking. Thus, all DPRs / Flood Management Proposals solely focus on techno-economic aspects of structural measures	organizations / NGOs may also be invited on regular basis to assess environmental issues and their bearing on flood, mitigating social issues like migration, livelihood , health etc.
Convergence	Scheme convergence	CADWM	MI component	CADWM guidelines mandate adoption of MI structures in 10% of the command area. However, as on date only 3% of the total target under MI has been met	To increase awareness among cultivators and ensure faster access to subsidy for drips and sprinklers under PDMC scheme, transfer of MI component to 'Other Interventions' component under PDMC scheme, which has similar provisions, is suggested
		CADWM	Structural interventions –	Convergence with MGNREGA for construction of water courses was found to be	Detailing out the CADWM components which can be carried out while satisfying

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
			construction of water courses	minimal owing to 50-50 material-labour component provision under MGNREGA which does not support the high material component needed under CADWM works	the 50-50 material-labour component of MGNREGA or by allowing certain material intensive CADWM works like construction of lined field channels using MGNREGA funds. A notable example of implementation of such convergence is the work done by the Madhya Pradesh in Dhar district under *Sahastradhara* scheme
		PDMC	PDMC	Convergence with other schemes, such as MGNREGA, PMKSY-WDC, is not happening effectively across most states (except Punjab, Maharashtra, Jharkhand). State level stakeholders have mentioned that it is mainly due to	Convergence with other schemes, such as MGNREGA, PMKSY-WDC to be strengthened and guidelines to allow water source created under such schemes can be linked to MI system. This will help in

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				coordination issues between departments responsible for implementing various schemes	saving funds spent on OI component
		WDC	WDC	It is pertinent to mention here that, as per the available information with DoLR, about 19% of the expenditure in the watershed project areas has been mobilized through convergence with the other relevant schemes. DoLR has been taking measured to guide states to effective convergence however states have been found wanting in this respect. Some states have not yet created an institutional	As per DoLR, the States should expedite the implementation and completion of projects on priority by optimal utilization of available funds and mobilizing funds through convergence with schemes of similar nature like MGNREGA etc. There is also a need to ensure convergence with MGNREGA for the maintenance of the built structures. DoLR has been taking measured to guide states to

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				arrangement at the field level for effective convergence. Few states, namely Andhra Pradesh, Karnataka, Telangana, Tamil Nadu and Bihar had shown good progress but states like Uttar Pradesh, West Bengal, Madhya Pradesh and North Eastern states have been lagging.	effective convergence by issuing various advisories. Convergence should be brought in at the planning phase of the project and not in the implementation phase. Moreover, as suggested by the Parliamentary Standing Committee on Rural Development a dedicated institutional mechanism should be created to facilitate convergence in states. There is a need for ensuring involvement at Chief Secretary level for departments to take convergence seriously and regular meetings should be held to oversee the

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
					convergence work on a rolling basis.
		NRCP	Convergence with AMRUT and funding from IFIs	Due to lack of funds, in some projects, the projects are being implemented along with AMRUT and also funded by IFIs such as JICA	Proper convergence mechanism is required to be able to identify convergence opportunities
Gaps in broad sectoral outcomes	Financing in the sector	AIBP and CADWM	LTIF (loan servicing through NABARD)	Initial fund shortage by states addressed now with loans at subsidized rates from NABARD (under LTIF scheme). However, funds disbursed to the tune of Rs. 1,847 Cr. is reported to be lying unutilized in 6 states; with 3 projects contributing to around 67% of the unutilized funds	i. Guidelines may be developed to disburse the funds to states in several tranches (instead of a single lump sum) based on utilization of previous tranche; however in such cases adequate provisions need to be built in so as to streamline the procedure between proposal/ application (by state) and

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
					release of funds (from NABARD) to avoid any inadvertent delays ii. In case of funds lying unspent in a particular project for more than a defined time period, the amount should be returned to NWDA/ NABARD who may then disburse it to another PMKSY-AIBP project in that or other states
Gaps in broad sectoral outcomes	Project Management issues and Slow project execution	AIBP	AIBP	a. Delay due to land acquisition and R&R issues b. Inability of states to match state budget c. Delay in transfer of funds from states to implementing	a. R&R - creation of separate R&R wing under water resources department to expedite resolving R&R issues b. Land acquisition- task force

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				agencies affected contractor mobilization d. Inability of contractors to simultaneously mobilize resources across different projects (particularly to address the critical paths)	involving different departments to be created who should meet monthly to resolve inter-departmental clearance issues c. Direct transfer of fund in case of states prone to delay in transfer of funds to implementing agencies d. Development of a contractor management tool at national level for earlier detection of bottlenecks and critical paths
		SPFM	SPFM	As per cabinet note, 69 SMI and 2 MMI projects should have been completed by June 2020. However, only 18 SMI projects have been completed so far. Many projects are	• Periodic review meeting among high level officials (e.g. secretary) • Central level monitoring to expedite clearances

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				delayed because of issues related to land acquisition, R&R, etc.	• Separate agency for managing rehabilitation and resettlement related activities • Local NGOs to be involved to educate PAPs about project benefits
		WDC	WDC	The key reasons for delay in project execution is delay in release of funds. The key factors for which this delay is caused is as follows: • States often delay in the release of their matching share making it very difficult to complete the projects on time. • Delayed, staggered and inadequate release of funds by GOI has resulted in stretching the project beyond the	• States should take necessary measures to release their contribution to watershed projects on time to ensure speedy completion of projects. Further, timely release of funds from the Centre is important in this regard. In case of absence of proper documentation or deficiencies in the proposals, such delays are caused. Therefore, proper capacity

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				proposed timeline. In case of absence of proper documentation or deficiencies in the proposals, such delays are caused. Therefore, proper capacity building should be done at the state level to ensure proper documentation and formalities such that these delays can be avoided. • Watershed Committees within the district do not complete the works in time and therefore are unable to utilize the available funds as per the schedule leading to delay in receipt of share from the Central Government.	building should be done at the state level to ensure proper documentation and formalities such that these delays can be avoided. • Progress on works being undertaken by Watershed Committees (WC) needs to be monitored closely to ensure they adhere to the agreed schedule. Further, WC should submit the utilisation certificate on time to avoid any delay in the release of funds from the Central Government. SLNA and PIA should build the capacity and guide WC to identify and tackle the issues causing

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
					delay and address them from time to time.
Gaps in broad sectoral outcomes	R&D in the sector	PDMC	PDMC	Currently, there are no R&D activities happening for this scheme. Also, there is no fund allocated for R&D activities	R&D on development of low-cost MI technology is required given the focus of the scheme is on small and marginal farmers. Low-cost technology can be expected to significantly improve the adoption rates since the target beneficiary group may be unable to adopt MI technology on account of high investment required of them. This will reduce the financial burden on states. There are other areas (such as - use of MI system for high density crop cultivation, cost-

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
					effective and durable underground piping system etc.) which warrant requirement of R&D. Therefore, Govt. should allocate separate fund dedicated for R&D activities
		WDC	WDC	• There is no dedicated fund allocation for research and development under the guidelines. • Government of India has come out with a flexi-fund scheme to carry out state-specific innovations w.r.t watershed development. The guidelines for the same have been issued by the Finance Ministry. • Earlier the amount earmarked	

Sectoral objective	Major issues	Relevant CSS scheme	Scheme component	Component Performance	Way Forward Recommendations
				for innovation was 10 per cent of the budget. Recently it has been revised up to 25 per cent.	

3.2 Recommendations at Sectoral Level

The detailed recommendations for the water resources sector is provided earlier. The table below summarises the key issues and corresponding recommendations at sectoral level.

Table 148: Recommendations – Sectoral level

Sl.no	Recommendations
Supply Side	
1.	**Issue**: Low total water storage capacity leads to inadequate buffer stock during periods of droughts, summer months as well as high run-off of surface water into sea **Solution**: • Focus on creating additional decentralised storage structures across the country on large scale at village levels. Existing village ponds to be rejuvenated, desilted and/or expanded. • A large-scale initiative on de-siltation of all existing major and medium irrigation reservoirs may be initiated. Further the silt recovered may be provided to farmers/WUAs for improving fertility of their agricultural fields and the sand can be used for construction works. Alternatively, dredging of accumulated silt may also be attempted for very large dams. Extensive catchment area treatment should also be undertaken for all reservoirs to avoid silt deposition. • A feasibility study to increase the existing height of the reservoirs may be taken up in a systematic manner. If feasible the height of the reservoirs may be increased • Going forward, since the focus should remain on small decentralised storage structures, a robust census of Minor Irrigation and other such small storage structures created is of utmost importance • State WRDs must have dedicated budget (including pre-planned O&M schedule) for operations and maintenance of the dams to address the existing O&M issues

Sl.no	Recommendations
	• Integrated operations and monitoring system of dams may be introduced to maximize water storage capacity of dams on the same river, especially during the monsoon season through integrated operations • Using select groundwater storage aquifers for storage of water may also be explored. With increased knowledge on aquifers and improved recharge techniques, Mega-scale Artificial Recharge Schemes may be implemented after conducting detailed feasibility study for the same. Such schemes can create large underground storage in suitable geological areas, without acquiring land as well as with no threat of evaporation loss (as in surface water reservoirs).
2.	**Issue:** Spatial variance in surface water availability leads to unequal distribution and availability **Solution:** • Pace of implementation of river interlinking projects may be increased by: o Prioritizing intra-state river inter-linking projects as these may be quick wins due to less political interventions o Promoting its environmental sustainability through workshops for better acceptability o Empower a central agency, either the Central Government (Ministry of Jal Shakti) or a Central Regulatory Authority may be formed to act as a referee in case of disputes. o Alternatively, for better coordination among the states, river basin authorities- may be created as special bodies with representatives from all participating States. The above should also help in better management of water sharing treaties and disputes. • Lift Irrigation (LI) projects can also be promoted with alternative innovative financing options like PPPs (Hybrid Annuity Model). Use of solar power as a source can also be promoted.
3.	**Issue:** Unregulated extraction of GW has led to decrease in percentage safe groundwater units and inadequate GWL monitoring wells **Solution:**

Sl.no	Recommendations
	• States should be encouraged to adopt the Groundwater (Sustainable Management) Bill, 2017, after suitable customizations. Focus on decentralised and participatory enforcement of GW related regulations through WUAs and similar grassroot level organisations. • Remote and real-time telemetry-based water sensors may be installed across states for accurate and updated GWL data. Rain gauges may also be installed for accurate data on rainfall. Modelling and analysis of real-time GWL and rainfall data to track extraction of GW. • Participatory GWL Monitoring may also be undertaken by involving SHGs, WUAs or volunteers who may be trained to monitor GWL at GP level. The same may be shared with the State level GW authorities by phone or through an application on a regular basis. • Implement real-time telemetry-based meters for GWL measurement to monitor GW extraction through bore wells • Additional analysis using satellite data (such as NASA's Gravity Recovery and Climate Experiment) of groundwater level changes may also be undertaken at regular intervals to measure seasonal changes in groundwater levels
4.	**Issue:** Inadequate micro level information of depleted aquifers **Solution:** • Water budgeting at GP level may be carried out by using micro level (at least GP) information. Such water budgeting document can be used to prepare a GP-wise water security plan • GP level rainwater and GWL recording can be used to understand the extent of natural recharge of the aquifer and therefore plan for artificial GW recharge initiatives • Attempts may be made to digitize GWL data and integration of data from all GWL recorders (under the NHP or NWIC) and use advanced mathematical techniques like artificial algorithms to check the quality of the data sets. Thereafter, the existing data may be used for analysis and planning of GW recharge initiatives. CGWB may collaborate with IITs and NITs to undertake research on the GWL data collected.
Demand Side- Irrigation	

Sl.no	Recommendations
5.	**Issue:** There is a large gap between IPC and IPU **Solution:** • Standard guidelines and methodology should be developed for assessing the IPC and IPU • For monitoring IPU effectively, remote sensing may be used for real-time data on cropping. • Completion of distributary networks, field channels, lining of canals and adequate O&M of the existing canals need to be undertaken. The MoJS may plan for incentivising the states in the form of additional subsidy/central funds, based on reduction of IPC-IPU gap.
6.	**Issue:** Low irrigation coverage and low agricultural productivity **Solution:** • The existing Irrigation Census may be further strengthened by introducing community participation and support from WUAs initiatives and technology to collect this data. • Creation of additional small and decentralised storage structures under PMKSY/MGNREGA • Rainwater harvesting at village level may be further encouraged for increasing the coverage of irrigation in convergence with the recently launched Jal Shakti Abhiyan (JSA) • Artificial GW recharge initiatives in select water scarce zones • River Interlinking projects and Lift Irrigation projects will also increase irrigation coverage.
7.	**Issue:** High dependency on groundwater for irrigation **Solution:**

Sl.no	Recommendations
	• Regulating the supply of electricity supplied for GW pumping and limiting it to a few hours • Fixing ceilings for water/ power used per hectare and thereafter providing cash incentives to farmers in the form of DBT corresponding to the quota in convergence with PM-KISAN • Provide power subsidy in the form of DBT only to targeted farmers; subsidy may be provided to farmers practicing micro-irrigation or cultivating water efficient crops only. • Measure the quantum of power and water for each connection; this may have an impact on the farmers psychology who in turn may reduce water abstraction and wastage
8.	**Issue:** Low irrigation efficiency **Solution:** • Incentivize introduction of piped irrigation networks (PIN) for new irrigation projects; use of solar power as a source can also be promoted in convergence with the various GoI schemes • Lining of old canals based on detailed condition assessment studies may also be taken up on a large scale to increase the irrigation efficiency. A detailed feasibility study including cost benefit analysis to determine impact of reduction of seepage on groundwater level may be conducted before undertaking such projects.
9.	**Issue:** Cropping pattern bias towards water intensive crops **Solution:** • In the long term, less water intensive crops (like ragi, jowar, bajra) may be promoted by promoting nutritional security and therefore through change in mindset and food habits. • Promotion and strengthening of E- platforms (like e-NAM) for wider awareness and acceptance among the farmer community. • Introducing MSP for less water intensive crops and undertake actual procurement. • Strong market integration for offtake of agricultural produce and remunerative crop price must be ensured to promote MI adoption and avoid slip backs • Adopting the concept of crop colonies as part of the regulated farming.

Sl.no	Recommendations
	• By using water quota as a tool, crop planning, water budgeting and crop rotation policy may be implemented at WUA level. • In addition to individual farmer-based beneficiary model, basin-centric approach for widespread implementation of MI initiatives in a specific area may be undertaken in a time bound manner
Demand Side- Industrial	
10.	**Issue:** Low water use efficiency and pricing of water for industries **Solution:** • Promote water efficient processes across all water intensive industries. Appropriate tariff and mandatory reuse of treated wastewater; especially in regions of water scarcity.
Demand Side- Domestic	
11.	**Issue:** Low water use efficiency and pricing of water for domestic sector **Solution:** • Encourage water savings by metering of water supply and levying appropriate tariff rates. Intermediate tariff (until meters are installed) based on Built Up Area (BUA) of the property. • Ring fencing of water revenue collected by ULBs should be made mandatory to ensure financial sustainability. ULBs may be mandated to have sub-budgets for water supply
12.	**Issue:** Inadequate O&M and financing of drinking water schemes **Solution:** • O&M of common infrastructure may be handed over to a private/ professional agency. Inside ULB area – ULBs to take responsibility for O&M of distribution network • Water Audit for ULBs may be made mandatory and audit reports to be put on public domain. • Extensive capacity building for ULB officials to enable them to undertake efficient O&M
Wastewater	

Sl.no	Recommendations
13.	**Issue:** Need for wastewater treatment and wastewater reuse **Solution:** • State level action plan may be prepared to identify STP requirements and mapping of the same with the possible demand centers in the state (industrial clusters, agriculture etc.). • In line with NMCG, similar missions for creation of STPs for other major rivers • Wastewater treatment for rural and semi-urban areas through modular and decentralized wastewater treatment plants may be explored • Reuse of wastewater may be included in the old NRCP or NMCG schemes. • For fast adoption, reuse projects in water scarcity areas may be taken up on priority • Further formalization and promotion of use of recycled water for agriculture through capacity building and IEC activities for farmers • Wastewater reuse roadmap may be prepared and extended to industrial and domestic sectors- gradually mandating reuse targets for industries as well as for large cities (starting with large commercial SEZs and housing complexes)
Broad Sectoral outcomes	
14.	**Issue:** Low agriculture water use efficiency **Solution:** • Micro-irrigation to be adopted in larger scale and removal of blanket subsidy on power for irrigation. MI guidelines need to be crop specific and tailored based on climatic/ soil conditions. This will allow farmers to get better subsidy; maintain better land productivity
15.	**Issue:** Inefficiency of GW management **Solution:** • It may be made mandatory by state GW authorities, for users to disclose GW related data including detailed drilling data of soil strata. Such information will be beneficial to create a profile of the area; GWL in the area can also be shared and be digitized.
16.	**Issue:** Absence of water regulator in all states **Solution:**

Sl.no	Recommendations
	• State level regulatory authority for water can monitor the progress of goals set in the state water policy and regulate the quantity of water for different category for users. It may be authorised to arbitrate on water related disputes. • Providing more subsidy on certain schemes (e.g. micro-irrigation / PDMC) to states where independent regulatory authority has been formed. • Provide a one-time grant to States whereby initiation fund may be provided for setting up an independent water regulatory authority in the state.
17.	**Issue:** Issues related to financing in the sector **Solution:** To improve financing in the sector, the following initiatives are suggested: • Mandatory formation of WUAs and assured service levels to beneficiaries (or strengthening where it exists) • Stronger outreach, including training and capacity building of the WUAs may be focused • Strengthening of the Irrigation Act • Online collection/local payment collection of irrigation fees through agents/WUAs • Linking of disbursal of agricultural loans/other govt. support to payment of irrigation fees • In case of Micro-irrigation projects – PPP initiatives may be explored • Alternative financing mechanisms like Outcome financing and Impact financing may be explored for financing of water sector related projects
Overall nature and responsiveness of Water sector	
18.	**Issue:** Issues related to planning and data management in the sector **Solution:** • Pooling and collection of existing data related to the water resources sector through state WRD (like APWRIMS); to include both water supply and use related data • In line with the NHP which aims to improve Supply side data availability, demand side data may also be collected from the various responsible agencies by designing a similar scheme. Moreover, when coverage of metering and monitoring

Sl.no	Recommendations
	infrastructure becomes more widespread, decentralized data collection from all demand centers (irrigation, domestic and industrial) may be attempted. Involvement and support from various associations like WUAs, civil societies, industry associations, etc. may be sought for this. • A separate scheme may be undertaken dedicated to water resources planning at state level. A comprehensive sector plan covering - water supply and demand for irrigation, industrial and domestic sector, water use efficiency etc. is required to be undertaken. • In Irrigation department at state level, three wings. (1) Construction and Design Wing- Focus on technical designs, asset creation and (2) Operations wing- Focus on O&M of existing assets, and other softer aspects like Community mobilization, and (3) Commercial Wing - focusing on commercial aspects like service fee collection, etc. A fixed percentage of the capital expenses budget for the department should be allocated for O&M. • Water entitlement for all category of users- domestic (bulk), industrial and irrigation may be implemented to promote water use efficiency. • In drinking water supply - bulk water production and transmission may be undertaken by a single entity (preferably Water Supply Authorities in case of Urban and ZPs in case of rural), whereas drinking water distribution related activities are conducted by a separate entity (preferably ULBs in case of Urban and GPs via VWSCs in case of rural).

3.3 Synthesis of Scheme/ Umbrella Level Recommendations

The summary recommendations for major issues identified at scheme level for the PMKSY, IC, NRCP and FMBAP schemes are listed in this section.

Table 149: AIBP– Recommendations

Sl.no	Recommendation
1.	**Issue:** Progress in almost all the ongoing MMI projects is marred by delays owing to land acquisition and R&R issues. **Recommendation:** Creation of an inter-departmental task force in every state (with on-going projects) who should meet on a month basis to fast-track clearances and creation of a separate R&R wing under each state water resources department to expedite resolutions of R&R issue specific to the projects
2.	**Issue:** The economic utility of the capital intensive MMI projects has been called to question many a times because of their unreliability in delivering the envisaged benefits to the end beneficiaries. One of the main causes is negligible maintenance of the assets over the period which stems from lack of accountability of the scheme-owners to the beneficiaries. **Recommendation:** Adopt a progressive shift from construction based to service-based approach. This may be attempted by adopting the following approaches: • Change in funding approach: The eligibility criteria for selection of MMI projects receiving central grants could be made more favourable for ERM of old projects. Measures like canal automation (as part of ERM projects) is expected to deliver twin benefits of higher state regulation of water resources and better service delivery to the end beneficiaries. • Improvement in maintenances: The central government may explore introducing a new scheme through which central grants may be released to states for (non-establishment component of) maintenance expenditure for the maintenance of selected MMI projects. Additional incentives may be provided to states that have adopted various water sector reforms like increase in state budget allocation for maintenances, setting up water resources regulatory authority, etc.

Sl.no	Recommendation
	• Change in organizational structure: The shift towards better service delivery and operation plan needs to be backed by change in current resource profile of the irrigation departments; resources from other disciplines like agro-economists, anthropologists/sociologists could be deployed along with those from engineering disciplines. Also, in view of the huge spread of irrigation projects, outsourcing of non-core works (like maintenance, revenue assessment and fees collection) to private agencies may be explored (as already being initiated by some states like Andhra Pradesh).
3.	**Issue:** Current distribution loss in irrigation systems in India (40% to 50%) is quite high compared to other countries like Philippines, Malaysia, Colombia, Egypt and others. **Recommendation:** Develop guidelines mandating state to explore feasibility of piped distribution networks in all branch and distributary networks for all new/ ongoing projects.
4.	**Issue:** Unabated water withdrawal particularly by cultivators at higher elevation or rim of the storage reservoirs **Recommendation:** The Ministry should explore options for introducing provisions for expanding command area by legalizing the lift irrigation schemes – a national guideline in this aspect may be prepared to specify the eligibility criteria and other norms. The implementing agencies should be encouraged to critically explore the possibility of inclusion of lift irrigation proposals (particularly in project areas with high incidences of lifting) in the main irrigation system in their initial proposal.
5.	**Issue:** Some of the outcome parameters as defined in the Ministry of Finance's 'Output Outcome Framework' are not tracked. Also, conduct of impact assessment studies was observed to be limited. **Recommendation:** Ensure transparency by conducting regular third party impact studies (under the Impact Assessment Studies scheme) along with holistic tracking of indicators (both output and outcome indicators) in MIS dashboard Standard guidelines may be developed for assessment of the parameters like IPC-IPU over the years, which should be followed by adequate dissemination of those guidelines to the relevant stakeholders and accordingly trainings of state personnel may be conducted to avoid disparities in methods of calculation across states. Creation

Sl.no	Recommendation
	of statistical cells at both central and state levels for reconciliation of project level data and use of remote sensing technologies (along the lines of Ministry's recent initiatives of remote crop assessment) may be explored to ensure timely update of IPC-IPU figures. Also, as short-term measures, linking the existing MIS dashboard with the CADWM MIS dashboard for IPU data and reconciliation of groundwater related data with state dashboards like APWRIMS/ monthly or quarterly reports by State Ground Water Boards are suggested.

Table 150: CADWM – Recommendations

Sl.no	Recommendation
1.	**Issue:** Limited involvement of WUAs at the time of project inception/ planning stage and also in stages thereafter, which is further complicated by laxity in implementation of non-structural components like appointment of social facilitators **Recommendation:** Prioritize implementation of non-structural components over structural ones. To ensure acceptability of the scheme among the cultivators and sustenance of the WUAs and scheme, the release of 2nd CA instalment (or some portion thereof) for structural interventions may be made subject to the completion of the following: registration of the WUAs, appointment of social facilitator for the project, conduct of specified trainings by social facilitators and release of the one-time infrastructural component (in those areas already catered by the 1st instalment). A national pool of social facilitators may be created by integrating similar agencies working across related sectors like watershed development, rural drinking water (under Jal Jeevan Mission), etc.
2.	**Issue:** Non-revision of cost-norms under structural interventions **Recommendation:** Revision of cost norms based on market prices and state's schedule of rates is suggested; formula for revising the base price of different cost components based on inflation indices should be developed
3.	**Issue:** Progress under micro-irrigation component has been minimal; major issues being lack of awareness, cultivator's unwillingness and unreliable water availability

Sl.no	Recommendation
	Recommendation: Explore scheme rationalization by transferring the micro-irrigation component to the Other Interventions component under the extant Per Drop More Crop Scheme (of MoA&FW) and ensure assured water supply round the year through adoption of conjunctive use of groundwater measures. Construction of tubewells/ bore wells under the MI component may be explored to ensure water availability in off seasons (say summer or Rabi season) in areas with adequate groundwater level.
4.	**Issue:** Deficiencies in MIS dashboard have been noted for some of the non-structural interventions. **Recommendation:** The ministry should ensure regular and proper update of MIS database. Linking of subsequent CA instalment releases with physical and financial progresses reflected in MIS may be explored. This should be supported by adequate hand-holding of state agencies through trainings by NIC and continuous monitoring and support by regional CWC offices
5.	**Issue:** Limited convergence with other government schemes **Recommendation:** Ministry should identify type of works under CADWM that may be covered in line with the 50:50 material – labour component mandated under MGNREGA Also, adequate consultations with MoA&FW are suggested to identify the extant agricultural subsidy schemes where WUAs could be registered as beneficiaries.

Table 151: RRR– Recommendations

Sl.no	Recommendation
1.	**Issue:** The current checklist for B-C ratio, takes only irrigation potential into account; despite the scheme having multiple other objectives like groundwater recharge and provisioning of drinking water. **Recommendation:** The checklist for calculation needs to be revised to include other factors like provisioning of drinking water, groundwater recharge, livelihood generation activities like pisciculture and other direct-indirect benefits of the scheme, including socio economic benefits.

Sl.no	Recommendation
2.	**Issue:** Output-outcome framework does not mention separate outcome for each scheme objective. **Recommendation:** There is a need to evolve format and procedures to carry out post project evaluation. The output- outcome framework and objective based outcomes should be tracked at RRR scheme. Additional indicators (mainly outcome based) corresponding to scheme objectives like groundwater recharge, agricultural productivity, improvement of catchment area of tank commands, capacity building, revenue generation from fisheries, tourism, domestic and industrial water supply may be tracked to understand holistic benefits accruing from the scheme.
3.	**Issue:** Erratic rainfall pattern poses a major risk to scheme sustainability, which is unaddressed under current scheme guidelines. **Recommendation:** To ensure sustainable irrigation management, power subsidies that favour indiscriminate abstraction of water resources should be reduced/removed and replaced by direct benefit transfer, as initiated by Telangana and Odisha. Scope of work under RRR may be enhanced to include percolation tanks. Additionally, waterbodies may be connected to adjacent canal system so that excess flood waters may be stored in these canals when water demand for irrigation is comparatively less. This would reduce the incidences of flooding while additional water stored may be gainfully utilized for irrigation and other allied purpose during dry season.
4.	**Issue:** Encroachment of water body limits scheme implementation and further contributes to adverse impacts like flash floods. **Recommendation:** Challenges like encroachments can be addressed through active involvement of WUAs since project inception. Encouraging the use of water body by the villagers for economic benefits like assured income generation activities may motivate villagers to protect them. A proportion of revenue generated through activities like fisheries, drinking water provision, agriculture undertaken in restored water bodies may be utilised by WUAs to generate funds for O&M.Additionally, a certificate may be issued by the Gram Panchayat before inclusion of water bodies under RRR instead of waiting till the release of second instalment.

Table 152: SMI– Recommendations

Sl.no	Recommendation
1.	**Issue:** High seepage and transmission losses in unlined canals constructed under SMI in few states. Such canals are more prone to siltation, waterlogging and damages. **Recommendation:** Replacing earthen canals with lined canals/ provisioning of pipe distribution network may be considered to improve water use efficiency. Canal lining may lead to increase in velocity and rugosity coefficient. Hence, the discharge carrying capacity of canal would increase, while seepage losses, water logging and maintenance cost would reduce. However, water losses from unlined canals and infiltration surplus of applied water has also been found to increase aquifer recharge. While canal lining augments the potential for groundwater development in some geographies; it contributes to issues like waterlogging and soil salinity in others. Hence, decision of canal lining and selection of lining material may be based on local aquifer characteristics likes soil permeability, watershed physiograpy and underlying climatic pattern.
2.	**Issue:** Temporary and permanent non-usage of the surface water schemes due to low discharge and drying up of water bodies. **Recommendation:** To ensure utility of SMI, the scheme design needs to be sequential in nature. Provisioning of conveyance system through creation of diversion structures like weirs should be considered only after there is adequate facility for water storage in the upstream. In this regard, the scheme could be operated in close coordination and convergence with RRR/other centrally/ state sponsored which includes component of creation/ restoration of surface water structures.
3.	**Issue:** Despite the vast amount of untreated wastewater generated by the country, which is expected to grow further, there are no provisions for wastewater reuse in SMI guidelines. **Recommendation**: Inclusion of wastewater resuse as a part of scheme guidelines would aid in creation of nutrient rich and reliable water supply for irrigation. Necessary studies in this regard may be undertaken to develop safety norms for use of treated wastewater in agriculture and from the perspective of public health.
4.	**Issue:** Envisaged aim/ output/ outcome/ impact are not mentioned in HKKP -SMI scheme guidelines**.**

Sl.no	Recommendation
	Recommendation: Other challenges like unclear scheme guidelines; increasing pressure on groundwater resources and lack of O&M provisioning may be addressed by making the scheme guidelines more comprehensive with well-defined output, outcome and impact indicators; provisioning of IEC-BCC activities to create awareness and financial strengthening of WUAs.

Table 153: PDMC – Recommendations

Sl.no	Recommendation
1.	**Issue**: In some states, separate departments are responsible for MI and OI components (e.g. Agriculture/ Horticulture department is responsible for MI and Watershed department is responsible for OI component). Hence, there is either less focus on water storage structure creation under OI component or such structures under OI are not effectively linked to MI systems and it hampers the progress of MI cultivation. **Recommendation**: A single department should be accountable for implementing the entire PDMC scheme (both MI as well as OI components) at state level. This will help to integrate the water sources created under OI components with MI systems effectively, which is currently not happening in effective way across many states due to presence of two different departments for managing these two components. This arrangement would help to achieve better progress of MI. Similar arrangement is observed in some states (e.g. Maharashtra, Tamil Nadu); where single department (i.e. Horticulture department) manages both the components and there is no such challenge in linking water sources under OI with MI systems.
2.	**Issue**: There is huge variance between market prices and cost norms per guidelines for the MI and OI components. **Recommendation**: Unit cost norms for material cost of MI system (such as drip, sprinkler etc.) and material and installation cost of OI components (construction of tube well/ bore well, water lifting devices, construction of community tanks/ farm ponds etc.) specified in the scheme guidelines should be revised so that base prices for all

Sl.no	Recommendation
	components reflect current market price. Then, base prices should be escalated annually using an appropriate index and escalation formula to take care of inflation.
3.	**Issue**: High initial investment required to be made by farmers, especially small and marginal farmers, for MI system is one of the factors constraining its wider adoption. Some states (e.g. Assam, Andhra Pradesh, Himachal Pradesh, Jharkhand, Maharashtra, Manipur, Punjab, Rajasthan) find difficult to arrange their share of funds including the additional top-up subsidy in timely manner that leads to project delay. **Recommendation**: Short-term solution: The scheme guideline may include provision for drip system with class I grade of laterals along with class II or class III which are currently mandated in the guideline for reducing the cost of drip system. In drip system, laterals account for around 65-70% cost of the entire drip system. Wall thickness of class II grade laterals of 16 mm dia. is 0.7 to 0.9 mm. Drip system with such class II grade laterals with 1.2 m spacing costs around Rs. 50,000 for 1-acre (~ 0.4 ha) land. Class I grade of laterals are also available in the market. It is used by the farmers who are not taking subsidy through this scheme. These laterals have wall thickness of 0.4-0.5 mm and rest of the specifications remain same. Drip system with class I grade laterals costs around Rs. 28,000 for 1-acre (~0.4 ha) land; thus, around 44% less cost as compared to class II (grade mandated in the guidelines). Hence, cost of drip system can be significantly reduced by using lower grade of laterals. Usage of thin walled lateral (0.4 mm wall thickness) is also observed in developed countries (such as US). However, there is caveat related to longevity. This class I grade laterals last for around 3 years whereas class II grade laterals last for 5-6 years. However, as per the key informants of the MI companies (e.g. Jain Irrigation, Netafim, Mahindra EPC etc.), there are many instances where farmers have used class I grade laterals for 6-7 years with proper maintenance. Similarly, as a short-term measure, cost of sprinkler system can be reduced by using plastic nozzle instead of metal nozzle.

Sl.no	Recommendation
	Long-term solution: R&D on development of low-cost MI technology may be explored given the focus of the scheme is on small and marginal farmers. Also, a separate allocation may be considered for such R&D activities. Govt. can collaborate with MI companies and the research institutes to find out other ways to reduce the cost of MI systems. Low-cost technology can be expected to significantly improve the adoption rates since the target beneficiary group may be unable to adopt MI technology on account of high investment required of them. If cost of MI system can be reduced, this will also reduce the subsidy requirement and thus, the financial burden on states.
4.	**Issue**: Many states (such as Bihar, Assam, Manipur etc.) have indicated fragmented landholding as an issue because more than 80-90% farmers are small and marginal in these states. The farm holding is as low as 0.1 acre. Since minimum area mentioned in the MI guideline is 0.4 ha (around 0.99 acre) and subsidy for farm size smaller than that is calculated on pro-rata basis, it leads to comparatively higher costs for MI systems in case of such smaller farms. For example, let's consider two farms - 0.4 acre and 0.2 acre. If all other factors remain same, the subsidy calculated for 0.2 acre will be half of that for 0.4 acre. However, the actual cost of MI implementation for 0.2 acre will not be half of that for 0.4 acre, instead it may be more than that because there are few fixed components (e.g. filter, venturi fertilizer injector assembly etc.) and costs of those components do not vary with the farm size (in case of such smaller farms). **Recommendation**: Farm holding of less than 0.4 ha and appropriate cost norms for such farms to be provided in the guidelines. This will help to increase MI adoption rate among the farmers having fragmented landholdings.
5.	**Issue**: Subsidy allocation is currently made based on SC/ST population in a state. Some states are unable to utilize the entire funding allocated for SC/ST farmers since their landholding is significantly lower compared to their population. **Recommendation**: SC/ST fund allocation should be determined based on their landholding instead of their concentration in the overall population in the state. This will reduce instances of unutilized funds allocated for SC/ST farmers.

Sl.no	Recommendation
	Issue: There is lack of awareness campaign, training sessions, capacity building programs, which are essential to improve MI adoption rates, across many states (e.g. Assam, Manipur, Bihar, Jharkhand, Punjab etc.). Additionally, some states (e.g. Maharashtra, Rajasthan, Tamil Nadu, Andhra Pradesh etc.) have reported that absence of dedicated allocation for these activities could be possible reason for inadequate training and capacity building across some states. **Recommendation**: A separate allocation of fund for IEC and capacity building may be made considering their importance in improving awareness and adoption of MI technology. This fund may be carved out of the 5% funding currently provided for administrative expenses. The guideline should lay down the specific objectives of IEC and capacity building, activities to be undertaken, how the outputs and outcomes of such activities will be tracked.
6.	Digital media should be adopted for awareness campaign, training program and capacity building activities. One innovative model could be awareness creation through social media platforms, such as Facebook, YouTube etc. Short 5-minute video (e.g. video for MI installation, system maintenance, Do's and Don'ts, crop wise cultivation using MI etc.) can be uploaded over such digital platforms. It will increase reach while reducing cost of awareness program and capacity building activities. For example, Andhra Pradesh has started such activities through displaying small videos, audio-visual sessions (e.g. installation, maintenance, benefit of MI etc.) at village level kiosks of Rythu Bharosa Kendra (RBK). Key Performance Indicators (KPI) for the services being offered by the MI companies can be defined and the MI companies can be incentivized/disincentivized based on KPI ratings. This may help to improve monitoring of the work undertaken by the MI companies.
7	**Issue**: Most states provide top-up subsidy over and above the stipulated limit (i.e. 55% for small and marginal farmers and 45% for others). However, some states (e.g. Assam, Andhra Pradesh, Himachal Pradesh, Jharkhand, Maharashtra, Manipur, Punjab, Rajasthan) find it difficult to arrange their share of funds including the additional subsidy in timely manner that leads to delay.

Sl.no	Recommendation
	Recommendation: Central Govt. may increase the central assistance by a certain percentage for small and marginal farmers and proportionately decrease it for general farmers considering the fact that the primary target is small and marginal farmers. It will help to reduce top-up subsidy provided by the states for small & marginal. State Govt. may reduce the top-up subsidy by a certain percentage for general farmers considering that they can afford the non-subsidy portion of MI cost. This will also reduce the overall funding requirements by the states.
8	**Issue**: PMKSY-PDMC MIS requires district wise and crop wise physical and financial progress data from the state and thus, the format is very lengthy. Apart from that, server issues are also there. Hence, many states find it very difficult to upload the data over the dashboard at regular interval as mandated in the scheme guidelines. **Recommendation**: PMKSY-PDMC MIS system at the central level may be integrated with the MIS system at the state level for the states which currently maintain separate MIS dashboard. This will help in seamless data flow without any lag. Also, this will reduce the effort made by the state officials for uploading district wise, crop wise data over the dashboard.

Table 154: WDC – Recommendations

Sl.no	Recommendation
1.	**Issue:** There is a need to ensure community participation in WDC projects. **Recommendation:** To ensure adequate community participation, there should be proper documentation of community oversight (digitized attendance registers, photo/video uploads of meetings with timestamps). Further, before and during project implementation, the project benefits should be properly disseminated, and awareness created. Social audit should be performed, and beneficiaries and stakeholders should be encouraged to report any deviation during project implementation.
2.	**Issue:** Lack of inter-departmental coordination is lacking leading to inefficiencies in project execution.

Sl.no	Recommendation
	Recommendation: The States should expedite the implementation and completion of projects by a dedicated institutional mechanism to handle watershed issues, remove bottlenecks, coordinate and undertake quick decision making at state level. In order to ensure convergence in project implementation, it is recommended that the responsibility of implementation at watershed level be entrusted with inter-departmental team/committee consisting of members from following line departments: • Agriculture Department • Panchayati Raj/Rural Development Department • Land Resource Department • Water Resources Department • Forest Department • PHE/RWSS Department
3.	**Issue:** Poor condition of the structures created under the scheme during O&M Phase **Recommendation:** In the O&M phase of watershed projects proper monitoring should be carried out and awareness should be created among the beneficiaries and handholding support should be provided after the implementation of the scheme to ensure proper maintenance of project assets by the beneficiaries. To enable capacity building at village level, a multi-level programme could be adopted: • State level officials to be trained by Central organizations (like NRAA) as Trainers • District level officials to be trained by trainers in State Level as grassroot trainers • Block and Village level stakeholders to be trained by the grassroot trainers Further, a booklet or guidebook could be created in multiple languages for knowledge dissemination and training of village level stakeholders. There should be additional dissemination through web portals and these training materials should be accessible by all.
4.	**Issue:** Lack of equity in watershed projects – between ridge and valley farmers, landless and landholding, farmers, various genders, etc. **Recommendation:** There are equity issues between upper reaches (Ridge) and lower reaches (Valley), which are inhabited by poor farmers and rich farmers respectively.

Sl.no	Recommendation
	Most of the harvesting structures are constructed in the valley. This can be mitigated to an extent by involvement of multiple departments as recommended. In addition to this, the scheme planning, and design should also ensure social equity – by ensuring involvement of and benefits to weaker sections including SC/ST, women, landless farmers, etc. This may be ensured by putting weightage on social equity at the time of selection of SHGs as well as selection and prioritization of projects. Further, there should be an added emphasis on livelihood component, which supports the poorer farmers/stakeholders in a watershed.
5.	**Issue:** Poor quality DPR leading to implementation challenges in watershed projects **Recommendation:** To improve the quality of DPRs and the overall scheme, the following could be adopted: • Each state creates a list of empanelled reputable consultants/agencies to prepare DPR. This could be based on some minimum technical and financial parameters set by the Centre for such consultants/agencies • Centre could publish guidelines for DPR preparation, which among other things emphasizes on extensive local consultations and a bottom-up approach • Centre could prepare a model DPR document, which could be used by states or agencies appointed by them in preparing DPRs • An automated IT based system for preparing DPRs could be created, which generates a DPR on input of technical information. • A national level PMU is formed for vetting and approving all DPRs for the scheme.

Table 155: Irrigation Census- Recommendations

Sl.no	Recommendations
1.	**Issue:** Manual enumeration of Village and Scheme level schedules, leading to errors and increase of time-lag. **Recommendation:** The enumeration process may be made "paperless" i.e., the schedules should be entered on a tab or similar equipment where all the fields will be entered electronically as practised in States like Andhra Pradesh. The data collection module should have in-built validation mechanism. This will help in reducing the time

Sl.no	Recommendations
	spent for field level validation. Hence data entry part will be taken care of during enumeration. The validated data will be ready for tabulation which is currently done through a software.
2.	**Issue:** Analysis of MI Census data is restricted to technical aspects of Minor Irrigation and socio-economic issues are not addressed. **Recommendation:** Carry out socio-economic survey with basic indicators pertaining to socio-economic parameters like migration, change in earnings, spending on education and health, adopting insurances etc. Along with the MI census, socio-economic survey should also be conducted, and the report should include analyses of the parameters and find out correlation with that of minor irrigation. Impact of minor irrigation on livelihood, health, sanitation, education, migration may also be conducted by engaging external agencies. This will help in identifying socio-economic issues and help in planning for augmenting CCA, reducing gap between IPC and IPU, which will have impact on lives of the farmers,
3.	**Issue:** Dissemination of analyses to the agrarian population and MI scheme owners is not done as dissemination of report results are restricted to policy makers. **Recommendation:** The results on major parameters like IPC -IPU gap, groundwater and surface water consumption and few others should be communicated back to the villagers in form of simple messages. Information-Education-Communication (IEC) strategies should be worked out to effectively communicate and bring out behavioural change amongst the farmers and MI scheme owners. This will also help in initiating participatory planning process for MI schemes. In addition, MI census results may be shared with other departments like Fisheries, Tribal Welfare, MSME, etc. to address the specific needs of industries, drinking water, pisciculture and others.
4.	**Issue:** Lack of village level records pertaining to Minor Irrigation. **Recommendation:** Creating an online and offline archive of village level records like land records, village maps etc.
5.	**Issue:** Irrigation Census is restricted to minor irrigation sources only. **Recommendation:** The scope of Irrigation Census should be expanded to cover Major, Medium, Minor and especially Micro-irrigation. Such a comprehensive census of all types of irrigation schemes in India would provide a better scenario of irrigation status

Sl.no	Recommendations
	as whole. Data points like IPC, IPU, CCA, etc. would provide the macro picture. In such scenario the schedule designing, database and table modules need to be modified appropriately.
6.	**Issue:** Comprehensive dashboards depicting the existing scenario of each State, District, Block and Village is lacking. **Recommendation:** A dashboard should be developed to present the census data that is currently available on the website of MI Stat Wing. The dashboard should contain real-time progress of enumeration and supervision process, newer initiatives by the States, infographics on major indicators and indexes and basic data analyses facility.

Table 156: NRCP – Recommendations

Sl.no	Recommendations
1.	**Issue:** Inadequate capacity of sewage treatment infrastructure due to lack of ULB capacity and unavailability of financial resources with the states **Recommendation**: NRCP guidelines should include the following components: - • Creating city level sewerage master plan with population projection • Developing phase wise plan for creation of sewer networks, STPs, integrating existing septage systems • Exploring alternate funding options for rapid capacity addition – PPP HAM, IFI funding, philanthropic organizations, CSR funds of private players • Exploring innovative models such as - One City One Operator • Creating enabling structure for long term tripartite agreements for PPP
2.	**Issue**: Lack of measures for holistic river conservation and abatement of other sources of pollution **Recommendation:** • Maintaining min e-flow in rivers throughout the year • Non-structural approaches for protecting river basins during floods – floodplain zoning, catchment area treatment • Treatment of sewage from all sources – septage treatment plants, organic farming, afforestation

Sl.no	Recommendations
	• Knowledge sharing of best practices available with NMCG
3.	**Issue:** Lack of capacity utilization of STPs due to lack of backend sewer network **Recommendation:** • Increase in capacity utilization of STPs through construction of I&D network • Convergence with AMRUT to ensure STPs and I&D structures are created in conjunction with future planning of sewer networks, household connections
4.	**Issue**: Lack of O&M in constructed assets due to unavailability of fund and manpower causing STPs to become defunct **Recommendation**: • Exploring private sector participation – HAM or EPC with long term O&M • Execution of performance-based contracts or technology neutral contracts to ensure operational efficiency of STP • Including revenue generation options for contractor – selling of treated wastewater, treated sludge, agreements with thermal power plants
5.	**Issue**: Non-compliance with recent revisions in NGT norms and discharge standards of sewage treatment **Recommendation**: • Inventorisation of STPs by treatment technology, output parameters & compliance • Earmarking of funds for modernization of STPs for compliance with revised NGT norms post notification of NGT order by MoEF&CC
6.	**Issue**: Mixing of industrial effluents with domestic sewage **Recommendation:** • Inventorisation of non-compliant industrial units, notification to CPCB/ SPCB • Mandatory policies to ensure self-regulation & control by industries
7.	**Issue**: Lack of holistic river basin pollution monitoring infrastructure **Recommendation**: • Setting up of Real-time Water Quality Monitoring Stations (RTWQMS) • Monitoring of river health through biodiversity index, assimilative capacities • Development of a central dashboard with indicators from RTWQMS and tracking parameters in planning, works and post–construction phases

Sl.no	Recommendations
8.	**Issue:** Even for the sanctioned projects, completion schedules are often stretched due to delay in receipt of funds primarily due to states not being able to provide matching share of funds. It is proposed that changes in the fund sanction and fund transfer mechanism to the PIA be explored. **Recommendation:** • There should be a mechanism of providing in-principle approval for a project based on pre-feasibility report submitted by the state/ PIA. A detailed project assessment, DPR can be submitted post the in-principle approval and before fund sanction. This would save effort, cost and time of the PIAs submitting detailed proposals for projects which might get rejected later. • The central share of funds may be released directly to the PIA in tranches through creation of an SPV. The fund can be transferred to an escrow account basis utilization. • The state government may release their share in tranches as per availability and requirement.
9.	**Issue**: There has been delay in implementation of projects due to issues such as delay in planning, land acquisition litigations and delay in release of matching state share against funds from centre. **Recommendation**: It is proposed that NRCP scheme should add certain time bound "Conditions Precedent" which needs to be satisfied prior to approval of projects and sanction of funds by NRCD. including. - • Submission of Certificate of Possession of the land to be used for construction of STP by the PIA • Consent of state and Panchayat departments for usage of the land for construction of STP • Testing of influent parameters by NABL accredited laboratory and reporting of industrial contaminants (if any) • Identification of fund by state government for contribution to state matching share of the project

Sl.no	Recommendations
	• Identification of PIAs for implementation of the project along with approval of project design by the PIA as per DPR. No further changes in the project design shall be permitted during implementation phase except written approval from NRCD
10.	**Issue:** There is very low public awareness about the NRCP scheme, and the projects being undertaken. During KIIs, it was noted that many state water resources departments were even not aware of the projects and scheme objectives. **Recommendation**: • The concessionaire should also take up awareness campaigns for sensitizing the local populace and encouraging use of the project structures created. NGOs and voluntary organizations should be engaged for this purpose. • Social media footprint should be enhanced by creating Facebook page, Instagram profile, Twitter handles to make people more aware of the projects being undertaken. • Rivers have a local appeal and often have religious connects with the people. This people-river connect needs to be strengthened by building more organizations in line with "Love Tapi Care Tapi" group and involving more grass-root level people. • Increasing public awareness about NRCP should be monitored by public perception surveys.

Table 157: FMBAP- Recommendations

Sl.no	Recommendations
1.	**Issue:** Lack of Basin level planning and monitoring of flood management measures for 20 River Basins in India **Recommendation:** Formation of River Basin Organization (RBO) at National and Basin level may be explored.To facilitate planning of flood management measures thereby considering physical integrity of the river systems and its relations with the socio-cultural aspects of the people in the basin, it is important to constitute River Basin Organization at National level and at the respective River Basins. The RBOs involved in managing the river systems should provide an 'enabling environment' for understanding the dynamic and complex river system through an 'interactive approach' to scale-up and scale-out participatory management. This will require the government

Sl.no	Recommendations
	institutions to restructure with a view to devolve powers to community institutions for evolving rational options for river basin development in light of flood management. Such institutions that are community-based should be 'learning organisations', that will emerge gradually through debates and networking with different actors by devolving responsibilities to the local institutions, promote realistic options for basin development and provides a flexible framework for managing the complex and dynamic river basin system.
2.	**Issue:** Scientific assessment of flood prone areas due absence of State specific Master Plans **Recommendation:** Mandate preparation of State specific Master Plans. Necessary support for preparation of Master Plans need to be given by the Monitoring Agencies. The Master Plans will help in demarcating various flood zones digitally through imagery process. The Master Plans will also include interlinking of rivers which would help in beneficially diverting the flood waters.
3.	**Issue:** Enactment of Flood Plain Zoning Bill 1975 across all States, **Recommendation:** Flood-plain zoning measures aim at demarcating zones or areas likely to be affected by floods of different magnitudes or frequencies and probability levels, and specify the types of permissible developments in these zones, so that whenever floods actually occur, the damage can be minimised, if not avoided.
4.	**Issue:** Lack of planning at grassroot level for structural measures **Recommendation:** Formation of village level committees or involvement of existing committees like WUAs. Substantial planning for flood management structures and non-structural measures is done at the State level with technical support from CWC, GFCC and BB. However, community involvement in planning of Structural measures and monitoring the progress of the structures will help in increasing the ownership towards flood management as a whole. The issues of operations and maintenance can also be effectively looked after by the community-based organizations so formed or existing CBOs.
5.	**Issue:** Flood Management Plans do not consider the socio-economic factors like reducing migration, sustaining livelihood, health and sanitation issues/

Sl.no	Recommendations
	Recommendation: Inclusion of the socio-economic parameters into the Flood Management Plans may be explored. Such measures will help in planning and ascertain fund allocation towards activities for livelihood generation, reducing incidences of diseases.
6.	**Issue:** The FMP component is confined to structural measures like construction of embankments, check dams spurs, revetments, porcupines etc. Anti-siltation activities are nor taken up in a significant manner. **Recommendation:** Apart from the structural measures undertaken so far within the scope of FMBAP, additional activities / interventions like River Dredging and Catchment Area Treatment should be actively considered**.** River Dredging: Silting at places where the rivers emerge from the hills into the plains, at convex bends and near their outfall into another river or lake or sea, is a natural phenomenon. Accordingly, rivers exhibit a tendency to braid/meander/form deltas. Dredging of the river would dig out sediments from the river-bed and will increase the water retention capacity of the river. Consequently, the pressure on the banks would be reduced minimizing the chances of flood and erosion. Selective desilting/dredging at outfalls/confluences or local reaches can, however, can be adopted as a measure to tackle the problem locally. Catchment Area Treatment: The rivers bring heavy sediment load from the catchments. These coupled with inadequate carrying capacity of the rivers are responsible for causing floods, drainage congestion and erosion of riverbanks. Inadequate capacity of the rivers to contain within their banks the high flows brought down from the upper catchment areas following heavy rainfall, leads to flooding. The state governments/SDMAs should, therefore, take up appropriate watershed management measures including afforestation, check dams, detention basins etc. in the catchment of rivers to prevent soil erosion, enhance water conservation and minimize water and sediment runoff.

3.4 Summary for Rationalization of Scheme

Some potential opportunities for scheme rationalization have been identified based on the study so far as listed below. However, these need to be studied and analysed in more depth to develop any specific recommendations in this regard.

Table 158: Summary for Rationalization of Scheme

Scheme Name	Scheme Performance[250]	Relevance of the scheme	Rationalisation Recommendation	Discussion or Way Forward
CADWM				Transferring and merging the micro-irrigation component under CADWM with the OI component under PDMC scheme may be considered to streamline subsidy flow for drips and sprinklers and generate more acceptability among the cultivators through the awareness generation campaigns undertaken by horticulture department under PDMC.
Surface Minor Irrigation (SMI)				Bringing HKKP-SMI under HKKP-RRR may be considered since objective of RRR viz; improvement and enhancement of storage capacity of water bodies is a necessary condition to ensure
Repair, Renovation and Restoration				

[250] Based on weighted analysis of EESI+E

Scheme Name	Scheme Performance[250]	Relevance of the scheme	Rationalisation Recommendation	Discussion or Way Forward
of Water Bodies (RRR)				utility of SMI projects during periods of low/ no flows.

The rationale for the rationalization decisions are detailed out in the 'recommendations and solutions' sections for the relevant schemes.

Scheme Performance and Relevance infographics legend

Satisfactory Average Needs Improvement

Rationalisation recommendation infographics legend

Satisfactory To be merged To be discontinued

Appendix

Appendix 1: Case Studies

1. Enhancing existing resource utilization through effective irrigation system management by WRD department, Madhya Pradesh

Problem statement: During 2009-2011, area under the WRD department in Madhya Pradesh witnessed a sharp decline in irrigation system utilization (i.e. % of irrigation potential utilized against the irrigation potential created) – 32% and 34% utilization were recorded in 2009-10 and 2010-11 respectively. During 2010-11, out of the 2.79 mha area under WRD management in Rabi season, only 0.94 mha (35%) has been utilized.

Solution offered: In 2011-12,the WRD department set a target to arrest the gap between IPC and IPU and increase the irrigation potential utilized to 1.6 mha in rabi season, which is almost a 70% increase over the preceding years. To bridge the gap between IPC and IPU, emphasis on pre-irrigation maintenance, rehabilitation of old irrigation projects and improved management using target setting and monitoring through conventional and web-based tools were adopted.

Some of the key initiatives adopted by the department are summarized below:

- Real-time measurement and monitoring of the available water resources
    - Web-based monitoring of smaller reservoirs and tanks were established, thus eliminating the need of paper-based reporting
    - To avoid internet connectivity constraints, a SMS based module for major reservoirs water readings was developed which was integrated into the WRD Enterprise Information Management System (EMIS)
    - Web-based monitoring system facilitated in disclosure of real-time data for target and actual irrigated area and thus helped in ensuring accountability and transparency; the public information was also triangulated through ground truthing by tail reach farmers, members of WUAs, etc.

- Regular monitoring by higher management using ICT and video-conferences were set up; water access at tail-end villages was fixed as one of the key performance metrics

- Timely pre-emptive maintenance was given utmost priority to improve system performance

    - Pre-Rabi inspections were made mandatory for WRD staff to ensure FSL at main canal. This was complimented by delegation of additional authority to divisional offices to conduct small maintenance work during the month-long maintenance timeframe between mid-September to mid-October

    - Last-mile connectivity were ensured through rehabilitation of 4,000 minor irrigation schemes, lining of old earthen canals which led to a jump in area served from 0.37 mha to 0.76 mha in just 2 years

    - The above initiatives were supported by adequate and timely budget support from the state government; annual expenditure per unit area increased from Rs. 112/ ha in 2009-10 to Rs. 820/ ha in 2015-16

    - Also, participation of WUAs was ensured through delegation of civil works of less than Rs. 50 lakh each to 50 WUAs under Madhya Pradesh Water Sector Restructuring Project

Impact: During 2009-10 to 2015-16, the state succeeded in creating 2.06 mha of which around 64% was achieved through improved management of existing schemes and the remaining through construction of new schemes. The average utilization efficiency increased from 32% in 2009-10 to 85% in 2015-16. All these concerted efforts also resulted in increase in irrigated area from 2.53 mha in 2013-14 to 2.69 mha in 2014-15 and 2.81 mha in 2015-16 and increase in food grain production from 30.07 MT in 2013-14 to 34.09 MT in 2014-15 and 37 MT (expected) in 2015-16.

Sustainability: The sustainability of the irrigation management measures undertaken is bolstered to some extent by the adoption of the following practices: real-time public disclosure of system outputs (like irrigated area) and constant feedback from tail reach farmers ensuring

proper accountability and performance of the irrigation staff, commitment of additional regular funds for maintenance by state government through shift in approach from build-neglect-rehabilitate model to one of sustainable irrigation development and management and empowerment of the WUAs.

(Reference: RS Julaniya et al., A Management Approach to Increase Irrigated Area and Production in Madhya Pradesh, India; Dr Tushar Shah (2016) "Har Khet ko Pani?: Madhya Pradesh's irrigation reform as a model"*)*

2. Improvement in water use efficiency through canal automation under PMKSY-AIBP ERM project at Narayanpur Left Bank Canal, Karnataka

Problem statement: The Narayanpur Left Bank Canal system in Karnataka was suffering from various system deficiencies – it was operating at 31.75% WUE (water use efficiency) against the designed efficiency of 51%; water shortages were being recorded in 1,05,632 Ha of tail end villages and 37,000 ha area reported water logging and salinity issues. Some of the key contributing factors were high seepages in unlined portions of canals, pooling owing to excessive siltation, canal breeches and damages in sluices and gates leading to water-logging incidences, unauthorized water withdrawal and violation of rotational/ warabandi schedule affecting water supply at tail ends, absence of any water regulatory system and rampant violation of the cropping pattern and over-irrigation leading to salinity and absence of adequate operators for canal maintenance and operation.

Solution offered: The Krishna Bhagya Jala Nigam Limited (KBJNL) initiated remodelling and automation of the NLBC system along with SCADA implementation and GIS based Irrigation Management Information system (INMIS) to improve the water efficiency. Phase I of the system was launched in 2014 and it was later incorporated under PMKSY – AIBP ERM projects in 2016. As on date, Phase I of SCADA automation and GIS system has been completed while Phase II is in progress. Some of the key projects features are summarized below:

- Implementation of SCADA system: SCADA system software was implemented for monitoring and operation of the automated gates and integration of the system information with the wider information system network.

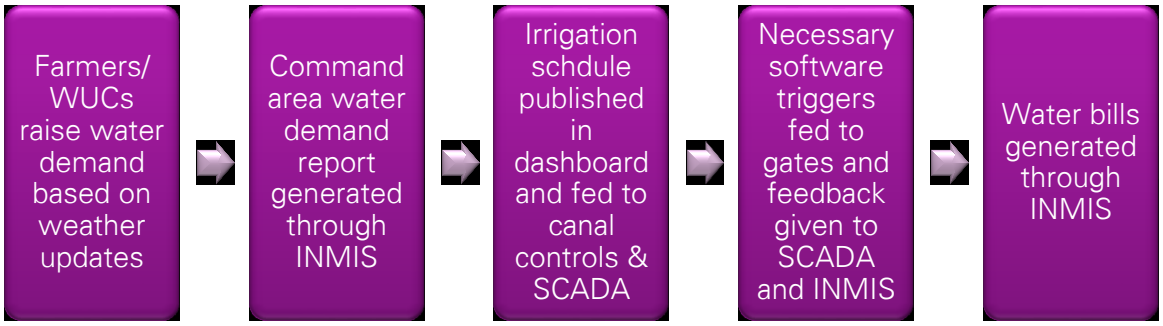
- Automation of the existing gates: All existing radial gates at CR and HR locations were retrofitted with SCADA based electrical and mechanical fitments comprising water level sensors, remote gate control panels, adequate wireless data communication networks etc. for ensuring automatic flow discharges and metering applications. The automated gates are powered by solar powered system.

- Setting up a hybrid wireless data communication network: Considering huge span of the canal network, a main SCADA centre, data concentrator station and slave stations were set up to ensure hybrid wireless data communication network.

- Establishment of an Irrigation Network Management System (INMIS): An INMIS was set up and integrated with existing systems of KBJNL to ensure seamless data flow between the irrigation management staff and end users. This system controls all information related to water demand and usage and is integrated with the SCADA software for canal water regulation and revenue bill generation.

- Setting up information kiosks for farmers: 210 information kiosks were set up for dissemination of information to farmers in relation to irrigation schedule, weather forecasts, state wide commodity prices, access to other important government links. It also stores details of the farmers along with canal jurisdiction offices, cropping pattern adopted and water demands.

  A graphical representation of the modus operandi of the entire system is illustrated below:



Outcome:. Automated gate control reduced water losses endemic in manual operations and systematic water allocation and distribution resulted in overall improvement in system efficiency. Water was delivered to the tail end reaches for the first time. Online water demand raising and automatic bill generation facilitated increase in operational efficiency. Improved system responsiveness and dissemination of information improved user experiences. The completion of works is expected to result in improvement in total water use efficiency to the tune of 21.69% - while conveyance efficiency is expected to increase from 60% to 75%, on farm field application efficiency from 53% to 71% and drainage efficiency from 71% to 80%.

Sustainability: To ensure sustainability of the scheme benefits, active involvement of the water users has been initiated through establishment of Facilitation Centres for farmers at Narayanpur and regular conduct of IEC activities in the command area by the irrigation officials. Interactive information exchange, assurance of demand based supply and performance based disbursements to WUCs are facilitating in generating more interest among the water users.

(Reference: Sidharth Charkha et al (2019)., "Narayanpur Left Bank Canal Automation Project"; documents shared by project authorities during KPMG primary survey; Krishna Bhagya Jala Nigam Limited "Presentation on Improvement in Water Use Efficiency")

3. Facilitating canal restoration and effective WUA operation through community mobilization by specialized agency at Satak Tank project in Khargone district, Madhya Pradesh

Problem statement: The Satak tank minor irrigation scheme at Khargone in Madhya Pradesh was facing deterioration in irrigation system structures with decline in water availability at tail reaches. This was further exacerbated by the lack of any legal provision for enabling the WUAs to impose any collection levy on the water users to conduct regular maintenances.

Solution offered: Action for Social Advancement (ASA), an NGO, was appointed to facilitate capacity building of the WUAs for the Satak minor irrigation scheme in Khargone district. The key objective was to ensure effective functioning of the Satak WUAs and generate adequate funds for the canal restoration process through community collection drive. Some of the steps taken by ASA to ensure the same are summarized below:

a. Community mobilization through awareness campaigns:
    - ASA held series of awareness campaigns using village wise quiz competitions, local folk media (Kalki-turra) and wall paintings. 36 community volunteers were trained as Jal Praharis, who also helped later in the water distribution process. Baseline surveys were conducted to understand the needs of the farmers and also agriculture support services were provided.

b. Capacity building initiatives:
    - A training module was prepared by ASA – in the 1st phase emphasis was put on communicating the rights, role and responsibilities of the WUA and its members while in the 2nd phase, attention was focussed on developing the institutional capacity of both the WUA and WRD through training programmes on water distribution management, gender sensitization and dispute resolution. Training were conducted on social audit.
    - Exposure visits were conducted to neighbouring states

c. Community contribution collection drive:
    - To ensure a transparent collection process, a formalized instrument of agreement 'anshdaan anuband' was introduced between the WUA and the users.

Contribution receipts were given to the payees and collected fund was deposited in the common bank account

- To encourage more collection, letters of appreciation were issued to the payees and printed posters were pasted at the gram choupal

d. Gender mainstreaming

- WUA voting rights were extended to spouses of the existing WUA members through necessary amendment in the PIM act.
- Extensive awareness campaigns were conducted to sensitize the villages about women participation and franchise rights
- Self-help groups were set up to ensure women empowerment

Impact:

- Community contribution by farmers touched 20% of the cost of physical works which exceed the 10% target set by the authority (ICEF). Such contributions for canal restoration also helped to create a sense of ownership among farmers.
- Increase in irrigation rotation frequencies resulted in 20-30% improvement in wheat production (in Balkhar village), increase in jobs for agricultural laborers with greater adoption of labour intensive commercial crops like cotton and chilli which greatly helped the landless labourers
- Around 73% of spouses of landowners casted vote in the last reported WUA elections
- Social audits were conducted in every 6 months

Sustainability: Hand-holding activities and capacity building programmes organized by ASA improved the technical competency of the WUAs. Also the half-yearly social audits and the transparent mechanisms set up for fees payment and undertaking of physical works helped to instil of sense of trust among the WUA members. However, in terms of sustainability the following concerns were reported:

- Scope for further hand-holding of sub-committee member and women participants were reported for ensuring sustenance of their operation
- Continuation of equitable water distribution particularly to tail end farmers is dependent on the physical condition of the canal structures to operate at full discharge capacity

- Financial sustainability of the WUAs need to be ensured by retaining their ability to levy and collect taxes and through establishment of backward and forward market linkages to agricultural activities.

(Reference: Action for Social Advancement, "ICEF-M.P. WRD Project on Participatory Restoration and Management of Irrigation Systems by Water Users Associations in M.P.")

4. Ensuring effective convergence with other government programmes like MNREGS at Dhar district, Madhya Pradesh

Problem statement: The CAD guidelines have proposed executing works in convergence with existing watershed programmes and MGNREGA schemes; however the extent of actual convergence achieved was reported to be quite low due to absence of any detailed enabling policy guidelines and tardy implementation of the same by the implementing authorities.

Solution offered: In 2008, the MP Panchayat and Rural Development department formulated two schemes for facilitating development and management of irrigation infrastructure using MNREGS funds. Some of the key features of the implementation strategy is highlighted below:

- Enabling policies: MNREGS funds used for canal rehabilitation and construction of field channels under Sahastradhara scheme.
- Joint planning: Joint walk-throughs conducted with farmers by NVDA to prepare detailed estimates of minor canal repairs followed by submission of technical sanction plan by Executive Engineer to the Panchayat.
- Faster fund disbursal: Funds were directly transferred to the WUA's account by the Jilla Panchayat (thus bypassing the Gram Panchayat)
- Hand-holding by specialized agencies: NVDA together with the appointed NGO Development Support Centre (DSC) provided technical support to the WUAs in relation to technical planning and estimation, MNREGS labour orientation, training of supervisors (/ mate), preparation of job cards, bookkeeping and accounting. Exposure visits for WUA members were arranged by DCS to successful projects in Madhya Pradesh, Gujarat and Maharashtra. 20 local youths were trained as Kolaba Sahayaks/ mate of MNREGS works. IEC and awareness campaigns involving graphic and visual shows were arranged to sensitize the villagers.
- Implementation by WUAs: The WUAs got the opportunity to carry out the R&M under the MNREGS assisted canal repairing works themselves, thus obviating the need for appointment of departmental/ private contractors.

Impact:

- 147 km of canal network was repaired and 93 km of earther field channels were created in Maan and Jobat projects. New field channels facilitated water access to tail end users in Kukshi block.
- Direct transfer of MNREGS funds to WUAs instilled a sense of ownership and accountability among the members.
- 6,500 ha of additional area was brought under irrigation. Irrigated area in Maan and Jobat projects increased from 7000 ha and 5000 ha in 2007-08 to 11,400 ha and 7,700 ha in 2009-10 respectively.
- The farmers reported increase in net income by Rs. 10,000/ ha. Majority of the farmers were able to irrigate more than 50% of their land and sow two crops in a season by adoption of new crops like wheat, cotton, chilly, pulses, etc.
- Substantial increase in groundwater was reported in areas where field channels have been constructed.

(Reference: Tapan Patel et. al. (2010), "Best Practices on MNREGS Assisted Canal Rehabilitation under Participatory Irrigation Management in Dhar, Madhya Pradesh).

5. Ensuring proper maintenance of field water courses through innovative community contribution facilitated by Khairani WUA at Baksa, Assam

Context: The Khairani WUA was set up by a group of volunteers in Assam to restore flood mitigation structures. It was formally registered in 1990s mainly with an intention to streamline the receipt of government subsidies and technical assistance of the irrigation officials. As on date, the WUA is functioning effectively with 14 Central Level Committees (CLCs) and has adopted certain set of uniform working rules and compliance methods. Considering the economic position of the WUA members where a large chunk of the members hail from scheduled tribes and backward classes with agriculture as the primary source of income and thus the economic, an innovative contribution system has been developed.

Solution: The WUA's working rules have no provision for monetary collection of water taxes. All the taxes are collected in the form of labour and activities undertaken by WUA. Participation and contribution of labour for WUA's activities are mandatory for each member, failing which stiff monetary penalty of Rs. 150/ day is imposed. Absence in more than 3 consecutive days attracts an additional penalty of Rs. 125/ day. Additional penalties are further applied in case of absence in more than 50% working days. In case of non-payment of penalties, strict actions like seizing of properties worth the penalty fees are applied. Also, fines are imposed in case of withdrawal more water compared to the allotted one. The penalty fees form an important source for conducting repair and maintenance organization.

(Reference: Vasant P. Gandhi et al., November 2019, Institutional Structure, Participation, and Devolution in Water Institutions of Eastern India)

6. Enhancing water storage capacity through community-based tank desiltation works: Mission Kakatiya, Telangana

Problem statement: While agriculture in Telangana has traditionally been dependent on tanks; most of these ran dry by 2014 owing to continued negligence and reducing tank storage capacity. Hence, dependency on groundwater increased and water table in the vicinity depleted.

Solution offered: "Mission Kakatiya" was launched by the Government of Telangana in 2014 to prioritise restoration of 46, 531 minor irrigation tanks to their original capacity towards effective utilisation of water allocated for minor irrigation sector (255 TMC).

The strategy adopted is as follows:

- Identification and prioritisation of tanks:
    - Reconciliation survey was conducted to ascertain number of different types of minor irrigation sources viz. percolation tanks, private kuntas and small tanks for restoration.
    - The tanks for which repair works had already been undertaken under programs like RRR/ state plan were identified.
    - The tanks with greater ayacut and those which had not been covered under any other program were given priority. The order of prioritisation was decided in consultation with district minister/ local MLA/ public representatives.
- Civil works:
    - Tanks were desilted, dilapidated sluices/ weirs were repaired and bunds were strengthened.
    - Irrigation channels were re-sectioned to ensure smooth distribution of water to fields.

- The importance of the program was publicised and end-users were motivated to participate.

- Interdepartmental coordination was ensured by constitution of District Level Implementation, Monitoring and Evaluation Committee; which constituted members from irrigation and CAD, agriculture, fishery, rural development, forest, fishery, revenue, groundwater and public relation department.

Impact: By March 2018, the program was successful in restoration of 22,500 tanks, leading to outcomes like increased water storage capacity and enhanced on-farm moisture retention. It resulted in reduction of gap ayacut by 63%, agricultural diversification, reduced use of chemical fertilisers, enhanced on-farm water retention, improved soil nutritive value and water accessibility to small and medium farmers. Additionally, it also led to development of fisheries and livestock, increase in groundwater levels and income augmentation of farmers.

(References: Composite Water Management Index by NITI Aayog, August 2019. Selected best practices in Water Management, prepared by NITI Aayog with the support of Teri University, August 2017. Mission Kakatiya, Irrigation and CAD Department, Government of Telangana*)*

7. Ensuring water security through community-based tank desiltation: Gaalmukt Dharan Gaalyukt Shivar Yojana

Problem statement: Out of 580,000 tanks of various sizes spread across India, Maharashtra has the highest i.e. 42% of irrigation tanks. Since these come under the purview of state government; various line departments are involved in management while community involvement is limited. As a result of siltation, compounded by lack of regular maintenance; the storage capacity of these traditional structures diminished, leading to cascading effect on environmental and socio-economic condition of the state.

Solution offered: Gaalmukt Dharan Gaalyukt Shivar Yojana' (silt free water reservoirs and silt applied farms), launched in 2017, is an initiative by Maharashtra Government towards ensuring water security through activities like community-based tank desiltation under RRR and WDC, along with awareness generation for efficient water utilisation.

- A Desilting Policy Committee was established by the state, which recommended desiltation of 31,459 small dams and water tanks in the state.
- Considering its potential in improving drought resilience, the program was included as part of revised state water policy in 2019.
- Active involvement of CSRs/NGOs was promoted: While the state government provided fuel subsidy; machine rent cost was contributed by community/ pooled through CSR/ NGO funds.

Impact: Impact evaluation study by The Nature Conservancy and Watershed Organisation Trust indicates:

- Increase in water holding capacity and improved organic carbon in the soil after silt application. However, the effect was found to vary depending on soil characteristics: texture, bulk density and water holding capacity.
- The total area under cultivation increased during both Rabi and Kharif season while proportion of rainfed and wasteland areas reduced. Additionally, area under water saving technology increased by more than 2 times.
- A reduction in per acre cost of fertilisers was observed for major crops.

- The average annual income was found to increase from Rs. 37, 489 to Rs. 92, 855. This further led to enhancement in socio-economic status of farmers:
- With benefit-cost ratio of 1.31 (for three tanks), desiltation was found as economically viable activity, even when only enhancement in soil fertility was considered. Other direct-indirect benefits of desiltation like increased water storage capacity and improved soil texture were not accounted for in calculations.
- Other impacts: reduction in migration, increase in biomass leading to more fodder for livestock and groundwater recharge.

(References: Zade et al, 2020. 'Gaalmukt Dharan, Gaalyukt Shivar (Tank Desiltation) Scheme in Maharashtra, India: Policy Concerns and the Way Forward', 16/0 Law, Environment and Development Journal. Sood et al., 2018. 'An Impact Evaluation Study and Proposed Guidelines for Water Tank Desiltation in Maharashtra' by The Nature Conservancy, India and Watershed Organisation Trust.)

8. Technical strategies to operate minor and medium irrigation schemes towards improving groundwater systems: Vavuniya, Sri Lanka

Problem statement: With increase in abstraction of groundwater resources due to rise in population, the pressure on groundwater resources is increasing. This has led to issues like declining water table and waterlogging.

Solution offered: A regional aquifer simulation model was developed for a restricted catchment: 185.23 km^2 in Vavuniya district, Sri Lanka. This was used to find out operational policy favouring groundwater conservation. It found:

- Case 1: Foregoing cultivation by 25-35% for two consecutive seasons reduced water table loss by 45-65% in 80% of the catchment area.
- Case 2: Peripheral boundary treatment to reduce permeability by 35-45% lead to rise in water table by 0.457-0.838 m in areas closer to treated boundary during recharging season.
- Case 3: Combining 1&2 i.e. peripheral reduction in permeability by 35-45% and foregoing cultivation by 45-55% lead to increase in water table by 1.067 - 1.448 m during discharge season. Similar trend was observed during recharge season but to lesser extent. Overall, 60-70% of loss in water table was reduced between two seasons in 95% of the catchment area.

Envisaged impact: The gain in water table would reduce the cost of energy (fuel/ electricity). This shall increase the degree of economic cultivation per unit irrigation water, thereby increasing economic crop yield. It would also indirectly contribute to GDP and GNP.

(Reference: Sivakumar, 2013; Conjunctive Use of Surface and Groundwater to Improve Food Productivity in Vavuniya District in the Dry Zone Area)

9. Comparative Benefit-Cost analysis to evaluate most appropriate material for canal lining: Case Study of Neera Devdhar Canal

Problem statement: Water flowing in canals is prone to seepage and evaporation losses. Seepage losses are dependent on channel geometry while evaporation losses are proportional to area of free surface. Increased seepage losses in unlined canals may lead to rise in water table, resulting in waterlogging and soil salinity. This would reduce cultivable area and may further need installation of costly drainage systems.

Solution offered: The benefits of canal lining and corresponding B-C ratio were evaluated in Neera Devdhar canal. The results obtained upon lining are as follows:

	HDPE + Concrete	HDPE + Shotcrete	IITD + Concrete	IITD + Shotcrete
B/C ratio	10.43	7.33	9.59	6.88

- Seepage losses were found to reduce by 70% upon lining with concrete while they reduced by 90% when lined with shotcrete. However, these materials would also require continuous maintenance due to expansion and contraction of cracks.
- The study concluded HDPE sheets as best option for lining to aid in reducing seepage losses from lining cracks. Subsidies are also provided by the government to use these sheets for lining.
- Concrete and shotcrete may be used as covering, towards protecting HDPE from damages.
- Further, sensor system (Radar/ bubbler) may be used to evaluate discharge at different sections of canal. This could aid in locating section-wise seepage losses.

Impact: With the help of HDPE sheets and sensor system, seepage losses in canal may reduce up to 100%. This would lead to increase in command area, reduce requirement for maintenance and increase channel capacity.

(Reference: Kadu, Rajmane and Hailkar (2017), 'Case Study of Neeru Devdhar canal seepage losses and canal lining0, International Journal for research in applied science and engineering technology.)

10. Solar Powered Community Lift-Micro-irrigation Project in Talwara and Hazipur Blocks of District, Hoshiarpur

Problem statement: The Kandi belt comprising 10% of the total area of Punjab is mostly rainfed. The area suffers from severe shortage of drinking water and poor socio-economic conditions of the farmers. Hoshiarpur district falls in this Kandi belt. Soil erosion is another major concern in this area as during monsoon period most of fertile soil gets eroded, resulting in unavailability of assured irrigation source coupled with soil degradation. Being sub-mountainous and remote area, the electricity supply is highly unreliable. The productivity is also very less as the farmers are only able to do mono-cropping and that too depends on rainfall only. The Govt of Punjab, taking stock of this situation, constructed Kandi canal which became lifeline of Kandi area. However, there was another problem in that area. The right canal bank being at lower elevation is possible to be irrigated through gravitational flow whereas the left canal bank being at higher elevation could be irrigated utilizing lift irrigation only.

Solution offered: The Govt of Punjab approved a Solar Powered Lift-Micro-irrigation project with total cost of Rs. 42.10 Cr. with funding from under RKVY and NABARD. The project was started in January 2015 and commissioned on 7th August 2017. The project is operated and maintained by hand holding local community and Water User Associations (WUA's) for initial 7 years thus providing gestation period for farmers to develop their fiscal and technical capacity. The project was designed as integrated solar powered, fully computerized and automated micro-irrigation project. The solar energy gives leverage over grid-based systems. The micro-irrigation and automation (SCADA, Remote Terminal Units, Hydraulic Valves, Level Transmitters, Pressure Transmitters etc.) help in water conservation and equitable distribution of scarce resource respectively. The project consists of 3 main lift points from Kandi canal and booster stations (sump wells) are also provided at various points to enable water to reach at higher elevations. A total of 1,200 households and 8,500 beneficiaries have been benefitted by this project. The project beneficiaries include 3,730 women and 2,450 SC people.

Impact:

- Increase in income has been observed in the range of around 85% to 229% (Maize: 85%, Wheat: 127%, Mustard: 125%, Sesamum: 229% etc.)

- The project has given employment opportunity to local youth, who are working in the project as helper, guard etc.
- People who earlier migrated for work have started cultivating their own lands. Linkages established with local processing units are also helping these farmers getting instant cash return
- The farmers are getting demo of best practices, knowledge about latest agricultural practices, water conversation technologies etc. through the established training centres and experts from prestigious institutions. These training centres are also providing livelihood-based training sessions to landless and women community
- Due to proximity of urban areas, allied activities such as dairy farming is also growing

Replicability: Water scarcity issue is also prevalent in many other states (e.g. Haryana, Rajasthan etc.) in India. In those states, many areas suffer from unreliable electricity supply. Hence, similar model can be adopted across those areas to leverage benefits of micro-irrigation and improve socio-economic condition of farmers.

Sustainability: Being solar energy based, the project has ensured sustainable resource use in terms of energy. The project has focused on sustainable water resources management through efficient water use by micro-irrigation systems. Training centres are educating the beneficiary farmers and WUAs for effective O&M of irrigation assets, sustainable use of water etc., helping in proper utilization and maintenance of irrigation assets.

(Reference: https://dswcpunjab.gov.in/contents/success-stories/Solar-Powered-Community-Lift-Micro-Irrigation-Project.html)

11. Ramthal Drip Irrigation Project, Ramthal, Karnataka

Problem statement: Around 60% water was being lost due to conveyance, evaporation, percolation and seepage in traditional methods of canal network and flow irrigation. Being a drought-ridden state, it was difficult for Karnataka to afford such huge water loss. There were other problems in the canal command areas including inequitable distribution of water, salinity problem due to excess irrigation, gap in design and actual area and flow, poor drainage, less water at the tail end of canals, no measuring device or control structures, uneven crop growth and yield, soil deterioration at canal head ends due to water logging and poor drainage etc.

Solution offered: The Govt. of Karnataka launched Asia's largest drip irrigation programme under Stage II of Ramthal Lift Irrigation Project in 2017. This project is an example of Integrated Micro-irrigation. In this project, canal water is delivered directly using HDPE/PVC piping network to irrigate around 24,000 ha area. Salient features of this project:

- Mega community drip irrigation project
- Total beneficiary: More than 15,000 farmers
- Infrastructure cost borne by the Govt.
- System operation through wireless automation
- O&M of system for first 5 years by Krishna Bhagya Jala Nigam Limited (KBJNL)
- Formation of WUA and marketing linkages

Impact:

- 90% additional area coverage using same quantity of water (i.e. 12,571 ha area covered in stage I by flood irrigation through canals vs 24,000 ha area covered in stage II by integrated drip irrigation. In both stages, water requirement remains same i.e. 2.77 TMC)
- Doubled the no. of beneficiaries with same resources
- Equitable distribution of water irrespective of topography and distance of farm from the water source
- Improved standard of living of project beneficiaries
- Improved crop quality and produce

Replicability: Similar integrated micro-irrigation project can be adopted in other states where canal or other assured irrigation source is available. Govt. of Haryana is also planning for similar project powered by solar energy.

Sustainability: O&M by 3rd party, participatory irrigation management by WUAs and marketing linkages will be helpful for maintaining sustainability of this project.

(Reference: http://pmksy-mowr.nic.in/aibp-mis/Manual/Ramthal%20Micro%20Irrigation,%20karnataka.pdf; http://www.kbjnl.karnataka.gov.in/kbjnlenglish/content/ramthal-marol-lift-irrigation-scheme)

12. Upliftment of SC farmers to mitigate migration: A case study of Jangalahalli village of Kapalamadagu GP in Kolar (Karnataka)

Problem statement: Under Batch-4 PMKSY-WDC programme implemented in Mulbagal taluk, Schedule Caste (SC) farmers having aggregate landholdings of up to 10 hectares in Jangalahalli village of Kapalamadagu GP were migrating to towns in search of jobs. Their lands were unproductive and were left barren/fallow.

Solution offered: After project intervention due to land treatment from upper reach to lower reach and via various watershed activities such as bunding, construction of Nalabund and check dams, agroforestry, dry land horticulture, boulder checks and diversion channels have converted uncultivable land into productive cultivable lands. Water stored in the water harvesting structure has helped the farmers to undertake intensive cultivation of commercial crops.

Impact: In Jangalahalli village, watershed development programme has not only raised the income level of SC farmers but also facilitated them to sustainably settle down in their farm, thereby reducing migration and poverty.

Sustainability: By overall upliftment of farmers' economic condition along with sustainable management and conservation of soil and water the watershed project in Jangalahalli village has contributed substantially towards the sectoral challenge, national priority and Sustainable Development Goals (SDG). The intervention has helped the farmers to sustainably settle on their land with adequate sources of livelihood.

(References: As reported by WCDC of Kolar in the written response to the questionnaire)

13. Construction of Recharge Shafts to improve groundwater table; a Case study of Tamil Nadu

Problem statement: Recharge of groundwater sources in a cost-effective manner

Solution offered: SLNA of Tamil Nadu reported that they have adopted the construction of Recharge Shafts to improve the groundwater table as a cost-effective and innovative intervention. It was reported by the SLNA that Recharge Shafts are the most efficient and cost-effective structure to recharge the shallow aquifers. Recharge Shafts of 0.5 to 1 metre diameter and 10 to 15 metres deep were constructed across the state watersheds.

Impact: The impact reported was the rise in groundwater level from 0.33 meter to 3.28 meter in the intervention watershed areas of Tamil Nadu.

Sustainability: Given the success and cost-effectiveness, so far 17,879 Recharge Shafts have been created with an expenditure of Rs. 68.10 Cr. These structures are sustainable and are effective for long duration leading to sustainable recharging of groundwater sources.

(Reference: Based on written response against questionnaire submitted by the SLNA of Tamil Nadu)

14. Environment Sustainability: A Case study of Salulamang village in Mokokchung district of Nagaland

Problem statement: Salulamang is one of the few villages in Mokokchung district where public transportation is not available. The main occupation of the villagers was Jhum cultivation and Jhum cultivation was practised extensively before the intervention of PMKSY-WDC. Around 60 households were engaged in Jhum cultivation over a total area of around 90 Hectares in 2012.

Solution offered: In the initial 2-3 years, mixed cropping was done in the rubber plantation area. About 27 units of piggery have been initiated under livelihood activities, rubber plantation has been encouraged on a large scale and setting up of micro-enterprise unit has provided a source of income for the villagers. Technical inputs on land use and construction of engineering structures, viz. water harvesting structures and gully plugs have made water available for use in fields and other plantation areas. The technical assistance provided through the programme for management of orange plantation has been beneficial to the farmers and contributed to the success of the activity, eventually increasing production and generating more income for the farmers.

Impact: However, after the intervention of WDC, Jhum cultivation has gradually decreased and the villagers have taken up rubber plantation. During the study and monitoring visits by the evaluating agency, it was noted by the agency that the Land Resources Department has been performing commendably in reaching out to villages through PMKSY-WDC. The average land under Jhum per household has exhibited a decreasing trend, i.e. 1.5 Hectare per household in 2012 to 0.75 Hectare per household in 2016, resulting in a reduction of the total area under Jhum to 22.5 Hectares (2016) from 90 Hectares (2012).

Sustainability: Green coverage created by plantation crops over abandoned Jhum land provides safe shelter for wildlife, birds, insects and microbes. Thereby, through watershed intervention and promotion of economic activities in the villages under PMKSY-WDC, there has been a significant reduction in Jhum practice in the state which has a favourable impact on the environment.

(Reference: Various social impacts of PMKSY-WC with special focus on reduction of Jhum cultivation, 2016, MELD in Nagaland-NABARD Consultancy Services Pvt. Ltd.)

15. Recharge of groundwater sources; Case Study of Gokak Taluk of Belagavi district

Problem statement: The latest Assessment of Dynamic Groundwater Resources of the State 2017 is made jointly by the Central Ground Water Board and the State Ground Water Department. As per the last report, Gokak taluk was categorised as "Semi Critical" based on the stage of groundwater development ('Semi Critical' is where Groundwater extraction is between 70 to 90%).

Solution offered: Karnataka Watershed Development Department is implementing PMKSY-WDC (formerly IWMP) in a phased manner all over the State. As per the department, the watershed development activities have helped in water conservation, groundwater recharge, reduction in soil erosion, increased productivity etc. The project (IWMP-20/11-12) was sanctioned in the year 2011-12 to treat an area of 2080 hectare in Gokak Taluk of Belagavi district at an estimated cost of Rs. 312 lakh under Batch-III. In an area of about 548 hectares bunding was done and 127 Water Harvesting Structures (WHS) was constructed by spending Rs. 265.77 lakh.

Impact: The interventions made through watershed development activities in the form of rainwater harvesting structures have led to a spurt in recharge of the aquifers in the area. Thus cumulatively 20,310 cubic metres of rainwater is made available for recharge to groundwater body in the area annually. However, the watershed development activities have helped in augmenting the water resources in the taluk and has restored the taluk to "Safe" category. The farmers were favourably impacted as their wells were getting groundwater inflows as before. The effect of watershed activities observed in the rejuvenation of defunct wells is demonstrated as the irrigated area increased from 0 to 37 acres in Kharif and 0 to 25 acres in Rabi.

Sustainability: The permeable topsoil and weathered and fractured rocks underneath are the factors that lead to good recharge. Such recharge has rejuvenated the defunct wells, can sustain additional wells in the area, and also can sustain the water yield from wells over an extended period.

(Reference: Rejuvenation of defunct Dug wells due to watershed development activities', 2020, Watershed Development Department, Government of Karnataka.)

16. Sustainable livelihood opportunities for women; Case Study of Yeiikha and Yow Miijaiim Self-Help Groups (SHGs) in Phek district of Nagaland

Problem statement: Providing sustainable livelihood opportunities to landless and women

Solution offered: Land Resource Department of Phek District facilitated the formation of two SHGs, namely; Yeiikha SHG & Yow Miijaiim SHG in the year 2017 with ten women members in each group. The primary purpose of collectivizing and forming the groups was to improve the socio-economic status of poor rural women, especially to enhance their income. Seed money amounting to Rs. 10,000 each was given to both the groups. Tree beans (Parkia), a very important multipurpose tree species, having many utilities such as rich nutritional value as it is abundant in minerals and vitamins, medicinal value, use as insecticides and pesticides, enriching the soil by fixing atmospheric nitrogen, etc. Besides, tree bean (Parkia) the SHG members are also engaged in weaving and kitchen gardening.

Impact: Each SHG has been earning Rs. 40,000-50,000 annually from the sale of Parkia. The Self-Help groups collect the entire produce of their village and transport it to the nearest market which is 114 km away from their village and sells it.

Sustainability: The group maintains cash book, savings book, meeting minutes register and all other relevant registers thereby facilitating their financial independence in the long run. The livelihood component of the programme has helped the women in the SHGs to earn a sustainable livelihood thereby contributing to equity.

(Reference: Success stories: Bringing visible changes in the economy of the rural community, Booklet provided by SLNA of Nagaland)

17. From source of sorrow to place of prosperity, Swan River in Himachal Pradesh

Scheme details:

- Scheme Name: Channelization of Swan River
- Target Area: Swan River watershed, Una district, Himachal Pradesh
- Total Project Cost: Rs. 945.49 Cr.
- Broad Scope:
  - Afforestation
  - Civil works for soil and river management (check dams and embankments, etc.)
  - Soil protection and land reclamation (terracing and soil addition, etc.)
  - Livelihood improvement activities (agricultural development, small-scale infrastructure installation, income generating activities, etc.)
  - Institutional building (purchase of equipment, training, hiring of facilitators, etc.)
- Implementing Agency: Forest Department and Irrigation and Flood Control Department, Government of Himachal Pradesh
- Area covered: 95 Gram Panchayats of Una District, within which 61, 900 Ha of land were treated to protect the land from soil erosion and floods, regenerate the forest cover and enhance agricultural productivity.

The Problem: District Una is situated on the bank of Swan River, which flows from North to West direction. This river during monsoon period creates devastating floods in District Una. Due to continuous silting, the bed of Swan River had risen constantly due to which meandering action took place. The width of the river had increased, and fertile land situated on both banks was turning barren due to silt deposits. Besides, some of the fertile land situated near the banks had been lost during the floods.

Approximately, 10,000 ha. of agriculture land was affected by floods and annually 2,000 ha. of fertile land were not being cultivated owing to fear of floods. During the past 10-12 years extensive damage to civil structures, properties, human life and livestock had been reported. The estimated loss to crops and property was to the extent of Rs. 15 Cr. per annum.

Solution offered: The forest department was the nodal department for the project. The participating line departments were agriculture, horticulture and animal husbandry. The overall administration, planning and implementation of the project was with the Project Management Unit (PMU). The Chief Project Director was the overall in charge of the project and responsible for all administration and financial matters and maintaining liaison with the government. He was assisted by a team of Additional Director, Joint Director (administration), Deputy Project Directors Agriculture, Horticulture, Animal Husbandry, Social Development Expert, Environment Education Expert and Training Expert. Three Project Implementation Units were established at Una, Amb, and Gagret headed by the Deputy Directors. At Panchayat level Panchayat Development Committees (PDCs) were established in all the 96 Gram Panchayats of the Project area.

The Detailed Project Report for providing embankments on both banks of Swan River for a length of 16.67 km. from Jhalera bridge to Santokhgarh bridge in Phase-1 was prepared based on mathematical modelling studies carried out by Central Water Power Research Station (CWPRS),

Pune. This project amounting to Rs. 102.71 Cr. was accepted by the Technical Advisory Committee of Ministry of Water Resources, Govt. of India. To adopt an integrated approach, it was proposed to treat the entire catchment instead of just the sanctioned portion of 16.67 km. In all 42 most vulnerable points requiring emergent flood control works were identified. Out of these, 40 have since been completed at a cost of Rs. 9.28 Cr. An additional amount of Rs. 24.57 Cr. has been approved under NABARD for phase-I.
Also, a provision of Rs. 106.83 Cr. has been made for treatment of catchment area of tributaries falling from Jhalera bridge to Santokhgarh bridge. The Forest Department has planted around 60,000 trees of different varieties in 50 ha. In addition to this, check dams in the tributaries and planting of grass and bushes for bank protection have also been done.

Community involvement: People's participation was key to the success of this project and community participation was seen as an important aspect. No fund needed to be allocated for land acquisition as the villagers had come forward and donated their land for the project. This led to savings to the tune of Rs. 500 Cr. The people donated their land with the expectation that the agriculture in the remaining portion of land after construction of the project would give them better returns. The report by JICA says that "The project will be implemented on national forests and on private land chosen through community participation. The project will not involve any land acquisition or involuntary resettlement."

Impact: The Swan River Project has benefitted the villages situated by the side of the river from the massive erosion and siltation caused by the flash floods. During the Focus Group Discussion with villagers of Una, the villagers reported "*Since the Channelization of Swan River has been implemented by the Government, it changed our destiny for better as today, we are earning a reasonable money by producing seasonal vegetables and cash crops on the reclaimed land and have shifted back to our traditional vocation of farming*". Some of the benefits are summarized below:

- The analysis of cropping pattern revealed that the total area under cereals decreased from 69% to 54%; however, with the increase in the irrigation facilities by the project interventions, the area under vegetable crops increased from 31% to 46 % of total cropped area. The cropping intensity increased from 193% to 199% after the project implementation.

- During the project implementation period, the average size of livestock unit increased from 1.62 to 2.71. The share of milk to the total income from livestock was found to be highest among different livestock products.
- As a result of increases in the income from agricultural crops, fruit crops and livestock by about 43%, 35%, and 55%, respectively, the overall farm income has increased by 50% during the project implementation period.
- The employment generation in agriculture has increased with the implementation of the project. The annual per farm labour employment in horticulture and livestock, showed an increase of 213% and 65% respectively.
- Community-based groups formed under the project are involved in marketing of produce.

Sustainability: In order to ensure the proper utilization of created facilities over time, there is a need for adopting certain measures at local level - local asset management committees may be formed under the guidance of the block and district authorities.

(References: *FGD & KII as part of primary survey; Research Report No. 70: Impact analysis of integrated watershed project in Swan catchment, Una district, Himachal Pradesh, Department of Agricultural Economics, Extension Education and Rural Sociology, CSK HPKV, March 2014)*

18. Combating flood with information driven actions, Bihar

Project details:

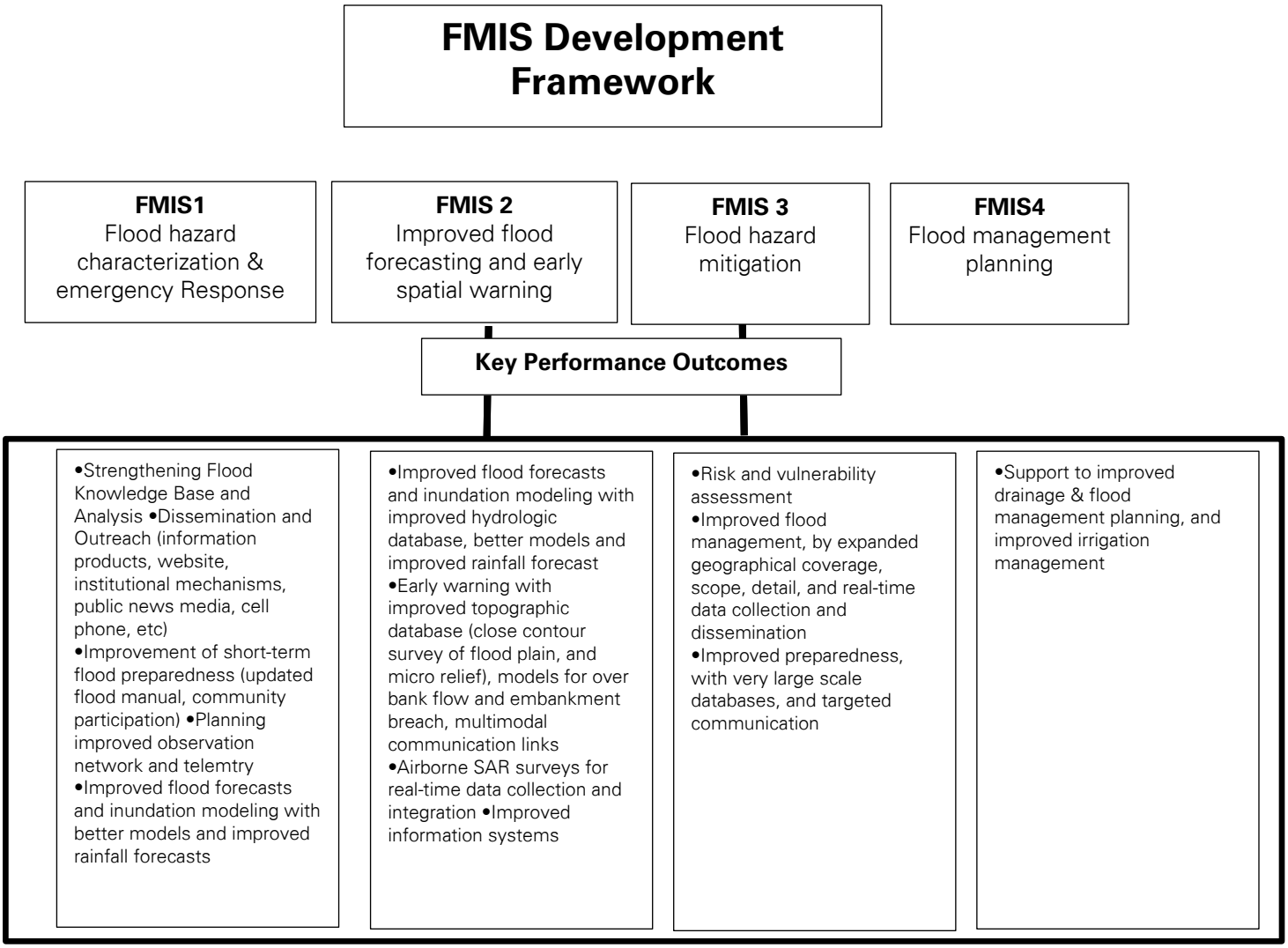
- Scheme Name: Flood Management Information System (FMIS)
- Target Area: Bihar
- Total Project Cost: Bihar – Rs. 10.86 Cr. funded by World Bank
- Scheme Scope:
    - Development of technical and institutional capacity of the State for flood management
    - Improved flood forecasting in terms of lead time and accuracy
    - Prediction of expected inundation
    - Development of updated flood control manuals
    - Upgrading hydrologic measurements
    - Use of Online Analytical Processing (OLAP) and data mining tools for planning of schemes using forecasted data
- Implementing Agency: Flood Management Information System Cell (FMISC), Government of Bihar
- Area covered: Phase – I : Flood prone area in North Bihar, from Burhi Gandak river in the west to Kosi river in the east, including the districts of East Champaran, Muzaffarpur, Begusarai, Samastipur, Dharbanga, Sitamarhi, Sheohar, Madhubani, Supaul, Saharsa, and Khagaria covering about 26,000 sq. km. in area; Phase – II: Entire North Bihar together with Patna, Bhagalpur and Munger district have been targeted to be developed.

Solution offered: Flood Management Information System, Bihar finds its genesis in the brainstorming meeting on Jan 18, 2006 in which the Government of Bihar (GoB) and the World Bank agreed on a water sector partnership matrix and action plan in three time horizons. In the short term, it was proposed to improve the technical and institutional capacity of the State of Bihar for flood management, introduce extensive use of modern information technologies, and develop and implement a comprehensive Flood Management Information System (FMIS) in priority areas. Flood Management Information System Cell (FMISC) was created under the overall supervision of Chief Engineer (CE), Monitoring and Planning, in Water Resources Department (WRD), GoB, and under Superintending Engineer (SE), Flood Monitoring Circle, to develop and operate the Flood Management Information System (FMIS) with technical assistance from the

World Bank. Currently, one Executive Engineer as In-Charge, and six Assistant Engineers (and one peon) have been deputed to FMISC.

Major functions of FMISC are:

- To ensure operational readiness of FMIS prior to each flood season.
- To operate and disseminate information products as per plan and schedule.
- To respond to emergency data requirements through the use of FMIS.
- To follow-up on dissemination to enable effective utilization.
- To analyze feedback and experience of every flood season for improving FMIS.



The FMIS in the first stage covered the focus area from Burhi Gandak River in the west to Kosi River in the east in North Bihar which is the most flood prone area in the State. This included 11

districts i.e. East Champaran, Sheohar, Sitamarhi, Muzaffarpur, Madhubani, Dharbanga, Samastipur, Supaul, Saharsa, Khagaria, and Begusarai covering 26,000 sq. km.

The FMIS Phase I was initiated in August 2006 and was scheduled to be completed by October 2007. Further extension to the project till June 2008 was granted by the World Bank and the project was eventually completed on this date. The project components included development of FMIS, improvement of flood forecasting, update of Bihar Flood Information Website, preparation of updated flood control manual, conducting training and upgradation of hydrologic measurements and telemetry.

FMIS Phase-II started on May 2010. In the meantime, the FMIS sustained itself on the internal resources of the Water Resources Department during 2008 to 2010. The FMIS Phase II was scheduled to be completed by 31 December 2012 , which was extended till 30 November 2014.

Impact: As a result of FMIS in Bihar, following achievements have been realized:

- Flood modelling: Real-time Flood Forecasts are made using statistical and deterministic model.
- FMISC is releasing monthly E-Bulletin since May-2007. This is an in-house production and gives a brief account of activities in FMISC.
- Flood Management Information System Cell, Bihar, Patna issues Daily Flood Information Bulletin during monsoon season generally from 15th June to 15th October. The bulletin carries information on observed rainfall in Nepal, Bihar and three days maximum rainfall forecast from IMD and river water level for all six sub-basins/rivers of North Bihar viz Gandak, Burhi Gandak, Bagmati (including Adhwara group of rivers), Kamala, Kosi and Mahananda.
- Inundation Maps: These maps indicate the extent of flood water spread. The inundation extent is derived from RADARSAT Layers/ Imagery provided by NRSC in processed 1bit image format.
- FMISC also provides regular embankment news, detailing the status of embankments in Bihar. Embankment Assets Management System for Bagmati and Kosi is currently functional and is providing up to date information on embankment conditions by collecting information from department officials and select community members through field data collection application and SMS.
- Following information products are regularly uploaded in the website for public viewing:

- Inundation map
- Flood intensity map
- Village level inundation map
- River status map during flood
- Post flood River Status Map

Replicability: In order to address the flood situations in the flood prone states in India, the FMIS need to be rolled out across all states. Further the FMIS should contain modules for addressing land planning, zoning of flood plains, silt management besides integrating with flood forecasting and hydro-meteorological observations. The water flow data can also be used for irrigation in arid and semi-arid regions.

Sustainability: Sustainability analysis mechanisms, including 'Dynamic Sustainability' concepts, may be adopted in the flood management planning process. To ensure sustenance of benefits realized through FMIS, it is imperative to upgrade the application models in the FMIS and also ensure seamless integration with new applications.

(References: http://www.fmis.bih.nic.in; KII as part of primary survey)

19. IT based enumeration of Irrigation Census in Andhra Pradesh

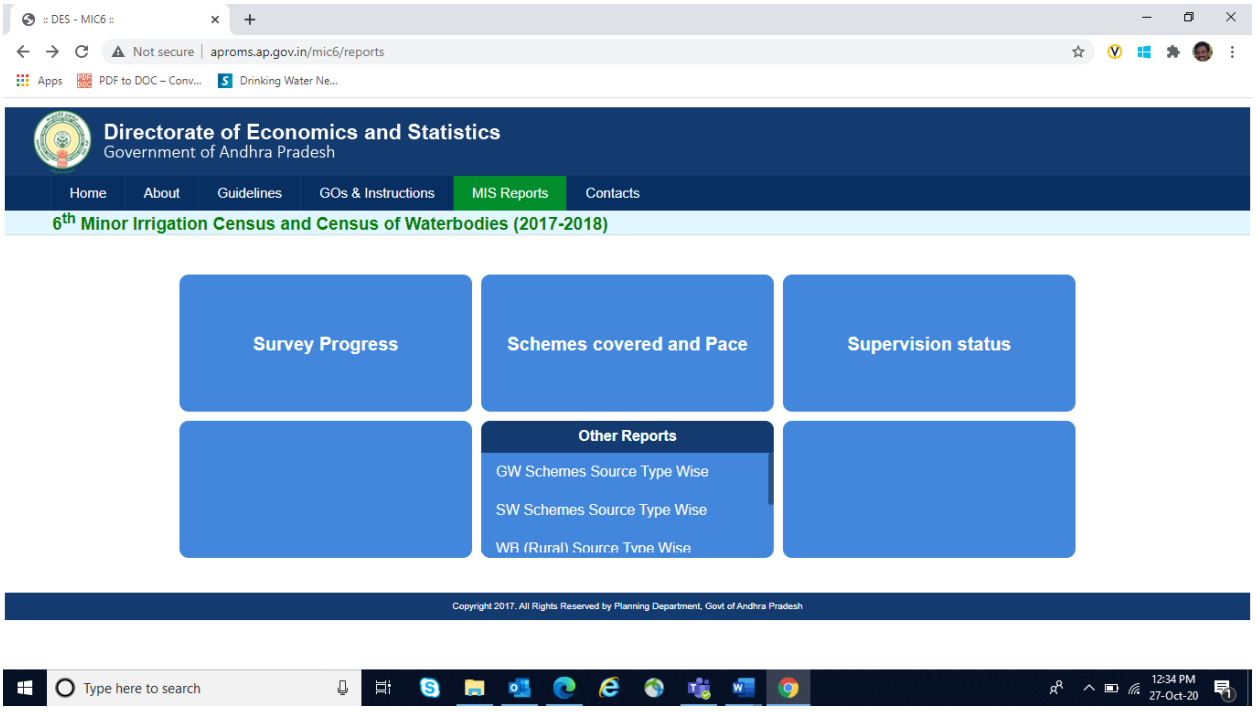
Problem Statement: Irrigation Census involves enumeration of data for all groundwater and surface water minor irrigation sources across all villages in India. The 6th Irrigation census also involved canvassing of data for water bodies in villages and urban local bodies. The enumeration process is done by canvassing five schedules to cover all aspects of minor irrigation. Huge data collection leading to issues like manual errors, missing data, operational issues are frequently experienced leading to increased time and resource lag, needless to say of issues like coordination, data tabulation and data validation techniques.

Solution offered: Andhra Pradesh is one of the few States that have conducted "Paperless" 6th Minor Irrigation Census. During the State Level Coordination Committee (SLCC) meeting prior to execution of 6th MI census, it was decided to conduct the survey through tab/ mobile app without canvassing the schedules to save time and avoid data entry errors. Accordingly, customized software was developed in-house. Tab / mobile app was developed with android version for canvassing all schedules of 6th Minor Irrigation Census and Census of Water Bodies. All the 5 schedules (Ground Water, Surface Water, Census of Water Bodies in Rural and Urban areas and Village schedule) as designed by GoI were integrated into the 3 schedules covering all the information. "Postgre SQL" is used for storing the captured data through tab/ mobile application.

Trainings were conducted for the field and supervisory functionaries at State, District and Mandal level before commencement of the census.

Pilot survey was done to test the application covering all the schedules of groundwater, surface water schemes and water bodies @ 2 schemes each in all 13 districts both in Rural and Urban areas. 'All the table' scrutiny checks were incorporated in the app as per instructions of GoI. Photographs along with latitudes and longitudes of water bodies are captured in the Census of Water Bodies. The app has been developed with provision to upload the canvassed data automatically in the NIC software structure in one go through back end bulk data entry.

Exclusive Web portal (http://aproms.ap.gov.in/mic6/dashboard) was established for day to day monitoring of the fieldwork of 6th MIC & CWB featuring different MIS Reports viz., (1) Survey progress (2) Schemes covered and pace (3) Supervision status and (4) Other reports.



WhatsApp group was formed to resolve the field level issues and to share the clarifications. Senior Officers from DE&S were allotted districts for monitoring and supervision. Core Group Team was constituted with group of officials. The team visited all districts and explained the process of rectification of errors in the portal at Mandal level as part of validation of the enumerated data.

Impact: The application has immensely benefitted the enumerators in terms of data collection and primary data validations, thus saving time and resource. The data consolidation was done in much lesser time. The progress of data collection was effectively monitored by the supervisors using the desktop application. The gaps or delays were monitored, and corrective actions were taken immediately.

Replicability: The applications that were used for Irrigation Census in Andhra Pradesh are very common and widely used in various IT applications across all sectors of business and social sectors. The modules can thus be replicated in other states and UTs. Furthermore, MI Stat wing, can further improve the application and incorporate provisions for online transmission of data to the server for data tabulation. Inbuilt data validation modules may be made a part of the overall application to complete correctness of data prior to tabulation.

Such an approach may be adopted for survey of medium and micro-irrigation schemes as well. A consolidated IT based application operatable with mobile / tab containing multiple schedules with inbuilt validation modules for all irrigation schemes can be thought of. The application may also use Machine Learning / AI techniques for analysis and predictions pertaining to water availability and demand. Such prognosis will immensely help the irrigation sector as a whole in identifying area specific issues and devise plans accordingly.

(Reference: KII with Nodal Officer, Andhra Pradesh as part of primary survey)

20. Automating the Irrigation Census – ensuring data reliability

Problem Statement: Minor Irrigation schemes in India are large in number and the data generated at field level are collected through manual canvassing of paper schedules. As a result, inadvertent delays and errors are experienced during validation and tabulation of data. On account of the massive importance of MI census data in terms of its applicability by various important government agencies like MoWR, CWC, CGWB, Water Resources Departments at State level for framing policies pertaining to appropriate usage of groundwater and rejuvenation of the sources, a need for having web-based application for accuracy and quick processing of data was felt by the MI Stat wing, MoWR. It was understood that adoption of the system may led to certain advantages like elimination of duplicate entries, timeliness, need based generation of tabulated data and archiving of historical data.

Solution offered: National Informatics Centre (NIC) was requested to develop a software, meeting the above-mentioned requirements. The work was adequately taken up by all States and extended to the districts, wherein adequate manpower was appointed for data entry. In the 5th MI census, a web-based software was created for the first time wherein, three different schedules for data entry namely, village schedule, ground water schedule and surface water schedule were introduced. For the 6th MI census and 1st Census of Water Bodies, five schedules viz., village schedule, ground water schedule, surface water schedule, urban schedule and the water body schedule, were incorporated for web-based data entry. The reliability of the data was checked through sample checks by the supervisors. In order to ensure data accuracy, timely tabulation of data and analysis, a software was developed with the following features:

- User friendliness
- Data verification ability
- Modules for data tabulation
- Data dissemination through websites
- Inbuilt models for identifying trends like pattern
- Decision Support System with Query Module

The overall objective of the project was to gather correct data. The databases collected from all States/ UTs have been merged for making a National level database and several reports have

been generated. The application has been divided into three modules based on their functionality i.e. Data Entry Module, Abstract Creation and Decision Support System (DSS). The objective of Data Entry Module is to gather the validated base/enumerated data. Abstract Creation Module will process these data (base/enumerated data) for generating a database that will be used by Decision Support System. DSS Module will generate all types of reports, queries and provide useful information.

Impact: Some of the major impacts noticed due to wide application of the web-based software are as follows:

- Efficient planning and decision making for development of Water Resources through consistent and consolidated information.
- Empowerment of end users to perform in-depth analysis
- Prediction of irrigation potential utilization and segmentation of areas through Online Analytical Processing (OLAP) models.

Replicability: The application documentation can be shared with other sectoral departments. Currently the scope of Irrigation Census is limited to Minor Irrigation only. The modules can be made applicable for medium and micro-irrigation schemes as well. Such an approach will bring majority of the irrigation schemes and their data under single accessibility. This will facilitate coverage of broader issues pertaining to irrigation and will help the policy makers in framing better schemes or revising components of the existing schemes as well.

Sustainability: Such a system can definitely be sustained by enabling strong data archives and archives of the analyses. Introduction of newer modules, software and update of the application on regular basis will ensure easier use of the application. Better analysis through application of Machine Learning techniques will also help the researchers towards analysis of village specific irrigation issues in a detailed manner.

(Reference: KII with DDG, MI Stat wing, DoWR, Govt. of India)

21. Balanced and sustainable development of river ecosystem through bio-monitoring efforts

Problem statement: The presence and growth of flora and fauna in rivers to a large extent depends on the quality of river water. Hence, it is important to monitor the presence of bio-organisms in the river to assess river health.

Solution offered: Odisha State Pollution Control Board (OSPCB) regularly undertakes biomonitoring of rivers. The mechanism involves sampling flora and fauna such as micro invertebrates and calculation of a bio-diversity index based on the population of different types of samples. The higher the bio-diversity index, the more diversity of micro-organisms in the river water, which indicates cleaner river water.

I**mpact**: Regular bio-monitoring mechanism has helped OSPCB in assessing the river health and taking appropriate measures in notifying the concerned department about actions.

Replicability: Such bio-monitoring mechanisms can be adopted by other State Pollution Control Boards to assess the health of the river ecosystem and presence of flora and fauna in the rivers.

(Reference: KII with Odisha State Pollution Control Board)

22. Financial support for projects through assistance from multilateral funding agencies

Problem statement: It was noted that the funds available with NRCD is inadequate to bridge the existing sewage treatment gap in the country. In addition, multiple proposals submitted for central funding under NRCP scheme have been rejected in recent years due to shortage of funds. Hence, external funding options such as multilateral funding agencies needs to be explored.

Solution offered: The Mula Mutha River Project in Pune is being implemented by the Pune Municipal Corporation under NRCP scheme with a loan assistance from JICA. The loan amount is 19.064 billion Yen. The remaining project cost is being shared between Government of India and Pune Municipal Corporation in the ratio of 85:15. Although, the funding pattern for states (other than north-eastern states) is 60:40, here since a significant portion of the project cost is being funded by JICA, central funding for the remaining cost is higher than in other cases.

Impact: Financial support has helped the Pune Municipal Corporation to take up such a large project (396 MLD STP) on River Mula Mutha.

Replicability: Since 2014-15, proposals amounting to Rs. 5,400 Cr. have been rejected by NRCD citing shortage of funds. Considering the shortage of funds with NRCD, such innovative funding mechanisms such as loan assistance from MFIs will enable large projects to be undertaken under NRCP scheme.

(Reference: KII with National River Conservation Directorate and Pune Municipal Corporation)

23. Improving sustainability of assets created under NRCP through appointment of private contractors for long terms

Problem statement: In many cases, the operational efficiency of the STPs created under NRCP is low and some STPs have become defunct due to lack of operations and maintenance (O&M) primarily owing to lack of funds and technical expertise. Hence, there is a need to involve private contractors for long term O&M to improve sustainability of the assets being created.

Solution offered: The Kolhapur Municipal Corporation has appointed a private contractor for a period of 15 years on Design, Build, Operate and Transfer (DBOT) mode. The contractor is responsible both for construction and O&M post construction. The contractor is made quarterly payments only during the O&M period. There is no fixed construction period. The contractor is incentivized to complete construction early and start operation so that they can get paid early.

Impact: The involvement of the private contractor has ensured smooth running of the 76 MLD STP in Kolhapur on River Panchganga. The STP is currently operating at 95% capacity. This has also ensured regular upgradation, retrofitting and modernization of sewage treatment technology to meet extant NGT discharge standards.

Sustainability: The involvement of private contractors has helped improved sustainability of the assets created under NRCP scheme and incentives such as renewal of contract based on contractor performance can also ensure that desired performance levels are achieved.

(Reference: KII with Kolhapur Municipal Corporation)

24. Holistic river conservation through maintaining of minimum environmental/ ecological flow in rivers

Problem statement: Most rivers in India except the Himalayan rivers have become seasonal with no flow in them during the lean season. They only have flow in them during the months of June-February. In the lean season, they almost have no flow. pollutants have an assimilative property and river water dilutes the pollutants. Hence, when there are very low levels of surface water, the pollution level measured in terms of BOD and COD will be high. It is important to maintain a minimum environmental or ecological flow in the rivers to dissipate the pollutants. This is currently not under the purview of NRCP scheme.

Solution offered: NMCG has provisions for Aviral Dhara or Wholesome River. Environmental water requirement (EWR) assessment methods, for ascertaining how much water should be retained in rivers to sustain ecological functioning and desired levels of biodiversity, have been developed under Aviral Dhara. Under NMCG, there is special focus on increasing base flow and aquifer recharge. Minimum environmental flows have been notified for different sections of the Ganga and violation of the e-flow norms would lead to closure of respective water-consuming projects such as hydroelectric projects and/ or imposing heavy penalties.

For non-perennial rivers it is often difficult to get data on hydrology, and ecological functioning. However, many tributaries of Ganga like the Damodar, Hindon, Kali etc are non-perennial. Hence the learnings from "Aviral Dhara" programme remains applicable.

For non-perennial rivers a case study through a method known as "DRIFT-ARID"[251] was adopted in South Africa which needs to be looked upon in the case of NRCP as well. This method explores refining the normal technique of EWR measurements over a period, through different types of non-perennial rivers. Many non-perennial rivers have enough water even during the dry season to carry out EWR measurements to be extrapolated using the DRIFT model data of perennial rivers. The fundamental requirement of such method is availability of enough data. Hence this needs to be adopted initially in select non-perennial rivers with a minimum e-flow and be replicated to others over time.

[251] Environmental Water Requirements of Non-Perennial Rivers, Michael C Grenfell

Impact: Adoption of such measures will ensure a minimum ecological flow in the rivers throughout the year and help reduce pollution in river water.

Sustainability: Additional project components for inclusion of the measures discussed above is needed for the NRCP scheme. This will help improve efficacy of the scheme and enhance sustainability.

(Reference: KII with National Mission for Clean Ganga and Environmental Water Requirements of Non-Perennial Rivers, Michael C Grenfell)

25. Holistic river conservation through river front development measures

Problem statement: Protection of riverbanks is an integral part of river conservation. In particular, during monsoon, regular floods affect the structures created on the riverbanks, habitations and cause soil erosion in adjacent lands. Hence, riverbank protection is needed for holistic river conservation.

Solution offered: Sabarmati riverfront project in Ahmedabad under which the Sabarmati riverfront has been beautified and developed as a tourist attraction.

Impact:

- Protection of riverbank and retention of water flow
- The abandoned land of riverbed and nuisance at the centre of the City was converted into people's attraction; tourist destination; creation of infrastructural and recreational facilities
- The capex spent could be recovered through direct revenue collected via tourist footfalls and indirect revenue in the form of taxes.

Replicability: The model is replicable for any river front and can be adopted as a measure to protect the riverbanks especially during floods.

(Reference: KII with Ahmedabad Municipal Corporation)

26. Holistic river conservation through afforestation measures

Problem statement: Protection of riverbanks is an integral part of river conservation. In particular, during monsoon, regular floods affect the structures created on the riverbanks, habitations and cause soil erosion in adjacent lands. Hence, riverbank protection is needed for holistic river conservation.

Solution offered: NMCG currently working with Department of agriculture for 5-7 km belt along Ganga to undertake organic riverbed farming along the rivers in Uttarakhand. A pilot research is being undertaken on Agri-run off and promotion of organic farming along the Ganges. MoEF&CC is also taking this up to extend to other 13 rivers and looking at convergence with CAMPA funds.

Impact: Such afforestation measures not only protects riverbanks but also is a source of revenue generation through organic farming.

Replicability: The model is replicable for any river front and can be adopted as a measure to protect the riverbanks.

(Reference: KII with National Mission for Clean Ganga)

27. Holistic river conservation through adoption of river basin conservation approach

Problem statement: Since the fund available with NRCP is limited, projects for conservation and sewage treatment along major river basins should be prioritized to be taken up under the scheme. Hence, there is a need to take an approach towards river basin conservation of major rivers.

Solution offered: The Rhine river flows across Switzerland, France, Germany and the Netherlands to reach the North Sea. During the rapid industrialization of 1800s, there was rampant river pollution where untreated chemicals from industries as well as untreated sewage was thrown into the river much like in India today. Multiple actions and international cooperation were targeted through the Rhine Action Programme. However, results only started being visible in the 1980s. Restoration of river water quality to drinking standards, ecological rehabilitation, restoring salmon population were few of the key success indicators. Currently, Rhine 2020 programme is ongoing to continuously monitor and maintain the river health including flood prevention and groundwater protection. This entire programme wouldn't have been successful without intense trans-boundary cooperation between multiple governments and citizens.

Impact: The Rhine 2020 program has been immensely successful in improving the quality of water of River Rhine.

Sustainability: A key learning from the Rhine Action programme is that a river basin conservation effort is not a one-time effort but a continuous process and spans decades and requires immense collaboration and stakeholder engagement throughout the process.

(Reference: Rhine 2020 Action Program)

28. Exploring revenue generation options during O&M through wastewater reuse

Problem statement: The NRCP scheme focuses on sewage treatment infrastructure only and the full responsibility of the O&M of the STPs created rests with the state government and PIAs. In some cases, it was noted that Project Implementing Agencies (PIAs) are unable to provide adequate funds and hence limited maintenance activities are being undertaken on the assets created such as upgradation to new technologies, retrofitting, cleaning etc. This has led to some STPs becoming defunct and not functioning to full capacity. There is also limited focus on revenue generating activities during O&M.

Solution offered: Learnings can be derived from the case study of River Nag and Pili in Nagpur on wastewater treatment and reuse. In April 2020, pollution abatement works on Rivers Nag and Pili in Nagpur has been approved at a total cost of Rs. 2,324 Cr. to be funded by JICA and partially (15%) by Nagpur Municipal Corporation. The project includes construction of 2 STPs (48 MLD and 43 MLD respectively) and laying of 1,362 km of sewage lines for diversion of sewage from 100 small streams that flow into River Nag/ Pili downstream. An arrangement of water swap has been undertaken for wastewater reuse. Raw water sent in bulk to the industries under Nagpur Municipal Authority is diverted to water treatment plants for the city, thus increasing availability of potable water for Nagpur residents. In turn, recycled water from the city is again being diverted for industrial use. This water swap arrangement, operational since 2015, is additionally using municipal treated wastewater from Nagpur for cooling purposes in the power plants at Koradi, Khaparkheda and Mauda.

Impact: The above water swap arrangement has helped Nagpur Municipal Corporation take up wastewater reuse in a unique way and ensuring long term sustainability of the project.

Sustainability: The above model is sustainable in the long term since there will always be a demand for water from the industries and there will always be wastewater generated from the city. This model can be adopted where there are major towns and cities situated on riverbanks.

(Reference: Nagpur Pili river water swap arrangement published in news articles)

29. Water resources management balancing economic principles, ecological sustainability and political contexts, Murray-Darling River Basin in Australia

Problem statement: The Murray-Darling River Basin in Australia, which accounts for almost one-seventh of the total land mass of Australia, witnesses extreme spatial and temporal variation of rainfall. The rainfall, within the Basin, varies from 1,400 mm/ year in the highlands to 300 mm/ year in the northwest. The basin also witnesses large variation in seasonal rainfall year to year – annual variation to the extremes of 10,000:1 has been reported in the Darling river. Notably, the basin also has relatively low annual discharge compared to other river systems in the world.

Solution offered: Water shortages together with environmental concerns and degrading water quality (as indicated by declining biodiversity, increase in algal bloom and water salinity), led to the adoption and evolution of various frameworks and legislations in the Basin related water allocation, inter-region water trading, water quality trading and water delivery and pricing, as discussed below.

- Cap on surface water diversion, along with periodic monitoring and audits, to contain the declining river health
    - Various caps on water diversion are set for the states
    - Periodic audits of compliance to the Cap on water diversions are enabled by the Murray-Darling Basin Agreement and agreements by the Council of Australian Governments (COAG). The Murray-Darling Basin Authority (MDBA) has developed Sustainable Diversion Limit Reporting and Compliance Framework to manage water use exceeding limits in dry and wet years. Compliance to these agreements are further incentivized through tranche payments to the states based on the status of the reforms undertaken.
    - Water allocation plans, as prepared at the local level, are given the status of statutory documents and thus states are accountable to implement them.
    - These Cap measures are further facilitated by introduction of inter-region water trading.
- Introduction of inter-region water trading

- Different instruments of water trading have been introduced like high security licences where agreed volume of water is provided except in drought condition and low/ general security licences with varying water volume from year to year based on availability.
- Introduction of legislations by some states (like South Australia and New South Wales) allowing separation of land and water titles and practice of both permanent and temporary (say lease of water for a particular period) trades allows even persons with no land to posses water licence as an investment. Also, water title holders may sell surplus water without selling the land.
- To account for transmission gains and losses in the system, various exchange rates have been introduced; e.g. transfers upstream are assigned exchange rate of 0.9 (10 ML in South Australia = 9 ML in New South Wales which is upstream).

- Development of a system for dealing with salinity issues
  - Introduction of salinity interception schemes with various restrictions on states; e.g. states like Victoria and New South Wales are not allowed to approve any proposals, that may increase salinity by 0.1 EC in the Murray river, unless they have any access to salinity credits.
  - A Salinity Audit was undertaken to develop a new salinity strategy and strengthen the existing salinity interception schemes.
- Development of frameworks and legislations in relation to water pricing and delivery
  - Various economic considerations in relation to water pricing and fees collection were codified by the COAG in its water pricing policy.
  - Various states have established adequate institutional mechanisms to facilitate the cost recovery measures.
    - States like New South Wales have set up an Independent Pricing and Regulatory Tribunal (IPART) which is responsible for determining the cost structure for bulk water pricing.

        - In South Australia, a catchment water board is responsible for levying water charges based on future infrastructure and water requirements. Different pricing slabs are introduced for industrial and domestic users while irrigators with only valid licenses are allowed to draw water. All new infrastructure/ projects are approved based on full cost recovery principle.

- Involvement of various stakeholders and separation of the role of planning and regulation from operation
    - Skill based local boards, set up in various jurisdictions, are responsible for determination of water allocation.
    - Day to day operations and water delivery are entrusted to the corporations, who have no direct role in policy development. Many of the states have undertaken 'corporatization' of the operations of water delivery through involvement of private parties, e.g. the Murray Irrigation Limited, a private entity, holds around 75% of New South Wales general water security entitlements.

Impact: During the initial year, New South Wales recorded sales amounting to more than 10% of total entitlements while a two year pilot project in the Malle region of South Australia, Victoria and New South Wales saw trade volumes to the tune of 9.8 GL. Water trading facilitated the adoption of water efficient practices and gradual shift from lower to higher value agricultural products like viticulture and horticulture crops. Under the salinity interception schemes, states like Victoria and New South Wales have earned salinity credits of 15 EC. The salinity interception schemes led to reduced salinity in South Australia and more awareness and adoption of cost effective measures to protect irrigated lands from land degradation. 'Corporatization' of the water delivery mechanisms including the involvement of consortiums of private irrigators ensured buy-in from the water users in both the planning and delivery processes including cost recovery.

As on July 2020, 13 water resource plans are in place and over 2,100 GL of water is managed by the Basin's environmental water holders. The 2020 Basin Plan Evaluation report highlighted achievement of various positive ecological responses including delivery of adequate water to Coorong, Lower Lakes and Murray Mouth during the drought season. The report also noted how ongoing reforms in water trading markets (surface water), particularly in the well-established

southern Basin market, have led to improvement in drought resilience and transition towards high value water usages.

Sustainability: In order to ensure the sustenance of the water management practices introduced earlier, it is imperative to update the provisions based on the recent developments. For example, the initially exempted institutes like Australian Commonwealth Territory and Queensland need to adopt the water Cap measures to avoid any potential conflict with other water users who are currently under the ambit of the Cap measures. Various contentious issues like introduction of Cap on groundwater and farm diversions need to be reconsidered. To further facilitate the water trading mechanisms, there is a need to reduce the transaction costs (like the brokerage fees, time cost and approval costs). Also, provisions like strengthening the long-term commitments need to be introduced to account for the ecological impacts of the trade.
The Interim Report (August 2019) of the Australian Competition and Consumer Commission (ACCC) has highlighted various deficiencies in relation to settings and governance of water trading mechanisms, that are understood to undermine the efficiency of the trading mechanisms. The 2020 Basin Plan Evaluation report identified six priority areas for the future ranging from full implementation of Basin plan to adoption of various climate resilience and integrated water management practices to achieve social, economic and environmental outcomes.

(Reference: Darla Hatton Mac Donal and Mike Young, International Water Management Institute " A Case Study of the Murray-Darling Basin"; Murray-Darling Basin Authority "The 2020 Basin Plan Evaluation" https://www.mdba.gov.au/sites/default/files/pubs/bp-eval-2020-overview.pdf, Murray-Darling Basin Authority website https://www.mdba.gov.au)

30. Addressing water shortages through quota control and economic incentives, Shiyang River Basin in China

Problem statement: During the early 2000s, the Shiyang River Basin, an inland river basin in Northwest China, was witnessing significant decline in both surface water and groundwater levels owing to increase water demand, resulting in severe water conflict among the water users in the different reaches. From 1950 to 2003, irrigated area in this region increased by 30% while water use increased by 75%.The increasing water demand led to a decrease in surface water flow from 500 million m^3 in 1950s to 98 million m^3 in 2003 while the number of tubewells in the Minqin County alone peaked to 14,000.

Solution offered: To mitigate the water shortages and the ecological crisis, a River Basin Management Bureau was set up and a comprehensive water management plan (CWMP) was approved by the Ministry in 2006 outlining the following targets – increase in surface water availability in downstream Minqin area from 98 million m^3 in 2003 to 290 million m^3 by 2020, decrease in groundwater extraction from 517 million m^3 in 2003 to 86 million m^3 by 2020 in the Minqin area and from 747 million m^3 to 418 million m^3 in the whole basin during this period. A number of institutional mechanisms and economic measures have been initiated to meet the targets, the most notable being introduction of water consumption permits, as discussed in detail below:

- Water consumption permits have been granted to the individual households, which were determined based on the number of household members and type of crops cultivated. For example in the Minqin County, the permit allows water consumption for developing 2.5 mu of irrigated area per capita while household with more than 2.5 mu irrigated area per capita could obtain additional water through plantation of horticulture crops and transforming land to greenhouses.
- An Integrated Circuit Card (IC card) technology was introduced to monitor water consumption permit. The electronic systems were installed in the tubewell and the respective WUAs were allotted the IC card. Each farmer was entitled to purchase maximum water permits of 415 m^3 per mu. The WUAs coordinated the consumption patterns of the members to ensure equitable distribution.

- In irrigated areas dependent solely on groundwater or a mixture of both surface water and groundwater, a two-part (basic + volumetric) has been introduced. Also, different tariff levels were set for various cropping patterns – water for greenhouse and drip irrigation were exempted from the basic water fee and also eligible for availing 20% and 50% discounts in surface water and groundwater fees respectively while tariff for water intensive crops attracts a premium of 50% for groundwater and 30% for surface water respectively.
- Steep premiums, to the tune of 150% to 300%, were imposed on fees charged, in case of consumption exceeding the permissible limits.

Impact: Water cost recovery in the area has significantly improved over time, with surface water fee per m^3 in the middle reaches increasing from 0.08 yuan to 0.2 yuan during 2007 to 2017, while that in the lower reaches recording increase from 0.1 yuan to 0.24 yuan. Water consumption permits facilitated adoption of water efficient practices with the economic output per m^3 of water increasing from 1.3 yuan in 2009 to 9.33 yuan in 2015. These measures facilitated the shift from traditional grain crops to cash crops in the SRB province with farmer's income registering a two-fold increase. As reported, implementation of various provisions of the CWMP led to a jump in average agricultural water-use coefficient from 0.53 to 0.58 and reduction in water use per irrigated land from 626 m^3 to 430 m^3 during 2007 to 2015.

Sustainability: As per the evaluation reports released by the Gansu government, significant improvement in water usages during 2007 to 2015 have been reported owing to these measures. To ensure sustenance of these benefits, measures like water consumption benefits were supplemented by adequate changes in institutional and funding mechanisms like development of WUAs and special fund/ subsidy allocations.

However, it may be noted that the water permit trading has been limited to only between the WUAs within the same ID. Also, a decline in trade volume was recorded between 2015 and 2016. At the local level, the trade was limited due to heterogeneity issues, while at the national and state levels, it was impaired by lack of necessary regulatory framework and legislation.

(Reference: Liuyang Yao et al., MDPI, "China's Water-saving Irrigation Management System: Policy, Implementation and Challenge", December 2017*)*

31. Improvement in water fees collection through canal contracting in Jinghuiqu Irrigation District in China

Background: In the late 1900s, the Jinghuiqu irrigation bureau initiated a number of institutional reforms including reforms of lateral canal management – lateral canals were contracted to private parties (individual or consortium). As on 2000, 428 of the 538 lateral canals were contracted. Some of the key features of the contracting mechanism are highlighted below:

- The using rights of the lateral canals were auctioned with minimum bid price of 2,000 yuan per km
- The terms of validity ranged from 10-15 years for irrigation staff to 15-20 years for other contractors
- Each contractor was entitled to minimum water diversions based on the past five years data with an annual increase of 3% in future
- Development of right of land along the lateral canals was entrusted to the contractor
- A performance linked salary mechanism was introduced for the administrative staff in each irrigation bureau

Impact: In general, as noted in the article 'Irrigation reform in Asia: A review of 108 cases of irrigation management transfer' by Aditi Mukherjee et al. (2010), the model of lateral canal contracting to private contractors yielded 'better results' compared to Participatory Irrigation Management PIM in China. In the Jinghuiqu irrigation district, the contracting reforms facilitated a substantial reduction in number of staff in the irrigation stations which led to savings to the tune of 1.4 million yuan for the irrigation bureau.

Sustainability: To sustain the irrigation facility management and avoid potential issues in relation to water allocation, water volume metering and fee collection, the irrigation bureau released standardized rules for invoicing, metering, construction cost for lateral canal improvement projects and water fee for the reformed canals. To ensure transparency, the methods of water charging and amount charged need to be publicly disclosed.

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