सत्यमेव जयते

नीति आयोग

National Institution for Transforming India

# COMPOSITE WATER MANAGEMENT INDEX

## NITI Aayog

## August 2019

In association with

Ministry of Jal Shakti and Ministry of Rural Development

सत्यमेव जयते

जल शक्ति मंत्रालय

MINISTRY OF JAL SHAKTI

सत्यमेव जयते

Ministry of Rural Development

Government of India

डॉ. राजीव कुमार
उपाध्यक्ष
**DR. RAJIV KUMAR**
**VICE CHAIRMAN**
**Phones:** 23096677, 23096688
**Fax** : 23096699
**E-mail** : vch-niti@gov.in

सत्यमेव जयते

भारत सरकार
नीति आयोग, संसद मार्ग
नई दिल्ली–110 001
Government of India
NATIONAL INSTITUTION FOR TRANSFORMING INDIA
NITI Aayog, Parliament Street
New Delhi-110 001

# PREFACE

In a first-of-its-kind endeavor towards *Jal Sanchay*, *Jal Sanrakshan*, and *Jal Sinchan*, the Composite Water Management Index (CWMI) was developed by NITI Aayog to reinforce the spirit of competitive and cooperative federalism in India. The Index proposed a policy shift in water resources management, from the conventional style of investment in major infrastructure projects, to undertaking grass-root level activities with participation of local communities which could ensure equitable access of water. It is also aimed at fostering a culture of evidence and data-backed policy decisions for efficient management of water resources in the country.

India is home to ~17% of world's population but has only 4% of the world's freshwater resources. Managing these for a huge population is a mammoth task. It is estimated that about two lakh people die every year due to inadequate water, sanitation and hygiene. In 2016, per person disease burden due to unsafe water and sanitation was 40 times higher in India than in China and 12 times higher than in Sri Lanka. With the country generating huge amounts of waste water annually, mismanagement of waste water, which also contaminates groundwater, lack of liquid waste management, poor sanitation conditions and poor hygiene habits have contributed to a significant portion of population suffering from water-borne diseases.

The annual utilizable water resources in the country are 690 BCM from surface sources and 447 BCM from groundwater. In spite of possessing surface water resources, India is highly dependent on groundwater resources for day to day survival. Right now India is facing the challenge to fulfill its demand through the existing but depleting resources. To supplement its present resources, we have to find unconventional solutions involving recycle and reuse of water, rainwater harvesting, etc. It is possible to store 214 BCM of surplus monsoon runoff in ground water reservoir. We have to go back to the era when people valued and conserved each drop.

In view of the limitations on availability of water resources and rising demand for water, sustainable management of water resources has acquired critical importance. The Index would provide useful information for the States and the concerned Central Ministries/Departments, to formulate and implement suitable strategies for improved management of water resources. It has been finalized after an elaborate exercise including feedback from the States and consultation with reputed experts. It is gratifying to note that the indicators of CWMI Round I have been largely incorporated in the Jal Shakti Abhiyan which

स्वच्छ भारत
एक कदम स्वच्छता की ओर

was recently inaugurated by the Hon'ble Prime Minister. This reflects the comprehensiveness and granularity of the CWMI in assessing the water situation in India and giving direction to water-smart policies for years to come.

I am hopeful that the efforts of NITI Aayog will sensitize, motivate and better equip every individual with the knowledge of judicious use of water. I congratulate Mr. Amitabh Kant for encouraging and guiding Mr. Avinash Mishra, Adviser, Water Resources, NITI Aayog, and his team of officials and young professionals, to persevere on the mission of water management and come out with Round II of CWMI. CWMI generated a momentum towards water conservation activities and the increase in participation and data reporting by the States. My compliments to the Central Ministries/Departments, State Governments, Water Resources Vertical at NITI Aayog and our knowledge partners, for the preparation of this Report.

(Dr. Rajiv Kumar)
Vice-Chairman
NITI Aayog

August 13, 2019
New Delhi

अमिताभ कांत
Amitabh Kant
मुख्य कार्यकारी अधिकारी
Chief Executive Officer

सत्यमेव जयते

भारत सरकार
नीति आयोग, संसद मार्ग,
नई दिल्ली-110 001
Government of India
NATIONAL INSTITUTION FOR TRANSFORMING INDIA
NITI Aayog, Parliament Street,
New Delhi-110001
Tel. : 23096576, 23096574 Fax : 23096575
E-mail : ceo-niti@gov.in, amitabh.kant@nic.in

# FOREWORD

Under the leadership of Hon'ble Prime Minister, India has adopted inclusive development as the key developmental paradigm for our Nation. In order to ensure the inclusive development for all, it is necessary that benefits of policy or intervention must reach the last mile, especially, when the intervention is about a life shaping resource like Water. Water in spite of being the focal point for economic and social development of the human race, is the most inefficiently used public good. The increased scarcity of water is affecting the broad spectrum of economic, social and developmental activities of the Nation. It not only affects GDP directly in the form of loss of productivity of agriculture, industrial and service sector but also decreases the ability of the human resources to think, invent and produce which indirectly hampers the growth of the Nation. While water is a renewable resource, it is at the same time a finite resource. Over the years, expanding agriculture, growing industrialization, increasing population and rising standards of living have increased our water demands at same static supply. Efforts have been made to collect water by building dams and reservoirs and creating ground water structures such as wells, but mismanagement of the resources and lower user efficiency has resulted in a water stress situation in the Nation.

Currently, nearly 820 million people in 12 major river basins of India are facing high to extreme water stress situation. Out of these, 495 million alone belong to Ganga river basin which generates nearly 40 percent of the country's GDP. The scarcity of water resources also has many cascading effects including desertification, risk to biodiversity, industry, energy sector and risk of exceeding the carrying capacity of urban hubs. It's a fact that water is a State subject and its optimal utilization and management lies within the domain of the States. By considering all these, it is very clear that now the Nation has to come up with interventions which measure not only the outcomes but also the effort involved in achieving these outcomes. Thus, in 2018, NITI Aayog had come out with the first round of Composite Water Management Index as a useful tool to assess and improve the performance in efficient management of water resources. Through Round I of Composite Water Management Index, we were able to sensitize the issue of water management among the people and we successfully conveyed the message of water conservation to the masses, private developers and government agencies. NITI Aayog's unique effort for this tool of conservation and management of water resources had been appreciated all over the world and was focus point of many discussions and conferences.

The new government, in 2019, picked up the challenge of water management and conservation by launching Jal Shakti Abhiyan - a campaign for water conservation and water security in 1592 water stressed blocks in 256 districts on 1$^{st}$ July 2019. Inspired by the Hon'ble Prime Minister's impetus on Jal Sanchay, the Jal Shakti Abhiyan is a time-bound, mission-mode water conservation campaign. If implemented well, this program has the capacity to change the overall scenario prevailing in water sector of India. To supplement these efforts, NITI Aayog has prepared the second Round of Composite Water Management Index. Once again, we have focused on the critical issues related to water management in the country. In addition to this, two new indicators related to 24*7 piped water supply to villages and villages having individual household water meters are included in the Index. These two indicators fulfil the mandate of our Hon'ble Prime Minister to achieve the objective of 24 x 7 supply of piped water to not only urban areas but also rural areas. As Round one of the Index had set a context for conservation of water resources, Round two is focusing on policy-oriented decisions which can be taken in the water sector. The results of Round two of the Index depicts the everlasting impact created by Round one. Various indicators have shown significant improvement which indicates that states are now more serious and motivated to improve the situation of water in their respective areas.

But this would have not been possible without the incessant efforts of various people. I would like to acknowledge the continuous support and guidance provided by Dr. Rajiv Kumar, Vice Chairman, NITI Aayog; Dr. Ramesh Chand, Member, NITI Aayog; Shri Parameswaran Iyer, Secretary, Jal Shakti Ministry; Shri U.P. Singh, Secretary, Jal Shakti Ministry; and Dr. Amarjeet Sinha, Secretary Ministry of Rural Development.

I appreciate the work done on the Index, progress monitoring and pursuance with the State Governments by Shri Yaduvendra Mathur, Special Secretary, NITI Aayog.

I would like to acknowledge the efforts in state sensitization, handhold support, compilation and uploading of data on the portal by Shri Avinash Mishra, Adviser (Water Resources & Land Resources), NITI Aayog and his team of officials, Shri N. Kumar Vel, Scientist 'D', Shri Gopal Saran, Scientist 'C', and Dr. Namrata Singh Panwar & Ms. Arunima Chandra, Young Professionals.

I wish to convey my sincere thanks to Dalberg Advisors for commentary, data analysis, and narration and IPE Global for third-party data review and validation.

Last but not the least, I personally appreciate the commendable job carried out by various State Governments in collecting the relevant water related data from 9 to 10 departments which is a mammoth task in itself. The Index would have not been completed without the hard work put in by a large number of States' and UTs' officials at all levels who have toiled to collect, collate, and upload the data on the portal under the guidance of the Chief Secretary and the Principal Secretaries of the States-in-charge of water resources. I wish to acknowledge and appreciate their efforts.

NITI Aayog under the able leadership of Hon'ble Prime Minister and as the agent of innovation and change in the Nation will keep on initiating such endeavors to instill the spirit of cooperative and competitive federalism in the states and to engrave India as the forerunner of innovation on the world map.

**(Amitabh Kant)**

**Dated: 13 August, 2019**
**Place- New Delhi**

# CONTENTS

# KEY ABBREVIATIONS

| Abbreviation | Expanded version |
|---|---|
| ADB | Asian Development Bank |
| APA | American Planners Association |
| AUD | Australian Dollar |
| BCM | Billion Cubic Meters |
| CAD&WM | Command Area Development and Water Management |
| CAG | Comptroller and Auditor General of India |
| CCD | Consortium for DEWATS Dissemination Society |
| CGWB | Central Ground Water Board |
| CSE | Centre for Science and Environment |
| CSR | Corporate Social Responsibility |
| CWC | Central Water Commission |
| CWMI | Composite Water Management Index |
| DDUGJY | Deen Dayal Upadhyaya Gram Jyoti Yojana |
| DEWATS | Decentralised Wastewater Treatment Systems |
| EPW | Economic and Political Weekly |
| ESG | Environmental, Social and Governance |
| FAO | Food and Agriculture Organisation |
| FSTP | Fecal Sludge Treatment Plant |
| FY | Financial Year |
| GDP | Gross Domestic Product |
| GIS | Geographic Information System |
| GO | Government Order |
| GOI | Government of India |
| GW | Groundwater |
| HH | Household |
| ICMR | Indian Council of Medical Research |
| ICRISAT | International Crops Research Institute for the Semi-Arid Tropics |
| IEC | Information, Education, and Communication |
| IHME | Institute for Health Metrics and Evaluation |
| INR | Indian Rupee |
| IPC | Irrigation Potential Created |
| IPU | Irrigation Potential Utilized |
| ISF | Irrigation Service Fee |
| ISRO | Indian Space Research Organization |
| IVA | Independent Validating Agency |
| IWMP | Integrated Watershed Management Programme |
| JMP | Joint Monitoring Programme |
| JNNURM | Jawaharlal Nehru National Urban Renewal Mission |
| KERC | Karnataka Electricity Regulatory Commission |
| KJJY | Krishak Jivan Jyoti Yojana |
| KPI | Key Performance Indicator |
| MDWS | Ministry of Drinking Water and Sanitation |
| MIS | Management Information System |

| | |
|---|---|
| MLD | Million Litres per Day |
| MMI | Major and Medium Irrigation |
| MNREGA | Mahatma Gandhi National Rural Employment Guarantee Act |
| MNREGS | Mahatma Gandhi National Rural Employment Guarantee Scheme |
| MoEFCC | Ministry of Environment, Forest and Climate Change |
| MoWR | Ministry of Water Resources, River Development, and Ganga Rejuvenation |
| MSME | Micro, Small and Medium Enterprise |
| MSP | Minimum Support Price |
| NARP | National Agricultural Research Project |
| NBSS & LUP | National Bureau of Soil Survey & Land Use Planning |
| NCRB | National Crime Records Bureau |
| NGO | Non-Governmental Organization |
| NIMF | National Irrigation Management Fund |
| NJY | Niranthara Jyothi Yojane |
| NMC | Nagpur Municipal Corporation |
| NRSA | National Remote Sensing Agency |
| OECD | Organisation for Economic Co-operation and Development |
| O&M | Operation and Maintenance |
| PHFI | Public Health Foundation of India |
| PIB | Press Information Bureau |
| PIM | Participatory Irrigation Management |
| PLOS | Public Library of Science |
| PMKSY | Pradhan Mantri Krishi Sinchayee Yojana |
| PPP | Public-Private Partnership |
| RKVY | Rashtriya Krishi Vikas Yojana |
| RS | Remote Sensing |
| SC | Scheduled Caste |
| SME | Small and Medium Enterprise |
| ST | Scheduled Tribe |
| TMC | Trillion Meter Cubic |
| UDPFI | Urban Development Plans Formulation and Implementation |
| UN | United Nations |
| UNCCD | United Nations Convention to Combat Desertification, 1994 |
| UNICEF | United Nations International Children's Emergency Fund |
| USAID | United States Agency for International Development |
| USD | United States Dollar |
| UT | Union Territory |
| WALMI | Water and Land Management Institute |
| WHO | World Health Organization |
| WRG | Water Resources Group |
| WRI | World Resources Institute |
| WUA | Water User Association |
| WUE | Water Use Efficiency |
| WWF | World Wildlife Fund |

# LIST OF TABLES

# LIST OF FIGURES

# INTRODUCTION

Scientific management of water is increasingly recognized as being vital to India's growth and ecosystem sustainability. The Government of India is being proactive about water management and has created the Ministry of Jal Shakti to consolidate interrelated functions pertaining to water management. The newly formed Jal Shakti Ministry under the guidance of Hon'ble Prime Minister has strived to over bridge the water challenge by launching the Jal Shakti Abhiyan - a campaign for water conservation and water security in 1592 water stressed blocks in 256 districts, to ensure five important water conservation interventions. These will be water conservation and rainwater harvesting, renovation of traditional and other water bodies/tanks, reuse, bore well recharge structures, watershed development and intensive afforestation. These water conservation efforts will also be supplemented with special interventions including the development of Block and District Water Conservation Plans, promotion of efficient water use for irrigation and better choice of crops through Krishi Vigyan Kendras. Inspired by the Hon'ble Prime Minister's impetus on *Jal Sanchay*, the Jal Shakti Abhiyan is a time-bound, mission-mode water conservation campaign. Government is advocating the adoption of best practices in water sector across India and recognizes that data-based decision making is going to be key to effective water management. This report by the NITI Aayog is an effort in this direction and reports progress made by various States & Union Territories on a set of comprehensive water management metrics.

## THE COMPOSITE WATER MANAGEMENT INDEX

**The National Institution for Transforming India (NITI) Aayog has developed the Composite Water Management Index (CWMI) to enable effective water management in Indian states.**

The **CWMI** is the first comprehensive collection of country-wide water data in India based on in-depth structured questionnaires followed by focus group discussions to generate qualitative information. **It represents a major step towards creating a culture of data-based decision-making for water in India, which can encourage "*competitive and cooperative federalism*" in the country's water governance and management.** The Index and this associated report are expected to: (1) establish a clear baseline and benchmark for state-level performance on key water indicators; (2) uncover and explain how states have progressed on water issues over time, including identifying high-performers and under-performers, thereby inculcating a culture of constructive federal competition amongst states; and (3) identify areas for deeper engagement and investment on the part of the states. Eventually, NITI Aayog plans to develop the Index into a composite, national-level data management platform for all water resources in India.

**This is the second edition of the CWMI published by NITI Aayog**. The first edition was published in 2018 and became a very well-received publication, in and outside the country, as is also reflected by the increase in participation of the number of states and two union territories (Delhi and Puducherry) for the first time. CWMI is the first of its kind to monitor key water-related metrics that are relevant for India going forward. The metrics spanned a range of upstream and downstream categories, including coverage of piped water supply for the population on the one hand and groundwater management and source protection on the other. **The Index has been developed in close collaboration with multiple national and state stakeholders and involved a robust data validation process.** The Index uses water data from both central and state sources for three years—the base year (FY 15-16), FY 16-17, and the current reference year FY 17-18—thereby enabling not only benchmarking of the current water performance of states, but also the study of the evolution of water performance over time. States were required to fill out the necessary data on a NITI Aayog portal available in public domain. At the backend, this data aggregation involved a massive exercise across 25 states and 2 Union Territories (UTs) in the country, including a complex process of liaising between multiple agencies and departments within states, followed by validation by a third party. Data for several indicators in the Index—including groundwater restoration, irrigation management, on-farm water use, rural and urban drinking water supply, and water policy frameworks—was compiled and then triangulated with contributions across all levels, from union and state water departments to department engineers and local authorities.

**This coordinated exercise was led by the Water Resources Vertical within NITI Aayog and the data was then reviewed and verified by an Independent Validation Agency (IVA)—IPE Global**. The IVA liaised with relevant state departments to verify and update the data included in the CWMI. The agency also requested and received supporting documents against each indicator included in the Index from State Nodal Officers (SNOs). The IVA also conducted field visits across nine states and UTs as part of its robust validation process. Finally, observations and results were shared with the SNOs after the validation exercise. Subsequently, the IVA also shared the validation results through a conference held at NITI Aayog on the 4$^{th}$ of February 2019 to present the results of the 25 states and 2 UTs that had submitted the data. The conference also helped the IVA to present the discrepancies, fill data gaps, and highlight deviations found during the process of verification with each state.

The compilation and collection of data from 25 states and 2 UTs proved to be a tedious but rewarding exercise, and NITI Aayog appreciates the commendable work, cooperation, and suggestions of state governments in this regard.

# SECTION I

EXECUTIVE SUMMARY

STATE SUCCESS STORIES

WATER RISKS & RELATED IMPLICATIONS

# EXECUTIVE SUMMARY

**Water has been recognized as being vital to India's economic growth, wellbeing of its people, and the sustainability of ecosystems.** Over the last few years, the Government of India as well as State Governments have been implementing a range of projects focused on groundwater recharge; responsible use of water for agriculture; and use of technologies such as micro-irrigation. Similarly, ranges of legislation promoting water-efficient energy production or discouraging water pollution by industry have been enacted. More significantly, the Government has consolidated institutional structures under the Ministry of Jal Shakti to bring interrelated water management functions together and drive more effective outcomes.

**Data-based decision making and competitive federalism can drive significant improvements in water management in the country.** Across the country, there are thousands of decisions taken on a periodic basis that determine the use of and replenishment of water resources of the country. These include decisions pertaining to irrigation policies, watershed management, water supply processes, water pricing, and even export policies that impact "virtual water". It is important that these decisions get taken on the basis of high-quality water data and also that different States & Union Territories in India learn from each other's best practices, thereby constantly improving their water management practices.

**The Comprehensive Water Management Index (CWMI) 2019 measures the performance of States on a comprehensive set of water indicators and reports relative performance in 2017-18 as well as trends from previous years (2015-16 & 2016-17).** Such a benchmarking exercise can go a long way in creating a common frame for progress for water in India and also highlight the need for specific improvements.

**States are displaying progress in water management, but the overall performance remains well-below of what is required to adequately tackle India's water challenges.** ~80% of the states assessed on the Index over the last three years have improved their water management scores, with an average improvement of +5.2 points. But worryingly, 16 out of the 27 states still score less than 50 points on the Index (out of 100), and fall in the low-performing category. These states collectively account for ~48% of the population, ~40% of agricultural produce, and ~35% of economic output[1] of India.[2]

**High-performers continue to demonstrate strong water management practices, but low-performers are struggling to cope up.** Top performers such as Gujarat, Andhra Pradesh, Madhya Pradesh, and Himachal Pradesh have further increased their scores over the last three years, with improvement ranging from 4 to 11 points. On the other end, out of the 14 low-performing states from FY 15-16, only Haryana, Goa, and Telangana have been able to cross the 50-point threshold. Jharkhand, Uttar Pradesh, Odisha, Bihar, Nagaland, and Meghalaya still score less than 40 points, and the average improvement in low-performing category[3] over the last three years stands at 3.1 points, lower than 5.2-point average improvement observed across states.

---

[1] Economic output based on Net State Domestic Product at Current Prices (2011-12 Series) for 2015-16

[2] "List of States with Population, Sex Ratio and Literacy Census 2011", *Census 2011*, accessed May 6, 2019, https://www.census2011.co.in/states.php; "Agriculture - Statistical Year Book India 2017" *Ministry of Statistics and Programme Implementation*, accessed May 16, 2019, http://mospi.nic.in/statistical-year-book-india/2017/177; *Economic Survey 2017-18 Volume 2: Statistical Appendix* (Ministry of Finance, 2018), page A28, http://mofapp.nic.in:8080/economicsurvey/pdf/Annexures_Volume_2_Combine_25_jan_2018.pdf

[3] Refers to states in the low-performing category for FY 17-18 given on page 61 of this Report

**Large economic contributors have low-water management scores; poor management here can hamper India's economic progress.** Uttar Pradesh, Rajasthan, Kerala, and Delhi, 4 of the top 10 contributors to India's economic output,[4] have scores ranging from 20 points to 47 points on the CWMI. Given the indispensable role of water in any form of economic activity, water shortages can lead to reduced output in these states, and as a consequence, threaten India's aspirations to be an economic superpower in the future. These four states collectively account for over a quarter[5] of India's population, and reduced economic activity will reduce employment and livelihood opportunities in these large population clusters.

**Food security is also at risk, given that large agricultural producers are struggling to manage their water resources effectively.** None of the top 10 agricultural producers in India,[6] except Gujarat and Madhya Pradesh, score more than 60 points on the CWMI. This is concerning given that assessment on almost half of the Index scores is directly linked to water management in agriculture.

**On the positive side, greater focus on water governance and increased data discipline amongst states is building a pathway for driving long-term success.** States have displayed strongest improvement on the Policy and Governance theme amongst the nine themes included in the Index, with the theme median score rising by ~30% over the last three years. This indicates an increasing institutional ability of states to design policies to counter water-related risks. Further, data discipline, a driving principle behind development of the Index, is evolving as a practice amongst states. Data reporting on the Index is improving across states, and cases of states not reporting data on indicators have reduced by ~70%.[7]

**Going forward, states need to build on this momentum, and upgrade their water management practices to show outcomes and not just outputs.** Several disparities exist in water management amongst states. There are clear opportunities for high-performing states to become torchbearers of good water management practices in the country. Improved knowledge-sharing amongst states can enable them to learn from each other and solidify water management practices across the board. States should actively seek out guidance and solutions from one another and encourage diffusion of knowledge (including through exchange programmes of scientists and administrators) across borders. NITI Aayog is fully prepared to support cooperative federalism in this critical area. This will also help the country cooperate and coordinate its response to tackle the present water crisis that the country is facing. States also need to track the overall outcomes of their policy making and water administration, and make sure that improved legal, administrative, and operational outputs are leading to outcomes like increased groundwater levels, rejuvenated surface water sources, and improved piped water supply for rural and urban inhabitants. Without an outcome-based approach, state investments in water management are unlikely to have a desired positive impact on their water situations.

---

[4] Economic output based on Net State Domestic Product at Current Prices (2011-12 Series) for 2015-16, and the analysis does not include states that have not been assessed on the Index; based on data from *Economic Survey 2017-18 Volume 2: Statistical Appendix* (Ministry of Finance, 2018), page A28, http://mofapp.nic.in:8080/economicsurvey/pdf/Annexures_Volume_2_Combine_25_jan_2018.pdf

[5] "List of States with Population, Sex Ratio and Literacy Census 2011", *Census 2011*, accessed May 6, 2019, https://www.census2011.co.in/states.php.

[6] Analysis does not include states that have not been assessed on the Index; based on data from "Agriculture - Statistical Year Book India 2017 *Ministry of Statistics and Programme Implementation*, accessed May 16, 2019, http://mospi.nic.in/statistical-year-book-india/2017/177

[7] The figure does not include data reporting statistics for Arunachal Pradesh, Delhi, and Puducherry, given these states and UTs have been included in the Index assessment for the first time in FY 17-18

# State success stories: participatory and decentralized rural water management

Recognizing the levels and threat of water scarcity in the country, a number of states have designed participatory irrigation management programmes to promote decentralized water management and drive adoption of sustainable water management practices. This chapter highlights some of the prominent programmes states have implemented with such an approach. All states must learn from these models and potentially replicate them to tackle their respective water challenges.

## Mukhya Mantri Jal Swavlambhan Abhiyan (MJSA), Rajasthan

Rajasthan's Mukhya Mantri Jal Swavlambhan Abhiyan, launched in 2016, is a multi-stakeholder programme which aims to make villages self-sufficient in water through a participatory water management approach. It focuses on converging various schemes to ensure effective implementation of improved water harvesting and conservation initiatives.[8] Use of advanced technologies such as drones to identify water bodies for restoration is one unique feature of the programme. Gram Sabha in villages are responsible for budgeting of water resources for different uses, providing greater power to the community members in decision-making. In the first two phases of the programme, 7742 villages in Rajasthan benefited by 2.3 lac water conservation activities. In the second phase, 1.35 lac water conservation structures were created in 4213 villages. The program has benefited more than 88 lac people and 93 lac heads of livestock, covering an area of more than 33.50 lac hectares. After first phase there was 56% reduction of water supply through tankers and an average rise in the groundwater table by 4.66 feet in 21 non-desert districts of the states. 50,000 hectares of additional land had been made fit for cultivation in the districts and 64% of the installed hand-pumps had been rejuvenated.[9]

---

8 "Mukhya Mantri Jal Swavlamban Abhiyan", *Rajasthan Mukhya Mantri Jal Swawlamban Abhiyan 2015*, accessed June 6, 2019, http://mjsa.water.rajasthan.gov.in/.

9 *Mukhya Mantri Jal Swavlamban Abhiyan – Phase II: Attaining Water Self Reliance*, (Government of Rajasthan, April 2018), page 1.

## NEERU-CHETTU PROGRAMME, ANDHRA PRADESH

The Andhra Pradesh government has launched the Neeru-Chettu programme as a part of its mission to make Andhra Pradesh a drought-proof state and reduce economic inequalities through better water conversation and management practices. The programme has a strong emphasis on improving irrigation and focuses on ensuring water supply in drought-prone areas and reducing the ayacut[10] gap through scaled-up adoption of scientific water management practices. Repair, renovation, and maintenance of irrigation assets are key activities and completing such activities before monsoons is a priority under the programme.[11] The state has repaired about 7,000 farm ponds and over 22,000 check dams under the programme.[12] Additionally, 102 lift irrigation schemes have been commissioned or revived by the state.*13* Efforts under the Neeru-Chettu programme have enabled irrigation access to nearly 2,10,000 acres of land in the state.[14]

## JALYUKT SHIVAR ABHIYAN, MAHARASHTRA

10 Area served by an irrigation project

11 "Neeru Chettu", *Water Resources Department, Government of Andhra Pradesh, accessed June 6, 2019,* https://irrigationap.cgg.gov.in/wrd/neeruchettu

12 *"Neeru Chettu", Water Resources Department, Government of Andhra Pradesh,* https://aphrdi.ap.gov.in/documents/Trainings@APHRDI/AEEs/Srikalahasthi/presentations/iv%20week/Chittibabu/2%20neeru%20chettu%20presentation.pdf

13 Ibid.

14 Ibid.

The Maharashtra government launched the Jalyukt Shivar Abhiyaan in 2015-16 with the mission to make Maharashtra drought-free by 2019, and an aim of making 5000 villages water scarcity free, every year. Focus areas under the programme include deepening and widening of streams, construction of cement and earthen stop dams, work on nullahs and digging of farm ponds. The programme also involves geo-tagging of water bodies and use of a mobile application to enable web-based monitoring.[15] Programme initiatives have led to an increase in groundwater levels of 1.5 - 2 metres.[16] Additionally, 11,000 villages have been declared drought-free and agricultural productivity has increased by 30-50%.[17]

## Mission Kakatiya, Telangana

Telangana's flagship Mission Kakatiya programme, launched in 2014, aims to restore over 46,000 tanks across the state[18] and bring over 20 lakh acres land under cultivation.[19] The programme objectives include enhancing the development of minor irrigation structures, promoting community-based irrigation management, and restoration of tanks to enable effective utilization of the 255 TMC water allocated for minor irrigation under the Godavari and Krishna river basins.[20] Over 22,500 tanks had been restored till March 2018 as per reports.[21] The initiative has helped boost the water storage capacity of water bodies and enhance on-farm moisture retention capacity in the region. As per reports, Mission

15 "Jalyukt-Shivar", *Maharashtra Remote Sensing Applications Centre*, accessed May 16, 2019, http://mrsac.maharashtra.gov.in/jalyukt/; "Maharashtra Aims to Be Drought-Free By 2019, Launches New Programme", *@Businessline*, last modified 2019, accessed May 9, 2019, https://www.thehindubusinessline.com/news/national/maharashtra-aims-to-be-droughtfreeby-2019-launches-new-programme/article6975358.ece.

16 *Jalyukt Shivar Abhiyan*, Soil and Water Conservation Department Government of Maharashtra, http://cgwb.gov.in/Bhujal-manthan/bm3-file3.pdf.

17 Ibid.

18 "Mission Kakatiya", *Government of Telangana*, accessed July 31, 2019, http://missionkakatiya.cgg.gov.in/homemission

19 "Mission Kakatiya phase IV works gain momentum", *Telangana Today*, accessed June 6, 2019, https://telanganatoday.com/mission-kakatiya-phase-iv-works-gain-momentum

20 *Supra* note 18

21 "6,000 tanks to be restored under Mission Kakatiya phase IV", *Times of India*, accessed June 6, 2019, https://timesofindia.indiatimes.com/city/hyderabad/6000-tanks-to-be-restored-under-mission-kakatiya-phase-iv/articleshow/63281992.cms

Kakatiya has also led to an increase in the gross area irrigated under tank ayacut by 51.5% compared to the base year.[22]

## Sujalam Sufalam Yojana, Gujarat

The Sujalam Sufalam Yojana iss a water conservation scheme by the Gujarat government which focuses on deepening of water bodies before monsoons and increasing water storage for rainwater collection. Its inaugural run was from 1st May, 2018 – 31st May, 2018. The programme involved desilting of water bodies across the state and encouraged a participative approach. The state set a target to increase water storage capacity by 11,000 lakh cubic feet through deepening of 13,000 lakes, check dams, and reservoirs,[23] which was achieved successfully by the state as per media reports.[24] After the programme's success in 2018, the second edition was launched in 2019 in which the state increased its financial contribution to 60% for programme activities, requiring private entities to pay only the remaining 40%.[25]

In addition to participatory water management programmes being implemented across the country, states such as Madhya Pradesh have launched schemes to provide financial aid to farm owners for the construction of irrigation structures on private land. Further, Punjab has launched a scheme to incentivize farmers for efficient water use in irrigation through financial rewards.

## Kapil Dhara Yojana, Madhya Pradesh

---

22 Ibid.

23 "CM Launches Sujalam Sufalam Jal Abhiyan", *Gujarat Marching Ahead Volume 4 May 2018,* accessed June 6, 2019, https://gujaratinformation.net/uploads/publication/eng_pak_may2018.pdf, page 16.

24 "Guj CM launches second edition of water conservation scheme", *Business Standard*, accessed June 6, 2019, https://www.business-standard.com/article/pti-stories/guj-cm-launches-second-edition-of-water-conservation-scheme-119022300670_1.html.

25 Ibid.

The Kapil Dhara Yojana by the state of Madhya Pradesh is a unique scheme under the MGNREGA programme to develop irrigation facilities on private land of small and marginal farmers, through the construction of dug wells, farm ponds, check dams, etc. The programme focuses on providing financial support to landholders without access to irrigation facilities and prioritizes marginalized communities to maximize impact. The programme has contributed to improved productivity, intensity, and diversity of crop production in the region and generated livelihood sources.[26]

## PANI BACHAO PAISE KAMAO, PUNJAB

The state of Punjab has introduced an innovative programme to break the water-energy nexus, under which farmers are being provided with a fixed electricity quota and receiving INR 4 per kilowatt hour for every unit of electricity saved through direct benefit transfers (DBTs). The scheme has been launched by the Department of Power on a pilot basis in the districts of Jalandhar and Hoshiarpur, and allows farmers to join on a voluntary basis.[27] Although the scheme is yet to achieve scale, it provides a unique solution to the widespread problem of electricity and water wastage by farmers by encouraging them to be efficient in resource utilization through supplementary income upon being water-efficient.

## JAKHNI VILLAGE, BUNDELKHAND, UTTAR PRADESH

[26] *Enhancing Sustainable Livelihoods of the Poor Through Convergence of Mahatma Gandhi NREGA with various schemes*, Ministry of Rural Development (2014), page 88, http://www.indiaenvironmentportal.org.in/files/file/convergence_MGNREGA_STORY.pdf

[27] "Around 200 farmers enrolled in Paani Bachao, Paise Kamao scheme, 10 felicitated in Bambiwal village", *TERI*, accessed June 6, 2019, https://www.teriin.org/press-release/around-200-farmers-enrolled-paani-bachao-paise-kamao-scheme-10-felicitated-bambiwal.

5 years ago Jakhni village of Banda district in the Bundelkhand region was one of the most water scarce regions of India. The area was witnessing heavy outgoing migration in search of water and better livelihood opportunities. But over the course of 5 years, villagers including Shri Uma Shankar Pandey, have drastically changed their water situation by putting rigorous efforts in water conservation such as construction of farm ponds, restoration/rejuvenation/restoration of water bodies, collection and utilization of grey water, raising of farm bunds, and intensive plantation of trees. The most inspiring fact is that the farmers of Jakhni undertook the entire work end-to-end without any external funding, machinery, or resources. Now, Jakhni village has developed to become a water self-sufficient village and is reaping the benefits of improved agricultural production. Once a drought prone village, now produces nearly 23,000 quintals of Basmati rice, and production of other crops has also increased many folds. Jakhani village serves as an excellent example for village water-budgeting modeled around collection and storage of rainwater within the village boundaries and utilizing it for life protection and economic development.[28]

[28] Based on the data provided to NITI Aayog by the Sarvodaya Adarsh Jal Gram Swaraj Abhiyan Samiti, Jakhni, Banda, Uttar Pradesh

# WATER RISKS & RELATED IMPLICATIONS

**As the building block for life, water is essential for healthy, stable, and sustainable civilizations. Therefore, scarcity can disrupt a country's social stability, hamper its economic prosperity, and destroy its ecology and ecosystems. If water management is not improved, India will not be an exception. Presently,** India is facing water challenge, which stems not only from the limited availability of water resources but also its mismanagement. The impact of water scarcity is already being severely felt in some regions, and if states and UTs fail to control the situation, it is only going to deteriorate.

**As evidence from this year's CWMI data suggests, states in India are making progress overall but have a long way to go in absolute terms of improving water management if India is to afford its citizens the quality of life they deserve, support economic growth, and sustain its ecosystems on a long-term basis.**

**In the second edition of the CWMI, in order to press upon the urgency and importance of improving India's management of water, a new section highlighting key water risks cutting across social and political, economic, and environmental spheres has been added.** This includes present and future risks; cases where the impacts of water shortage are already being felt and are likely to worsen, and others that are yet to come but imminent, and require immediate intervention if India is to mitigate their harmful effects.

Under social and political risks, the CWMI explores the most critical impacts of India's water situation on the quality of life of its citizens and the social stability of the nation. Economic themes explore risks to industrial growth and energy production. Finally, environmental themes highlight the current and potential ecological harm to the environment over a long period of time from a water lens.

## Social and Political risks

Social stability is predicated on people's access to resources to survive and live healthy lives. Depleting access to clean water impacts food security and health, and can cause social unrest and political instability. Key risks under this category include food security and the carrying capacity of urban centres.

### *Risk to food security*

**About 74% area under wheat cultivation and 65% area under rice cultivation faces extreme levels of water scarcity**

**Expected water demand-supply gap of up to 570 BCM by 2030 in agriculture sector**

Virtual water export adds to the problem – **export of ~37 lac tonnes of Basmati rice alone costed India 10 trillion litres of water** in 2014-15

**Achieving food security for India, with its rising population, is going to be a significant challenge, and water scarcity will make the goal tougher to attain.** India will host more than 1.5 billion people by 2030,[29] and serving the food needs of its entire population will be a daunting task. Water shortages in the country are going to make this task harder. Wheat and rice, India's two major staple crops for Indians, are already being affected by water-related issues. About 74% of the area under wheat cultivation and 65% of the area under rice cultivation faces significant levels of water scarcity.[30] These trends are expected to only get worse if immediate measures are not taken. Estimates suggest that the water demand-supply gap in agriculture could be as high as 570 BCM by 2030.[31] Groundwater resources, which account for 62% of irrigation water,[32] are declining in 52% of the cases[33] and highlight a serious water concern for the agriculture sector. Key reasons for this decline include a lack of well-considered water pricing for agricultural use, energy subsidies that promote over-extraction, and sub-optimal matching of crops with the agro-climatic and water zones in states. Further, our international trade in agricultural commodities is contributing to large quantities of virtual water loss through the export of water-intensive crops. As an illustration, India exported more than 10 trillion litres[34] of embedded or virtual water through the export of ~37 lakh tonnes of Basmati rice in 2014-15[35] alone, which could have been used to grow much larger quantities of other crops, such as wheat or millet, that have smaller water requirements. As another illustration, Punjab, which produces more than 10% of India's paddy,[36]

29 "World Urbanization Prospects 2018 - Population Division", *United Nations*, accessed May 6, 2019, https://population.un.org/wup/Download/.

30 Shashank Singh, *Hidden Risks and Untapped Opportunities: Water and the Indian Banking Sector* (WWF-India, 2019), page 21, http://www.indiaenvironmentportal.org.in/files/file/hidden_risks_and_untapped_opportunities.pdf.

31 "Investments worth $291 bn needed to plug water demand-supply gap in India: Study", *ASSOCHAM India*, accessed May 4, 2019, http://assocham.org/newsdetail.php?id=6357.

32 *Dynamic Ground Water Resources of India* (Central Ground Water Board, 2017), page 1, http://cgwb.gov.in/Documents/Dynamic%20GWRE-2013.pdf.

33 As per data submitted by Central Groundwater Board of India

34 Roshan Kishor, "India is the biggest virtual exporter of water", *Live Mint*, accessed May 16, 2019 https://www.livemint.com/Opinion/bPPHFHv19qBaA5qrPa6SuN/India-is-the-biggest-virtual-exporter-of-water.html

35 Note: The 10 trillion litres figure has been independently validated using figures on official rice export data taken from "Export of Rice Export from India", *Directorate of Rice Development*, accessed May 6, 2019, http://drdpat.bih.nic.in/.; and water requirement per 1 kg of rice production taken from Dr. Vibha Dhawan, *Water and Agriculture in India* (OAV – German Asia-Pacific Business Association, 2017), page 8, https://www.oav.de/fileadmin/user_upload/5_Publikationen/5_Studien/170118_Study_Water_Agriculture_India.pdf. The actual estimates from the calculation is ~13 trillion litres and has been rounded off to a conservative estimate of 10 trillion litres

36 "State-Wise Production of Rice from 2012-13 to 2014-15", *Data.Gov.in*, accessed May 5, 2019, https://visualize.data.gov.in/?inst=dcf4a717-9599-4b74-8455-f5623d427fcf&vid=20501.

utilizes groundwater for meeting 80% of its paddy irrigation needs,[37] thus depleting its own and the country's groundwater resources. Production challenges are being felt across agrarian states as regions run out of their primary irrigation sources. Increasing consumer preferences for high-value crops and dairy and meat products, which require significantly higher amounts of water for production, will only further exacerbate the country's food security challenges. Climate change will also contribute to these challenges as increasing temperature levels, floods, and droughts create unfavourable environmental conditions for cultivation and impact crop productivity.

**Implications**

**States should start using a water lens while developing agricultural policies and incentives.** India needs to manage its international export of virtual water and also ensure that crop production patterns within the country, across different states, are aligned to regional water availability. Agriculture policies that reduce the export of water-intensive crops or limit minimum support prices (MSPs) and subsidies for water-intensive crops (particularly sugarcane, cotton, and rice) in regions with declining water tables, can significantly bring down water demand from the sector. The case of lower agriculture support to farmers by OECD countries leading to reduced pressure on water resources is a great example. OECD countries, in addition to decline in support at the overall level, have also shifted focus from input and commodity-linked production support towards investments in off-farm water supply infrastructure to promote efficiency in water utilization. There has also been an increased emphasis on adoption of water efficient technologies, management systems, farmer education, and advisory services etc., for enabling improvement in water resource management.[38]

**India should also consider developing an agricultural water export Index to track virtual water.** The country can potentially develop such an index to track the amount of virtual water exported by India through trade commodities to other countries. The Index could also help India understand which agricultural commodities lead to water export and can enable better policy and incentives that support water sustainability. The Water Footprint Network has already developed an interactive tool to calculate and map the water footprint by different users, assess its sustainability, and identify strategic interventions for improving water use. The proposed index can take inspiration and build further on this tool, and support development of a customized and targeted solution for managing virtual water exports from the agriculture sector.

**India should invest in scaling up micro-irrigation to increase coverage and sustainability.** While micro-irrigation has been known to be a vital solution to make India's agriculture more water efficient, the overall adoption rates still remain very low. Furthermore, farmers face significant problems in the sustained adoption of micro-irrigation across seasons due to maintenance challenges and cost pressures. A sustained programme for micro-irrigation that brings together financing support, operational support, and technical assistance is essential. GoI's 'Per Drop More Crop' component under the Pradhan Mantri Krishi Sinchayee Yojana promotes use of drip and sprinkler irrigation by farmers, and is a great initiative to drive adoption of micro-irrigation technologies in agriculture across the country.

---

[37] "Misaligned Agriculture: A Major Source of India's Water Problems", *Forbes India*, accessed May 6, 2019, http://www.forbesindia.com/article/iim-bangalore/misaligned-agriculture-a-major-source-of-indias-water-problems/50693/1.

[38] Kevin Parris, *Sustainable Management of Water Resources in Agriculture* (OECD, 2010), page 70, http://www.oecd.org/greengrowth/sustainable-agriculture/49040929.pdf.

## *Risk of exceeding the carrying capacity of urban hubs*

**5 of the world's largest cities under water stress present in India; Delhi ranks second on the list**

**No Indian city able to provide 24x7 water supply to its entire urban population**

**Expected water demand-supply gap of ~50 BCM for domestic sector by 2030, as future demand doubles present use**

**Urban hubs are likely to witness severe water shortages in the future, which could risk urban growth in India and reduce quality of life for urban citizens.** India's urban population is expected to reach 600 million by 2030,[39] and fulfilling its water needs will be a great challenge. Estimates suggest that the demand-supply gap for the domestic sector will stand at ~50 BCM in 2030, with the demand expected to double by that time.[40] The present situation is also not ideal. 5 of the world's 20 largest cities under water stress are in India, with Delhi being second on the list.[41] Additionally, 8 million children below the age of 14 in urban India are at risk due to poor water supply.[42]

Water supply infrastructure in the major metropolitan cities of the country, which was never designed to cater to such large population sizes, will be unable to serve the urban population. As of 2014, no major city in India supplied 24x7 water to its entire urban population,[43] and only 35% of urban households in India have piped water in their dwelling as the primary source to support drinking water needs, while others rely on piped water to plot/yard, tube wells, and public taps amongst other sources.[44] These water delivery challenges will further exacerbate as migration to major urban cities in search of better livelihood opportunities continues, and additional stress is put on the already-insufficient water resources and inadequate infrastructure. As of 2015, India treated only 30% of the wastewater generated in the country.[45] Lack of adequate infrastructure in cities to handle their own wastewater will add to the problem, and improper solid waste management may even lead to contamination of remaining groundwater resources.

In such circumstances, water shortages will become more frequent and water rationing by states will intensify further. Industrial growth in and around cities will be severely compromised as companies will move their operations to more water-secure locations. All these challenges can together create serious water scarcity conditions for urban dwellers where their basic water needs are not met. This will also endanger the aspirations of rural Indians seeking a better life in urban India, and nip rural-urban migration forces that are a part of India's journey towards becoming an industrialized modern economy.

---

[39] "World Urbanization Prospects 2018 - Population Division", *United Nations*, accessed May 6, 2019, https://population.un.org/wup/Download/.

[40] *Charting Our Water Future* (McKinsey & WRG, 2009), page 9, https://www.mckinsey.com/~/media/mckinsey/dotcom/client_service/sustainability/pdfs/charting%20our%20water%20future/charting_our_water_future_full_report_.ashx.

[41] Robert I. McDonald et al., "Water on An Urban Planet: Urbanization and The Reach of Urban Water Infrastructure", *Global Environmental Change* 27 (2014): pages 96-105,

[42] Suresh Kumar Rohilla et al., *Urban Water Sustainability* (Centre for Science and Environment, 2017), page 16, http://cdn.cseindia.org/attachments/0.84020200_1505207729_Urban-water-sustainability-report.pdf.

[43] "24X7 Water Supply: FAQs", *World Bank*, accessed May 16, 2019, http://www.worldbank.org/en/country/india/brief/faqs-24x7-water-supply.

[44] National Sample Survey Office, *Drinking Water, Sanitation, Hygiene and Housing Condition in India: NSS 69th Round* (Ministry of Statistics and Programme Implementation, 2014), page 82, http://mospi.nic.in/sites/default/files/publication_reports/nss_rep_556_14aug14.pdf.

[45] Suresh Kumar Rohilla et al., *Urban Water Sustainability* (Centre for Science and Environment, 2017), page 16, http://cdn.cseindia.org/attachments/0.84020200_1505207729_Urban-water-sustainability-report.pdf.

**Implications**

**A strong focus on urban regional water planning can help mitigate water risks in urban settlements.** An integrated approach to land-use planning and zoning, which includes water as a key aspect, is the only way to ensure sustainable urban development where cities do not run out of water in the long run. State and city governments should consider water resource availability in the region while creating city plans and providing permits for new establishments, and restrict any development activities that are not sustainable in terms of water management. The central and state governments can also encourage such a shift in urban development through policies and tight monitoring. The American Planning Association (APA) in the United States serves as a great example, which has introduced water-related policy guidelines in its charter to promote sustainable development in cities and treats water as a critical and essential element in infrastructure planning. As a part of the initiative, APA has also committed to collaborate and work with federal agencies, organizations, and programmes to address present and future water issues, enhance technical skills of planners to enable them serve as water experts, and help advance legislations that support integrated approach to water management.[46]

[46] "APA Policy Guide on Water", American Planning Association, accessed May 16, 2019, https://www.planning.org/policy/guides/adopted/water/.

## Economic risks

Water is essential for the production of most physical goods (directly) and services (indirectly). Water scarcity poses a serious threat to sustainable economic activity in India and can hamper national growth. As the water crisis worsens, production capacity utilization and new investments in capacity may both decline, threatening the livelihoods of millions, and commodity prices could rise steeply for consumers due to production shortages. Such circumstances can lead to economic instability and disrupt growth. Key risks that lie ahead in India's case have been presented below.

### *Risk to sustainable industrial activity*

**Industries expected to draw 3x water compared to their actual consumption by 2030**

**Shutdowns possible as states prioritize irrigation and households needs, and fail to provide water to industries**

Water-intensive industries such as **Food & Beverages, Textiles, and Paper & Paper products likely to be worst affected**

**Water shortages in the country can hamper industrial operations and other economic activity, and and lead to muted economic growth.** Industrial activity accounts for ~30% of GDP contribution at the national level[47] and holds significant importance in India's economy. Estimates suggest that industrial water requirement will quadruple between 2005 and 2030,[48] highlighting the significant rise in demand by the sector over time. Additionally, a recent study reports that industries will need to draw three times the water compared to their actual consumption by 2030 due to water efficiency challenges.[49] Water shortages are already impacting, and will continue to impact, the sector in the form of erratic and insufficient water supply, hampering production processes and efficiency. It is possible that this shortage will drive up the cost of water and lead to a disproportionate impact on the Small-to-Medium Enterprise (SME) and Micro, Small and Medium Enterprise (MSME) segment. This can severely impact industrial production processes and cripple India's aspirations to be an economic superpower in the future. Worst 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.[50] Several incidents where water shortages have impacted production processes have emerged in the recent years. These impacts have ranged from industries operating at reduced capacity, to temporary shutdown of operations, and even curtailment of expansion projects. As reported in 2016, a steel plant in Vishakhapatnam, Andhra Pradesh was forced to operate on reduced capacity due to lower water availability.[51] Furthermore, a staple fibre plant of a major textile company in Nagda, Madhya

---

47 Ministry of Finance, *Contribution of Various Sectors to GDP* (Press Information Bureau, 2018), http://pib.nic.in/newsite/PrintRelease.aspx?relid=186413.; Central Statistics Office, *Key Economic Indicators* (Ministry of Statistics & Programme Implementation, 2019), https://eaindustry.nic.in/key_economic_indicators/Key_Economic_Indicators.pdf.

48 *Charting Our Water Future* (McKinsey & WRG, 2009), page 55, https://www.mckinsey.com/~/media/mckinsey/dotcom/client_service/sustainability/pdfs/charting%20our%20water%20future/charting_our_water_future_full_report_.ashx.

49 "Investments worth $291 bn needed to plug water demand-supply gap in India: Study", *ASSOCHAM India*, accessed May 16, 2019, http://assocham.org/newsdetail.php?id=6357.

50 WWF-India and Accenture Services, *Water Stewardship for Industries: The Need for a Paradigm Shift in India* (WWF-India, 2013), page 18, http://www.indiaenvironmentportal.org.in/files/file/water%20stewardship%20for%20industries_0.pdf.

51 "Vizag Steel Plant Faces Severe Water Crisis", *The Hindu BusinessLine*, accessed May 16, 2019, https://www.thehindubusinessline.com/news/national/vizag-steel-plant-faces-severe-water-crisis/article8447234.ece.

Pradesh was shut down for 2 months in 2015 due to water shortages.[52] In addition, a large Food & Beverage company had to scrap its plans for a USD 24 million factory near Varanasi, due to permit challenges from the authorities and community protests on water issues in 2014.[53]

Water scarcity is also going to have serious upstream impacts on India's economy through its banking sector, which is already stressed. According to a recent report, 39% of the portfolio of Indian banks[54] is exposed to sectors that face high levels of operational water risk, including agriculture and allied-activities (13.3%), power (6.8%), and basic metal and metal products (4.8%).[55] These risks can include actual water scarcity for production and/or regulatory and reputational risks from water contamination and conflicts with local communities due to over extraction from local sources. These water risks in bank portfolios can degrade the quality of bank assets through unanticipated and premature write-offs, downward revaluations, conversions to liabilities, and eventually, a rise in total non-performing assets (NPAs). The potential of such large-scale degradation in assets should trigger alarm bells for lenders as they look towards funding India's growth story over this decade and more to come.

**Implications**

**Industrial water quotas, tradable permits, and water availability linked licenses can help in optimizing water usage in scarce regions and minimize the water supply deficit.** Industrial water use can be optimized by giving permits that put caps on water consumption by each user, while industrial zoning can restrict water-intensive industries from setting up in water-scarce regions. This will help promote water efficiency amongst both small and large industries. Additionally, a tradable water permit system can be developed, where water entitlements and allocations are provided to industrial units annually, and they can freely trade their water quotas to maximize outputs and income by optimizing water use. The water market system in Australia's Murray-Darling Basin is one successful example, which supports water trading worth AUD 2 billion annually. It allows buying and selling of water entitlements and allocations amongst different users based on their own preferences and creates incentives for water to be moved to higher-value uses.[56] A similar system could be designed for industrial wastewater.

**Inclusion of water-specific elements in ESG compliance checks by banks during credit approval process is an example of effective top-down measure to incentivize improved water management practices by the private sector.** Given the high exposure of bank portfolio to sectors that face operational risks due to water stress, water shortages and scarcity pose a threat to banks' performance and functioning as well. ESG compliance checks by banks can act as effective tools to encourage sustainable use and effective water management amongst the companies that seek external funding for operations. While banks currently conduct ESG compliance checks for projects depending on the lending amount and period, there is scope to expand the project types considered for ESG compliance. Further, a strong focus on water-specific elements can help ensure the effectiveness of this strategy is

[52] *Quarterly Performance Review Quarter 1: 2015-16* (Grasim Industries Limited, 2015), page 9, http://www.grasim.com/pdf/Grasim_Q1FY15-16_Presentation.pdf.

[53] Archana Chaudhary, "Farmers Fight Coca-Cola As India's Groundwater Dries Up", *Livemint*, accessed May 16, 2019, https://www.livemint.com/Politics/55tZIXk1ov2ADNcLnVZRwN/Farmers-fight-CocaCola-as-Indias-groundwater-dries-up.html.

[54] "Reserve Bank of India - Data on Sectoral Deployment of Bank Credit", *Reserve Bank of India*, accessed May 16, 2019, https://www.rbi.org.in/Scripts/Data_Sectoral_Deployment.aspx.

[55] Ibid.

[56] "Water Markets and Trade", *Murray-Darling Basin Authority*, accessed May 5, 2019, https://www.mdba.gov.au/managing-water/water-markets-and-trade.

solid. Few banks have already put such initiatives into practice. An Indian bank uses pre-defined algorithm to raise red flags in case water availability in the region is insufficient to support business operations. Another bank conducts regular portfolio analysis for Environment and Risk management using cohesive tools, and covers water as a key non-financial risk.[57]

### *Risk of energy shortages*

**40% of India's thermal power plants presently located in water-scarce regions**

**70% of India's thermal power plants expected to face high water stress by 2030**

**70% of India's thermal power plants are likely to face high water stress by 2030,[58] severely hampering India's energy production and economic activity.** Thermal power[59] constituted more than 83% of India's total utility power generation in 2016,[60] and remains a major source of energy for all commercial activities. This critical source of energy will be threatened as freshwater resources decline, since 90% of thermal power plants in India rely on freshwater sources for cooling,[61] an essential process in thermal energy production. About 40% of India's thermal power plants are in water-scarce regions and are already beginning to face operational challenges.[62] 14 of India's 20 largest thermal utilities faced at least one shutdown between 2013-16 due to water scarcity, which cost companies and investors USD 1.4 billion.[63] If energy shortages intensify in India in the future due to thermal power shutdowns, businesses will become further vulnerable to power cuts and operational inefficiencies. This will reduce economic output, increase the cost of doing business, and slow down economic growth. To address some of these challenges, MoEFCC, for the first time in 2015-16, introduced regulations for thermal power plants, putting mandatory limits on their water consumption.[64] Regulations like these are need of the hour and should be seen as great examples by other regulators in the country to learn from.

**Implications**

**Diversifying energy sources to include renewable energy can potentially help India mitigate, to some extent, the effects of this energy crisis.** Shifting to alternatives such as solar and wind energy can reduce reliance on thermal power plants and create additional energy sources that are not

[57] Shashank Singh, *Hidden Risks and Untapped Opportunities: Water and the Indian Banking Sector* (WWF-India, 2019), page 27, http://www.indiaenvironmentportal.org.in/files/file/hidden_risks_and_untapped_opportunities.pdf.

[58] Luo Tianyi, Deepak Krishnan and Shreyan Sen, *Parched Power: Water Demands, Risks, and Opportunities for India's Power Sector* (World Resources Institute, 2018), page 1-7, https://wriorg.s3.amazonaws.com/s3fs-public/parched-power-india-0130.pdf?_ga=2.47442850.464575563.1557999082-1758852555.1556721696.

[59] Includes coal, natural gas, and nuclear energy

[60] Luo Tianyi, Deepak Krishnan and Shreyan Sen, *Parched Power: Water Demands, Risks, and Opportunities for India's Power Sector* (World Resources Institute, 2018), page 1-7, https://wriorg.s3.amazonaws.com/s3fs-public/parched-power-india-0130.pdf?_ga=2.47442850.464575563.1557999082-1758852555.1556721696.

[61] Ibid.

[62] Ibid.

[63] Ibid.

[64] Ministry of Environment, Forest and Climate Change, *Environment Ministry Notifies Stricter Standards for Coal Based Thermal Power Plants to Minimise Pollution* (Press Information Bureau, 2015), http://pib.nic.in/newsite/PrintRelease.aspx?relid=133726.

heavily reliant on water for production. The government has already set targets of installing renewable energy capacity of 175 Giga Watts by 2022,[65] and this will certainly contribute towards diverting this crisis.

**Water availability linked energy production should be the norm.** India has several thermal power plants in different stages of planning and commissioning.[66] The establishment of new thermal power plants should be away from water-scarce regions. This will also ensure avoidance of water shortage risks for future energy sources established in the country. In addition to this, there is also a need to improve the water-use efficiency amongst the existing thermal plants, which can be supported through adoption of modern technologies by these producers. As an example, NTPC is undertaking a host of initiatives to promote water efficiency in water conservation. Apart from adoption of water-efficient technologies for operations and production, NTPC is also exploring solutions such as desalination plants and floating Solar PV systems.[67] While desalination plants can create additional sources of water for human use, the floating Solar PV systems can reduce the natural rate of evaporation and support conservation of water.

---

65 Ministry of New and Renewable Energy, *A Target of Installing 175 GW of Renewable Energy Capacity By The Year 2022 Has Been Se* (Press Information Bureau, 2018), http://pib.nic.in/newsite/PrintRelease.aspx?relid=180728.

66 *National Electricity Plan* (Central Electricity Authority, 2018), annexure 5.4, http://www.cea.nic.in/reports/committee/nep/nep_jan_2018.pdf

67 *NTPC Practices & Initiatives in Water Conservation* (NTPC Power Management Institute, 2018), https://www.ntpc.co.in/sites/default/files/downloads/NTPCPracticesandInitiativesinWaterConservation.pdf.

## Environmental risks

As India's water crisis worsens, environmental damage will intensify with increased attempts towards finding additional water resources. This will lead to serious harm to the country's biodiversity, environment, and ecological balance. Key risks under the theme have been highlighted below.

### *Risk of biodiversity destruction*

**Human intervention impacts 35 species on average in biodiversity hotspots in India**

**The Western Ghats, Himalayas, and the North-East are amongst hotspots with threatened species category**

**Dam construction on the Kali river contributed to the Western Ghat's decline in forest cover of 30 percentage points in ~40 years**

**The rich biodiversity of India faces a serious threat from human activities undertaken in pursuit of creating additional water sources.** Red flags have already been raised over the cumulative impact of climate change, increasing temperatures, and human engineering of hydrological flows through dam construction and river diversion, on India's fragile biodiversity.[68] Building dams on rivers slows down the water flow, leading to sedimentation and reduction in nutrients carried by the rivers, whereas linking rivers can change salinity levels and monsoon patterns. Such changes in water composition and environmental factors can seriously harm the local flora and fauna that thrive on these water resources. The impact on biodiversity can manifest in the form of changing migration patterns, decline, and even extinction of species' population, all of which can lead to the destruction of biodiversity hotspots in the long run. As per an international study, 35 species are impacted on average[69] in Indian hotspots due to human activities.[70] The Western Ghats, the Himalayas, and the North-East fall in the category of hotspots with threatened species, and developmental activities in these areas have led to ecosystem damage in some cases. Six dams have been constructed on the Kali River in the Western Ghats of India, and such development projects have contributed to the decrease of forest cover from 85% to 55% between 1973 and 2016.[71] This is likely to have caused significant damage to its biodiversity hotspots, which host 325 and 190 species of flora and fauna, respectively.[72]

**Implications**

**Adapting our developmental approach to account for environmental sustainability can help maintain the ecological balance.** Environmental impacts need strong attention when new development activities, such as building dams or reservoirs, are planned. Our economic policy needs to evolve to include the incorporation of the economic value of biodiversity in planning as a necessary first step towards this goal. Undertaking smaller projects in more locations can also be tested, rather than a large project being executed in a single geographical region. The cumulative environmental footprint of such smaller projects might be lower compared to a large project.

68 Dr. Mihir Shah, *Water: Towards a Paradigm Shift in the Twelfth Plan* (EPW, 2013), https://www.indiawaterportal.org/sites/indiawaterportal.org/files/water-_towards_a_paradigm_shift_in_the_twelfth_plan_dr_mihir_shah_planning_commission.pdf.

69 Includes species impacted by at least one threat per 900 $km^2$ grid cell

70 James R. Allan et al., "Hotspots of Human Impact on Threatened Terrestrial Vertebrates", *PLOS Biology* 17, no. 3 (2019): e3000158.

71 SA. Shashishankar T.V. Ramachandra, "Focus: Ecology and Evolution: Eco-Hydrological Footprint of a River Basin in Western Ghats", *Pubmed Central (PMC)*, last modified 2018, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6302628/.

72 Ibid.

Adapting approaches to restore ecological balance have actually shown surprising results globally. The US-Mexico Colorado river agreement is a great example, where through collaborative action by the two nations the Colorado river's natural flow has been revived within five years of the agreement, and the river reached its natural destination for the first time after 16 years. Conservation groups in the region have also undertaken large-scale tree plantation activities to re-establish habitats and support resuscitation of bird populations and wildlife in the region.[73]

### *Risk of desertification*

**~30% of Indian land is degraded or faces desertification**

**Water erosion largest cause of desertification and is responsible for ~11% of total desertification**

**Cost of land degradation estimated at ~2.1% of India's 2014-15 GDP**

**~30% of Indian land is impacted by desertification and land degradation,[74] and this outcome is strongly linked to poor water management.[75]** Water management and desertification have a two-way relationship. Extensive groundwater extraction contributes to loss of vegetation cover, which eventually leads to desertification. Increasing desertification and land degradation diminish green cover, which reduces the land's capacity to recharge groundwater and regional water tables. Water erosion, which is a loss of soil cover due to rainfall and surface run-off, is responsible for ~11% of desertification,[76] making it the biggest cause of desertification in India. There are also perverse incentives that promote complacency on desertification and degradation close to urban areas—degraded land is easier to acquire for infrastructure and construction projects than fertile agricultural land. Therefore, a stronger emphasis is required on controlling this contributing factor to desertification and land degradation.

The cost of land degradation has been estimated at ~2.5% of India's 2014-15 GDP.[77] Land degradation can also cause up to 4% losses in Agricultural Gross Domestic Product in the future for India,[78] which could drive food prices up. Such events should be a major concern for a country like India, where a significant population still lives in poverty and the government invests heavily in food subsidies.

---

73 "A Sacred Reunion: The Colorado River Returns to the Sea", *National Geographic Society Newsroom*, accessed May 8, 2019, https://blog.nationalgeographic.org/2014/05/19/a-sacred-reunion-the-colorado-river-returns-to-the-sea/.

74 Desertification is defined as land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities (UNCCD)

75 *Economics of Desertification, Land Degradation and Drought in India: Vol I: Macroeconomic Assessment of The Costs of Land Degradation in India* (The Energy and Resources Institute (TERI), 2018), page 4, https://www.teriin.org/sites/default/files/2018-04/Vol%20I%20-%20Macroeconomic%20assessment%20of%20the%20costs%20of%20land%20degradation%20in%20In

76 *Economics of Desertification, Land Degradation and Drought in India: Vol I: Macroeconomic Assessment of The Costs of Land Degradation in India* (The Energy and Resources Institute (TERI), 2018), page 30, https://www.teriin.org/sites/default/files/2018-04/Vol%20I%20-%20Macroeconomic%20assessment%20of%20the%20costs%20of%20land%20degradation%20in%20In

77 *Economics of Desertification, Land Degradation and Drought in India: Vol I: Macroeconomic Assessment of The Costs of Land Degradation in India* (The Energy and Resources Institute (TERI), 2018), page xvi, https://www.teriin.org/sites/default/files/2018-04/Vol%20I%20-%20Macroeconomic%20assessment%20of%20the%20costs%20of%20land%20degradation%20in%20In

78 *Desertification: The Invisible Frontline* (UNCCD, 2014), page 8, https://www.unccd.int/publications/desertification-invisible-frontline-second-edition.

**Implications**

**Increasing green cover can help widen the reach of these conservators of the local ecosystem and curb desertification.** Afforestation is one of the most effective mechanisms of reversing desertification trends. However, there must be concerted efforts to afforest strategically and scientifically, so that the right mix of flora is propagated (e.g., local species, drought tolerant varieties of trees, etc.), with the appropriate density and diversity. Similarly, other initiatives to increase green cover, such as agroforestry under which trees or shrubs are grown next to crops and pasturelands, can reduce erosion and even enable increased biodiversity in areas currently covered with mono-cropping and without cover crops and natural barriers. Increased green cover can also have positive impacts on groundwater rejuvenation as water absorption and retention capacity of the soil increases, but there is a need to rely on local and grassroots knowledge to select trees particularly suited to the objectives and geography. China's 'Great Green Wall' initiative is a great example of a country making large-scale investments in tackling desertification. The country has planted 66 billion trees in the arid northern territory, and the State Forestry Administration claims to have reduced sandstorms by 20% and desertification by nearly 5,000 miles in the recent years.[79]

[79] "China's 'Great Green Wall' Fights Expanding Desert", *National Geographic*, accessed May 16, 2019, https://news.nationalgeographic.com/2017/04/china-great-green-wall-gobi-tengger-desertification/.; Laura Mallonee, Shannon Stirone and Michael Hardy, "The Lush Billion-Tree Spectacle of China's Great Green Wall", *WIRED*, last modified 2017, accessed May 16, 2019, https://www.wired.com/story/ian-teh-chinas-great-green-wall/.

# SECTION II

# BACKGROUND TO THE CWMI

**India is experiencing a very significant water challenge.** Approximately, 820 million people[80] of India - living in twelve river basins across the country have per capita water availability close to or lower than 1000m$^3$ – the official threshold for water scarcity as per the Falkenmark Index. About 82% of rural households in India do not have individual piped water supply,[81] and 163 million live without access to clean water close to their homes.[82] 70% of India's surface water is contaminated.[83] Average per capita water availability, which is already low enough for India to be categorized as water stressed, is expected to reduce further to 1341m$^3$ by 2025 and 1140m$^3$ by 2050,[84] close to the official water scarcity threshold.[85] Estimates suggest ~INR 20,00,000 crores in investments are required to bridge the expected water supply gap by 2030.[86]

**~82% rural households do not have piped water supply, and 163 million Indians live without access to clean water in their vicinity**

**~INR 20,00,000 crores worth investments required to bridge expected water supply deficit by 2030**

---

[80] *Water and Related Statistics* (Central Water Statistics, 2015), page 31, http://www.indiaenvironmentportal.org.in/files/file/Water%20&%20Related%20Statistics%202015.pdf.

[81] The reported statistic varies in case of other government sources. This is possibly due to other sources including piped water supply even through shared connections, while the reported statistics considers only individual households with piped water supply; presented number based taken from "Number of Individual House Holds Covered with PWS", *National Rural Drinking Water Programme*, accessed May 16, 2019, https://indiawater.gov.in/IMISReports/Reports/Physical/rpt_CoverageIndividualHousePipConnection.aspx?Rep=0&RP=Y.

[82] *The Water Gap: The State of The World's Water 2018* (Water Aid, 2018), page 10, https://washmatters.wateraid.org/sites/g/files/jkxoof256/files/The%20Water%20Gap%20State%20of%20Water%20report%20lr%20pages.pdf.

[83] M.N. Murthy and Surender Kumar, *India Infrastructure Report 2011: Chapter 19: Water Pollution in India* (IDFC, 2019), page 285, http://www.idfc.com/pdf/report/IIR-2011.pdf.

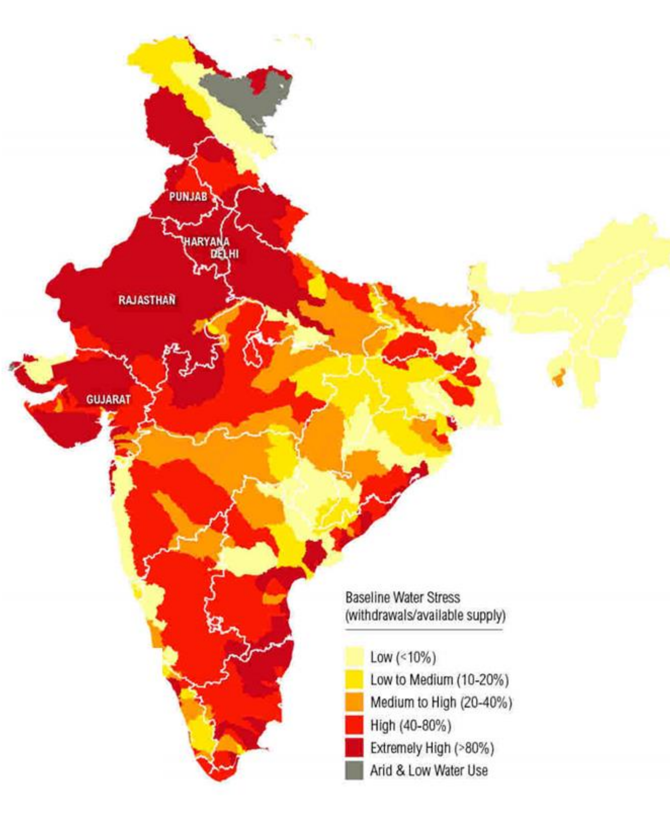
[84] Ministry of Water Resources, *Shortage of Water* (Press Information Bureau, 2017), http://pib.nic.in/newsite/PrintRelease.aspx?relid=168727.

[85] Per capita water availability less than 1000 m$^3$ is categorized as a situation of water scarcity

[86] "Investments worth $291 bn needed to plug water demand-supply gap in India: Study", *ASSOCHAM India*, accessed May 6, 2019, http://assocham.org/newsdetail.php?id=6357.

**Figure 1: Baseline water stress in India**[87]

*Ratio of total withdrawals and total flow (2010)*



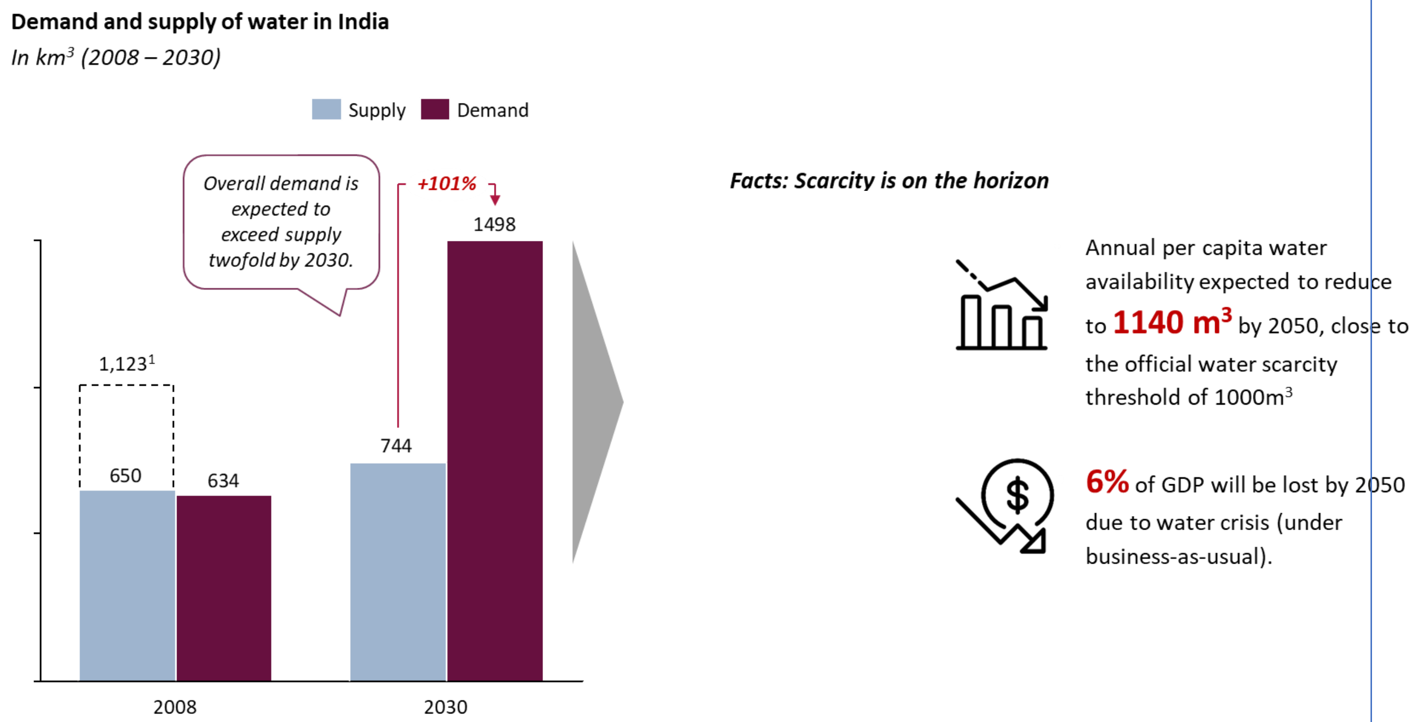

Droughts in agrarian states are becoming more frequent, and water shortage in cities is on the rise. While declining per capita water availability contributes towards India's water crisis, failure to manage its water resources effectively is also a major reason. India ranks as the third-largest exporter of groundwater through virtual water trade,[88] while 52% of its wells are facing declines.[89]

87 Luo Tianyi, Deepak Krishnan and Shreyan Sen, *Parched Power: Water Demands, Risks, and Opportunities for India's Power Sector* (World Resources Institute, 2018), page 1-7, https://wriorg.s3.amazonaws.com/s3fs-public/parched-power-india-0130.pdf?_ga=2.47442850.464575563.1557999082-1758852555.1556721696. Note: Baseline water stress measures total annual water withdrawals (municipal, industrial, and agricultural) expressed as a percent of the total annual available flow for 2010. Higher values indicate more competition among users.

88 *Beneath the Surface: The State of the World's Water 2019* (Water Aid, 2019), https://washmatters.wateraid.org/sites/g/files/jkxoof256/files/beneath-the-surface-the-state-of-the-worlds-water-2019-_0.pdf.

89 As per the data provided to NITI Aayog by Central Groundwater Board of India, Ministry of Jal Shakti.

**Figure 2: Demand and supply of water in India (forecast)[90]**
*In BCM (2008, 2030)*




Indeed, if nothing changes, the status of water availability will deteriorate rapidly. Best estimates indicate that India's water demand will exceed supply by a factor of two by 2030, with severe water scarcity on the horizon for millions.

**One of the key challenges driving this water crisis is the lack of water data. Data systems related to water in the country are limited in their coverage, robustness, and efficiency.** To solve a problem effectively, a country must understand and confront challenges scientifically and practically. However, the water sector suffers from the following key data problems that inhibit proper redressal of its issues.

- *Limited coverage:* Detailed data is not available for several critical sectors such as domestic and industrial water use, for which data is only available at the aggregate level and lacks the level of detail required to make informed policy decisions and allocations.
- *Unreliable data:* The data that is available is often of inferior quality, inconsistent, and unreliable due to the use of outdated methodologies in data collection. For example, estimates on

90 *Water & Related Statistics* (CWC, 2013), http://www.indiaenvironmentportal.org.in/files/water%20and%20related%20statistics.pdf; *Water in India* (FAO & UNICEF, 2013), http://www.indiaenvironmentportal.org.in/files/file/water%20in%20india.pdf; *Charting Our Water Future* (McKinsey & WRG, 2009), page 52, https://www.mckinsey.com/~/media/mckinsey/dotcom/client_service/sustainability/pdfs/charting%20our%20water%20future/charting_our_water_future_full_report_.ashx.; *High and Dry* (World Bank, 2016), page vii, http://www.indiaenvironmentportal.org.in/files/file/High%20and%20Dry.pdf.
Note: (i) Water supply for 2008 is Narsimhan's estimate of 650, while the planning commission estimate is 1,123, as represented by the error bar; (ii) Demand for 2008 is based on the planning commission's estimates; (iii) Supply and demand for 2030 are projections by McKinsey and Water Resources Group (WRG)

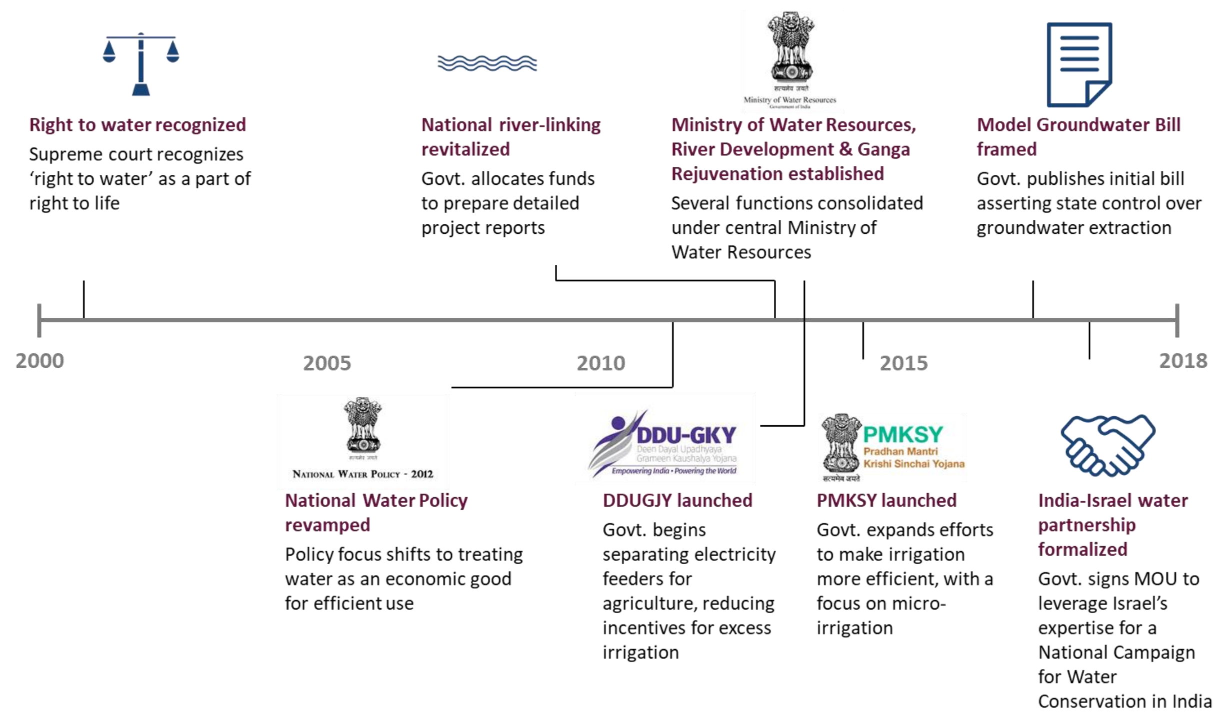
groundwater are mostly based on observation data from 15,640 wells, while there are 30 million groundwater structures[91] in the country.

- *Limited coordination and sharing:* Data in the water sector exists in silos, with very little horizontal and vertical data sharing across the value chain of water (from source to consumption to wastewater utilization), thereby reducing efficiencies.

Such data issues directly impact policy formulation, increase problems in infrastructure maintenance, promote sub-optimal user behaviour, and limit research and innovation.

**Despite the worsening water stresses in the country and significant challenges, there is room for optimism, with water management receiving increased policy attention over the past few years.** From 2000 onwards, the Indian government has taken several steps to move the country further along the path to effective water governance, with key policy decisions detailed in the timeline below.

**Figure 3: Water policy timeline in India (not exhaustive)**




Some of the key policy highlights include:

- *Institutional Governance*: The consolidation of functions into the central Ministry of Water Resources, to enable better decision-making for surface water projects and allocation.

---

91 *Overview of Groundwater in India* (PRS, 2016), page 7, https://www.prsindia.org/administrator/uploads/general/1455682937~~Overview%20of%20Ground%20Water%20in%20India.pdf; Working Group Report, *Sustainable Groundwater Management* (Planning Commission, 2011), page 8 and 24, http://planningcommission.gov.in/aboutus/committee/wrkgrp12/wr/wg_susgm.pdf.

- *Groundwater Bill:* The drafting and discussion of a model Groundwater Bill in 2017 that defines groundwater as being held "in trust" by the government and specifies a decentralized structure for its governance.
- *Innovative Micro-Irrigation Programme:* The renewed focus on micro-irrigation adoption by farmers in the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) to enable efficient on-farm water use.
- *Global Technology and Innovation Partnerships:* The formalization of a partnership with Israel,[92] the world leader in water governance and conservation, to leverage Israeli experience and knowledge for water conservation in India.

**Further, global events and examples have highlighted both the potential implications of water scarcity and the pathways to achieve water security.** As reported, the worsening water crisis in Cape Town, South Africa, with the city hovering dangerously close to "Day Zero" (when it runs out of water), has caused water rationing and civil strife in the city, and has highlighted the risks and challenges that lie ahead for many Indian cities, including Bengaluru.[93] Such crises, combined with the global examples of countries managing water effectively in a long-term sustainable manner, such as that of Israel,[94] have ensured that the momentum around effective water management has been increasing and that the sector is being accorded a high priority in the national policy agenda.

**Building on this policy push, NITI Aayog established a Composite Water Management Index (CWMI) for the country.** This Index established a national platform[95] in the public domain which provides information on key water indicators across states. This platform helps in monitoring performance, improving transparency, and encouraging competition, thereby boosting the country's water achievements by fostering the spirit of *"competitive and cooperative federalism"* amongst states. Further, the data can also be used by researchers, entrepreneurs, and policymakers to enable broader ecosystem innovation for water in India.

**This year's report continues the tradition of tracking, reporting, and analyzing states' performance on various components of water management.** It incorporates data collected over the 2017-18 period to highlight states' performance in the year gone by and provides a three-year longitudinal view of how the country is progressing on various components of water management.

---

92 "India-Israel Joint Statement during Visit of Prime Minister of Israel to India (January 15, 2018)", *Ministry of External Affairs*, accessed May 16, 2019, https://www.mea.gov.in/bilateral-documents.htm?dtl/29357/IndiaIsrael+Joint+Statement+during+visit+of+Prime+Minister+of+Israel+to+India+January+15+2018.

93 Vann II, "Cape Town is an Omen", *The Atlantic*, accessed May 16, 2019, https://www.theatlantic.com/science/archive/2018/09/cape-south-south-africa-water-crisis/569317/.

94 Policy programme paper on Israel's water economy can be accessed at http://taubcenter.org.il/wp-content/files_mf/thewatereconomyofisrael.pdf. Same was highlighted during the visit of Israeli Prime Minister to India in 2018 – *supra* note 108

95 Accessible at http://social.niti.gov.in/wtr-ranking

# OBJECTIVES AND SCOPE OF THE INDEX

## Scope and structure of the Index

### Themes and indicators

The Index comprises nine themes (each having an attached weight), covering groundwater and surface water restoration, major and medium irrigation, watershed development, participatory irrigation management, on-farm water use, rural and urban water supply, and policy and governance. The themes and their respective weights are displayed below *(Table 1*: Indicator themes and weights*)*. The themes are further sub-divided into 28 indicators, which are also listed below *(Table 2*: List of indicators for the CWMI*)*. In this edition of CWMI, two new KPIs have been added to KPI 20. These KPIs assess the continuity of water supplied to rural households, and coverage of water meters for pricing in such households.

It should be highlighted that the data collection exercise necessary to develop and populate the Index is unprecedented. Not only is data on several indicators being collected for the first time, but the exercise also involves deep collaboration amongst states, as well as extensive centre-state coordination.

**Table 1: Indicator themes and weights**

| No. | Themes | Weights |
|---|---|---|
| **1** | Source augmentation and restoration of waterbodies | 5 |
| **2** | Source augmentation (Groundwater) | 15 |
| **3** | Major and medium irrigation—Supply side management | 15 |
| **4** | Watershed development—Supply side management | 10 |
| **5** | Participatory irrigation practices—Demand side management | 10 |
| **6** | Sustainable on-farm water use practices—Demand side management | 10 |
| **7** | Rural drinking water | 10 |
| **8** | Urban water supply and sanitation | 10 |
| **9** | Policy and governance | 15 |
| | **Total** | **100** |

**Table 2: List of indicators for the CWMI**

| No. | Key Performance Indicator | Unit |
|---|---|---|
| 1 (a) | Area irrigated by waterbodies restored during the financial year 2016-17 as a percentage of the irrigation potential area of total number of waterbodies identified for restoration. | % |
| 1 (b) | Area irrigated by waterbodies restored during the financial year 2017-18 as a percentage of the irrigation potential area of total number of waterbodies identified for restoration. | % |
| 2(a) | Number of over-exploited and critical assessment units that have experienced a rise in water table in pre-monsoon 2017 as compared to water levels in pre-monsoon 2016 (recorded by the observation wells tapping the shallow aquifer monitored by the State and CGWB [piezometers installed for the purpose]) as a percentage of total number of | % |

| | | |
|---|---|---|
| | over-exploited and critical assessment units. | |
| 2(b) | Number of over-exploited and critical assessment units that have experienced a rise in water table in pre-monsoon 2018 as compared to water levels in pre-monsoon 2017 (recorded by the observation wells tapping the shallow aquifer monitored by the State and CGWB [piezometers installed for the purpose]) as a percentage of total number of over-exploited and critical assessment units. | % |
| 3(a) | Percentage of areas of major groundwater re-charging identified and mapped for the State as on 31.03.2017. | % |
| 3(b) | Percentage of areas of major groundwater re-charging identified and mapped for the State as on 31.03.2018. | % |
| 4(a) | Percentage of mapped area covered with infrastructure for re-charging groundwater to the total mapped area as on 31.03.2017. | % |
| 4(b) | Percentage of mapped area covered with infrastructure for re-charging groundwater to the total mapped area as on 31.03.2018. | % |
| 5 | Has the State notified any act or a regulatory framework for regulation of groundwater use/management? | Yes/No |
| 6(a) | Irrigation Potential Utilized (IPU) as a percentage of Irrigation Potential Created (IPC) as on 31.03.2017. | % |
| 6(b) | Irrigation Potential Utilized (IPU) as a percentage of Irrigation Potential Created (IPC) as on 31.03.2018. | % |
| 7(a) | Total number of major and medium irrigation projects in the State. | Number |
| 7(b) | Number of projects assessed and identified for the IPC-IPU gap in the State. | Number |
| 8 | Expenditure incurred on works (excluding establishment expenditure) for maintenance of irrigation assets per hectare of command area during the Financial Year of 2017-18. | ₹/hectare |
| 9(a) | The length of the canal and distribution network lined as on 31.03.2017 as a percentage of the total length of the canal and distribution network found suitable (selected) for lining for improving conveyance efficiency. | % |
| 9(b) | The length of the canal and distribution network lined as on 31.03.2018 as a percentage of the total length of the canal and distribution network found suitable (selected) for lining for improving conveyance efficiency. | % |
| 10 | Area under rain-fed agriculture as a percentage of the net cultivated area as on 31.03.2017 or previous year. | % |
| 11 | Number of water harvesting structures constructed or rejuvenated as a percentage of the target (sanctioned projects under IWMP, RKVY, MNREGS and other schemes) during the Financial Year 2017-18. | % |
| 12(a) | Assets created under IWMP. | Number |
| 12(b) | Geo-tagged assets as a percentage of total assets created under IWMP as on 31.03.2017. | % |
| 12(c) | Geo-tagged assets as a percentage of total assets created under IWMP as on 31.03.2018. | % |
| 13 | Has the State notified any law/legal framework to facilitate Participatory Irrigation Management (PIM) through Water User Associations (WUA)? | Yes/No |
| 14(a) | Irrigated command area in the state as on 31.03.2017. | Hectare |

| | | |
|---|---|---|
| 14(b) | Percentage of irrigated command areas having WUAs involved in O&M of irrigation facilities (minor distributaries and CAD&WM) as on 31.03.2017. | % |
| 14(c) | Irrigated command area in the state as on 31.03.2018. | Hectare |
| 14(d) | Percentage of irrigated command areas having WUAs involved in O&M of irrigation facilities (minor distributaries and CAD&WM) as on 31.03.2018. | % |
| 15(a) | Total irrigation service fee collected during the financial year 2016-17. | ₹ |
| 15(b) | Percentage of Irrigation Service Fee (ISF) retained by WUAs as compared to the fee collected by WUAs during the financial year 2016-17. | % |
| 15(c) | Total irrigation service fee collected during the financial year 2017-18. | ₹ |
| 15(d) | Percentage of Irrigation Service Fee (ISF) retained by WUAs as compared to the fee collected by WUAs during the financial year 2017-18. | % |
| 16(a) | Area cultivated by adopting standard cropping pattern as per agro-climatic zoning as a percentage of total area under cultivation as on 31.03.2017. | % |
| 16(b) | Area cultivated by adopting standard cropping pattern as per agro-climatic zoning as a percentage of total area under cultivation as on 31.03.2018. | % |
| 17(a) | Has the State segregated agriculture power feeder? | Yes/No |
| 17(b) | Area in the state covered with segregated agriculture power feeder as a percentage of the total area under cultivation with power supply during 2016-17. | % |
| 17(c) | Area in the state covered with segregated agriculture power feeder as a percentage of the total area under cultivation with power supply during 2017-18. | % |
| 18(a) | Is electricity to tube-wells/water pumps charged in the State? | Yes/No |
| 18(b) | Is yes, then whether it is charged as per fixed charges? | Yes/No |
| 18(c) | If yes, whether it is charged on the basis of metering? | Yes/No |
| 19(a) | Total irrigated area in the State as on 31.03.2017. | Hectare |
| 19(b) | Area covered with micro-irrigation systems as compared to total irrigated area as on 31.03.2017. | % |
| 19(c) | Total irrigated area in the State as on 31.03.2018. | Hectare |
| 19(d) | Area covered with micro-irrigation systems as compared to total irrigated area as on 31.03.2018. | % |
| 20(a) | Percentage of total rural habitations fully covered with drinking water supply as on 31.03.2017. | % |
| 20(b) | Percentage of total rural habitations fully covered with drinking water supply as on 31.03.2018. | % |
| 20(c) | Number of villages provided with 24*7 piped water supply as on 31.03.2017. | % |
| 20(d) | Number of villages provided with 24*7 piped water supply as on 31.03.2018. | % |
| 20(e) | Number of villages having individual household water meters as on 31.03.2017. | % |
| 20(f) | Number of villages having individual household water meters as on 31.03.2018. | % |
| 21(a) | Percentage reduction in rural habitations affected by water quality problems during the financial year 2016-17. | % |
| 21(b) | Percentage reduction in rural habitations affected by water quality problems during | % |

| | | |
|---|---|---|
| | the financial year 2017-18. | |
| 22(a) | Percentage of urban population being provided drinking water supply as on 31.03.2017. | % |
| 22(b) | Percentage of urban population being provided drinking water supply as on 31.03.2018. | % |
| 23(a) | Total estimated generation of wastewater in the urban areas as on 31.03.2017. | Million lit/Day |
| 23(b) | Capacity installed in the state to treat the urban wastewater as a percentage of the total estimated wastewater generated in the urban areas of the state as on 31.03.2017. | % |
| 24(a) | % waste-water treated during financial year 2016-17. | % |
| 24(b) | % waste-water treated during financial year 2017-18. | % |
| 25 | Whether the state has enacted any legislation for protection of waterbodies and water-supply channels and prevention of encroachment into/on them? | Yes/No |
| 26 | Whether the state has any framework for rainwater harvesting in public and private buildings? | Yes/No |
| 27(a) | Percentage of households being provided water supply and charged for water in urban areas as on 31.03.2017. | % |
| 27(b) | Percentage of households being provided water supply and charged for water in urban areas as on 31.03.2018. | % |
| 28(a) | Does the state have a separate integrated data centre for water resources? | Yes/No |
| 28(b) | Whether the data is being updated on the integrated data centre on a regular basis? | Yes/No |

## Categorization of states

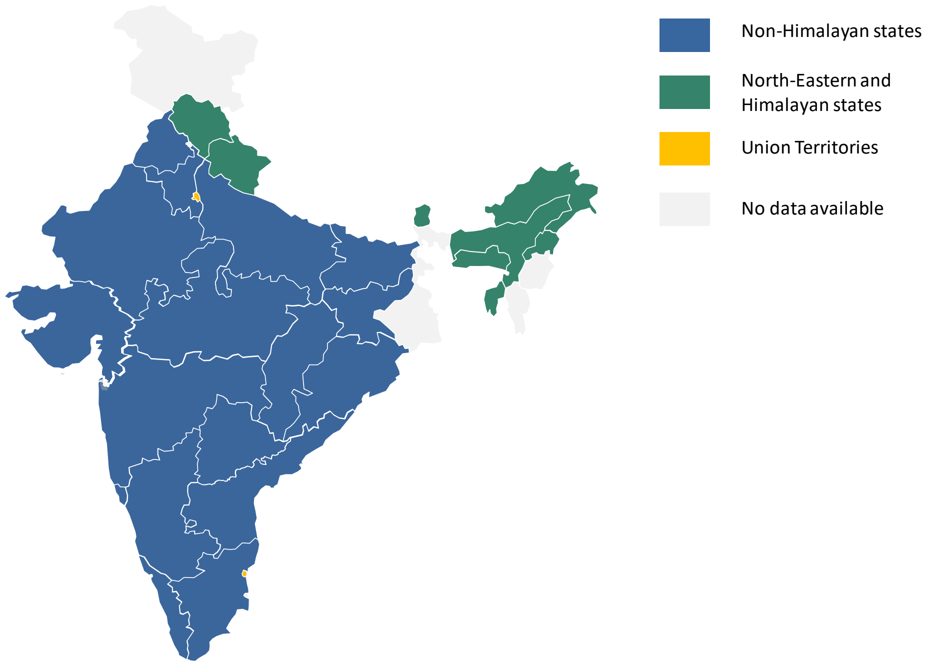
For the CWMI, the reporting states were divided into three special groups—non-Himalayan states, North-Eastern and Himalayan states, and Union Territories (UTs) to account for the different hydrological conditions across these groups.

**Table 3: Classification of states into non-Himalayan, North-Eastern and Himalayan, and UTs**

| Classification of states for CWMI | |
|---|---|
| ***Non-Himalayan states*** | Andhra Pradesh, Bihar, Chhattisgarh, Goa, Gujarat, Haryana, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh, West Bengal |
| ***North-Eastern and Himalayan states*** | Arunachal Pradesh, Assam, Himachal Pradesh, Jammu and Kashmir, Manipur, Mizoram, Meghalaya, Nagaland, Sikkim, Tripura, Uttarakhand |
| ***UTs*** | Andaman and Nicobar Islands, Delhi, Chandigarh, Daman and Diu, Dadra and Nagar Haveli, Lakshadweep, Puducherry |

The states in grey font above have not provided data for the Index. This categorization is also reflected in the map below.

**Figure 4: Categorization of states (including data availability)**




## Scope of this report

This report builds on the above-mentioned data collection and provides the results of the CWMI at multiple levels:

1. Overall/comparative analysis across states
2. Thematic analysis for each of the nine themes
3. Indicator-level analysis
4. Select case studies on best practices for water management across states

At each level, the report provides detailed, relevant analyses and insights on state performance across time, appropriate commentary on the broader context and background for the indicators, and key lessons and best practices to be kept in mind going forward.

# METHODOLOGY

## Data collection and validation

The Independent Validation Agency (IVA)—IPE Global—reviewed the data (indicator-wise) entered for each state in the NITI Portal by validating it against the source data, published data, supporting documents shared by the state, and other sources in the public domain.

The data was checked at three different levels:

- *Completeness*: The overall aim of this initiative by NITI Aayog was to arrive at a water index in order to assess the incremental progress made by states on several key parameters. Given this, completeness in input data was highly desirable, as an accurate comparative picture cannot be presented using incomplete datasets. Completeness of data was ensured by reviewing the following: (1) all districts of the state must submit data, and (2) all data elements (numerator, denominators, sub-components) must be reported.

- *Consistency*: To compare states effectively with each other, it was essential that all states used the same data sources, reporting methodology, and format. Thus, to ensure consistency across indicators, the information sources (department, data collection method, etc.), data entry formats, and timelines were carefully examined. This was primarily ensured through the following: (1) identification and resolution of data entry errors for data taken from reliable/acceptable sources, (2) check for internal consistency across indicators, as well as over a period of time, and (3) identification of statistical outliers.

- *Validity/triangulation*: Finally, the dataset was analyzed through multiple processes, such as (1) comparison with reliable, secondary sources of information in the water sector domain, (2) rapid primary validation by visiting select field locations, and (3) feedback from key stakeholders.

### Review methodology

The review process for the present report was initiated by the IVA in December 2018. The IVA developed a detailed review methodology for each indicator and sub-indicator. The methods and tools adopted to examine values entered against each indicator in the NITI Aayog social portal are listed below. State-specific reports were developed after the examination and verification of the data. In these reports, discrepancies were highlighted and shared with the state nodal officers, and the resolution of these discrepancies was undertaken in consultation with concerned stakeholders. Field visits across nine states and UTs—Madhya Pradesh, Uttar Pradesh, Jharkhand, Haryana, Punjab, Maharashtra, Goa, Karnataka, and Delhi—were also conducted to carry out physical verification of the data and understand the reporting methodology used by the states and UTs to collect, collate, and present data against specific indicators.

**Table 4: Review methodology for indicators**[96]

| No. | Indicators | Data sources | Methodology |
|---|---|---|---|
| **A.** | **Source augmentation and restoration of water bodies** | | |
| 1 | Area irrigated by water bodies restored during the financial year 2016-17 & 2017-2018 as compared to the irrigation potential area of total number of water bodies identified for restoration. | Water Resources Departments of states / State Reports/ Water MIS | 1. Review of formulas and calculations of the final value - errors documented, resolved and submitted.<br>2. Review of supporting documents (list of water bodies restored) to ensure accuracy.<br>3. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s).<br>4. Documentation submitted to NITI Aayog. |
| **B.** | **Source augmentation (Groundwater)** | | |
| 2 | Percentage of over-exploited and critical assessment units those have experienced rise in water table [recorded by the observation wells tapping the shallow aquifer monitored by the State (piezometers installed for the purpose) and CGWB] to total number of assessment units in pre-monsoon 2016-17 in comparison to pre-monsoon 2017-2018 | Central Ground Water Board (CGWB)/ Water Resources Department (MIS, where available) | 1. Review of supporting documents provided by SNOs against the portal entries.<br>2. Counter-checks with CGWB data on critical and over-exploited AU.<br>3. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s).<br>4. Documentation submitted to NITI Aayog. |
| 3 | Percentage of areas of major groundwater re-charging identified and mapped for the State as on 31.3.2017 & 31.3.2018 | State Administrative Report/GIS Maps Central Ground Water Board (CGWB) | 1. Review of supporting documents & GIS map (link if available) provided by SNOs against the portal entries.<br>2. Review of state portal for updated information on area to be re-charged, mapped and structures constructed.<br>3. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s).<br>4. Documentation submitted to NITI Aayog. |
| 4 | Percentage of mapped area covered with infrastructure for re-charging groundwater to the total mapped area as on 31.03.2017 & 31.3.2018 | State Administrative Report/ Central Ground Water Board | |

96 The validation method and data sources are indicative and not exhaustive. In some cases, the IVA was compelled to develop revised verification methods based on the information shared by the state nodal officer. In the absence of published reports and detailed information, the IVA also accepted declarations on final values submitted by a relevant, competent authority.

| No. | Indicators | Data sources | Methodology |
|---|---|---|---|
| 5 | Has the State notified any Act or a regulatory framework for regulation of Groundwater use/ management? | Copy of Act/ Government Order (GO) | 1. Collection of hard copies of the GO/ Act.<br>2. Documentation submitted to NITI Aayog. |
| **C.** | **Major and medium irrigation - Supply side management** | | |
| 6 | % of Irrigation Potential Utilized (IPU) to Irrigation Potential Created (IPC) as on 31.03.2017 & 31.3.2018 | State Administrative Report/Ministry of Agriculture and Water Resources Department | 1. Review of supporting documents provided by SNOs against the portal entries.<br>2. Calculations checked for accuracy.<br>3. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s).<br>4. Documentation submitted to NITI Aayog. |
| 7 (a) | Total number of major and medium irrigation projects in the State | State Administrative Report/Ministry of Agriculture and Water Resources Department / State Portal | 1. Review of projects/state reports and water portal developed by the state for updated information.<br>2. Review of supporting documents provided by SNOs against the portal entries.<br>3. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s).<br>4. Documentation submitted to NITI Aayog. |
| 7 (b) | Number of projects assessed and identified for the IPC-IPU gap in the State | | |
| 8 | Expenditure incurred on works (excluding establishment expenditure) for maintenance of irrigation assets per hectare of command area during the Financial Year 2017-18 | State Administrative Report/Water Resources Department | 1. Review of supporting documents provided by SNOs against the portal entries.<br>2. Calculations checked – based on total command area and individual components.<br>3. Supporting documents such as project details, water resource annual reports, reports from the irrigation department, etc., reviewed.<br>4. Sample states selected for Second Level Verification.<br>5. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s).<br>6. Documentation submitted to NITI Aayog. |
| 9 | The length of the canal and distribution network lined as on 31.03.2016 and 31.03.2017 vis-à-vis the total length of canal and distribution network found suitable (selected) for lining for improving conveyance efficiency | State Administrative Report/ Report/ Collect Project details / Project details on Portal | |
| **D.** | **Watershed development - Supply side management** | | |
| 10 | Area under rain-fed agriculture as a percentage of | State Administrative | 1. Review of supporting documents provided by SNOs against the portal |

| No. | Indicators | Data sources | Methodology |
|---|---|---|---|
| | the net cultivated area as on 31.3.2017 or previous year | Report/Agriculture Statistics – Annual report/ Ministry of Agriculture / Any other report available in the public domain<br>State Report/ Collect Project details | entries.<br>2. Calculations checked – Total projects under IWMP, RKVY and MGNREGS checked for completeness.<br>3. Supporting documents, such as project details, water annual reports, updated information state portal, Bhuvan website, etc., reviewed.<br>4. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s).<br>5. Documentation submitted to NITI Aayog. |
| 11 | Number of water harvesting structures constructed or rejuvenated as compared to the target (sanctioned projects under IWMP, RKVY, MGNREGS and other schemes) during the Financial Year 2017-18 | | |
| 12 | Assets created under IWMP & Percentage of assets created under IWMP geo-tagged as on 31.03.2017 & 31.03.2018 | IWMP Report | |
| **E.** | **Participatory irrigation practices - Demand side management** | | |
| 13 | Has the State notified any law/ legal framework to facilitate Participatory Irrigation Management (PIM) through Water User Associations (WUAs)? | State Administrative Report/ Water Resource Department/ Government Order/Framework | 1. Review of supporting documents provided by SNOs against the portal entries.<br>2. Sample states selected for Second Level Verification.<br>3. Any other document available in the public domain reviewed.<br>4. State declaration/letters from competent authorities collected.<br>5. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s).<br>6. Documentation submitted to NITI Aayog. |
| 14 (a), (c) | Irrigated Command Area in the State as on 31.03.2017 & 31.03.2018 | State Agriculture Dept., state water resources irrigation dept. | |
| 14 (b), (d) | Percentage of irrigated command areas having WUAs involved in the O&M of irrigation facilities (minor distributaries and CAD&WM) as on 31.3.2017 & 31.03.2018 | | |
| 15(a), (c) | Total irrigation service fee collected during the financial year 2016-17 & 2017-18 | State Report/ Water Resource Department | |
| 15(b), (d) | Percentage of Irrigation Service Fee (ISF) retained by WUAs as compared to the fee collected by WUAs during the Financial Year 2016-17 & 2017-18 | | |
| **F.** | **Sustainable on-farm water use practices - Demand side management** | | |
| 16 | Area cultivated by adopting standard cropping pattern as per agro-climatic zoning, to total area under cultivation | State Administrative Report/Ministry of Agriculture | 1. Review of supporting documents provided by SNOs against the portal entries.<br>2. Calculations checked for consistency. |

| No. | Indicators | Data sources | Methodology |
|---|---|---|---|
| | as on 31.03.2017 & 31.03.2018 | (Cropping pattern – area under each crop as against the recommended) | 3. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s).<br>4. Documentation submitted to NITI Aayog. |
| 17 (a) | Has the State segregated agriculture power feeder? | Power Department / Ministry of Agriculture (state report) | |
| 17 (b) | Area in the state covered with segregated agriculture power feeder as compared to the total area under cultivation with power supply during 2017-18. | | |
| 18 (a) | Is electricity to tube wells/ water pumps charged in the State? | State Administrative Report/ Ministry of Power and Agriculture (Budget, revenue documents) | 1. Review of supporting documents provided by SNOs against the portal entries.<br>2. Any information available online on electricity charges for the state, sample field visit and discussions with Power / Agriculture department reviewed.<br>3. Documentation submitted to NITI Aayog. |
| 18 (b) | If yes, then whether it is charged as per fixed charges? | | |
| 18 (c) | If yes, then whether it is charged on the basis of metering? | | |
| 19 (a), (c) | Total Irrigated Area in the State as on 31.03.2017 and on 31.03.2018 | Annual report, Ministry of Agriculture; Agriculture output and crop yield; State Reports | 1. Review of supporting documents provided by SNOs against the portal entries.<br>2. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s).<br>3. Documentation submitted to NITI Aayog. |
| 19 (b), (d) | Area covered with micro-irrigation systems as compared to total irrigated area as on 31.03.2017 and on 31.03.2018 | List of micro-irrigation systems with area – Annual reports, Ministry of Agriculture | |
| **G. Rural drinking water** | | | |
| 20 (a), (b) | Proportion of total rural habitations fully covered with drinking water supply as on 31.03.2017 and on 31.3.2018 | State Administrative Report; data available on National drinking water supply and sanitation report – specific years | 1. Counter checked with data available on the national drinking water supply and sanitation portal.<br>2. Information provided by state reviewed.<br>3. Review of state submission against accepted norms w.r.t provision of water supply in rural areas (~40 lpcd).<br>4. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s). |
| 20 (c), (d) | Number of villages provided with 24*7 piped water supply as on 31.03.2017 and 31.03.2018 | | |
| 20 (e), (f) | Number of villages having individual household water meters as on 31.03.2017 and | | |

| No. | Indicators | Data sources | Methodology |
|---|---|---|---|
| | 31.03.2018 | | 5. Documentation submitted to NITI Aayog. |
| 21 (a), (b) | % reduction in rural habitations affected by Water Quality problems during the Financial Year 2016-17 and 2017-18 | | |
| **H. Urban water supply and sanitation** | | | |
| 22 (a), (b) | % of urban population being provided drinking water supply as on 31.03.2017 and as on 31.03.2018 | State Administrative report; data available on National drinking water supply and sanitation report – specific years; UDPFI Norms/State planning guidelines w.r.t drinking water supply and sanitation | 1. Counter checked with data available on the national drinking water supply and sanitation portal.<br>2. Review of state submission against accepted norms w.r.t provision of water supply in urban areas (~135 lpcd).<br>3. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s).<br>4. Documentation submitted to NITI Aayog. |
| 23 (a) | Total estimated generation of wastewater in the urban areas as on 31.03.2017 | | |
| 23 (b) | Capacity installed in the state to treat the urban waste-water as a proportion of the total estimated wastewater generated in the urban areas of the state as on 31.03.2017 | State Administrative report; List of wastewater treatment facilities with capacities; State report; List of wastewater treatment facilities with capacities State Urban Department – reports | 1. Review of supporting documents (list of wastewater facilities, their capacities and the output).<br>2. Sample field visits to review wastewater treatment facilities/check estimations with available norms on wastewater (80% of water supplied).<br>3. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s).<br>4. Documentation submitted to NITI Aayog. |
| 24 (a), (b) | % waste-water treated during FY 2016-17 & FY 2017-18 | | |
| **I. Policy and governance** | | | |
| 25 | Whether the State has enacted any legislation for protection of water bodies and water-supply channels and prevention of encroachment into/on them? | Copy of legislation and orders/ reports | 1. Review of supporting documents provided by SNOs against the portal entries.<br>2. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s).<br>3. Documentation submitted to NITI |
| 26 | Whether the State has any | | |

| No. | Indicators | Data sources | Methodology |
|---|---|---|---|
| | framework for rain water harvesting in public and private buildings? | | Aayog. |
| 27 | Percentage of households being provided water supply and charged for water in the urban areas as on 31.3.2017 and as on 31.3.2018 | State Reports, annual report, National drinking water supply and sanitation data | |
| 28 (a) | Does the State have a separate integrated Data Centre for water resources? | Online portal link/ Departments incorporation and GO | 1. Review of government orders, date of incorporation, evidence on establishment of data centre along with links to website. 2. Documentation submitted to NITI Aayog. |
| 28 (b) | Whether the data is being updated on the integrated data centre on a regular basis? | | |

**Verification Process**

The data entered by the states was reviewed against data compiled at the Centre, annual reports available in the public domain, and government orders. For indicators related to rural drinking water and supply, data from Ministry of Drinking Water and Sanitation, National Rural Drinking Water Programme was referred to, in order to arrive at the final figure. Specified norms were used by the validating agency for calculating estimated wastewater generated and gap in water supplied in the urban areas.

Further, during the review process, the method and data sources were revised again based on the availability of data, information shared by relevant departments / authorities, and discussions carried with NITI Aayog and State Departments. Documentation of the reviewed data and state reports were shared with relevant stakeholders to ensure transparency in the verification process.

The Independent Validation Agency (IVA) also reviewed the supporting documents submitted by the states and UTs as evidence against their claim on progress made. The IVA, after a thorough review of the documents, discussed the gaps and discrepancies with the state nodal officers and concerned authorities at the state level. Further, a state specific validation report was shared with the Principal Secretaries, SNOs and other relevant officers highlighting the results of the verification carried. The reports were also copy marked to officials at NITI Aayog. The states and UTs were then requested to review the validation report and provide their feedback on the validated values. Subsequently, the IVA also presented the validation results through a conference held at NITI Aayog on the 4th of February 2019 to present the results of 25 states and 2 UTs that had submitted the data. The conference also helped the IVA in presenting the discrepancies, filling data gaps and highlighting deviations found during the process of verification with each state.

## Scoring methodology

The validated data was scaled, weighed, and summed to create the Composite Index. The transformations are represented below. A customized methodology has been applied for calculating non-binary UT scores given that the standardized scaling methodology could not be applied to only two observations in the category. The alternate methodology for UTs has also been represented below. However, the calculation of scaled value is done as per the defined methodology like in case of non-Himalayan and North-Eastern and Himalayan states.

### Positive indicators

For positive indicators (i.e. indicators for which higher values are better), the following formula was used to scale values.

$$Scaled\ value\ of\ positive\ indicator\ (S_i) = \frac{X_i - minimum\ value}{maximum\ value - minimum\ value}$$

After scaling, the values were distributed between 0 and 1, with the best performing state at 1 and the worst performing state at 0.

In case of UTs, the following methodology has been applied.

$$Scaled\ value\ of\ positive\ indicator\ (S_i) = \frac{X_i}{100}$$

### Negative indicators

Similarly, for negative indicators (i.e. indicators for which lower values are better), the scaled values were calculated as follows.

$$Scaled\ value\ of\ negative\ indicator\ (S_i) = \frac{Maximum\ value - X_i}{maximum\ value - minimum\ value}$$

After scaling, values were distributed between 0 and 1, with the best performing state at 1 and the worst performing state at 0.

In case of UTs, the state with lowest figure has been given full score, and vice-versa.

### Binary indicators

For binary indicators, a ‘Yes’ earned a score of 1, while a ‘No’ was awarded a score of 0.

### Index calculation

After scaling, based on the weights of each indicator, a Composite Index was calculated for FY 15-16, FY 16-17, and FY 17-18 for each state, using the following formula:

$$Composite\ Index - \frac{\sum(W_i \times S_i)}{\sum W_i}$$

To arrive at the weight of an indicator, the weight of a theme was equally divided amongst its constituent indicators.

The calculation of scores for the three years enabled the tracking and comparison of state-level performance over time.

## Limitations

There are some limitations to the Index, as detailed below.

### Data limitations

*Data sources:* IVA relied primarily on the data shared by the states directly as signed documents in the absence of water data present on verifiable public platforms. Each indicator is pre-defined with respect to input values of the numerator and denominator, which were the basis of the final calculations. However, several states shared the final values in the form of a declaration and not the details of how it was calculated. The IVA, however, accepted the data for this year as there are only a few monitoring and reporting mechanisms currently in place. Also, since the data was collected from nine different departments in a state, the irrigation or water sources authorities acting as points-of-contact often did not have the complete details of the data calculations and sources of other departments.

*Time lag:* There is a significant time lag between the latest data available in the public domain and the last financial year specified under CWMI. For example, published data related to ground water is available for the year 2013 and 2015, which cannot be extrapolated to the current date. Further, past reports and records are not maintained for several indicators at the state level. In such cases, the IVA has relied on declarations/ authorized letters from the state departments, especially due to the non-availability or non-readiness of relevant evidence and supporting documents.

*Change in nodal officers at the state water resource department/irrigation department:* The assigned nodal officers appointed for the CWMI-II initially were changed in some states, leading to critical information gaps. A few records pertaining to data, evidence, and calculations were lost in the transition, thereby delaying the review process. Additionally, lack of coordination amongst various departments involved the data reporting process also created challenges in timely data collection.

### Gaps and discrepancies

Given the data scarcity in the water sector in the country, and the fact that data for several of these indicators was being collected and compiled for the first time even at the state level, let alone the national level, there are certain data gaps that exist in the Index. The qualifications and gaps for data on each indicator are given in the table below. These are expected to be assessed and plugged in future iterations of the Index, in close collaboration with states.

**Table 5: Data gaps for indicators**

| No. | Indicators | Data sources | Observations |
|---|---|---|---|
| **A. Source Augmentation - Restoration of Water Bodies** | | | |
| 1 a, b | Area irrigated by water bodies restored during the financial year 2016-17 & 2017-2018 as compared to the irrigation potential area of total number of water bodies identified for restoration | Water Resources Department / State Reports/ Water MIS | Several states did not have data on the number of water bodies restored and its corresponding data on the increase in area irrigated by the restored units. States such as Chhattisgarh, Andhra Pradesh, provided a list of projects (scheme wise) under which water bodies were planned to be restored. However, most states shared the total area that was targeted and the achievement of improved irrigation potential. |
| **B. Source Augmentation - Ground Water** | | | |
| 2 | Percentage of over-exploited and critical assessment units that have experienced a rise in water table [recorded by the observation wells tapping the shallow aquifer monitored by the State (piezometers installed for the purpose) and CGWB] to total number of assessment units in pre-monsoon 2017-18 in comparison to pre-monsoon 2016-17 | Central Ground Water Board (CGWB)/ Water Resources Department (MIS if available) | Most states only provided the number of Assessment Units that are present in the critical and over-exploited category and the number that have registered an increase in the water table.<br>As informed by the nodal officers of the states, the readings are calibrated at the block level, however, it is not a regular practice. States such as Madhya Pradesh, Gujarat, Rajasthan, and Andhra Pradesh provided the IVA with the list of AUs under critical and over-exploited category and their respective change in the water table level. |
| 3 | Percentage of areas of major groundwater re-charging identified and mapped for the State as on 31.3.2017 & 31.3.2018 | State Report/GIS Maps Central Ground Water Board (CGWB) | Unlike Aquifer mapping which is widely monitored by the Central Ground Water Board (CGWB), the areas mapped for recharging ground water are not documented at the national level. States such as Goa, Bihar, Tripura, Meghalaya and Sikkim have not identified any area for mapping. States also did not have relevant data on area covered with infrastructure.<br>Most remaining states have provided IVA with information on the indicator. |
| 4 | Percentage of mapped area covered with infrastructure for re-charging groundwater to the total mapped area as on 31.03.2016 & 31.3.2017 | State Report/ Central Ground Water Board | |
| 5 | Has the State notified any Act or a regulatory framework for regulation of Groundwater | Copy of Act/ Government Order (GO) | No observation. |

| No. | Indicators | Data sources | Observations |
|---|---|---|---|
| | use/ management? | | |
| **C.** | **Supply Side Management – Major and Medium Irrigation** | | |
| 6 | % of Irrigation Potential Utilized (IPU) to Irrigation Potential Created (IPC) as on 31.03.2017 & 31.3.2018 | State Administrative Report/Ministry of Agriculture or Water Resources Department | IVA had to explain to the states on the IPC and IPU figures required as most of them use different nomenclature to define irrigation potential created, such as Culturable Command areas (CCA) and Gross Irrigated Area. |
| 7 (a) | Total number of major and medium irrigation projects in the State | State Administrative Report/Ministry of Agriculture or Water Resources Department / State Portal | Most of the states provided a list of major and medium projects along with IPC-IPU gaps as identified for uptake by the irrigation department. |
| 7 (b) | Number of projects assessed and identified for the IPC-IPU gap in the State | | |
| 8 | Expenditure incurred on works (excluding establishment expenditure) for maintenance of irrigation assets per hectare of command area during the Financial Year 2017-18 | State Administrative Report/Water Resources Department | Declarations were provided by the state nodal officers from the irrigation department. No information is available in the public domain. |
| 9 | The length of the canal and distribution network lined as on 31.03.2016 and 31.03.2017 vis-à-vis the total length of canal and distribution network found suitable (selected) for lining for improving conveyance efficiency | State Administrative Report/ Collect Project details / Project details on Portal | No observation. |
| **D.** | **Supply Side Management – Watershed Development** | | |
| 10 | Area under rain-fed agriculture as a percentage of the net cultivated area as on 31.3.2017 or previous year | State Administrative Report/Agriculture Statistics – Annual report/ Ministry of Agriculture / Any other report available in the public domain | Except for Puducherry, all states and UT (Delhi) have area under rain-fed agriculture. Since this is a negative indicator (implying that the greater the number the lower should be the scaled value), IVA has taken the value against Puducherry as 100. |
| 11 | Number of water harvesting structures constructed or rejuvenated as compared to the target (sanctioned projects under IWMP, RKVY, MGNREGS and other schemes) during the Financial | State Report/ Collect Project details | Data was collected separately for different schemes and then added later. States, such as Maharashtra, Tamil Nadu, and Assam, provided detailed list of structures w.r.t each scheme. |

| No. | Indicators | Data sources | Observations |
|---|---|---|---|
| | Year 2017-18 | | |
| 12 | Assets created under IWMP & Percentage of assets created under IWMP geo-tagged as on 31.03.2017 & 31.03.2018 | IWMP Report | The IVA used Bhuvan maps[97] to verify data provided by the states. However, as the volume of assets is high, the accuracy could not be confirmed through the maps and the validation team relied on data shared by the states. |
| **E.** | **Demand Side Management - Participatory Irrigation Practices** | | |
| 13 | Has the State notified any law/ legal framework to facilitate Participatory Irrigation Management (PIM) through Water User Associations (WUAs)? | State Administrative Report/ Water Resource Department/ Government Order/Framework | No observation. |
| 14 (a), (c) | Irrigated Command Area in the State as on 31.03.2017 & 31.03.2018 | | States were explained the difference between irrigated command area (net irrigated area) and gross irrigated area. |
| 14 (b), (d) | Percentage of irrigated command areas having WUAs involved in the O&M of irrigation facilities (minor distributaries and CAD&WM) as on 31.3.2017 & 31.03.2018 | | The national water mission mandates the formation of WUAs, which should be trained and engaged in O&M of irrigation facilities, to ensure sustainable use of water resources and improve water efficiency – most states have complied. |
| 15 (a), (c) | Total irrigation service fee collected during the financial year 2016-17 & 2017-18 | State Report/ Water Resource Department | No observation. |
| 15 (b), (d) | Percentage of Irrigation Service Fee (ISF) retained by WUAs as compared to the fee collected by WUAs during the Financial Year 2016-17 & 2017-18 | | Despite the presence of WUAs and the collection of irrigation service fee facilitated by them, states like Chhattisgarh, Madhya Pradesh, Kerala, Jharkhand, Odisha, Telangana, Tamil Nadu, Haryana do not let the WUAs retain a component of the fee. The fee is transferred to the WUAs for their subsistence and mandated work by the department. |
| **F.** | **Demand Side Management - Sustainable on-farm Water Use Practices** | | |
| 16 | Area cultivated by adopting standard cropping pattern as | State Administrative Report/Ministry of | There is enough literature in the public domain on different Agro-Climatic |

[97] "ISRO's Geoportal | Gateway to Indian Earth Observation | Applications", *Bhuvan Portal by National Remote Sensing Centre*, http://bhuvan.nrsc.gov.in/projects/iwmp/.

| No. | Indicators | Data sources | Observations |
|---|---|---|---|
| | per agro-climatic zoning, to total area under cultivation as on 31.03.2017 & 31.03.2018 | Agriculture (Cropping pattern – area under each crop as against the recommended) | Zones and the recommended crops under each of the zones. However, the states do not follow the recommended crops as given under any of the following three zoning patterns – a) 15 Agro-climatic regions by the Planning Commission; b) 127 Agro-climatic zones under National Agricultural Research Project (NARP); c) 20 Agro-ecological regions by the National Bureau of Soil Survey & Land Use Planning (NBSS & LUP). The IVA also referred to Agriculture Statistics at a Glance, June 2014, (Directorate of Economics & Statistic, and Ministry of Agriculture) to study the crops grown region-wise. The declarations shared by the state did not provide details on area under each crop grown in the state, except for Telangana. |
| 17 (a) | Has the State segregated agriculture power feeder? | Power Department / Ministry of Agriculture (state report) | Only states such as Andhra Pradesh, Haryana, Himachal Pradesh, Chhattisgarh, Gujarat, MP, Karnataka, Maharashtra, Punjab and Tripura have provisioned for segregated power feeders. The states did not provide details on the area covered with segregated power feeders. For Karnataka,[98] the IVA has accepted the number of feeder connections and not area. |
| 17 (b) | Area in the state covered with segregated agriculture power feeder as compared to the total area under cultivation with power supply during 2017-18. | | |
| 18 (a) | Is electricity to tube wells/ water pumps charged in the State? | State Administrative Report/ Ministry of Power and Agriculture (Budget, revenue documents) | The IVA observed conflicting statements submitted by the states on this indicator - electricity if charged at a fixed rate either could be due to a metered connection (with fixed unit rate) or a fixed amount charged irrespective of the usage. Some states have mentioned that there are no fixed |
| 18 (b) | If yes, then whether it is charged as per fixed charges? | | |
| 18 (c) | If yes, then whether it is charged on the basis of metering? | | |

[98] Niranthara Jyothi Yojane (NJY) is a Major State Flagship programme of Government of Karnataka which aims at bifurcating the rural area loads into agricultural & non-agricultural load & to provide 24 hours quality power supply to rural housing, drinking water, rural industries & fixed hours of quality power supply to the irrigation pump sets. Therefore, the main KPI for NJY is No. of feeders and information with respect to area covered with segregated agriculture feeder is not available or not the main objective of the scheme. Hence the number of IP Feeders with segregated agriculture power feeder is accepted.

| No. | Indicators | Data sources | Observations |
|---|---|---|---|
| | | | rates but metered connections. States like Maharashtra, Andhra Pradesh, Karnataka,[99] Bihar, Chhattisgarh,[100] have some connections that are metered (to HH paying income Tax) and some that are free as subsidy provided to BPL families or unmetered. IVA has accepted declaration as submitted by the SNOs. |
| 19 (a), (c) | Total Irrigated Area in the State as on 31.03.2017 and on 31.03.2018 | Annual report, Ministry of Agriculture; Agriculture output and crop yield; State Reports | Total Irrigated Area is the gross area under irrigation. This indicator is designed to capture accurate data for the specific year. The states submitted different figures, either based on net area or gross area under irrigation, causing confusion.<br>Further, several states did not have documented information against the area under micro-irrigation. |
| 19 (b), (d) | Area covered with micro-irrigation systems as compared to total irrigated area as on 31.03.2017 and on 31.03.2018 | List of micro-irrigation systems with area – Annual reports, Ministry of Agriculture | |
| **G. Rural Drinking Water – Supply** | | | |
| 20 (a), (b) | Proportion of total rural habitations fully covered with drinking water supply as on 31.03.2017 and on 31.3.2018 | State Administrative report; data available on National drinking water supply and sanitation report – specific years | No observation *(the data was available in the public domain).* |
| 20 (c), (d) | Number of villages provided with 24*7 piped water supply as on 31.03.2017 and 31.03.2018 | | Andhra Pradesh has 24*7 piped water supply in all the villages |
| 20 (d), (f) | Number of villages having individual household water meters as on 31.03.2017 and 31.03.2018 | | Goa and Puducherry have individual household meters across the villages. |
| 21 (a), (b) | % reduction in rural habitations affected by Water Quality problems during the Financial Year 2016-17 and 2017-18 | | |

[99] As per Tariff fixed by Karnataka Electricity Regular Commission (KERC), for IP sets below 10 HP, free electricity supplied. for IP sets above 10 HP, HH are billed as per the Tariff fixed by the KERC or recorded consumption in energy meter.

[100] The State Government of Chhattisgarh under Krishak Jivan Jyoti Yojana provides free electricity, 6000 units per year to 0-3 HP pumps & 7500 unit per year to 3-5 HP pumps. In addition to this, free power is also provided to SC/ST HH and beneficiaries falling under Uthan Yojna (to pump sets installed under the scheme). Remaining HH and electricity used beyond free units are charged at fixed rates.

| No. | Indicators | Data sources | Observations |
|---|---|---|---|
| **H. Urban Water Supply and Sanitation** | | | |
| 22 (a), (b) | % of urban population being provided drinking water supply as on 31.03.2017 and as on 31.03.2018 | State Administrative report; data available on National drinking water supply and sanitation report – specific years; UDPFI Norms/State planning guidelines w.r.t drinking water supply and sanitation | Several states struggled to collect data against this indicator. States like Madhya Pradesh, Gujarat, Goa, Himachal Pradesh, Puducherry reported 100% of urban population being provided with drinking water supply. Most of the states do not follow the norm which mandates at least 135 lpcd for urban areas.<br>The IVA used counter-calculations to verify the state submissions against this indicator. |
| 23 (a) | Total estimated generation of wastewater in the urban areas as on 31.03.2017 | | |
| 23 (b) | Capacity installed in the state to treat the urban waste-water as a proportion of the total estimated wastewater generated in the urban areas of the state as on 31.03.2017 | State Administrative report; List of wastewater treatment facilities with capacities; State report; List of wastewater treatment facilities with capacities State Urban Department – reports | Again, most states did not provide the IVA with details on capacity installed to treat wastewater. The information available in the public domain[101] also doesn't match with the submitted data. Further, the percentage of wastewater treated is also unavailable w.r.t each treatment plant and city as the water resource department faced difficulties in coordinating with the urban department to obtain this information. |
| 24 (a), (b) | % waste-water treated during FY 2016-17 & FY 2017-18 | | |
| **I. Policy and Governance** | | | |
| 25 | Whether the State has enacted any legislation for protection of water bodies and water-supply channels and prevention of encroachment into/on them? | Copy of legislation and orders/ reports | No observation. |
| 26 | Whether the State has any framework for rain water harvesting in public and private buildings? | | |
| 27 | Percentage of households being provided water supply and charged for water in the urban areas as on 31.3.2017 and as on 31.3.2018 | State Reports, annual report, National drinking water supply and sanitation data | No observation. |
| 28 (a) | Does the State have a separate integrated Data | Online portal link/ Departments | Only a few states have developed an integrated data centre for water |

[101] "National Status of Waste Water Generation & Treatment: Sulabhenvis Centre", *ENVIS Centre on Hygiene, Sanitation, Sewage Treatment Systems and Technology*, http://www.sulabhenvis.nic.in/Database/STST_wastewater_2090.aspx.

| No. | Indicators | Data sources | Observations |
|---|---|---|---|
| | Centre for water resources? | incorporation and GO | resources that is functional. However, a substantial part of the data available under the website is dated to 2015 or 2014, despite the site showing recent update dates. |
| 28 (b) | Whether the data is being updated on the integrated data centre on a regular basis? | | |

### Additional observations

Few stand-out cases from the data collection process have been highlighted separately below to provide greater emphasis:

- States such as Odisha, Bihar, Goa, Nagaland, Sikkim, Meghalaya, Assam, Tripura, and Arunachal Pradesh have declared that they have no critical or over-exploited groundwater units, and thus have not been scored for any of the indicators under the theme – Source augmentation (Groundwater).
- States such as Uttar Pradesh, Rajasthan, and Uttarakhand, and the UT Delhi have declared that there is no mapped area covered with infrastructure for re-charging groundwater as compared to the total area and therefore have been given the score of 0. On the other hand, states such as Punjab, Maharashtra and Haryana and the UT Puducherry have been given the score of 0 due to lack of data available with the states.
- For the indicator 20 (d), most of the states such as Uttar Pradesh, Jharkhand, Odisha, Kerala, Gujarat, Chhattisgarh, Rajasthan, Bihar, Telangana, Maharashtra, Karnataka, Tamil Nadu, Goa, Haryana, Nagaland, Meghalaya, Assam and Tripura have reported that there are no villages that are being provided with 24*7 piped water supply and therefore have been given the score of 0. On the other hand, states such as Sikkim, Uttarakhand and Arunachal Pradesh have been given the score of 0 due to insufficient data or no data being shared with IVA.
- For the indicator 20 (f), most of the states such as Uttar Pradesh, Jharkhand, Odisha, Kerala, Gujarat, Chhattisgarh, Rajasthan, Bihar, Telangana, Maharashtra, Karnataka, Tamil Nadu, Haryana, Nagaland, Himachal Pradesh, Meghalaya, Assam and Tripura have reported that there are no villages having individual household meters and therefore have been given the score of 0. On the other hand, states such as Sikkim, Uttarakhand and Arunachal Pradesh have been given the score of 0 due to insufficient data or no data being shared with IVA.
- For the indicator 21, states who had achieved 100% reduction in the previous years and had no further scope for reduction, were given the full score. This was applicable for both – bigger states as well as hilly states. Other states have been assigned the score as per the defined methodology such as Assam, Maharashtra, Rajasthan, etc.
- For indicator 17 in the case of Karnataka, the number of IP Feeders with segregated agriculture power feeder is accepted. As, Niranthara Jyothi Yojane (NJY) is a Major State Flagship programme of Government of Karnataka which aims at bifurcating the rural area loads into agricultural & non-agricultural load & to provide 24 hours quality power supply to rural housing, drinking water, rural industries & fixed hours of quality power supply to the irrigation pump sets. Therefore, the main KPI for NJY is No. of feeders and information with respect to the area covered with segregated agriculture feeder is not available or not the main objective of the scheme.

- Haryana has not shared data for most of the indicators in the previous year, whereas, it has shared data for the reference year, i.e. 2017-18, and therefore, the incremental performance is high.

*Note*: States that have not reported data due to non-applicability of the theme or indicator or due to non-availability of data, have been marked out as ‘Not available’ in the respective graphs. This can be used to distinguish states from the ones that have reported ‘0’ on the indicator.

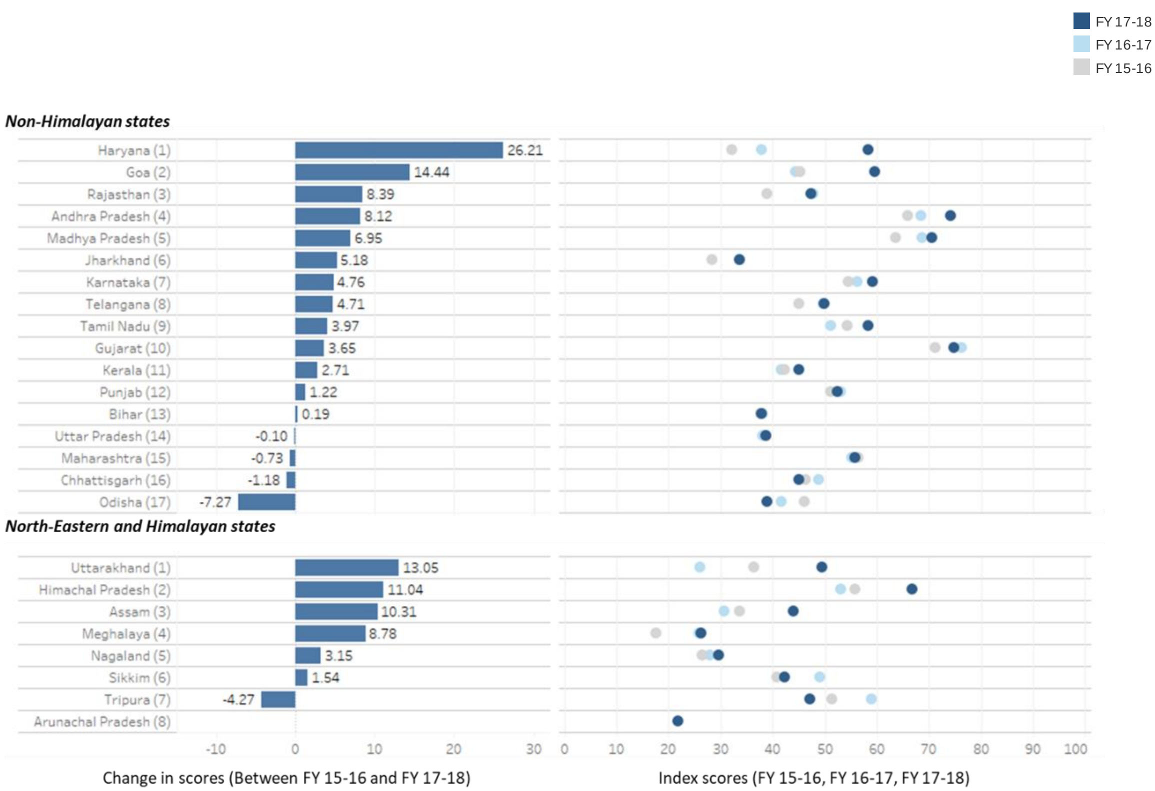
# KEY FINDINGS

States and Union Territories (UTs) have been scored on the Index which comprises nine themes, and a total of 28 indicators across themes, and have been divided into three categories: non-Himalayan states, North-Eastern and Himalayan states, and Union Territories (UTs). In this section, we present five broad observations from the analysis looking at overall progress in states followed by thematic summaries for the nine themes that the CWMI covers.

### *1. A majority of Indian states are demonstrating progress on the Water Index*

**Figure 5: Change in state-level performance over time—non-Himalayan states and North-Eastern and Himalayan states**

*Change in Composite Water Index scores (FY 15-16, FY 16-17, FY 17-18)*




**Promisingly, ~80% of the states (19 out of 24)[102] have shown improvement in their water management scores over the last three years.** 13 non-Himalayan states and 6 North-Eastern and Himalayan states improved their water management scores between FY 15-16 and FY 17-18. 10 states across these categories showed improvement greater than 5 points. The average change in scores across states was +5.2 points during this period. North-Eastern and Himalayan states displayed stronger improvement, with +6.2 points being the average change, higher than the +4.8 points observed in the case of non-Himalayan states. Haryana reported the maximum progress (of ~26 points) across three years, driven in

[102] Excludes Arunachal Pradesh, Delhi, and Puducherry as these states and UTs were not assessed on the Index for FY 15-16 and FY 16-17, and therefore previous year comparisons could not be made.

large part by higher scores on four themes—restoration of water bodies, watershed development, on-farm water use, and policy and governance. Goa, Uttarakhand, Himachal Pradesh, and Assam are four more states displaying improvement greater than 10 points during the three-year period *(Figure 5*: Change in state-level performance over time—non-Himalayan states and North-Eastern and Himalayan states*)*. On the other end, 5 states reported a decline in performance during the three-year period. This includes 4 non-Himalayan states and 1 North-Eastern and Himalayan state. Odisha reported the largest decline of 7.27 points, followed by Tripura which reported a decline of 4.27 points.

**Figure 6: Evolution of state rankings over time for non-Himalayan states, North-Eastern and Himalayan states, and UTs**

*Based on Water Index composite scores (FY 15-16, FY 16-17, FY 17-18)*

**Non-Himalayan states**

| | FY 17-18 | FY 16-17 | FY 15-16 | 1-year trend |
|---|---|---|---|---|
| Gujarat | 1 | 1 | 1 | ▬ *No change* |
| Andhra Pradesh | 2 | 3 | 2 | ⬆ *1 position* |
| Madhya Pradesh | 3 | 2 | 3 | ⬇ *1 position* |
| Goa | 4 | 11 | 10 | ⬆ *7 positions* |
| Karnataka | 5 | 4 | 5 | ⬇ *1 position* |
| Tamil Nadu | 6 | 7 | 6 | ⬆ *1 position* |
| Haryana | 7 | 16 | 16 | ⬆ *9 positions* |
| Maharashtra | 8 | 5 | 4 | ⬇ *3 positions* |
| Punjab | 9 | 6 | 7 | ⬇ *3 positions* |
| Telangana | 10 | 8 | 11 | ⬇ *2 positions* |
| Rajasthan | 11 | 10 | 13 | ⬇ *1 position* |
| Kerala | 12 | 12 | 12 | ▬ *No change* |
| Chhattisgarh | 13 | 9 | 8 | ⬇ *4 positions* |
| Odisha | 14 | 13 | 9 | ⬇ *1 position* |
| Uttar Pradesh | 15 | 15 | 14 | ▬ *No change* |
| Bihar | 16 | 14 | 15 | ⬇ *2 positions* |
| Jharkhand | 17 | 17 | 17 | ▬ *No change* |

**North-Eastern and Himalayan states**

| | FY 17-18 | FY 16-17 | FY 15-16 | 1-year trend |
|---|---|---|---|---|
| Himachal Pradesh | 1 | 2 | 1 | ⬆ *1 position* |
| Uttarakhand | 2 | 6 | 4 | ⬆ *4 positions* |
| Tripura | 3 | 1 | 2 | ⬇ *2 positions* |
| Assam | 4 | 4 | 5 | — *No change* |
| Sikkim | 5 | 3 | 3 | ⬇ *2 positions* |
| Nagaland | 6 | 5 | 6 | ⬇ *1 position* |
| Meghalaya | 7 | 7 | 7 | — *No change* |
| Arunachal Pradesh | 8 | *Not applicable* | *Not applicable* | *Not applicable* |

**Union Territories**

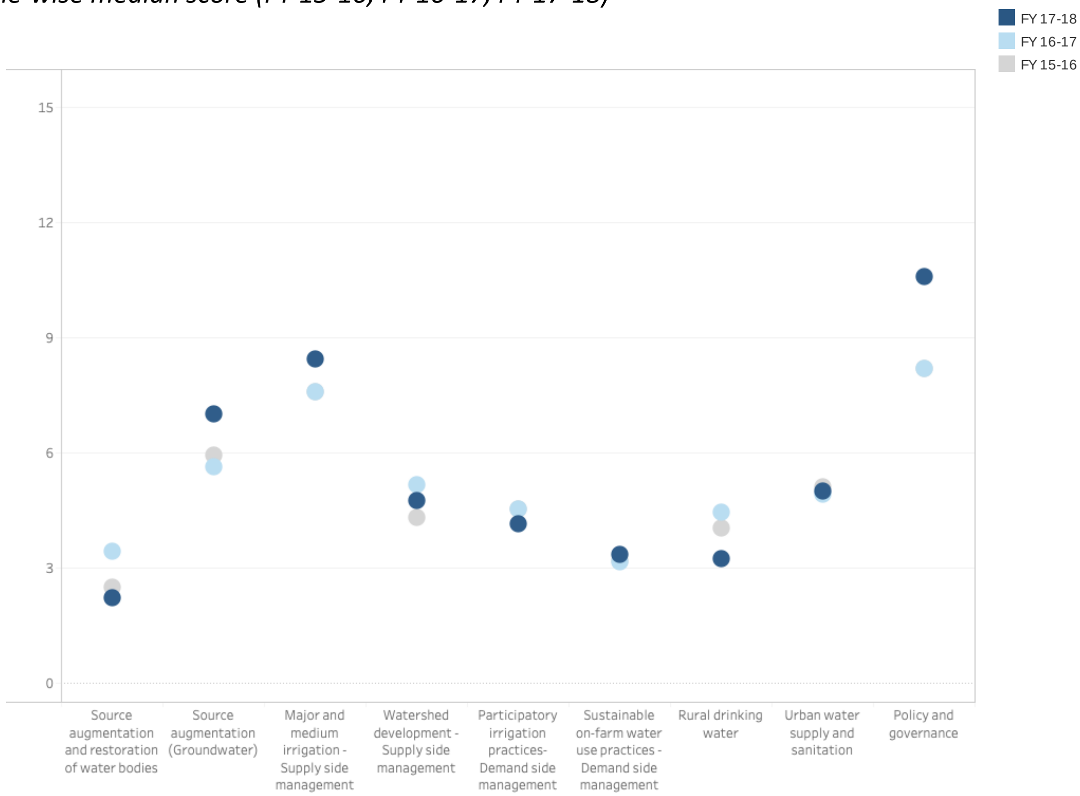
| | FY 17-18 | FY 16-17 | FY 15-16 | 1-year trend |
|---|---|---|---|---|
| Puducherry | 1 | *Not applicable* | *Not applicable* | *Not applicable* |
| Delhi | 2 | *Not applicable* | *Not applicable* | *Not applicable* |

## *2. High-performing states continue to lead on the Index*

**High-performing states retained their top spots in Index rankings, and the ranks of other states largely remained the same as well.** Gujarat retained the top position for the third consecutive year with 75 points and is closely followed by Andhra Pradesh with 74 points. Himachal Pradesh regained its top spot amongst North-Eastern and Himalayan states with 67 points, after slipping to the second position in FY 16-17. In middle- and low-performing states, ranks have remained largely the same as well and change was limited to 2 positions in most cases. Only 5 states—Haryana, Goa, Odisha, Chhattisgarh, and Maharashtra—displayed a change beyond 2 positions in their ranks between FY 15-16 and FY 17-18. While Haryana and Goa displayed a notable improvement of 9 and 6 positions, respectively, Odisha, Chhattisgarh, and Maharashtra's ranks declined by 5, 5, and 4 positions, respectively. The fall in ranks can be explained by a lack of improvement (resulting in relatively lower scores as score of other states improved) or even a decline amongst states across themes.

**Figure 7: Evolution of theme average scores over the years**

*Theme-wise median score (FY 15-16, FY 16-17, FY 17-18)*




### *3. But improvement is piecemeal*

**Improvement demonstrated by states and UTs is not consistent across themes, and average state performance declined on four themes.** While states and UTs demonstrated notable improvement on Policy and Governance and Source augmentation (Groundwater) themes, reflected in the 2.39-point and 1.06-point increase in respective median scores between FY 15-16 and FY 17-18, the median score of four themes declined during this period. These include Source augmentation and restoration of water bodies, Participatory irrigation practices, Rural drinking water, and Urban water supply and sanitation *(Figure 7*: Evolution of theme average scores over the years*)*. The decline was highest in the case of Rural drinking water, with the median and mean scores declining by 0.79 and 0.46 points, respectively. While the decline under all themes may not be considered large, it is still concerning given the failure of states to demonstrate progress on these themes, even as the water crisis is expected to get worse in the future.

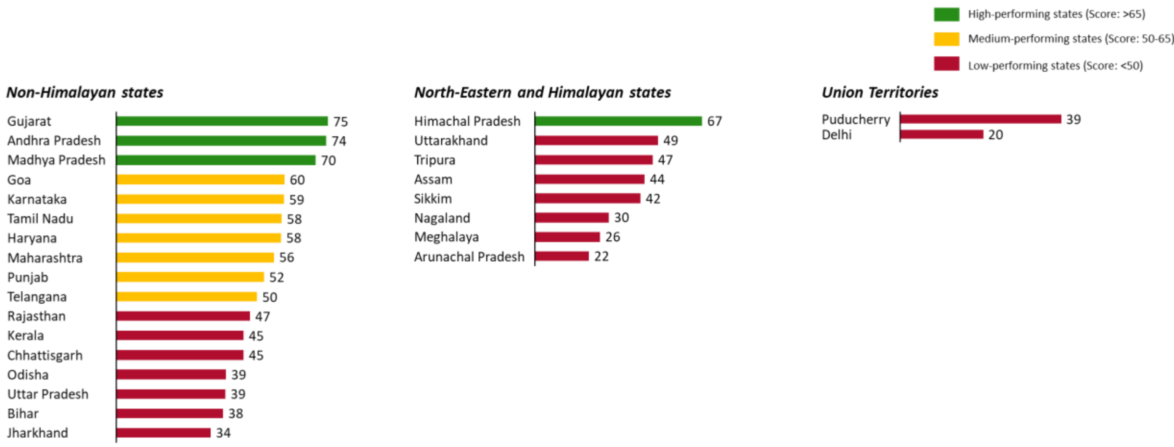
Conversely, data discipline is improving amongst states. Incidents of states not reporting data on indicators have reduced by ~70% compared to last year.[103] States such as Haryana, Goa, Uttarakhand, which were unable to report data on the several indicators in the previous year, have also improved

[103] The figure does not include data reporting statistics for Arunachal Pradesh, Delhi, and Puducherry, given these states and UTs have been included in the Index assessment for the first time in FY 17-18

considerably in terms of data reporting. This has also contributed substantially towards the increase in Index scores of these states, Haryana's improvement of 26 points over the last three years being the prime example.

**Figure 8: State-level performance on water resource management**[104]

*States scores on CWMI, Range 0-100 (FY 17-18)*




### *4. Improvement is also insufficient in states where it is most required*

**Apart from Haryana, Goa, and Telangana none of the other low-performing states from FY 15-16 have advanced beyond the 50-point mark in the last three years.** 16 out of the 27 states and UTs assessed on the Index in FY 17-18 scored less than 50% of total achievable score, and remained in the low-performing category *(Figure 8*: State-level performance on water resource management*)*. These include 7 (out of 17) non-Himalayan states, 7 (out of 8) North-Eastern and Himalayan states, and both the UTs assessed on the Index. The average improvement amongst the low-performing states[105] stands at 3.1 points, lower than 5.2-point average improvement observed across states in the last three years. Haryana, Goa, and Telangana are the only three low-performing states from FY 15-16 and FY 16-17 that crossed the 50-point threshold in the reference year. Bottom-performing states from FY 15-16 such as Jharkhand, Uttar Pradesh, Odisha, Bihar, Nagaland, and Meghalaya still scored less than 40 points on the Index. Delhi, assessed on the Index for the first time this year, scores lowest with 20 points. This is alarming considering Delhi's position as the country's capital territory, and its population of ~2 crore people whose water, arguably, is being poorly managed.

The presence of majority of states in the low-performing category is reflected in Index averages. The median score continues to stand below the 50-point mark, at 47.19 points, a 2-point increase compared to the base year. Given the severity of the water crisis in India, this modest improvement falls short of what is required to address the challenges that lie ahead of us.

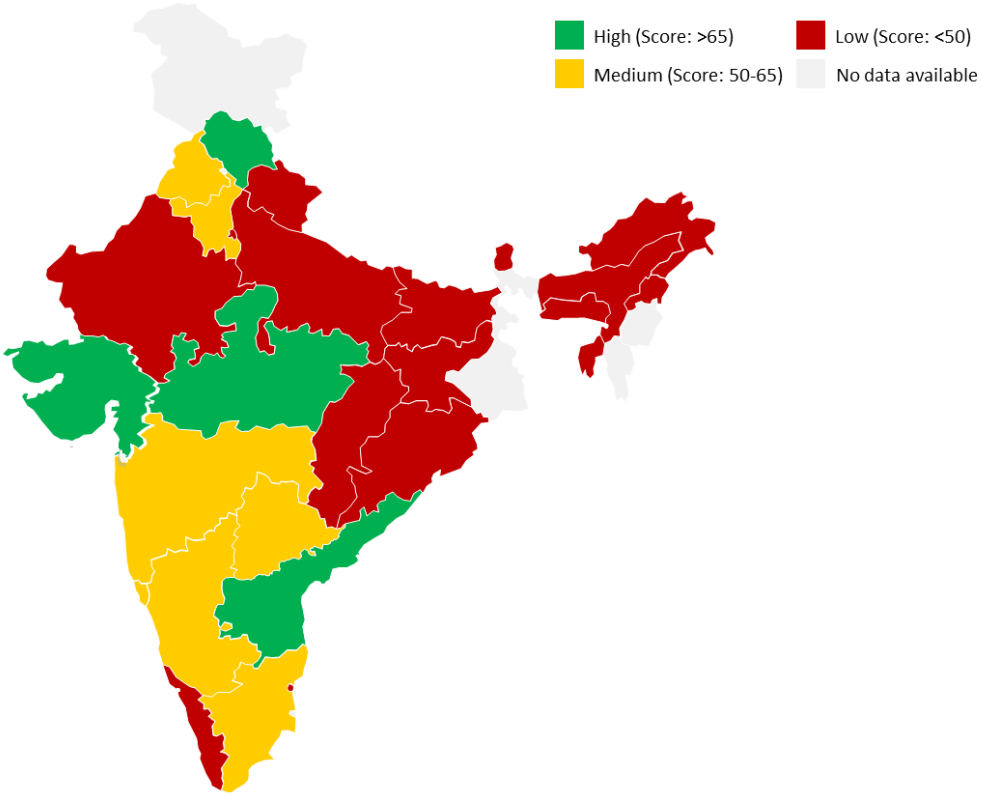
---

104 The scores for 'Non-Himalayan states', 'North-Eastern and Himalayan states' and 'Union Territories' were calculated separately, by using only the range of scores in the given category in the calculations. Thus, scores for 'North-Eastern and Himalayan' states were scaled considering only the range of scores in the 'North-Eastern and Himalayan states', while 'Union Territories' were scored through a different methodology, to account for the different hydrological conditions and geographical area of these states and UTs as compared to the rest of the country. This means that the scores of all states have been scored fairly and are, thus, comparable at even the national level across categories.

105 Refers to states in the low-performing category for FY 17-18

**Figure 9: High, medium, and low-performing states on water resource management**

*Classification according to CWMI scores (FY 17-18)*




### 5. *Worryingly, these low-performing states bear the largest burden of national population and economic production*

**The 16 low-performing states collectively account for ~48% of the population, ~40% of agricultural produce, and ~35% of economic output[106] for India.[107]** 4 large non-Himalayan states in this category alone—Uttar Pradesh, Rajasthan, Odisha, and Bihar—make up ~35% of India's population, and produce ~35% of its agricultural output. Further, Uttar Pradesh, Rajasthan, Kerala, and Delhi, 4 of the top 10 contributors to India's economic output,[108] have scores ranging from 20 points to 47 points on the Index. Looking beyond the 50-point threshold, none of the top 10 agricultural producers in India,[109] except

---

[106] Economic output based on Net State Domestic Product at Current Prices (2011-12 Series) for 2015-16

[107] "List of States with Population, Sex Ratio and Literacy Census 2011", *Census 2011*, accessed May 6, 2019, https://www.census2011.co.in/states.php.; "Agriculture - Statistical Year Book India 2017" *Ministry of Statistics and Programme Implementation*, accessed May 16, 2019, http://mospi.nic.in/statistical-year-book-india/2017/177.; *Economic Survey 2017-18 Volume 2: Statistical Appendix* (Ministry of Finance, 2018), page A28, http://mofapp.nic.in:8080/economicsurvey/pdf/Annexures_Volume_2_Combine_25_jan_2018.pdf.

[108] Economic output based on Net State Domestic Product at Current Prices (2011-12 Series) for 2015-16, and the analysis does not include states that have not been assessed on the Index; based on data from *Economic Survey 2017-18 Volume 2: Statistical Appendix* (Ministry of Finance, 2018), page A28, http://mofapp.nic.in:8080/economicsurvey/pdf/Annexures_Volume_2_Combine_25_jan_2018.pdf.

[109] Analysis does not include states that have not been assessed on the Index; based on data from "Agriculture - Statistical Year Book India 2017 *Ministry of Statistics and Programme Implementation*, accessed May 16, 2019, http://mospi.nic.in/statistical-year-book-india/2017/177.

Gujarat and Madhya Pradesh, score more than 60 points on the CWMI. This is concerning given that assessment on almost half of the index scores is directly linked to water management in agriculture. Lack of improvement in water management in all these states can have a national-level impact, given their substantial contribution towards India’s food production and economic output, apart from being home to substantial proportion of the country’s population. This could also result in significant risks for India’s social stability, economic growth, and food security if the situation remains unchanged. Severe water shortages in these states can even destabilize society and politics at the national and regional levels.

## Thematic Summary

The CWMI indicators are categorized into nine themes for strategic analysis and insights. Some of the key takeaways from these themes are presented below.

- **Source augmentation and restoration of water bodies**: Overall performance on surface water restoration slipped during FY 17-18 compared to FY 16-17, due to the decline in the performance of Maharashtra, Chhattisgarh, and Nagaland.
- **Source augmentation (Groundwater)**: Overall, states have displayed improvement in recharge of their groundwater resources between FY 15-16 and FY 17-18, but the median continues to remain below 50% of the total achievable score.
- **Major and medium irrigation**: Overall, the theme median stands at 8.4 points (out of 15), and North-Eastern and Himalayan states continue to outperform non-Himalayan states.
- **Watershed management**: States have moderate scores, with an almost equal split above and below the 50% mark. A collaborative (and grassroots-based) approach to watershed development and management is necessary for ensuring long-term benefits.
- **Participatory irrigation practices**: Overall, performance declined marginally in the last three years. Despite most states having legal frameworks to promote Water User Association (WUA) involvement, actual implementation of WUA responsibilities (such as involvement in O&M of irrigation assets) remains low.
- **Sustainable on-farm water use practices**: Overall, states have failed to show any significant improvement in on-farm water use efficiency. This is a pressing concern given the large-scale national push towards the adoption of micro-irrigation.
- **Rural drinking water**: Overall scores declined in FY 17-18 from a low base in FY 16-17 (less than 50% of the total achievable score), largely due to poor performance on the new service delivery indicators introduced under the theme this year.
- **Urban water supply and sanitation**: While water access remains high on average, significant gaps exist in wastewater treatment. States have shown improvement in creation of wastewater treatment capacity, but utilization of this capacity remains low.
- **Policy and governance**: An increase in theme averages suggests a growing focus by states on water as a subject as well as the use of regulatory frameworks for better resource management. However, water pricing and data centres remain improvement areas for most states.

## Key Takeaway

India can tackle its water crisis only if all of its regions cooperate and coordinate their response to the challenges their citizens are facing. The results of this year's exercise reveal an overall improvement in state performance, but severe disparities remain between states, and across themes, which must be bridged. States that are performing well have a responsibility and are well placed to become torchbearers of good water management for other regions in the country. Low-performing states need to give substantially greater attention to their water management practices, given that these regions account for a considerable share of the country's population and agricultural production. Improved knowledge-sharing amongst states can enable them to learn from each other and solidify their water management practices further. In addition to the water metric related analysis and commentary, this report also shares examples of progressive water management by leading states, from which others can seek inspiration. Such practices can be leveraged by states to enhance their performance on the Index and improve their overall water management. States should actively seek out guidance and solutions from one another and encourage diffusion of knowledge (including through exchange programmes of scientists and administrators) across borders.

# THEMATIC AND INDICATOR ANALYSIS

***What's in this section?***

*This section focuses on the analysis of state data at two levels (i) aggregate performance at the thematic level, and (ii) disaggregated performance at indicator level, presented separately for non-Himalayan states, North-Eastern and Himalayan states and Union Territories. States and UTs have been scored across nine themes:* ***Source augmentation and restoration of water bodies, Source augmentation (Groundwater), Major and medium irrigation, Watershed development, Participatory irrigation practices, Sustainable on-farm water use practices, Rural drinking water, Urban water supply and sanitation,*** *and* ***Policy and governance.*** *(Table 6*: Indicator themes and weights***)****. The ensuing patterns/ clusters are analyzed to identify themes where states are doing well at a national level, and those that could benefit from a greater policy push. It is important to emphasize that the Index is focused on the outcomes of actions and implementation undertaken by the states and does not reflect baseline per capita water availability across states.*

**Table 6: Indicator themes and weights**

| No. | Themes | Weights |
|---|---|---|
| 1 | Source augmentation and restoration of water bodies | 5 |
| 2 | Source augmentation (Groundwater) | 15 |
| 3 | Major and medium irrigation—Supply side management | 15 |
| 4 | Watershed development—Supply side management | 10 |
| 5 | Participatory irrigation practices—Demand side management | 10 |
| 6 | Sustainable on-farm water use practices—Demand side management | 10 |
| 7 | Rural drinking water | 10 |
| 8 | Urban water supply and sanitation | 10 |
| 9 | Policy and governance | 15 |
| | **Total** | **100** |

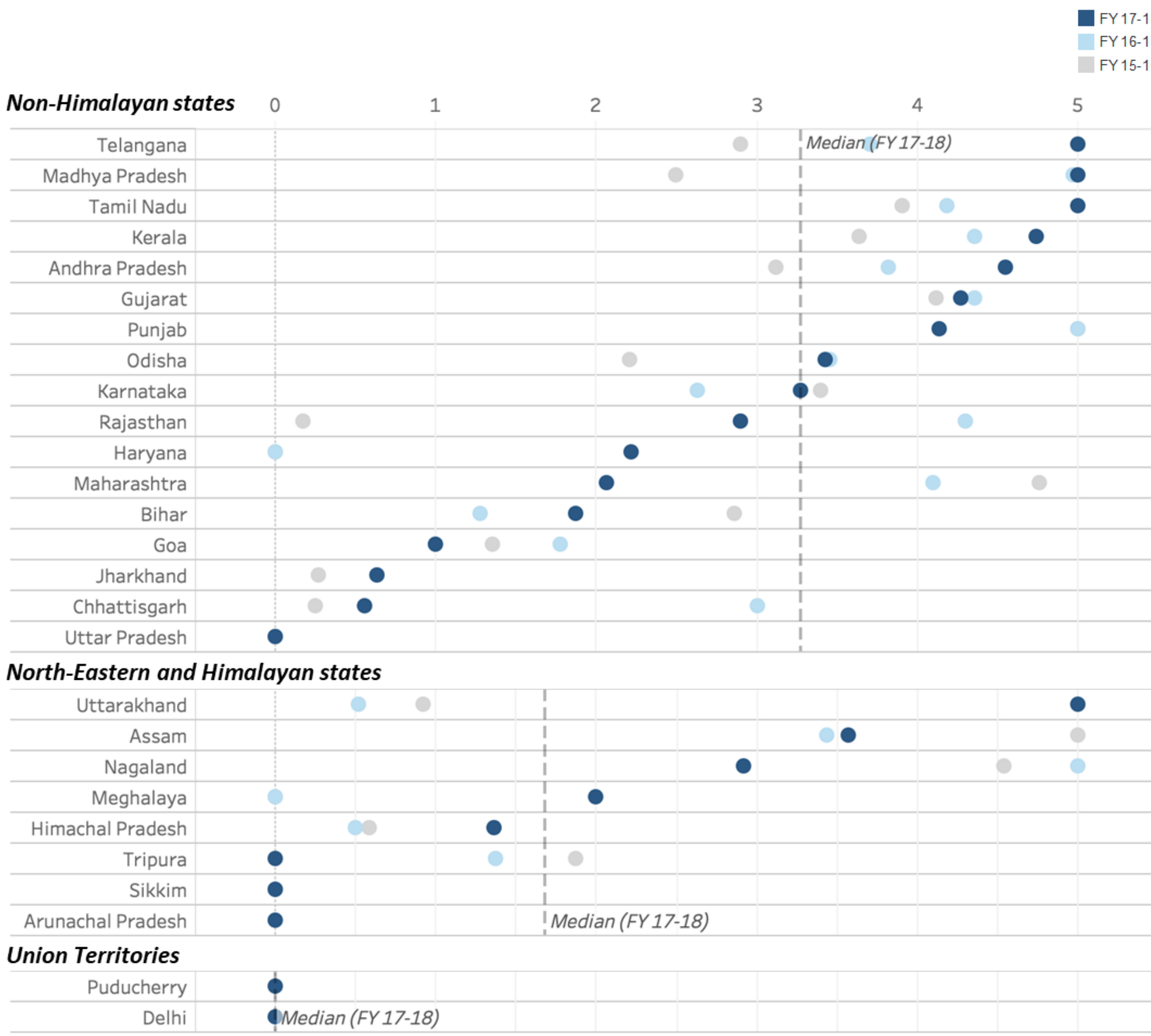
## Theme 1: Source augmentation and restoration of water bodies

**What does the theme mean?** The first theme covers state actions towards the restoration of surface water bodies such as rivers, ponds, and tanks, which boosts irrigation potential of a region by reducing seasonal variations in water availability. It accounts for five points (out of 100) in the Index. The theme includes only one indicator, which measures the area currently irrigated by restored water bodies out of the total irrigation potential of restored water bodies.

| Key highlights | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Telangana, Madhya Pradesh | Uttarakhand |
| **Bottom Performer** | Uttar Pradesh | Sikkim, Tripura, Arunachal Pradesh |
| **Median Score** | 3.27 | 1.68 |
| **1-year Median Change** | -0.43 | +0.74 |

**Figure 10: Performance of States and UTs on Theme 1 – Source augmentation and restoration of water bodies**

*Index scores, Range 0-5 (FY 15-16, FY 16-17, FY 17-18)*



**Overall performance on surface water restoration slipped during FY 17-18 compared to FY 16-17, due to poor performance by certain states.** The theme median and mean declined from 3.4 and 2.7 points to 2.2 and 2.4 between FY 16-17 and FY 17-18. This is after an increase of 0.9 and 0.4 points observed in theme median and mean scores between FY 15-16 and FY 16-17. The FY 17-18 decline is driven largely by lower scores of three states—Chhattisgarh, Maharashtra, and Nagaland—which reported a decline of greater than 2 points (40% of maximum score) from their FY 16-17 scores. Additionally, 8 states and UTs achieved less than 20% of the maximum score on the theme in FY 17-18, and contributed to the low theme averages. On the other end, Uttarakhand reported an increase of ~4.5 points between FY 16-17 and FY 17-18 and achieved a perfect score on the theme. Uttarakhand High Court has also directed the state government to tackle the issue of encroachment on water bodies by locals given the depleting quality,[110] and the improvement suggests that the state progress is being made on the ground.

Restoration of surface water bodies can unlock additional water resources to meet local needs and irrigation requirements, and therefore, reduce pressure on the severely threatened groundwater resources of the country. Raising awareness and encouraging civic responsibility amongst local communities for protection of local water bodies can significantly help in curbing encroachment and declining health of water bodies, and enable restoration of water bodies and conservation of our natural resources.

As mentioned earlier, the theme comprises of one indicator. The following section provides commentary on the indicator-level performance for the indicator assessed under the theme.

**Theme 1: Source augmentation and restoration of water bodies**
***[5 points]***

**Indicator 1: Area irrigated by water bodies restored during the given FY as compared to the irrigation potential area of total number of water bodies identified for restoration**

Indicator 1 measures the area irrigated by restored water bodies as a proportion of the total area that can be irrigated by restoring all identified water bodies, including rivers, ponds, tanks, etc. It measures a very tangible benefit of state efforts for restoration of water bodies—the irrigation potential gained. These efforts are in line with the national scheme[111] to restore 10,000 water bodies, being led by the Ministry of Water Resources (MoWR), Govt. of India.

---

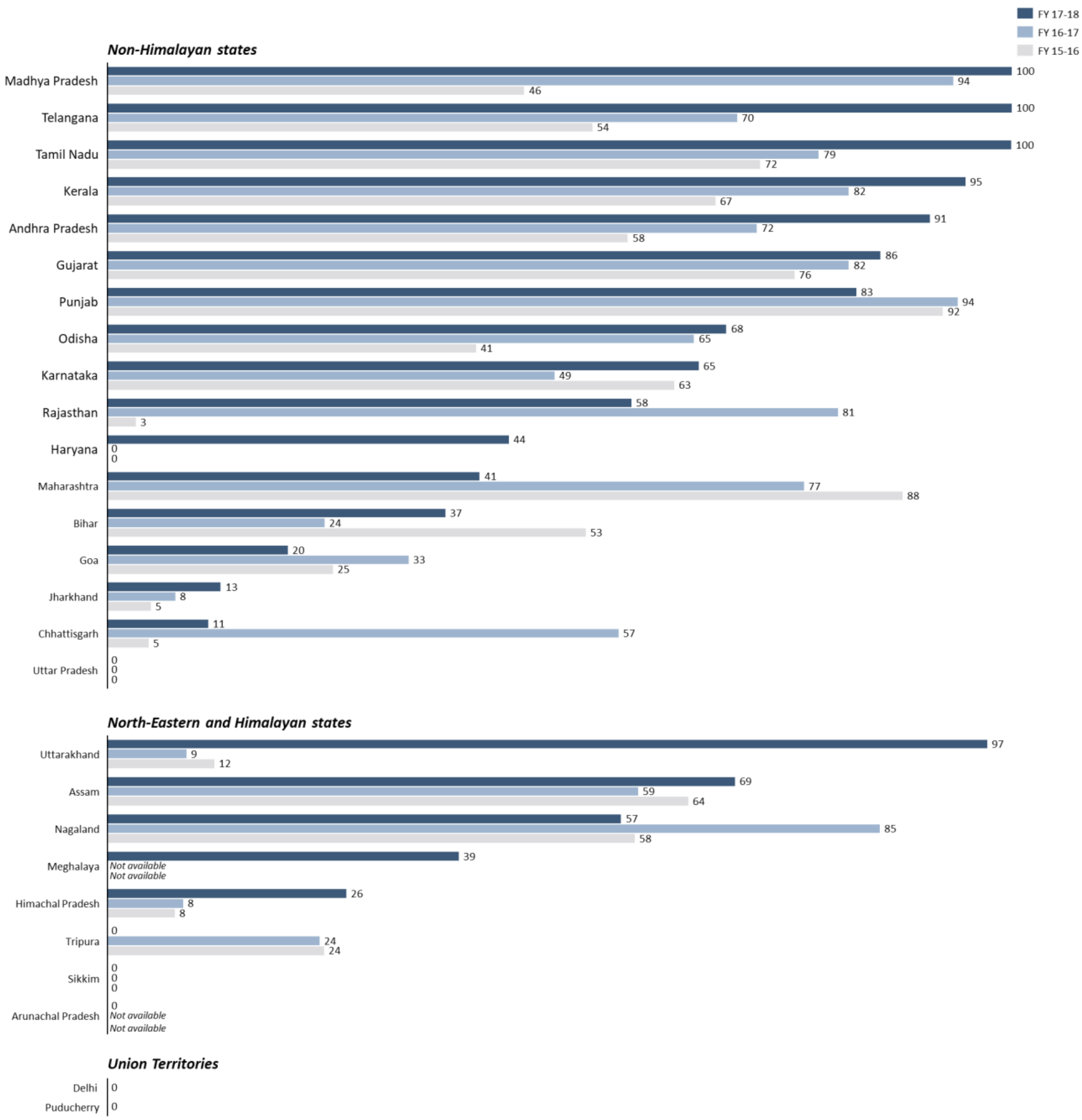
110 *Mohd. Salim* v. *State of Uttarakhand and Others, WPPIL 126/2014,* Uttarakhand High Court., https://services.ecourts.gov.in/ecourtindiaHC/cases/display_pdf.php?filename=/orders/2014/216700001262014_10.pdf&caseno=WPPIL/126/2014&cCode=1&appFlag=

111 Refers to the Repair, Renovation, and Restoration (RRR) component of the Pradhan Mantri Krishi Sinchayee Yojana's 'Har Khet Ko Paani' initiative

| Key highlights | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Madhya Pradesh, Telangana, Tamil Nadu | Uttarakhand |
| **Bottom Performer** | Uttar Pradesh | Tripura, Sikkim, Arunachal Pradesh |
| **Median Score** | 65.39% | 32.69% |
| **1-year Median Change** | -4.25% | +16.56% |

**Figure 11: Indicator 1: Area irrigated by water bodies restored during the given FY as compared to the irrigation potential area of total number of water bodies identified for restoration**

*In % (FY 15-16, FY 16-17, FY 17-18)*




**A lot of variation exists amongst states & UTs' performances, with the median state restoring ~45% of the possible irrigation potential of identified water bodies.** 8 out of 27 reporting states & UTs have restored more than 80% of the possible irrigation potential, while 8 states & UTs have achieved less than 20% of the potential. On average, the non-Himalayan states performed better compared to the North-Eastern & Himalayan states as well as the UTs, and have restored ~60% irrigation potential of the identified water bodies. The North-Eastern & Himalayan states and the UTs still lag behind, and only 3 states out of the 10 states and UTs in these two categories have reported restoration greater than 50% on the indicator.

5 states have demonstrated stand-out improvement of over 40 percentage points on the indicator over the three-year period. These are Uttarakhand, Madhya Pradesh, Rajasthan, Telangana, and Haryana. Rajasthan, although showed overall improvement across the three years, reported a decline of 23 percentage points in FY 17-18, after a massive improvement of 78 percentage points between FY 15-16 and FY 16-17.

Alarmingly, Maharashtra's performance on this indicator has consistently declined–47 percentage points on the whole—over the past three years. This is particularly worrying given the increasing frequency of droughts in the state, with the last drought occurring in 2018 itself.[112] Such events can develop conditions for crop failure and put significant burden on the farmers, and with high incidence of farmer suicides reported in the state in previous years (more than 3,000 in 2015),[113] these circumstances appear to be extremely concerning.

**Restoring minor irrigation structures and sources can help improve water availability and accessibility for small and medium farmers.** Local water bodies such as lakes and ponds can act as important water resources for irrigating small farmlands through minor irrigation infrastructure. Telangana's flagship Mission Kakatiya programme launched in 2014 is a great example, where the state's water bodies' restoration activities are enabling effective utilization of the 265 TM water allocated for minor irrigation under the Godavari and Krishna river basins. The programme builds on the concept of harnessing benefits of tank irrigation and aims to restore over 46,000 tanks across the state over a course of five years.[114] The programme involves aspects of enhancing minor irrigation structures, increasing command area, and community-based irrigation. The initiative has helped increase the water storage capacity of water bodies and enhance on-farm moisture retention capacity in the region, apart from improving access and availability of water for irrigation in case of small and medium farmers.[115]

112 Ministry of Agriculture & Farmers Welfare, *Impact of Changing Weather Patterns on Agriculture* (Press Information Bureau, 2018), http://pib.nic.in/PressReleseDetail.aspx?PRID=1555574.

113 *Accidental Suicides & Deaths in India 2015* (NCRB, 2016), page X, http://ncrb.gov.in/StatPublications/ADSI/ADSI2015/adsi-2015-full-report.pdf.

114 "Mission Kakatiya", *Government of Telangana*, accessed July 31, 2019, http://missionkakatiya.cgg.gov.in/homemission

115 *Selected Best Practices in Water Management* (NITI Aayog, 2017), page 6, https://niti.gov.in/writereaddata/files/document_publication/BestPractices-in-Water-Management.pdf.

**Case study:** Groundwater recharge: Maharashtra's innovative water bodies' desilting programme[116]






*Overview*

Maharashtra's 'Gaalmukt Dharan Gaalyukt Shivar Yojana' is an innovative drought proofing programme by the state's Soil and Water Conservation Department that tackles groundwater recharge issue of silt deposition in water bodies through creation of non-monetary farmer incentives. The programme involves desilting of water bodies by farmers using excavation machines, and allowing free use of the removed silt by farmers on their land to improve soil fertility. Desilting of water bodies restores the water storage capacity and improves percolation potential for groundwater recharge, while use of removed silt helps increase soil fertility for farmer, given its high organic content. The government provides fuel subsidies to operate excavating machines under the programme, while rental cost is arranged by the farmer either through farmer/community contribution or CSR of philanthropic funding pools. Farmer contribution on average remains at 70-80% of the total cost, but is recovered within seven to twelve months.

The programme has led to multiple benefits for the state including improved water table in the region, reduced government expenditure on crop compensation, spend on cattle camps for providing water and fodder, and decreased migration for employment opportunities.

*Key actions*

The government issued key guidelines related to silt removal activities for farmers as well as clear demarcation of responsibilities amongst different stakeholders involved.

Responsibilities such as inspiring farmer participation, coordinating between farmers and machine owners for making machines available at justified rates, and information regarding suitable water bodies for excavation are undertaken by the programme committees.

---

116 As per case study shared by the state government with NITI Aayog

The farmers rent excavating equipment and machines to undertake desilting of water bodies. Fuel subsidies, which make up about 10-15% cost, are provided by the government, while rest is arranged by the farmer.

Programme monitoring activities are undertaken through electronic media such as geo-tagging of water bodies, capturing images of de-siltation work, reporting through mobile application etc.

*Impact*

During its initial two years of implementation, the scheme has resulted in desilting of about 5,270 water bodies which involved excavation of about 32.3 million $m^3$ of silt. This covers more than 4,600 villages and benefits more than 6.5 million villagers. Removal of silt has increased water storage capacities of water bodies to the tune of about 32,300 thousand $m^3$ which is equivalent to supply of about 3.2 million water tankers. The silt removed from water bodies have been spread across more than 54,000 acres of farmland and has helped to increase the farm productivity by two to four times which has resulted in improvement in agricultural income by 50% to 100%.

*Lessons for other states*

- **Encourage community participation and co-investment**: States can target stronger community participation and investment in its programmes, which can help reduce the resource burden on the state as well as help develop a sense of ownership amongst the beneficiaries
- **Leverage existing synergies**: Building programmes that leverage synergies across domains can help states provide self-sustaining solutions, solve multiple challenges simultaneously, and receive widespread participation from stakeholders

## Theme 2: Source augmentation (Groundwater)[117]

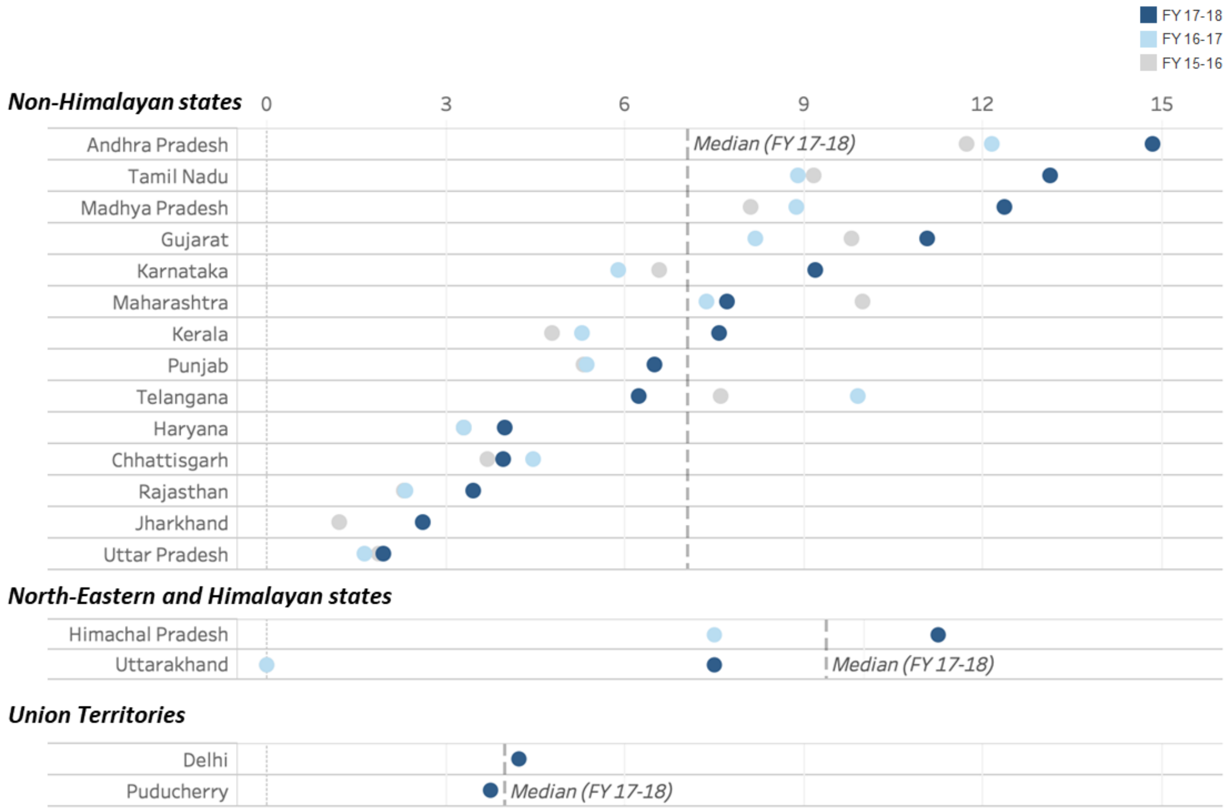
**What does the theme comprise?** This theme captures how well or not states have identified and recharged critical groundwater resources, and accounts for 15 points (out of 100) in the Index. This is the highest weight assigned to categories in the Index and signals the growing recognition of the national groundwater crisis. The theme includes indicators that measure a state's achievement in tasks mandated by CGWB (Central Ground Water Board) such as mapping the area for recharging over-exploited and critical groundwater resources (using GIS), building recharging structures such as wells and reservoirs on this identified area, and achieving increase in the water table level for these units. It also rewards a state for having established a regulatory framework for groundwater management, given the unfettered legal access that landowners (such as farmers) have to extract groundwater under their land.

| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Andhra Pradesh | Himachal Pradesh |
| **Bottom Performer** | Uttar Pradesh | Uttarakhand |
| **Median Score** | 7.04 | 9.38 |
| **1-year Median Change** | +1.42 | +5.63 |

[117] Source Augmentation (Groundwater) theme is not applicable to Odisha, Bihar, Goa, Assam, Meghalaya, Nagaland, Sikkim, Tripura, and Arunachal Pradesh, as these nine states reported having no over-exploited or critical groundwater units. Therefore, these states have not been discussed in this section.

**Figure 12: Performance of States and UTs on Theme 2 – Source augmentation (Groundwater)**

*Index scores, Range 0-15 (FY 15-16, FY 16-17, FY 17-18)*




**Overall, states have displayed improvement in recharge of their groundwater resources between the base year and reference year, but significant improvement is still required.** The theme median and mean increased from 5.9 and 6.0 points to 7.0 and 7.3 points between FY 15-16 and FY 17-18 but still remain below the 50% mark. About two-third reporting states (12 out of 18) have enacted regulatory framework for groundwater management but only 8 reporting states score more than 7.5 points (out of 15) on the theme, highlighting the need for focus beyond legislations. Seven states—Uttar Pradesh, Jharkhand, Rajasthan, Chhattisgarh, Haryana, Delhi, and Puducherry—score less than 5 points (out of 15). The five non-Himalayan states included in the list alone make ~27% of India's groundwater resources,[118] which highlights the severity of the problem. Uttar Pradesh by itself accounts for ~17% of the country's groundwater resources but scored less than 2 points on the theme.

Given that India's groundwater resources are depleting at an alarming rate, and as fast as 1 metre per year in case of 16% groundwater wells,[119] immediate interventions are required to tackle the issue. It is essential to influence user behaviour and limit groundwater use by sensitizing households and farmers about the depleting nature of these resources and potential consequences of their actions. Grassroot-level initiatives that involve strong community participation can potentially help in driving behaviour

[118] Measured as percentage of annual replenishable groundwater resources (2013) based on data from *Groundwater Year Book* (CGWB, 2016-17), page 40 onwards, http://cgwb.gov.in/Ground-Water/Groundwater%20Year%20Book%202016-17.pdf.

[119] "3 Maps Explain India's Growing Water Risks", *World Resources Institute*, accessed May 16, 2019, https://www.wri.org/blog/2015/02/3-maps-explain-india-s-growing-water-risks.

change, as well as create a sense of community-ownership among users for their groundwater resources, and therefore, support conservation and sustainable use.

As discussed earlier, the theme comprises of four indicators, and the following section provides commentary on the indicator-level performance for these indicators assessed under the theme.

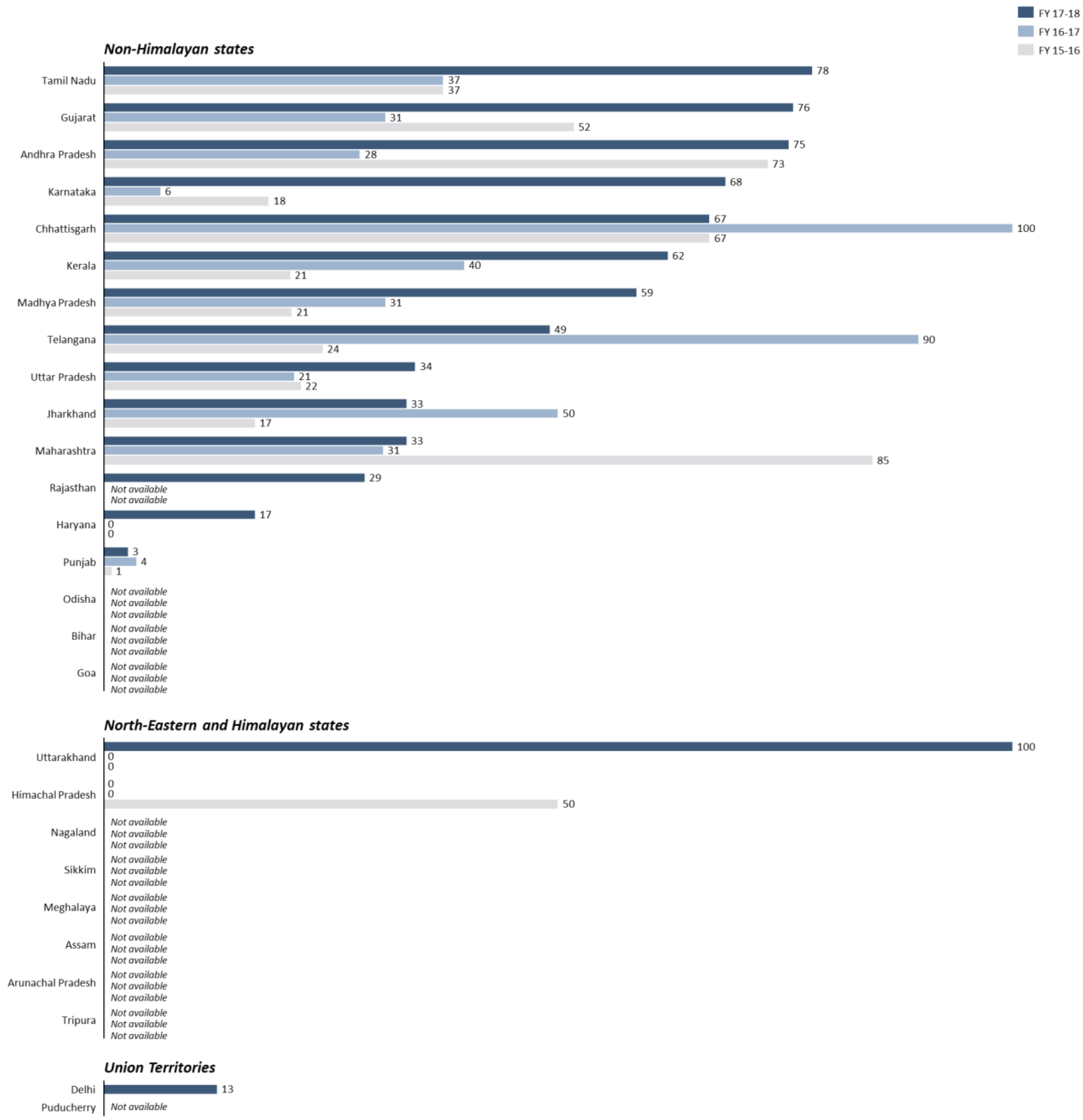
| Theme 2: Source augmentation (Groundwater) *[15 points]* | | | |
|---|---|---|---|
| **Indicator 2: Percentage of overexploited and critical assessment units that have experienced a rise in water table to total number of assessment units in pre-monsoon current FY in comparison to pre-monsoon previous FY** | Indicator 3: Percentage of areas of major groundwater re-charging identified and mapped for the State as on the end of the given FY | Indicator 4: Percentage of mapped area covered with infrastructure for re-charging groundwater to the total mapped area as on the end of the given FY | Indicator 5: Has the State notified any Act or a regulatory framework for regulation of Groundwater use/ management? |

Indicator 2 measures the percentage of over-exploited and critical groundwater units that have experienced a rise in water table levels as compared to the previous year. This indicator warrants special attention given the fact that India's groundwater resources are declining rapidly. Puducherry was unable to report data on the indicator and has been scored nil on the indicator in the Index calculation.

| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Tamil Nadu | Uttarakhand |
| **Bottom Performer** | Punjab | Himachal Pradesh |
| **Median Score** | 53.87% | 50% |
| **1-year Median Change** | +22.84% | +50% |

**Figure 13: Indicator 2: Percentage of over-exploited and critical assessment units120 that have experienced a rise in water table to total number of assessment units in pre-monsoon current FY in comparison to pre-monsoon previous FY**

*In % (FY 15-16, FY 16-17, FY 17-18)*




**States have displayed improvement on the groundwater recharge indicator in the last three years, with overall median rising by 27 percentage points between the base year and reference year.** The overall median increased from 22% in FY 15-16 to 31% in FY 16-17 and 49% in FY 17-18. The non-

120 As per CGWB Report "Dynamic Groundwater Resources in India: 2017", assessment units are blocks or Mandals or Talukas or firkas in the states

Himalayan states are major drivers of this improvement, and experienced increase of 14 percentage points on average across the last three years. 12 out of 14 percentage points growth observed during these three years was reported during the reference year. At the overall level, five states–Madhya Pradesh, Kerala, Karnataka, Tamil Nadu, and Uttarakhand—reported an improvement of greater than 30 percentage points across three years. Uttarakhand reported groundwater table rise in 100% of the over-exploited and critical assessment units. Maharashtra and Himachal Pradesh, on the other end, have reported decline of 52 and 50 percentage points, respectively, in the last three years, majority of which was experienced between FY 15-16 and FY 16-17. Maharashtra's decline in performance does not bode well with the state's 'Jalyukt Shivar Abhiyaan', launched with the aim to make Maharashtra a drought-proof state by 2019.[121]

**Encouraging community involvement, strengthening of groundwater governance institutions, and providing performance-based incentives can improve groundwater management across the country.** The 'Atal Bhujal Yojana - National Groundwater Improvement Management Programme', supported by the World Bank, is an example that builds on these concepts. The INR 6,000 crore scheme will be implemented in 8350 Gram Panchayats across the country, and will provide funds for strengthening institutions responsible for groundwater management, and fostering behaviour changes that promote water conservation and efficient use, through community involvement.[122] Communities are also expected to facilitate bottom-up groundwater planning under the project. The project proposal also included a Programme-for-Results (PforR) approach, under which disbursement of funds is linked to achievement of key results specified under the programme,[123] and is expected to help ensure delivery of tangible results. The project funding from the World Bank has been approved in 2018, and will be implemented over a course of five years.[124]

**Theme 2: Source augmentation (Groundwater)**
***[15 points]***

| Indicator 2: Percentage of overexploited and critical assessment units that have experienced a rise in water table to total number of assessment units in pre-monsoon current FY in comparison to pre-monsoon previous FY | **Indicator 3: Percentage of areas of major groundwater re-charging identified and mapped for the State as on the end of the given FY** | Indicator 4: Percentage of mapped area covered with infrastructure for re-charging groundwater to the total mapped area as on the end of the given FY | Indicator 5: Has the State notified any Act or a regulatory framework for regulation of Groundwater use/ management? |
|---|---|---|---|

Indicator 3 measures the percentage of over-exploited and critical groundwater units that have been mapped and identified for recharging by the state. The detailed mapping is done on the basis of sample

121 "Jalyukt-Shivar", *Maharashtra Remote Sensing Applications Centre*, accessed May 16, 2019, http://mrsac.maharashtra.gov.in/jalyukt/.

122 Ministry of Water Resources, River Development and Ganga Rejuvenation, *World Bank approves Rs. 6,000 crore Atal Bhujal Yojana*, (Press Information Bureau, 2018), http://pib.nic.in/PressReleseDetail.aspx?PRID=1534487

123 World Bank, *National Groundwater Management Improvement Programme: Environmental and Social Systems Assessment* (Ministry of Water Resources, 2016), http://mowr.gov.in/sites/default/files/ESSA-NGMIP-29Sep2016_0.pdf

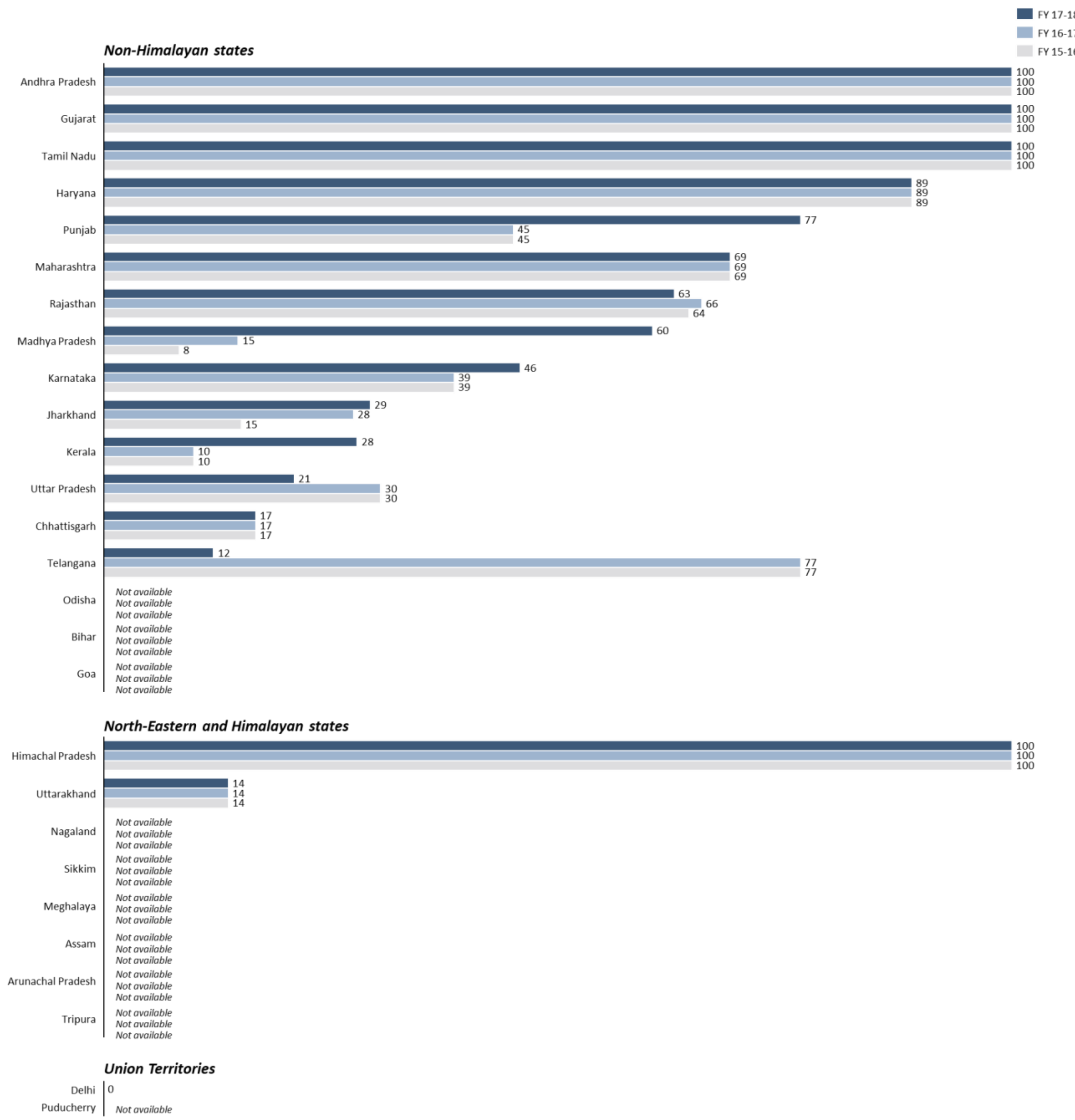
124 "Projects: Atal Bhujal Yojana (Abhy)-National Groundwater Management Improvement ", *World Bank*, http://projects.worldbank.org/P158119?lang=en

data collected by the Central Ground Water Board (CGWB) and are used to classify units as over-exploited and critical. Puducherry was unable to report data on the indicator and has been marked nil on the indicator in the Index calculation.

| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Andhra Pradesh, Gujarat, Tamil Nadu | Himachal Pradesh |
| **Bottom Performer** | Telangana | Uttarakhand |
| **Median Score** | 61.63% | 56.85% |
| **1-year Median Change** | +6.15% | 0% |

**Figure 14: Indicator 3: Percentage of areas of major groundwater re-charging identified and mapped for the state as on the end of the given FY**

*In % (FY 15-16, FY 16-17, FY 17-18)*




**No significant change has been observed in states' performance on the indicator, except in case of five states that reported mixed performance.** 8 out of 16 states that reported data on the indicator in the last three years, reported no change across the years. 4 out of these 8 states—Andhra Pradesh, Gujarat, Tamil Nadu, and Himachal Pradesh—have 100% coverage for all three years. The indicator median improved by 5 percentage points between the base year and reference year, largely due to significant movement in scores of five states. Madhya Pradesh reported a 52 percentage point increase between FY 15-16 and FY 17-18, while Telangana reported a decline of 65 percentage points on the indicator during the same time period. Apart from these two states, Punjab, Kerala, and Jharkhand reported a change greater than 10 percentage points on the indicator over the last three years, all of them moving in the positive direction, and contributing to the improvement of indicator averages. Worryingly, Uttar Pradesh, which accounts for more than 15% of India's groundwater resources alone[125] has mapped only one-fifth of major groundwater recharge areas. Given the fact that 61% of India's groundwater units are facing a decline,[126] it is essential for states to improve their performance on such groundwater related indicators, and undertake all necessary activities that can contribute towards conserving our depleting resources.

**Strategic use of Remote Sensing (RS) and Geographic Information Systems (GIS) technologies can help states identify and prioritize regions facing fast-enough decline in their groundwater resources.** Use of such technologies can enable states to have large-scale coverage with higher accuracy, while saving time and resources investment. Further, availability of this data in the public domain can also enable other civil society actors as well as community members in prioritizing regions for intervention as well designing initiatives for conserving groundwater resources in these areas. The state of Andhra Pradesh provides a great example of utilizing technology for managing its groundwater resources. The state has geo-tagged all of its 15 lakh bore-wells for effective monitoring and timely management of groundwater resources through an online platform. The real-time information of the groundwater levels provided by the platform has enabled significant rise in groundwater levels in the last 17 years, even in years of below-average rainfall.[127]

**Theme 2: Source augmentation (Groundwater)**
***[15 points]***

| | | | |
|---|---|---|---|
| Indicator 2: Percentage of overexploited and critical assessment units that have experienced a rise in water table to total number of assessment units in pre-monsoon current FY in comparison to pre-monsoon previous FY | Indicator 3: Percentage of areas of major groundwater re-charging identified and mapped for the State as on the end of the given FY | **Indicator 4: Percentage of mapped area covered with infrastructure for re-charging groundwater to the total mapped area as on the end of the given FY** | Indicator 5: Has the State notified any Act or a regulatory framework for regulation of Groundwater use/ management? |

Indicator 4 measures the percentage of mapped over-exploited and critical groundwater units that are covered with recharging infrastructure. CGWB guidelines mandate states to construct infrastructure such as recharging wells and reservoirs on critical and over-exploited units that can be used to boost groundwater levels. Punjab, Maharashtra, Haryana and Puducherry were unable to report data on the indicator and have been scored nil on the indicator in the Index calculation.

125 Measured as percentage of annual replenishable groundwater resources (2013) based on data from *Groundwater Year Book* (CGWB, 2016-17), page 40 onwards, http://cgwb.gov.in/Ground-Water/Groundwater%20Year%20Book%202016-17.pdf.

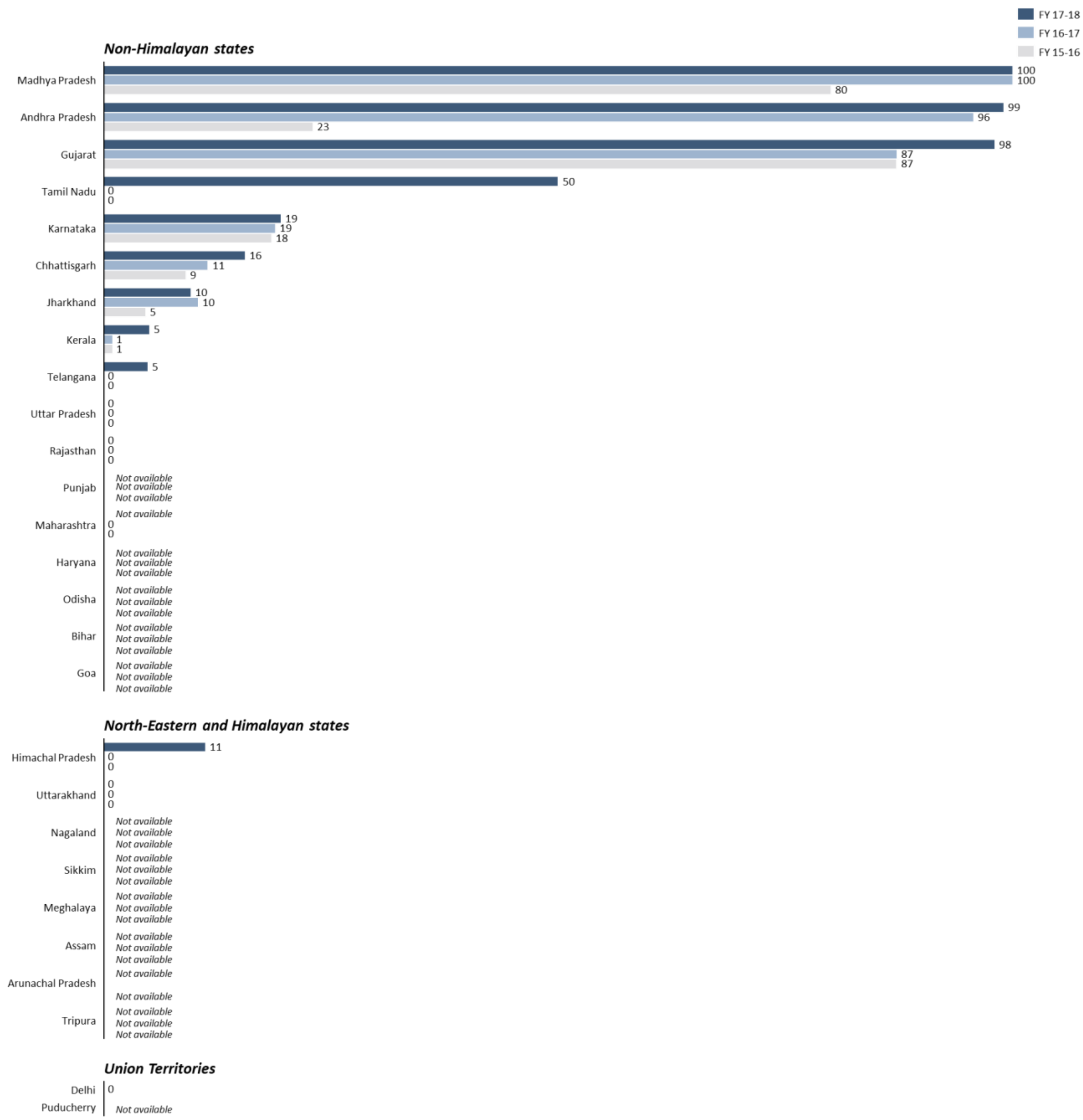
126 *Groundwater Scenario in India Pre Monsoon* (Central Ground Water Board, 2017), page 8, http://cgwb.gov.in/Ground-Water/GW%20Monitoring%20Report_PREMONSOON%202017.pdf.

127 As per case study shared by the state government with NITI Aayog

| Key highlights | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Madhya Pradesh | Himachal Pradesh |
| **Bottom Performer** | Uttar Pradesh, Rajasthan | Uttarakhand |
| **Median Score** | 15.58% | 5.60% |
| **1-year Median Change** | +9.88% | +5.60% |

**Figure 15: Indicator 4: Percentage of mapped area covered with infrastructure for re-charging groundwater to the total mapped area as on the end of the given FY**

*In % (FY 15-16, FY 16-17, FY 17-18)*




**Performance by majority states and UTs remains unsatisfactory on the indicator, with median state having 10% groundwater recharge infrastructure.** 10 out of 14 reporting states and UTs have less than 20% coverage of groundwater recharge infrastructure. The poor performance is also reflected in the overall median, which stands at 10% for FY 17-18, although higher compared to previous years but extremely low at an absolute level. Additionally, four states and UTs—Haryana, Maharashtra, Punjab, and Puducherry—have failed to report data on the indicator, which highlights the problem of data sharing by states.

Top performers on the indicators include Madhya Pradesh, Andhra Pradesh, and Gujarat. While Madhya Pradesh and Gujarat reported high recharging infrastructure coverage for all three years, Andhra Pradesh joined this category in FY 16-17 through an improvement of more than 70 percentage points on the indicator.

Overall unsatisfactory performance as well as poor data reporting by certain states and UTs on the indicator suggests low investment levels in maintaining and recharging groundwater resources. This does not augur well with the fact that 16% wells in India are declining as fast as 1 metre per year,[128] and states need to show stronger commitment towards conserving their groundwater resources. Developing groundwater recharge structures is a necessary activity in such a process, and can help states solidify the improvement displayed on Indicator 2 (rise in water table of critical and over-exploited assessment units), as well as sustain it on a long-term basis.

**Active community participation and contributions can deliver excellent results, as demonstrated by Hiware Bazar's example.** The drought-prone village from Maharashtra had been facing severe water shortages in the region in the 1970s, but through its community-led watershed management initiatives over the years, has become water-secure, and institutionalized effective groundwater recharge practices. Apart from undertaking traditional watershed development activities to capture rainwater, the village introduced bans on digging deep borewells, along with a water budgeting approach. Under this water budgeting approach, water availability is assessed for the year, and farmers are advised by Gram Sabha on crop selection based on this assessment. Additionally, production of water-intensive crops such as cotton and sugarcane are banned in the village. Such a forward-looking and long-term approach has enabled the village to ensure sufficient water availability even in years with deficit rainfall.[129] Learning from these interventions, the Government of Maharashtra has introduced water budgeting as one of the key concepts in its drought-proofing programme, which aims at making 5000 villages free of water scarcity every year.[130]

128 "3 Maps Explain India's Growing Water Risks ", *World Resources Institute*, accessed May 6, 2019, https://www.wri.org/blog/2015/02/3-maps-explain-india-s-growing-water-risks

129 "This Maharashtra Village Remains Untouched by Drought", *Down To Earth*, accessed May 6, 2019 https://www.downtoearth.org.in/news/water/untouched-by-drought-57666.

130 *Jalyukt Shivar Abhiyan*, (Soil and Water Conservation Department Government of Maharashtra), http://cgwb.gov.in/Bhujal-manthan/bm3-file3.pdf.

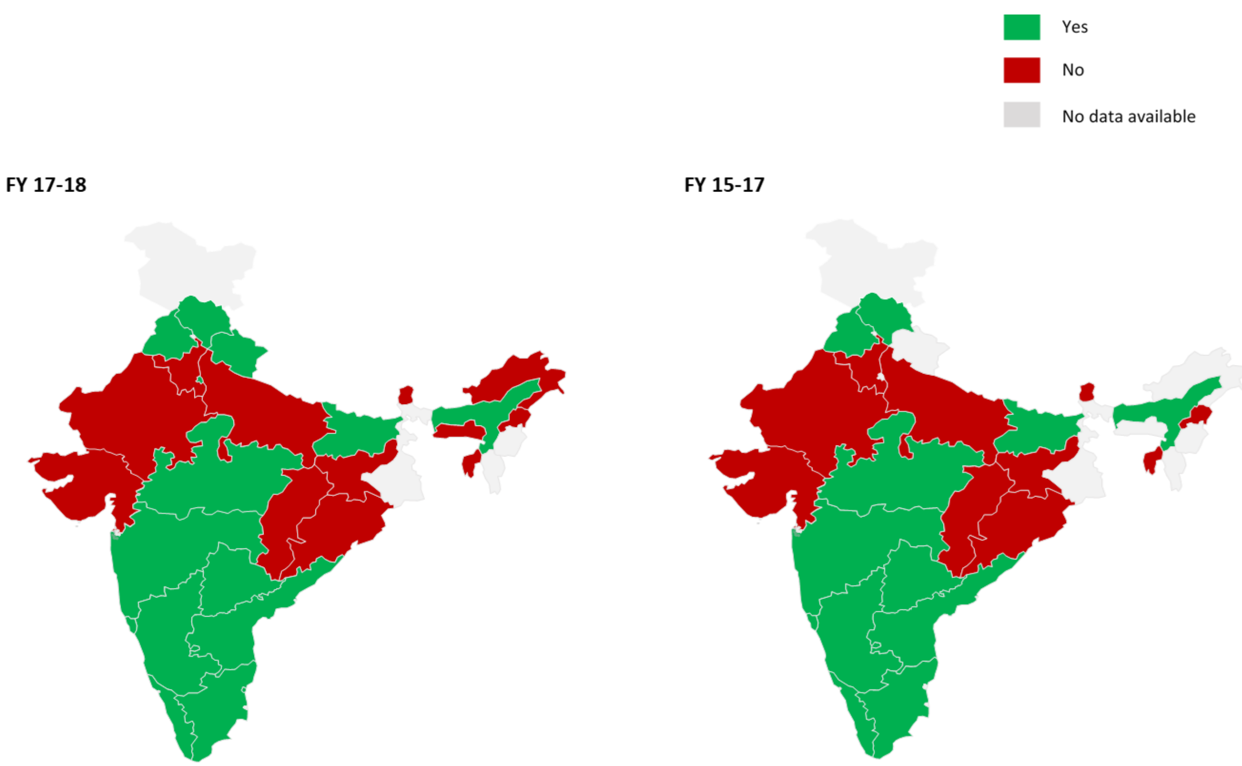
**Theme 2: Source augmentation (Groundwater)**
***[15 points]***

| Indicator 2: Percentage of overexploited and critical assessment units that have experienced a rise in water table to total number of assessment units in pre-monsoon current FY in comparison to pre-monsoon previous FY | Indicator 3: Percentage of areas of major groundwater re-charging identified and mapped for the State as on the end of the given FY | Indicator 4: Percentage of mapped area covered with infrastructure for re-charging groundwater to the total mapped area as on the end of the given FY | **Indicator 5: Has the State notified any Act or a regulatory framework for regulation of Groundwater use/ management?** |
|---|---|---|---|

Indicator 5 is a binary indicator that measures whether a state has adopted a legal or regulatory framework for the management and use of groundwater. The key driver of India's groundwater crisis is the current legal framework (riparian law) that ties land rights to water rights and allows landowners to extract groundwater unchecked. Since groundwater is a common, finite resource, this has implications for both the distribution and sustainability of groundwater in the country.

**Figure 16: Indicator 5: Has the state notified any Act or a regulatory framework for regulation of Groundwater use/ management?**

*(FY 15-17, FY 17-18)*




**As observed in the previous year, majority states and UTs have drafted a regulatory framework for groundwater management.** 12 out of 17 states and UTs assessed on the Source augmentation (Groundwater) theme, reported having a regulatory framework for managing groundwater during the reference year. Apart from these 17 states, Bihar, Goa, and Assam also reported having regulations for groundwater management, although these states have not been scored on the indicator given that the Source augmentation (Groundwater) theme is not applicable in case of these states. Uttarakhand, Delhi and Puducherry, the 3 states and UTs that reported data on the indicator for the first time in FY 17-18, also reported having a regulatory framework for managing groundwater.

**The state of Maharashtra provides a good example of using legislations to control extraction of groundwater resources.** The state, through the Maharashtra Groundwater Development and Management Rules 2018, has instituted provisions such as mandatory registration of wells and permission requirement for digging new wells, which is contingent on building a groundwater recharge structure alongside. Additionally, the rules also have provisions to regulate, and in some cases even prohibit, extraction of groundwater through wells, to limit unsustainable groundwater use practices undertaken by farmers in the state.[131]

[131] *Maharashtra Groundwater (Development and Management) Rules, 2018* (Water Supply and Sanitation Department, Maharashtra, 2018), https://gsda.maharashtra.gov.in/english/admin/PDF_Files/1533615572_Maharashtra_Groundwater_Rules_2018.pdf

## Theme 3: Major and medium irrigation—Supply side management[132]

**What does the theme comprise?** This theme focuses on irrigation systems and utilization across states, and accounts for 15 points (out of 100) in the Index. The high weightage emphasizes the government's continued policy focus on ensuring that irrigation systems are utilized and maintained, one of the major challenge areas identified in the Twelfth Plan. The theme has four indicators that broadly cover two areas—the gap between the envisaged irrigation potential of assets and the actual usage, and the maintenance and improvement of irrigation assets. This theme reflects the shift in policy focus from the creation of major irrigation assets, such as dams, to the efficient utilization of available water resources through greater connectivity and improved last-mile infrastructure, as expressed in the Twelfth Plan.[133] The major and medium irrigation theme is not applicable for six states and UTs—Nagaland, Sikkim, Meghalaya, Arunachal Pradesh, Delhi and Puducherry— which have not been scored for any of the indicators under the theme.

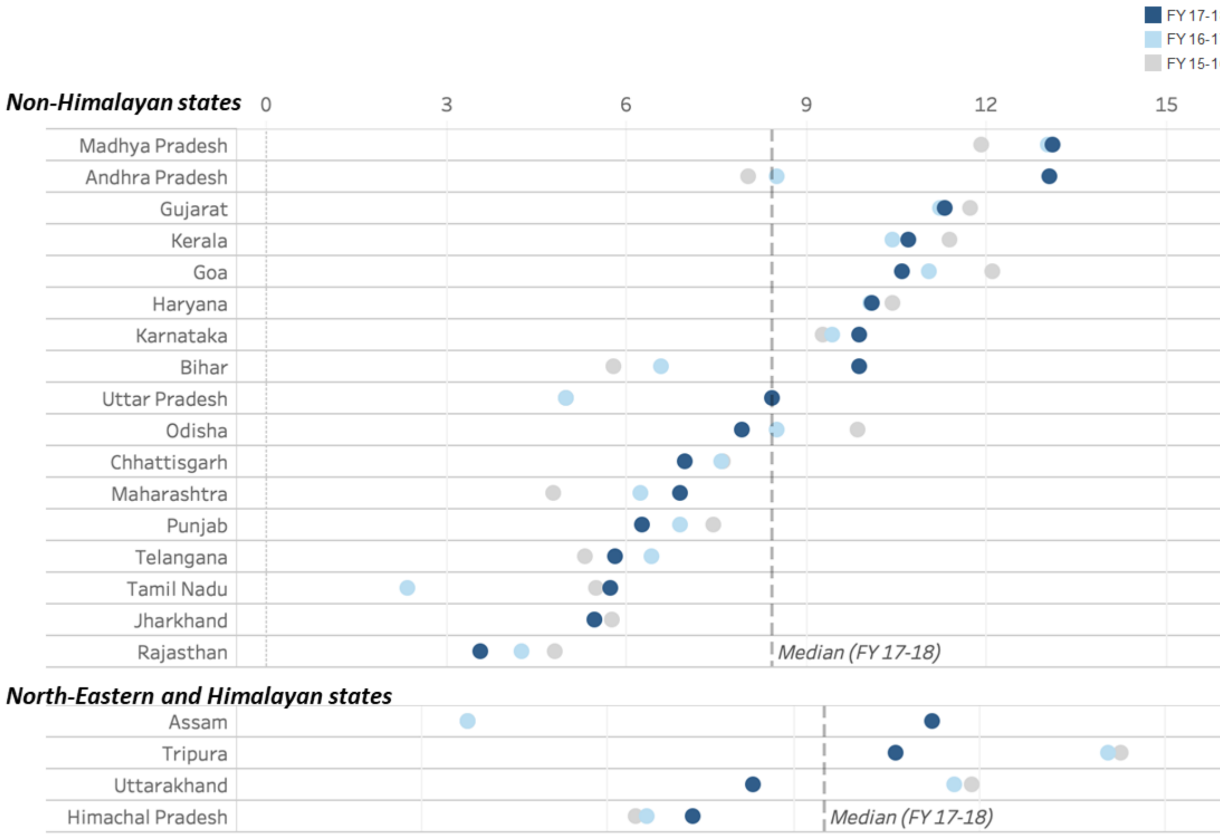
| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Madhya Pradesh | Assam |
| **Bottom Performer** | Rajasthan | Himachal Pradesh |
| **Median Score** | 8.43 | 9.49 |
| **1-year Median Change** | +0.86 | +0.38 |

[132] Major and medium irrigation – Supply side management theme is not applicable to Nagaland, Sikkim, Meghalaya, Arunachal Pradesh, Delhi, Puducherry, and therefore have not been discussed in this section

[133] Dr. Mihir Shah, *Water: Towards a Paradigm Shift in the Twelfth Plan* (EPW, 2013), https://www.indiawaterportal.org/sites/indiawaterportal.org/files/water-_towards_a_paradigm_shift_in_the_twelfth_plan_dr_mihir_shah_planning_commission.pdf.

**Figure 17: Performance of States on Theme 3 – Major and medium irrigation—Supply side management**

*Index scores, Range 0-15 (FY 15-16, FY 16-17, FY 17-18)*




**Overall, states have maintained their moderate performance on the major and medium irrigation theme, with North-Eastern and Himalayan states continuing to outperform non-Himalayan states.** The theme median and mean for the reference year stand at 8.43 and 8.73 points, displaying a modest increase of 0.8 and 0.5 from the base year (FY 15-16). Further, 13 out of 21 states assessed on the theme have scores higher than the 50% mark, and several of these states are clustered in the 9-12 points band. Madhya Pradesh and Andhra Pradesh are the top performing states, scoring more than 80% of maximum possible score. Assam displayed the maximum improvement (7.5 points) between the base year and reference year, but still utilizes less than 30% of the irrigation potential created. At the category level, North-Eastern and Himalayan states perform better than non-Himalayan states across all three years, and their category median and mean stand at 9.5 and 9.4 points for reference year, higher by 1.1 and 0.8 points compared to the non-Himalayan category averages.

**While irrigation potential is high in the country, challenges still remain in effective utilization.** In opinion of Dr. Mihir Shah,[134] Indian states have made significant infrastructural investments in irrigation, but bottlenecks such as low capacity of irrigation departments, and as a result lack of regular asset

[134] Dr. Mihir Shah, *Water: Towards a Paradigm Shift in the Twelfth Plan* (EPW, 2013), https://www.indiawaterportal.org/sites/indiawaterportal.org/files/water-_towards_a_paradigm_shift_in_the_twelfth_plan_dr_mihir_shah_planning_commission.pdf.

maintenance and delivery of quality services remain. Efficiency of irrigation assets is also low at 30%.[135] Improvement in these domains can lead to an increase in the irrigated land area as well as improve water use efficiency, which is also quite low in India's case. Encouraging Participatory Irrigation Management (PIM) (also discussed under theme 5 of the Index) is one potential way of reducing the gap between Irrigation Potential Created and Irrigation Potential Utilized, as it strengthens the accountability loop between users and irrigation departments, and ensures regular upkeep of systems.

As discussed earlier, the theme comprises of four indicators. The following section provides commentary on the indicator-level performance for these indicators assessed under the theme.

**Theme 3: Major and medium irrigation—Supply side management**
***[15 points]***

| | | | |
|---|---|---|---|
| **Indicator 6: Percentage of Irrigation Potential Utilized (IPU) to Irrigation Potential Created (IPC) as on the end of the given FY** | Indicator 7: Number of projects assessed and identified for the IPC-IPU gap in the state out of the total number of major and medium irrigation projects in the State | Indicator 8: Expenditure incurred on works (excluding establishment expenditure) for maintenance of irrigation assets per hectare of command area during the given FY | Indicator 9: The length of the canal and distribution network lined as on the end of the given FY vis-à-vis the total length of canal and distribution network found suitable (selected) for lining for improving conveyance efficiency |

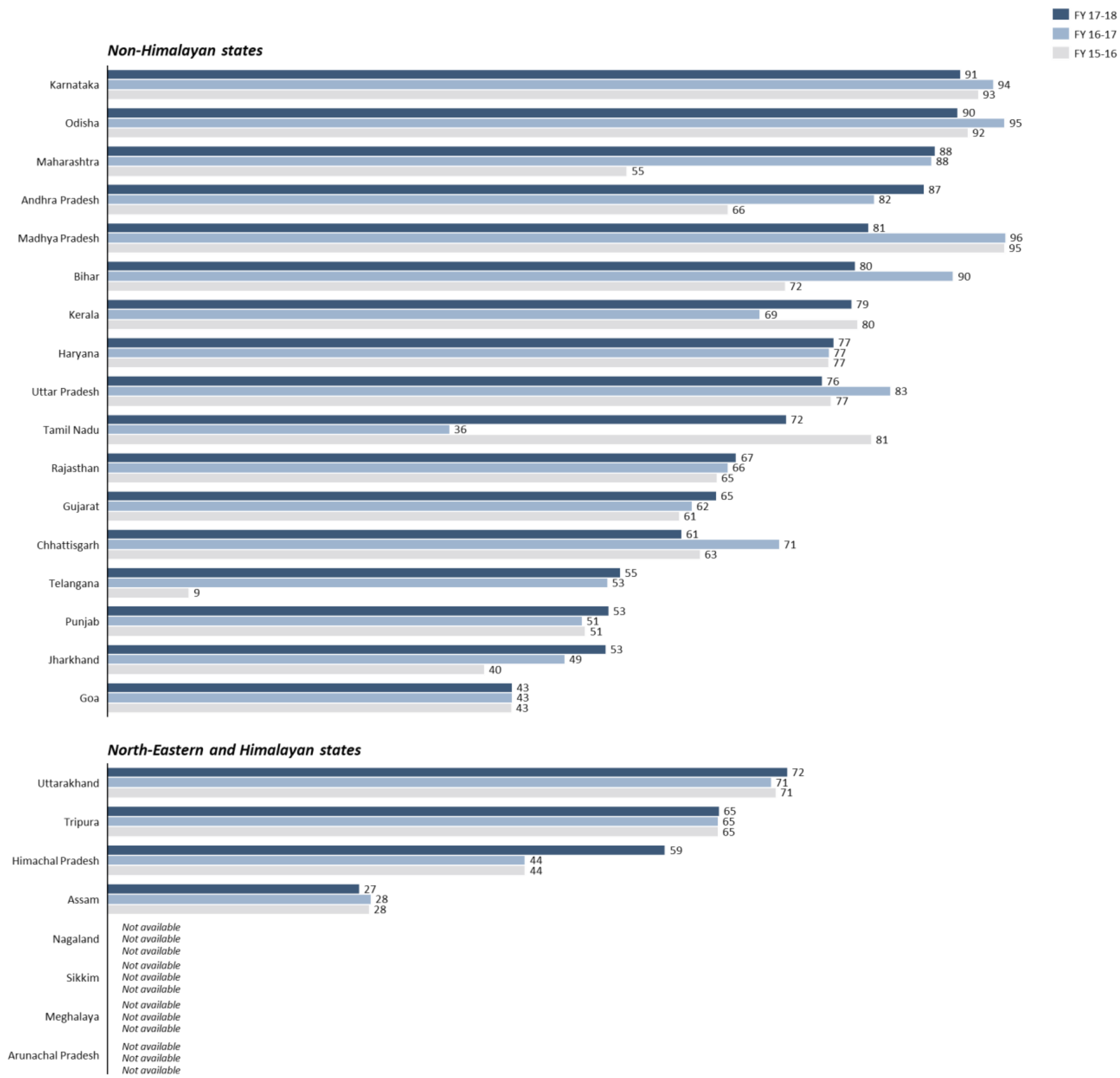
Indicator 6 measures the actual utilization of available water for irrigation by measuring the proportion of Irrigation Potential Utilized (IPU) to Irrigation Potential Created (IPC). IPC is defined as the total gross area proposed to be irrigated under different crops during a year as part of an irrigation scheme, where an area is counted multiple times if it is irrigated for multiple crops in a year. IPU is the area actually irrigated during that year. The ratio of IPU to IPC, thus, indicates the actual utilization of irrigation water and assets (higher being better).

| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Karnataka | Uttarakhand |
| **Bottom Performer** | Goa | Assam |
| **Median Score** | 76.06% | 62.22% |
| **1-year Median Change** | +4.57% | +7.50% |

135 *Strategy for New India@75*, (NITI Aayog, 2018), page 101, https://niti.gov.in/writereaddata/files/Strategy_for_New_India.pdf.

**Figure 18: Indicator 6: Percentage of Irrigation Potential Utilized (IPU) to Irrigation Potential Created (IPC) as on the end of the given FY**

*In % (FY 15-16, FY 16-17, FY 17-18)*




**Overall, irrigation potential utilization improved in the last three years, with median state utilizing 72% of its irrigation potential in FY 17-18.** The overall median for FY 17-18 stands at 72%, higher than the FY 16-17 and FY 15-16 median of 69% and 65% respectively. Among non-Himalayan states, Karnataka, Odisha, Maharashtra, and Andhra Pradesh are the top performers, with utilization rates greater than 85%. Although, Karnataka and Odisha form the top performers for FY 17-18, their utilization rates have declined marginally compared to FY 16-17. Madhya Pradesh, the top performing state in FY 16-17 with ~96%, also experienced a decline of ~15% between FY 16-17 and FY 17-18. Amongst North-Eastern and Himalayan states, performance remained largely same, with Uttarakhand and Assam being top and bottom performing states respectively for all three years.

**Continuous monitoring of irrigation assets can enable effective maintenance, helping states minimize the IPC-IPU gap.** Such an approach has been adopted by the Water Resource Department in Madhya Pradesh. The state has instituted web-based irrigation monitoring systems for assessing real-time performance of its irrigation sources. The information is used to identify assets with declining performance, as well as the scale of maintenance activity required to enhance capacity. Post identification, corrective measures are taken by the Water Resource Department. Such pre-emptive maintenance activities have led to a three-fold increase in the state's irrigated area between 2010-11 and 2014-15. Expenditure on repair and maintenance activities has been increased by ~7 times between 2009-10 and 2015-16, playing a critical role in delivering the successes.[136]

**Theme 3: Major and medium irrigation—Supply side management**
***[15 points]***

| Indicator 6: Percentage of Irrigation Potential Utilized (IPU) to Irrigation Potential Created (IPC) as on the end of the given FY | **Indicator 7: Number of projects assessed and identified for the IPC-IPU gap in the state out of the total number of major and medium irrigation projects in the State** | Indicator 8: Expenditure incurred on works (excluding establishment expenditure) for maintenance of irrigation assets per hectare of command area during the given FY | Indicator 9: The length of the canal and distribution network lined as on the end of the given FY vis-à-vis the total length of canal and distribution network found suitable (selected) for lining for improving conveyance efficiency |
|---|---|---|---|

Indicator 7 provides the percentage of major and medium irrigation (MMI) assets that have been assessed and identified for the IPC-IPU gap in a state, as well as the contextual indicator of the total number of MMI assets in a state.

| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Andhra Pradesh, Madhya Pradesh, Jharkhand, Punjab, Telangana, Goa | Tripura, Assam |
| **Bottom Performer** | Odisha | Uttarakhand |
| **Median Score** | 65.63% | 81.25% |
| **1-year Median Change** | +21.11% | +16.67% |

136 *A Management Approach to Increase Irrigated Area and Production in Madhya Pradesh, India* (International Commission on Irrigation and Drainage, 2016), http://www.icid.org/wif2_full_papers/wif2_w.1.1.04.pdf

**Figure 19: Indicator 7: Number of projects assessed and identified for the IPC-IPU gap in the state out of the total number of major and medium irrigation projects in the state**

*In % (latest data available from FY 15-16, FY 16-17, FY 17-18)*

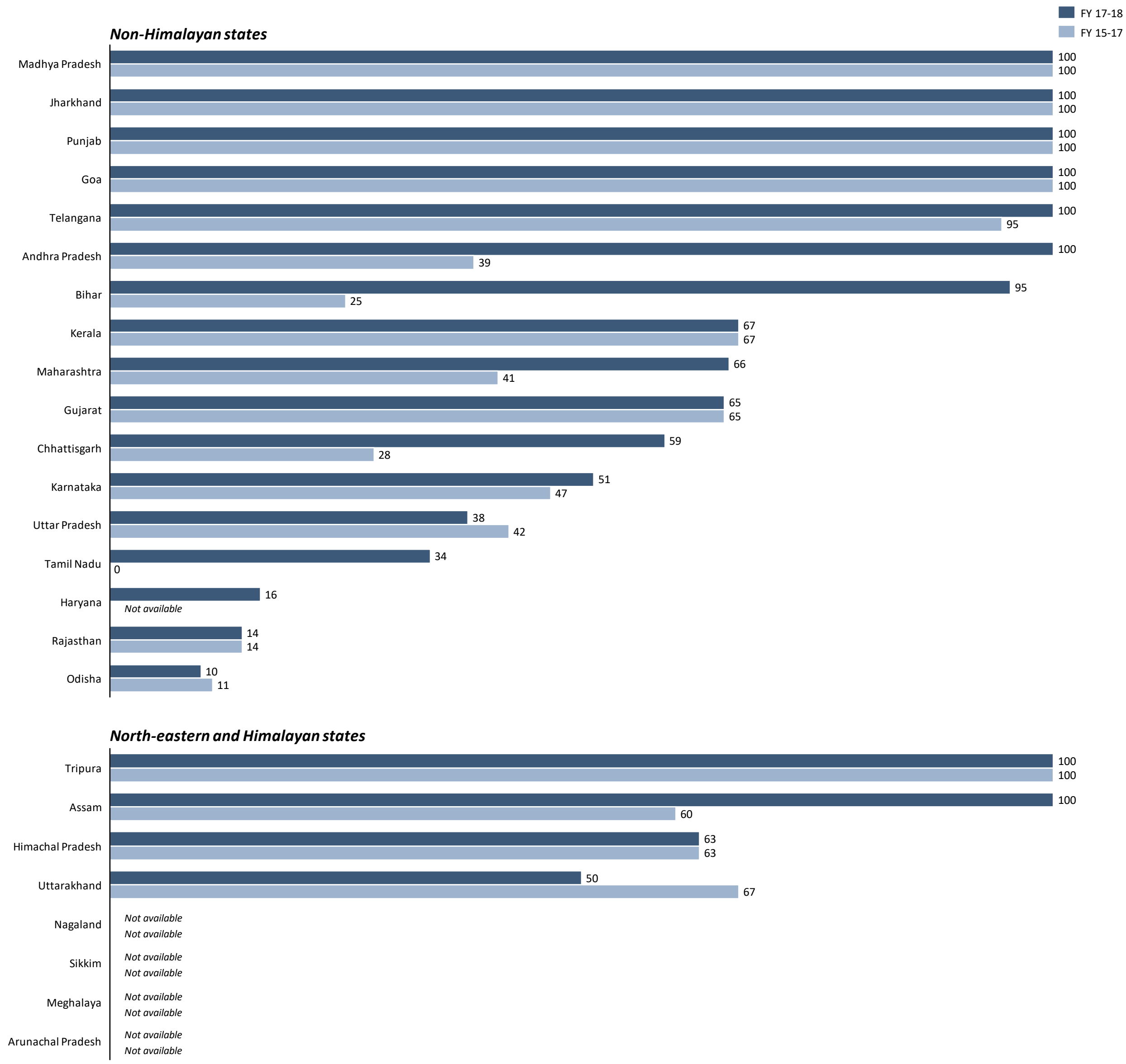
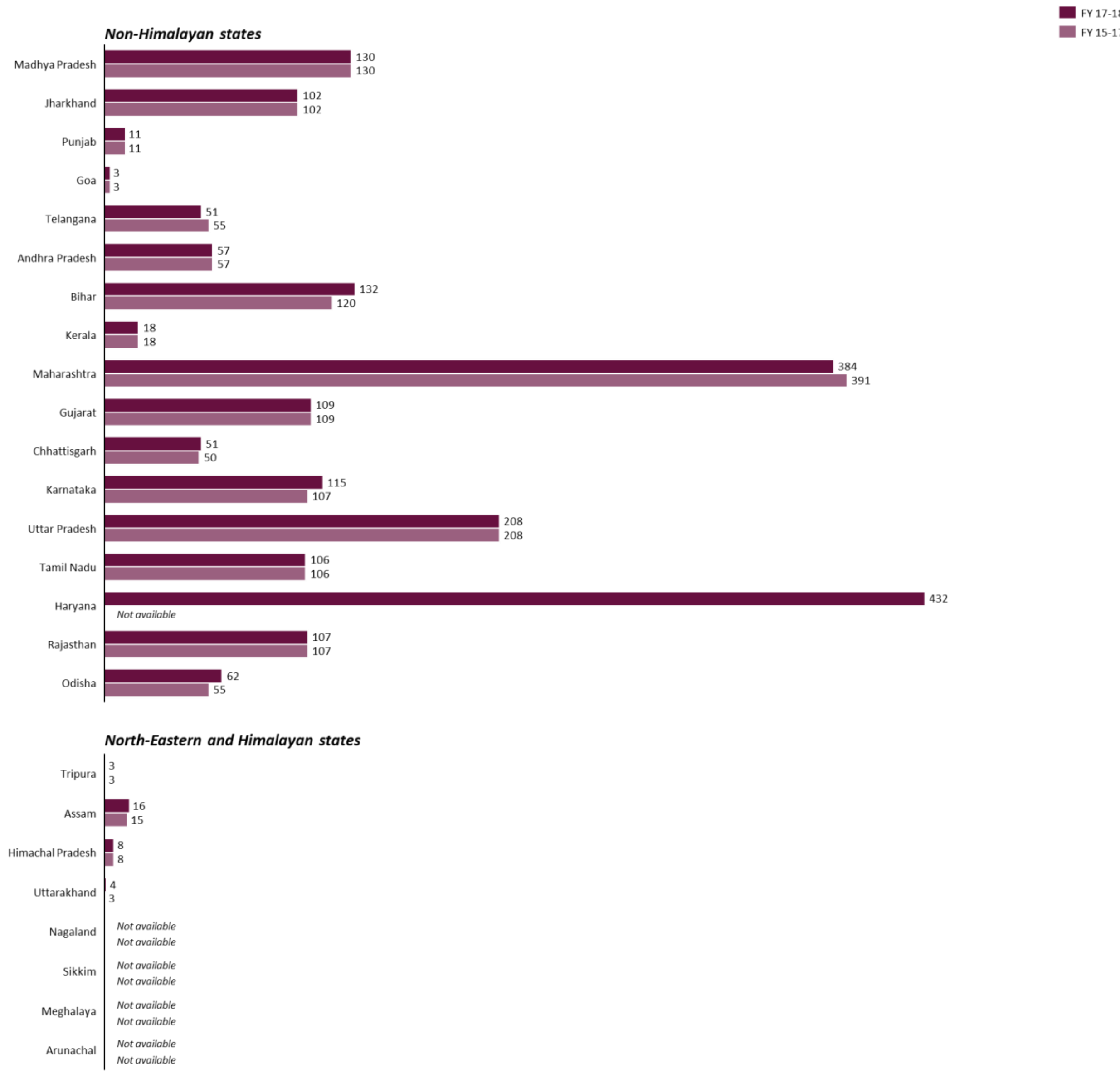


**Figure 20: Contextual indicator 7: Total number of major and medium irrigation projects in the state**

*(latest data available from FY 15-16, FY 16-17, FY 17-18)*




**Low-performing states have displayed improvement on the indicator in FY17-18.** The overall median increased by 5 percentage points between the base year and reference year. This change is in large part due to the significant improvement shown by states such as Bihar, Andhra Pradesh, Tamil Nadu, Chhattisgarh, and Maharashtra. The improvement ranged from 25 points (in case of Maharashtra) to 71 percentage points (in case of Bihar). Additionally, previously high performing states such as Madhya Pradesh, Jharkhand, Punjab, Goa, Telangana, and Tripura continue to display exceptional performance, and have reported 100% coverage on the indicator. Notably, Madhya Pradesh and Jharkhand, two of the top-performers, have more than 100 MMI projects in their respective states, and have assessed all of them for IPU-IPC gaps.

On the other end, Haryana and Rajasthan, with 432 and 107 MMI assets, respectively, have assessed only 16% and 14% of the total assets.

**Theme 3: Major and medium irrigation—Supply side management**
***[15 points]***

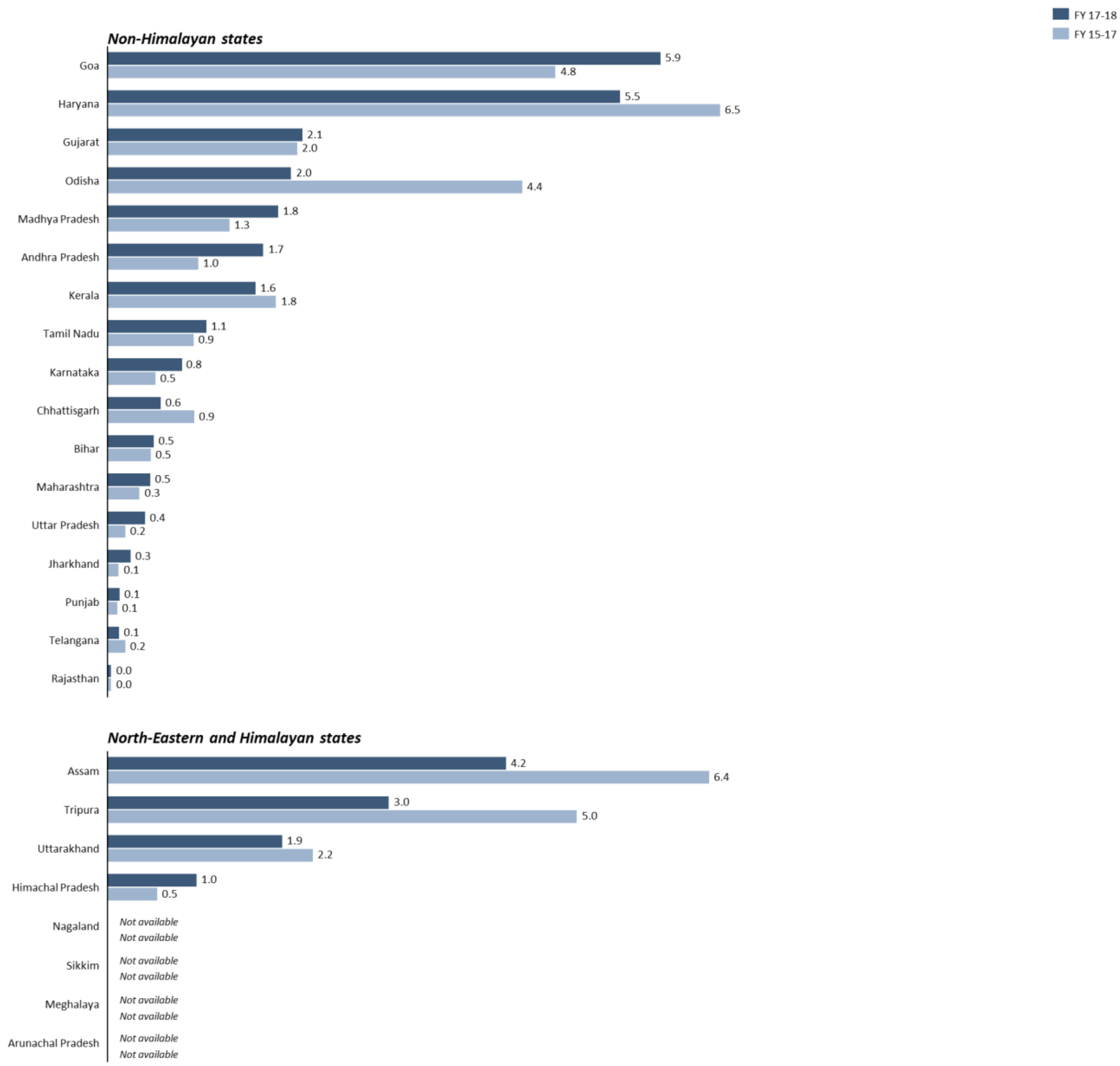
| Indicator 6: Percentage of Irrigation Potential Utilized (IPU) to Irrigation Potential Created (IPC) as on the end of the given FY | Indicator 7: Number of projects assessed and identified for the IPC-IPU gap in the state out of the total number of major and medium irrigation projects in the State | **Indicator 8: Expenditure incurred on works (excluding establishment expenditure) for maintenance of irrigation assets per hectare of command area during the given FY** | Indicator 9: The length of the canal and distribution network lined as on the end of the given FY vis-à-vis the total length of canal and distribution network found suitable (selected) for lining for improving conveyance efficiency |
|---|---|---|---|

Indicator 8 measures the expenditure on the maintenance of irrigation assets per hectare of command area in a state. According to government discussions on the Index, states with expenditures equal to or greater than INR 1,655 per hectare are awarded the maximum score, while states scoring below the cut-off are awarded a score equal to the state's expenditure per hectare divided by the cut-off of INR 1,655 per hectare.

| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Goa | Assam |
| **Bottom Performer** | Rajasthan | Himachal Pradesh |
| **Median Score** | INR 797 | INR 2433 |
| **1-year Median Change** | -INR 126 | -INR 1162 |

**Figure 21: Indicator 8: Expenditure incurred on works (excluding establishment expenditure) for maintenance of irrigation assets per hectare of command area during the given FY**

*In INR thousand/ hectare (FY 15-16, FY 16-17, FY 17-18)*




**The maintenance expenditure for median state increased by ~INR 130 between the base and reference year, while the mean maintenance expenditure by states declined by ~INR 235 during this period.**[137] The median expenditure by states increased from INR 928 to INR 1056, while the mean expenditure declined from INR 1895 to INR 1660 between FY 15-16 and FY 17-18. Both non-Himalayan states and North-Eastern & Himalayan states experienced a decline in the category median and mean between FY 15-16 and FY 17-18, although the North-Eastern and Himalayan states experienced a larger

[137] Decline of greater than INR 1000/per hectare in maintenance expenditure in case of Tripura, Assam, Haryana, and Odisha is likely to have contributed to the lower indicator mean. Given that these figures still stay above average in most cases, this does not reflect in the indicator median

decline of ~INR 1162 and ~INR 1016, compared to the ~INR 126 and ~INR 51 decline in case of non-Himalayan states.

This notable decline in North-Eastern and Himalayan states is due to lower expenditure by 3 out of the 4 reporting states in FY 17-18 compared to previous years. Maintenance expenditure reduced by ~INR 2160 and ~INR 2000 in case of Assam and Tripura, respectively, between FY 15-16 and FY 17-18, a respective decline of 40% and ~34% compared to their FY 15-16 expenditure. Among non-Himalayan states, most states reported an improvement, with Goa reporting the largest increase and becoming the state with the highest maintenance expenditure for FY 17-18. On the other end, Haryana (state with highest maintenance expenditure in FY 15-16 & FY 16-17) and Odisha reported a decline of ~INR 1062 and ~INR 2456 in their respective maintenance expenditure. Lack of funds for maintenance has been highlighted as one of the reasons for the under-utilization of irrigation potential in MMI assets.[138] Increased ISF collection by state irrigation departments can potentially help in increasing fund availability as well as strengthen accountability of these departments to conduct regular O&M of irrigation assets, and provide satisfactory services to end-users.

**Theme 3: Major and medium irrigation—Supply side management**
***[15 points]***

| Indicator 6: Percentage of Irrigation Potential Utilized (IPU) to Irrigation Potential Created (IPC) as on the end of the given FY | Indicator 7: Number of projects assessed and identified for the IPC-IPU gap in the state out of the total number of major and medium irrigation projects in the State | Indicator 8: Expenditure incurred on works (excluding establishment expenditure) for maintenance of irrigation assets per hectare of command area during the given FY | **Indicator 9: The length of the canal and distribution network lined as on the end of the given FY vis-à-vis the total length of canal and distribution network found suitable (selected) for lining for improving conveyance efficiency** |
|---|---|---|---|

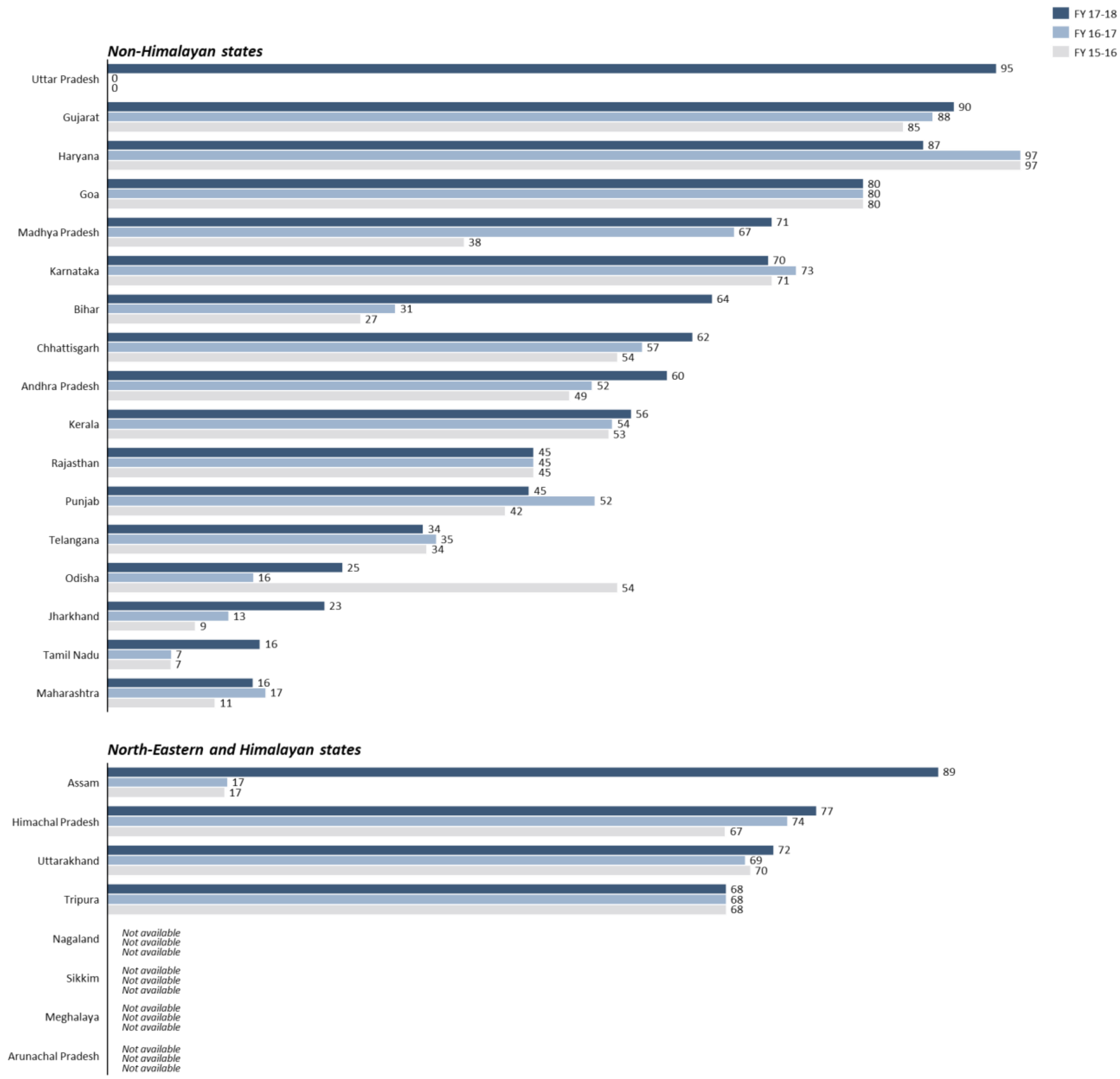
Indicator 9 measures the percentage of the suitable length of canals and distribution networks that the states have lined. Canal lining involves adding an impermeable layer to the edges to reduce seepage losses, make maintenance easier, and increase water output discharge rates.

| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Uttar Pradesh | Assam |
| **Bottom Performer** | Maharashtra | Tripura |
| **Median Score** | 59.59% | 74.50% |
| **1-year Median Change** | +7.99% | +5.99% |

138 *Working Group on Major & Medium Irrigation and Command Area Development for the XII Five Year Plan (2012-2017)* (Planning Commission, 2011), page 2, http://planningcommission.nic.in/aboutus/committee/wrkgrp12/wr/wg_major.pdf.

**Figure 22: Indicator 9: The length of the canal and distribution network lined as on the end of the given FY vis-à-vis the total length of canal and distribution network found suitable (selected) for lining for improving conveyance efficiency**

*In % (FY 15-16, FY 16-17, FY 17-18)*




**Canal lining by states has improved across the board, barring a few exceptions.** The overall median increased from 49% to 64% between the base year and reference year. 15 out of the 21 reporting states displayed improvement in lining of identified canals and distribution networks during the last three years, and 6 states reported an improvement of greater than 10 percentage points. Uttar Pradesh and Assam reported significant increase of 95 and 72 percentage points, respectively, during the three-year period, with most of the improvement being reported in FY 17-18. Notably, Uttar Pradesh reported 0% canal lining during the last 2 years; the improvement suggests a recent but strong focus on canal lining by the state. On the other end, Odisha reported the largest decline during the three-year period, of 29 percentage points, followed by Haryana reporting a 10-percentage point decline. North-Eastern and

Himalayan states perform better than non-Himalayan states on the indicator, with the category median standing at 75%, 15 percentage points higher compared to non-Himalayan states.

**Institutional and technical reforms can help optimize efficiency of existing dam-canal networks, as demonstrated by Madhya Pradesh's Water Sector Restructuring Project.** The World Bank supported project was implemented by state's Water Resource Department, and focused on reducing the system losses and enhancing efficiency to enable overall water savings. At the onset of the project, key indicators along with future targets were defined, and purpose-driven institutions such as State Water Resources Agency (SWaRA), State Water Tariff Regulatory Commission (SWaTReC) etc., were leveraged to ensure long-term implementation and sustainability of the project. Investments were made in last-mile networks, and rehabilitation activities were undertaken for existing canal infrastructure, including lining of large earthen canals and rehabilitation of minor irrigation schemes. This was complemented by regular maintenance activities undertaken by state department to desilt main irrigation canals, while WUAs led cleaning up of sub-minors and field channels. Further, monitoring activities were introduced and local bureaucracy was empowered to standardize processes. Through the project, an additional 651,000 hectares of land has been covered under irrigation services, and an average farm income of INR 22,674 per hectare has been achieved.[139]

[139] *Implementation Completion and Results Report, Madhya Pradesh Water Sector Restructuring Project* (World Bank, 2015), http://documents.worldbank.org/curated/en/131261468001492272/pdf/ICR3371-REVISED-Box394838B-PUBLIC-disclosed-1-14-16.pdf; Tushar Shah et al., *Madhya Pradesh's Irrigation Reform as a Model* (EPW, 2016), https://www.epw.in/journal/2016/6/commentary/har-khet-ko-pani.html.

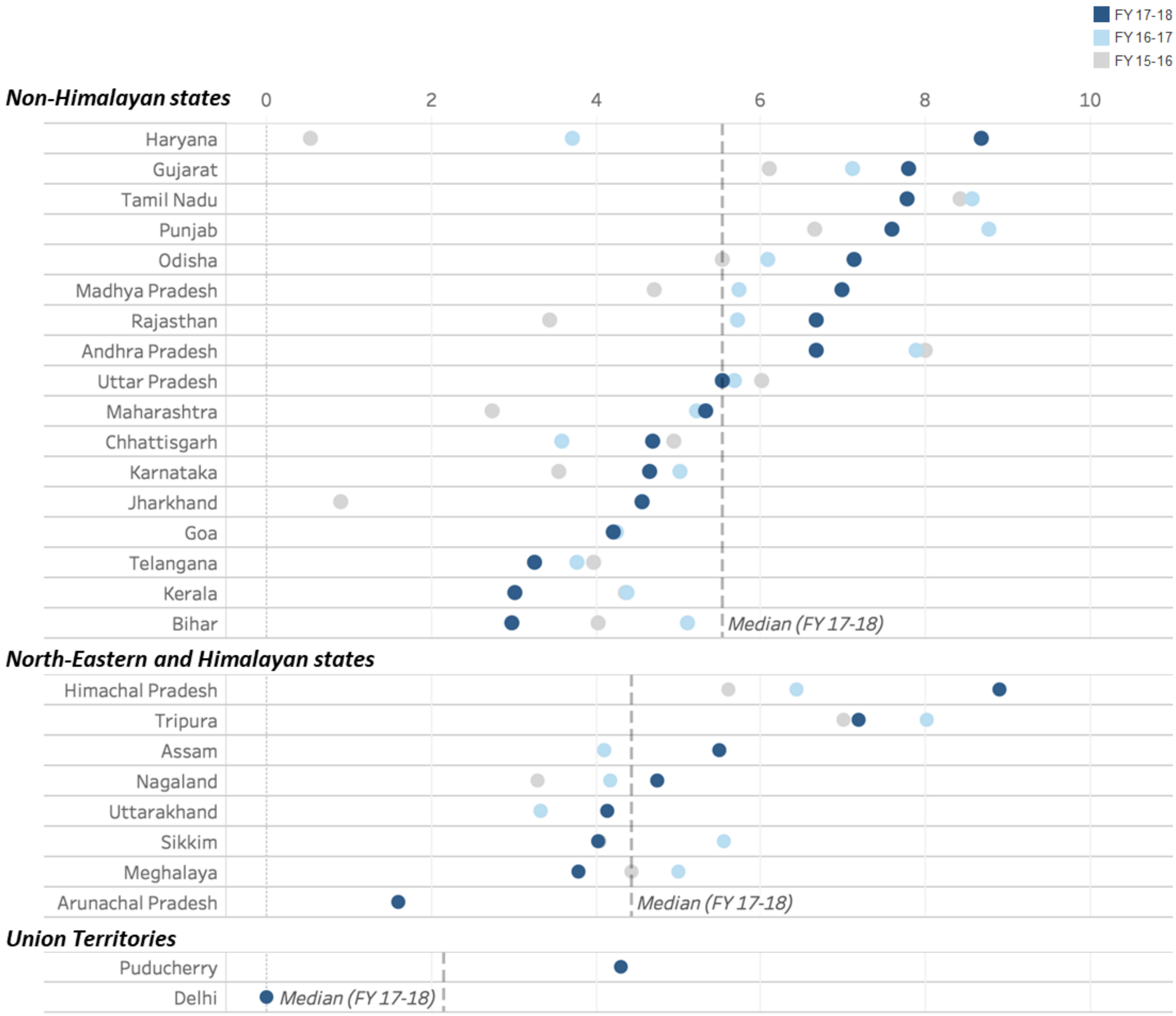
## Theme 4: Watershed development—Supply side management

**What does the theme comprise?** The fourth theme focuses on state performance on managing and restoring watershed units, and accounts for 10 points (out of 100) in the Index. The theme has three indicators that look at the proportion of a state's area under rain-fed agriculture (higher being worse), and the achievement of targets in the construction and geo-tagging of water harvesting structures under schemes such as IWMP.

| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Haryana | Himachal Pradesh |
| **Bottom Performer** | Bihar | Arunachal Pradesh |
| **Median Score** | 5.54 | 4.44 |
| **1-year Median Change** | +0.32 | -0.56 |

**Figure 23: Performance of States and UTs on Theme 4 – Watershed development—Supply side management**

*Index scores, Range 0-10 (FY 15-16, FY 16-17, FY 17-18)*




**States & UTs demonstrate moderate performance on the theme, with an almost equal split amongst states & UTs above and below the 50% mark.** 13 out of the 27 Index states & UTs have scores higher than five points, while the remaining 14 states & UTs reported scores less than that. The theme median and mean stand at 4.74 and 5.25 respectively for FY 17-18, around the 5-point mark. These are lower than FY 16-17 averages by 0.4 and 0.2 points. Broadly, two main clusters emerge—a cluster of states with scores between 4 and 6 points, and another one with scores between 6 and 8 points. At the category level, non-Himalayan states perform better than North-Eastern and Himalayan states across all three years, with the performance gap widening the most in FY 17-18. The increase in gap is driven by a decline in category averages of North-Eastern and Himalayan states, caused by relatively lower scores by Sikkim, Meghalaya, and Tripura in FY 17-18. Haryana displayed the maximum improvement (8.14 points) between the base and reference year, becoming the top performer amongst the non-Himalayan states. This improvement is driven largely by higher achievement of targets in construction and geo-tagging of water harvesting structures under the IWMP scheme.

**A collaborative and participatory approach to watershed development and management can help in ensuring regular maintenance and long-term use of such infrastructure.** Watershed development projects need to ensure that the built structures are in a well-functioning condition even after years of development and do not become redundant due to lack of proper upkeep. Involvement of community members, civil society organizations, and other local actors in such development projects can help in ensuring adequate maintenance activities are undertaken from time to time, and benefits of such structures can be reaped for longer periods. This can also reduce the need for reconstruction of such infrastructure in every few years and limit the resource investment required by the state.

As discussed earlier, the theme comprises of three indicators. The following section provides commentary on the indicator-level performance for these indicators assessed under the theme.

**Theme 4: Watershed development—Supply side management**
***[10 points]***

| Indicator 10: Area under rain-fed agriculture as a percentage of the net cultivated area as on the end of the current or previous FY | Indicator 11: Number of water harvesting structures constructed or rejuvenated as compared to the target (sanctioned projects under IWMP, RKVY, MGNREGS and other schemes) during the FY | Indicator 12: Percentage of assets created under IWMP geo-tagged as on the end of the given FY |
|---|---|---|

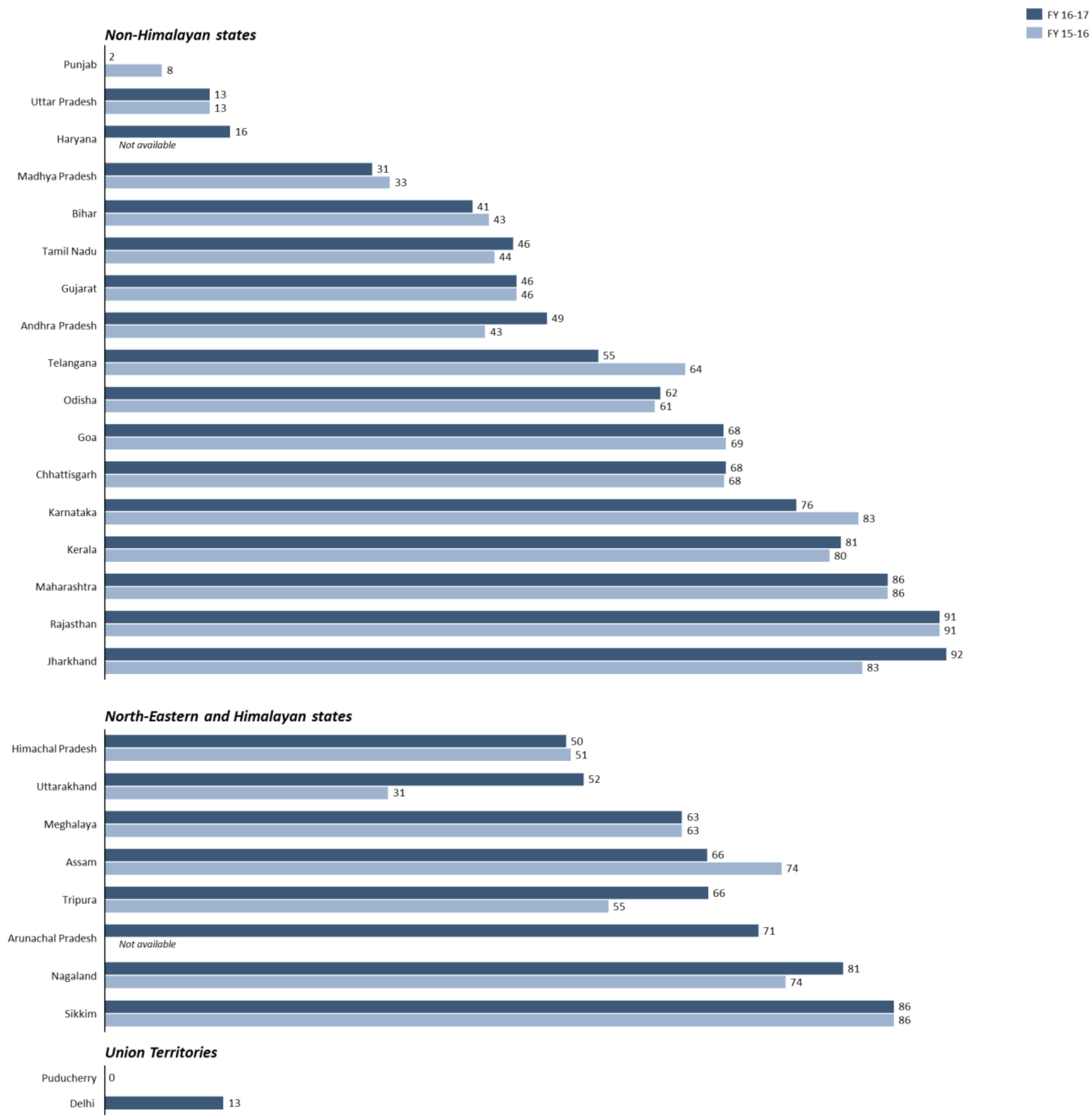
Indicator 10 measures the proportion of net cultivated area that is 'rain-fed' for a state. It is calculated by subtracting the area under irrigation from the net cultivated area. This is the only 'negative' indicator in the Index, since a lower percentage indicates better performance in irrigation water provision.[140]

| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Punjab | Himachal Pradesh |
| **Bottom Performer** | Jharkhand | Sikkim |
| **Median Score** | 54.83% | 65.84% |
| **1-year Median Change** | -7.69% | +2.80% |

[140] Scoring methodology has been adjusted accordingly to reflect the inverse nature of the indicator

**Figure 24: Indicator 10: Area under rain-fed agriculture as a percentage of the net cultivated area as on the end of the current or previous FY[141]**

*In % (latest data available from FY 15-16, FY 16-17)*




**Similar to previous years, most states remain highly dependent on rain-fed agriculture with median state having 62% cultivated area under rain-fed agriculture.** 17 states (out of the 27 states and UTs) reported having more than 50% area under rain-fed agriculture, highlighting inadequate coverage by irrigation systems in the country. This is also reflected in the indicator's overall median of 62% for FY 16-17, which when compared to the averages from FY 15-16 suggests a modest decline of 1 percentage

141 Data on the indicator has been collected only up to FY 16-17, and therefore has not been represented for FY 17-18

point. States such as Jharkhand, Rajasthan, Maharashtra, and Karnataka, even with over 100 MMI projects in the state, have rain-dependent agricultural areas ranging between 76% and 92%.

On the positive end of the spectrum, Punjab, Uttar Pradesh and Haryana, leading agricultural states in the country, have less than 20% area under rain-fed agriculture. Puducherry reported 0% area under rain-fed agriculture, and has complete irrigation coverage.

**Farm-level initiatives such as construction of water harvesting structures can help reduce dependence on rainfall and expand irrigation area.** Rain-fed agriculture area in India accounts for about 58% of the cultivated area and 40% of India's food production.[142] Given that such a large proportion of agricultural land remains highly dependent on rainfall, increasing access to irrigation networks in all such regions might entail significant time and resource investment. In such circumstances, effective water management practices can help maximize utilization of available water and meet irrigation needs in these regions. Per Drop More Crop component under the Pradhan Mantri Krishi Sinchai Yojana (PMKSY) scheme is one such initiative by the central government, which focuses on enhancing water efficiency at the farm level.[143] Anantapur district in Andhra Pradesh has successfully leveraged support under the scheme, and has increased irrigation potential by 15,783 hectares through construction of 51,825 water harvesting structures. As part of programme initiatives, a District Irrigation Plan (DIP) was launched to focus on drought-proofing the region. Further, defunct WUAs were revived, farm ponds were excavated, and resource maps and mobile applications were developed to suggest nearest water sources to farmers in dry spells as project interventions. Additionally, adoption of micro-irrigation was encouraged through training of 40,000 farmers, and has led to increased adoption of micro-irrigation systems in 39,801 hectares of land.[144]

[142] *Vision 2030* (Central Research Institute for Dryland Agriculture, 2011), http://www.crida.in/pubs/vision%202030.pdf.

[143] "Programmes, Schemes & New Initiatives" *Department of Agriculture Cooperation & Farmers Welfare*, http://agricoop.gov.in/divisiontype/rainfed-farming-system/programmes-schemes-new-initiatives

[144] *Best Practices: Pradhan Mantri Krishi Sinchayee Yojana* (Department of Administrative Reforms and Public Grievances), https://darpg.gov.in/sites/default/files/PMKSY%20-%20Best%20Practices_0.pdf

**Case study**: Watershed Management: Uttarakhand's decentralized approach[145]

*Overview*

Uttarakhand, through its decentralized watershed management project, has introduced an integrated approach towards addressing issues of water conservation and climate change management. The state has constructed check dams to store water from rivers, and is utilizing this water for irrigation by pumping it upstream to overhead tanks, using solar energy panels.

The project has been implemented in 3 districts, and has led to increased water availability for irrigation and reduce area under rain-fed irrigation. This has also led to an improvement in standard of living, and even reverse migration in some cases given improved irrigation facilities. Additionally, the project has also helped to reduce the distance travelled by women to fetch water for drinking and household purposes.

*Key actions*

The state, through support of a local civil society organization, provided on-farm training to farmers for construction of low-density polyethylene tanks to store water.

This was followed by construction of tanks with capacities upto 15000-18000 litres. These tanks were then connected to overhead tanks using pipes, and solar panels of 3000-watt capacity were installed to pump water in these tanks.

145 As per case study shared by the state government with NITI Aayog

*Impact*

The project has led to creation of capacity to hold upto 4, 35, 000 litres of water, and irrigation 50 hectares of area, previously under rainfed-irrigation. This has also enabled farmers to expand production to higher-revenue seeking crops such as chilli, onion, tomatoes, spinach, radish etc. Improved farming practices have also led to reverse migration in the region, given the enhanced livelihood opportunities from agriculture. Additionally, the project has also supported improvement of socio-economic status of local families in the region, along with reduction in distances travelled by women for collecting water.

*Lessons for other states*

**Integrating technology with traditional solutions**: States can leverage new innovations and technologies to modify traditional solutions, and contextualize them based on local requirements

**Theme 4: Watershed development—Supply side management**
***[10 points]***

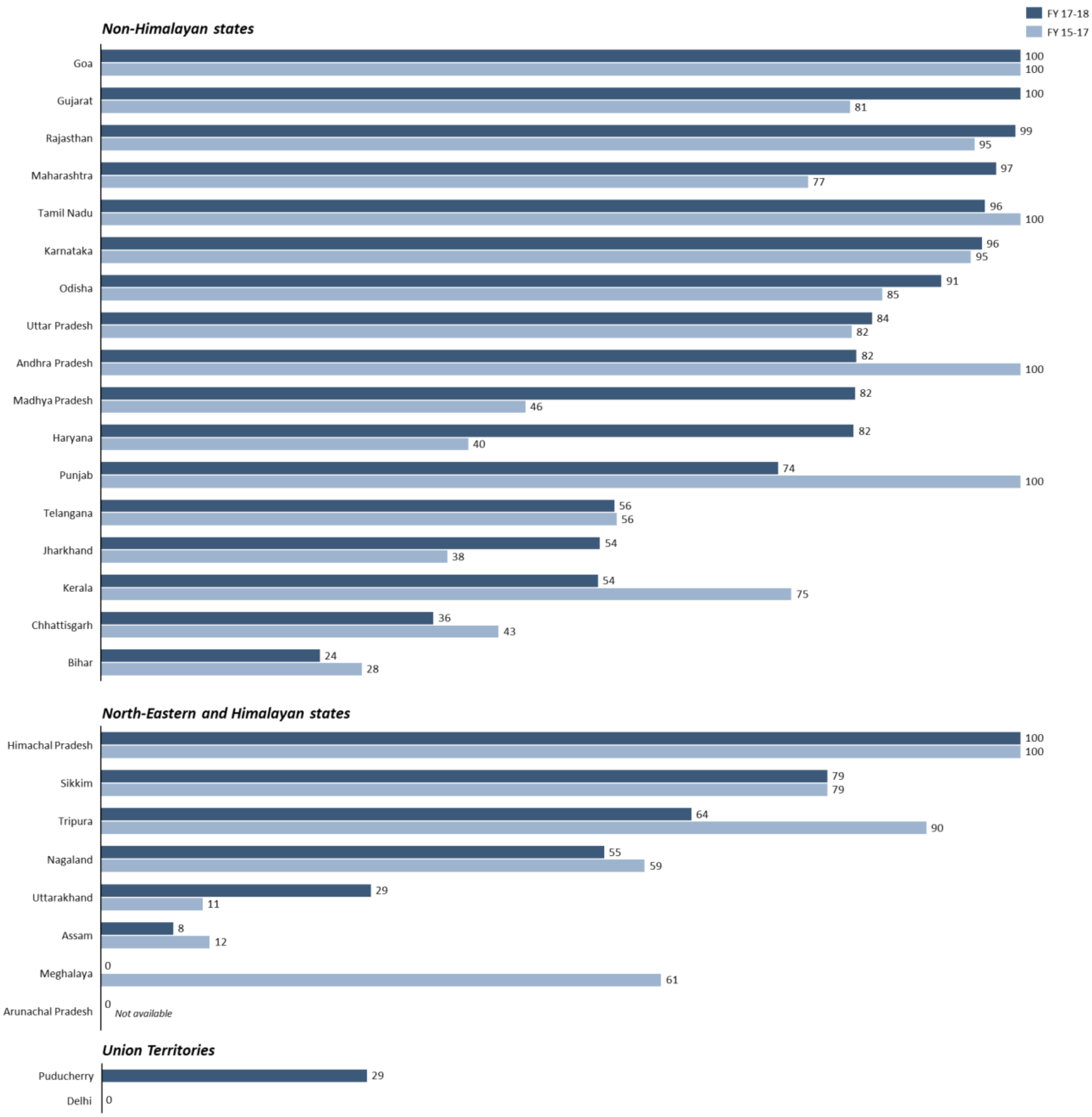
| Indicator 10: Area under rain-fed agriculture as a percentage of the net cultivated area as on the end of the current or previous FY | **Indicator 11: Number of water harvesting structures constructed or rejuvenated as compared to the target (sanctioned projects under IWMP, RKVY, MGNREGS and other schemes) during the FY** | Indicator 12: Percentage of assets created under IWMP geo-tagged as on the end of the given FY |
|---|---|---|

Indicator 11 specifies the percentage of targeted water harvesting structures constructed or rejuvenated in FY 17-18. These structures are being constructed under various schemes such as IWMP (Integrated Watershed Management Programme)—now the watershed component of PMKSY, MNREGS (Mahatma Gandhi National Rural Employment Guarantee Scheme), RKVY (Rashtriya Krishi Vikas Yojana), and others.

| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Goa, Gujarat | Himachal Pradesh |
| **Bottom Performer** | Bihar | Meghalaya, Arunachal Pradesh |
| **Median Score** | 82.17% | 42.10% |
| **1-year Median Change** | +0.72% | -18.84% |

**Figure 25: Indicator 11: Number of water harvesting structures constructed or rejuvenated as compared to the target (sanctioned projects under IWMP, RKVY, MGNREGS and other schemes) during the FY**

*In % (FY 15-16, FY 16-17, FY 17-18)*




**Overall, states achieved lower targets for constructing/rejuvenating water harvesting structures compared to previous years.** The overall median for the indicator declined from 78% in FY 15-17 to 74% in FY 17-18, respectively. Sharp decline in case of few states contributed to the lower average. 4 states—Meghalaya, Punjab, Tripura, and Kerala—reported decline of greater than 20 percentage points on the indicator, with Meghalaya reporting the highest decline of 61 percentage points between the base and reference year. Additionally, Delhi, a new addition to the Index in FY 17-18, also reported no achievement of its targets and further contributed to the decline in overall averages.

The averages for non-Himalayan states remained within the same range broadly for FY 15-17 and FY 17-18, while North-Eastern and Himalayan category experienced a decline of ~19 percentage points in the overall median between FY 15-17 and FY 17-18. This is driven by the significant decline observed in case of Meghalaya and Tripura, as highlighted previously.

**In addition to the government programme, traditional water harvesting systems can also be leveraged for building water harvesting structures.** "Vayalagam Tankfed Agriculture Development Programme" by Dhan Foundation is one such example that has been replicated in seven South Indian states and focuses on transforming isolated tanks into tank-based watersheds. Farmers and farm-labourers dependent on the water tanks are organized into groups, and members of such groups take lead of the restoration drive as well as tank maintenance. They are also encouraged to contribute financially or through labour support. According to the foundation, the programme has successfully rehabilitated over 2000 tanks and 104 watersheds, and mobilized funding of ~INR 83 crores from government, private organizations etc. and a notable community contribution of ~INR 21 crores in last 25 years.[146]

**Theme 4: Watershed development—Supply side management**
***[10 points]***

| | | |
|---|---|---|
| Indicator 10: Area under rain-fed agriculture as a percentage of the net cultivated area as on the end of the current or previous FY | Indicator 11: Number of water harvesting structures constructed or rejuvenated as compared to the target (sanctioned projects under IWMP, RKVY, MGNREGS and other schemes) during the FY | **Indicator 12: Percentage of assets created under IWMP geo-tagged as on the end of the given FY** |

Indicator 12 measures the percentage of assets created under Integrated Watershed Management Programme (IWMP) that have been geo-tagged, and the contextual indicator provides the total number of assets created under IWMP in a state. Geo-tagging of water conservation assets has been conducted by National Remote Sensing Agency, ISRO to set up an online geographic portal for monitoring and evaluating the performance of IWMP watersheds. The online portal displays a map, summary statistics, and other monitoring tools at the national, state, and district level for the programme, which can be used to understand the present distribution as well as additional requirement of assets in different regions. Goa was unable to report data on the indicator, and has been marked nil on the indicator in the Index calculation.

[146] "Vayalagam Foundation", *Dhan Foundation*, accessed May 6, 2019, https://www.dhan.org/themes/vayalagam.php.

| Key highlights | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Rajasthan | Assam |
| **Bottom Performer** | Uttar Pradesh | Uttarakhand |
| **Median Score** | 75.87% | 60.62% |
| **1-year Median Change** | -0.55% | +8.62% |

**Figure 26: Indicator 12: Percentage of assets created under IWMP geo-tagged as on the end of the given FY**

*In % (FY 15-16, FY 16-17, FY 17-18)*

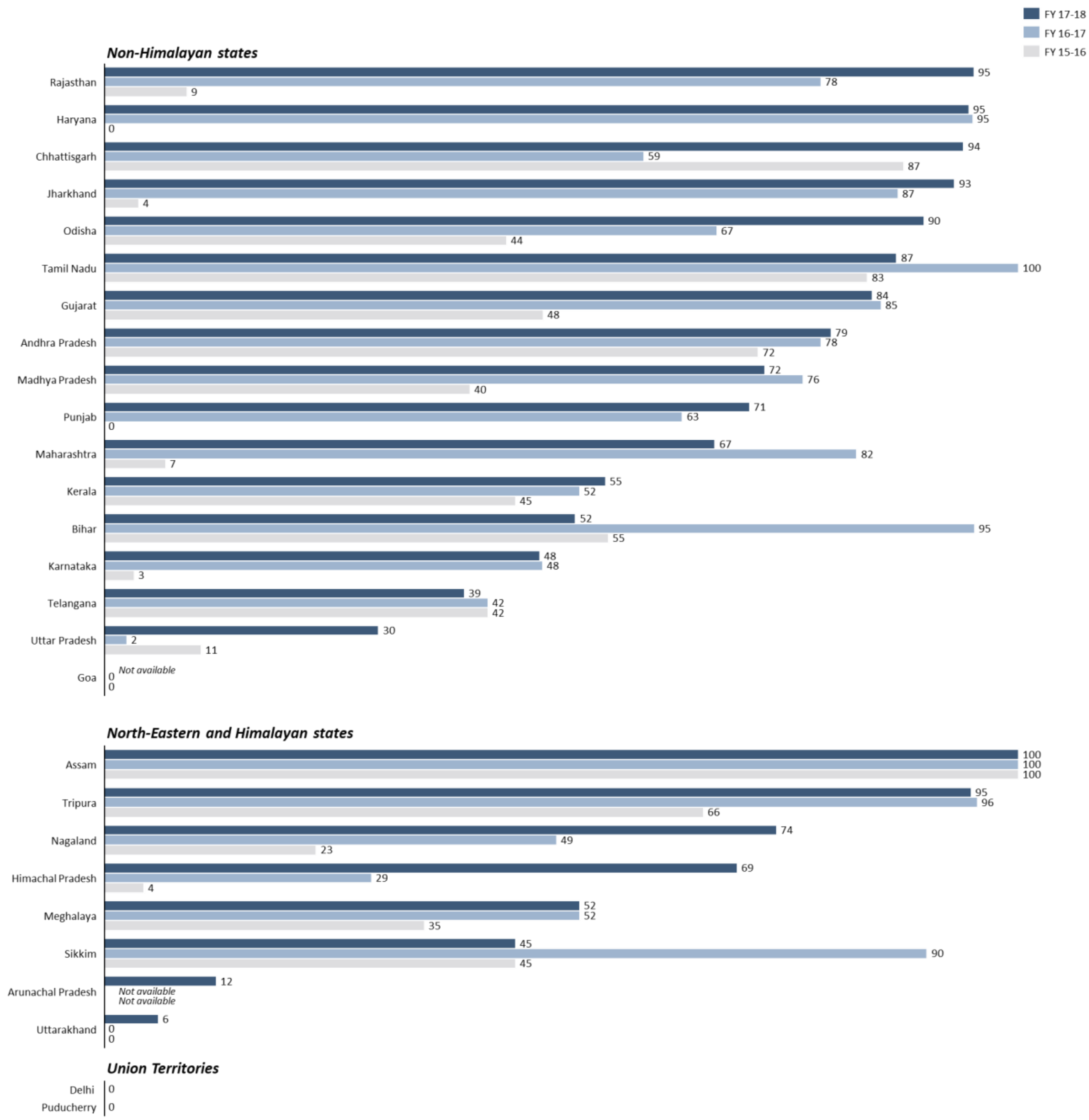
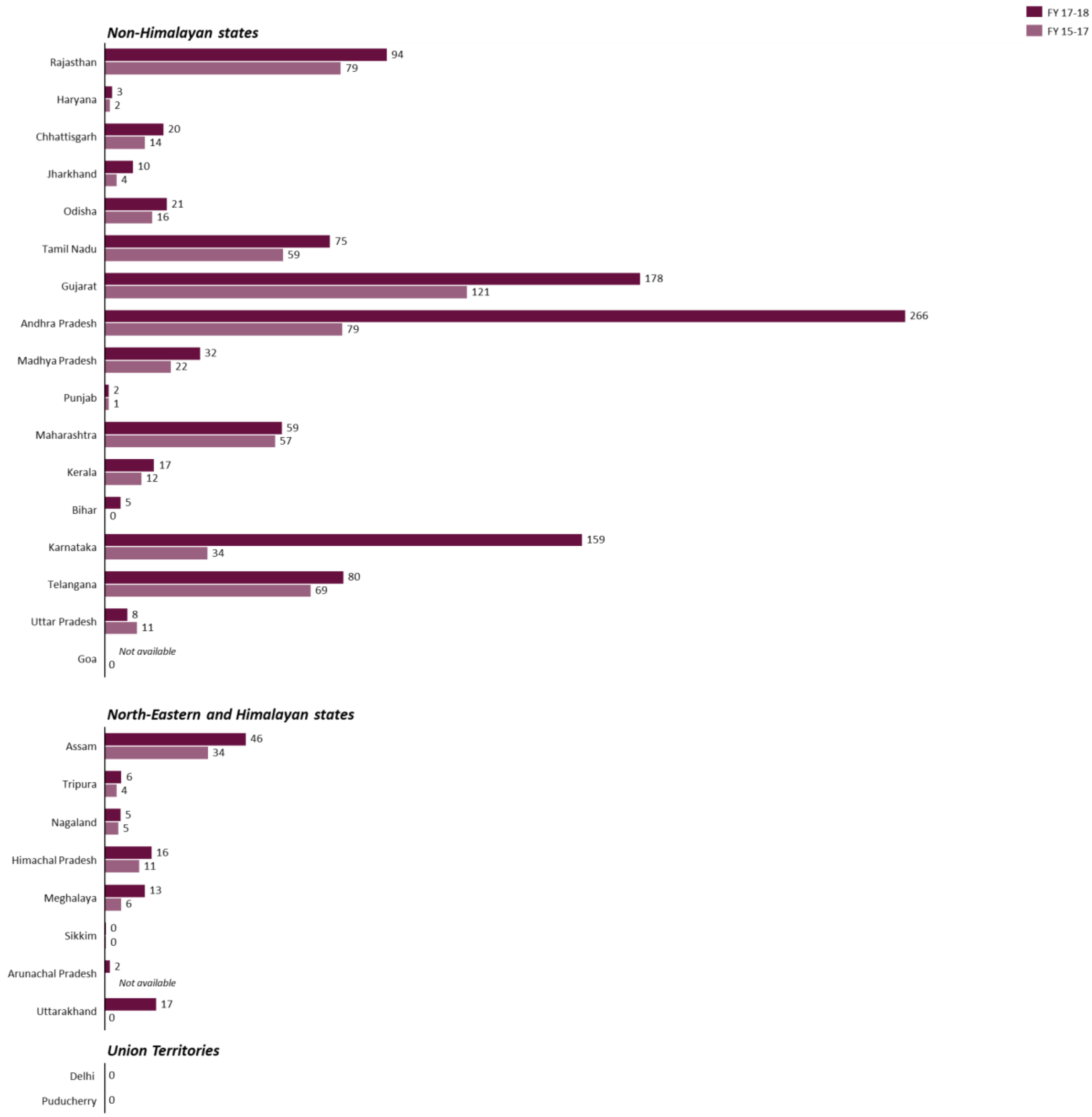


**Figure 27: Number of assets created under IWMP in states**

*In thousands (latest data available from FY 15-16, FY 16-17, FY 17-18)*




**Overall, states performed well on the indicator in FY 17-18, and have shown significant progress between base year and reference year.** 75% states (18 out of 24)[147] have geo-tagged more than 50% of their assets created under IWMP. The overall median for the indicator stands at 71% for FY 17-18, which is significantly higher than 38% from FY 15-16, and most of this improvement has been displayed between FY 15-16 and FY 16-17. Additionally, all except 2 states have reported higher or equal percentage of IWMP assets being geo-tagged in FY 17-18 compared to FY 15-16. States such as

[147] Goa, Delhi, and Puducherry have been excluded from the list of states as Goa did not submit data on the indicator, and Delhi and Puducherry reported zero assets created under IWMP

Rajasthan, Tamil Nadu, Gujarat, Andhra Pradesh, and Maharashtra, which have more than 50,000 assets, have also geo-tagged more than two-third of their IWMP assets. This demonstrates robust coverage displayed by states on the indicator, even with large number of IWMP assets. Such high geo-tagging percentage by states at the overall level is commendable.

**Geo-tagging of assets can assist states with informed and targeted policymaking, as well as developing plans for future developmental activities**. States can utilize this data for maintaining an updated inventory list, conducting repairs & renovations, as well as informing farmers about the available facilities. As mentioned earlier, Andhra Pradesh has geo-tagged all of its 15 lakh wells for effective monitoring and management.[148] Further, Andhra Pradesh and Telangana have conducted satellite-based baseline study in collaboration with National Remote Sensing Centre to understand the water use efficiency of their medium irrigation assets. These findings have been made available on the *Bhuvan* portal for public access, and cover information on several elements of the projects including administrative, infrastructure, irrigation, and socio-economic aspects.[149]

148 As per case study shared by the state government with NITI Aayog

149 "ISRO's Geoportal: Gateway to Indian Earth Observation Applications", *Bhuvan Portal by National Remote Sensing Centre*, http://bhuvan.nrsc.gov.in/projects/iwmp/.

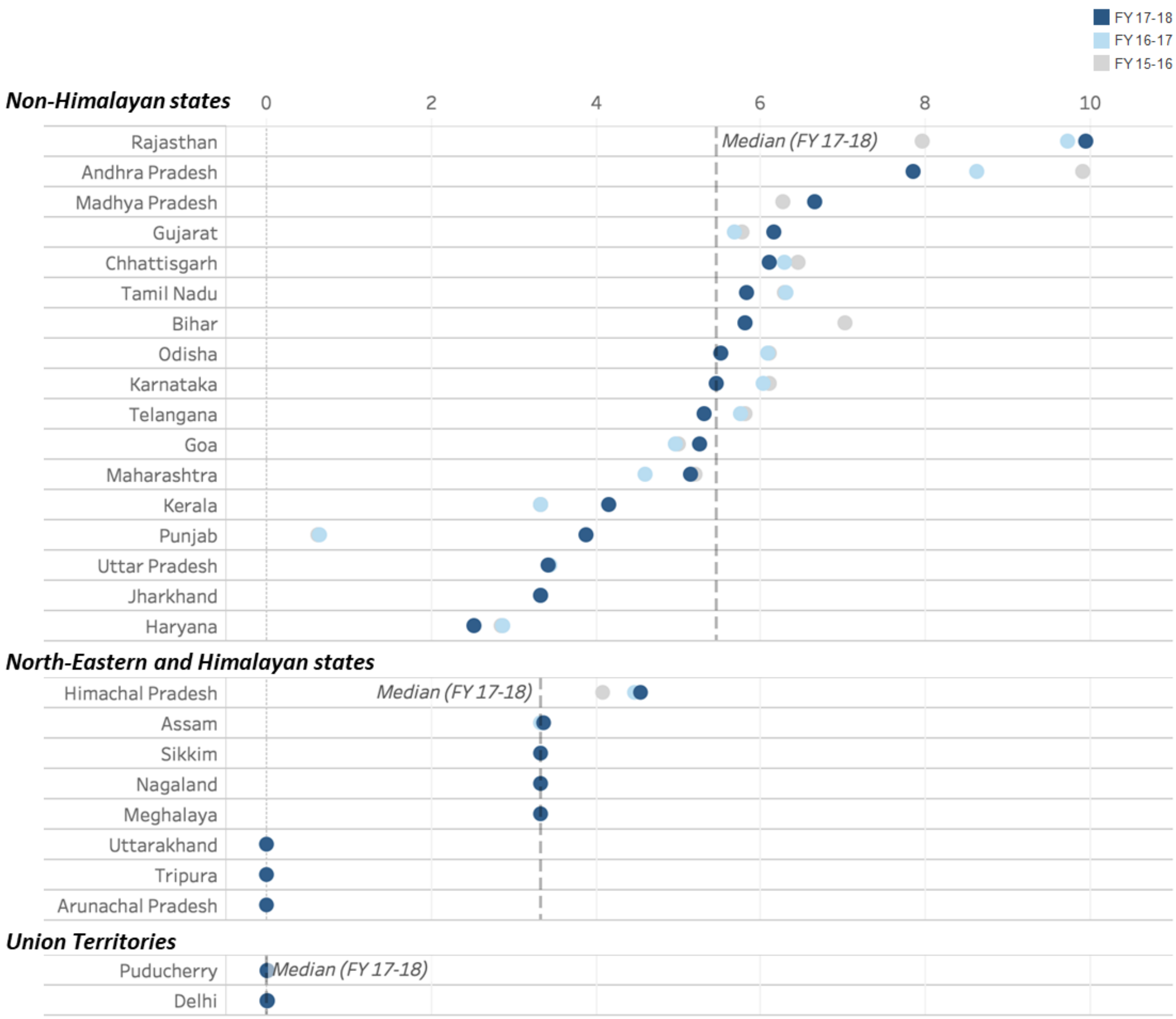
## Theme 5: Participatory Irrigation practices—Demand side management

**What does the theme comprise?** This theme focuses on the involvement of users in the irrigation ecosystem through local Water User Associations (WUAs), and accounts for 10 points (out of 100) in the Index. Several experts and committees, including the Working Group on Major and Medium Irrigation and Command Area Development of the Twelfth Plan, have identified WUAs as critical for improving the utilization of irrigation potential and maintaining and upgrading irrigation assets. Comprised of local water users—farmers, WUAs have several competitive advantages in the management of irrigation systems, including deep knowledge of local needs and constraints, the ability to monitor irrigation use and to maintain assets, and the capacity to achieve local buy-in for pricing and fee collection. This theme, thus, focuses on whether states have established a legal framework to involve WUAs in Participatory Irrigation Management (PIM), the proportion of areas where WUAs have actually been established, and the user fees that they have been allowed to retain as a proxy for the level of decentralization of irrigation management.

| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Rajasthan | Himachal Pradesh |
| **Bottom Performer** | Haryana | Uttarakhand, Tripura, Arunachal Pradesh |
| **Median Score** | 5.46 | 3.33 |
| **1-year Median Change** | -0.29 | 0 |

**Figure 28: Performance of States and UTs on Theme 5 – Participatory irrigation practices—Demand side management**

*Index scores, Range 0-10 (FY 15-16, FY 16-17, FY 17-18)*




**At the overall level, state and UT performance declined marginally in the last three years, despite majority states having legal frameworks to promote WUA involvement.** The median for the theme stands at 4.15, lower than the FY 15-16 and FY 16-17 averages. This is despite the fact that 80% of the reporting states (20 out of 25) have a framework in place to facilitate PIM through WUAs, suggesting regulatory frameworks, although may be necessary, but are not sufficient to improve participatory management practices. Theme indicators also reflect low rates of WUA participation in irrigation management activities, as well as unsatisfactory ISF collection by states and limited fee retention by WUAs, which are critical levers to enable sustainable participatory irrigation practices.

At the category level, non-Himalayan states perform better than North-Eastern and Himalayan states, but both categories haven't displayed any significant progress in the last three years. Rajasthan is the only state that has demonstrated exceptional performance on the theme, and achieved near-perfect scores in both FY 16-17 and FY 17-18.

As mentioned earlier, increased user participation in irrigation management can significantly improve asset maintenance and water use efficiency. While regulatory frameworks exist in most states to institutionalize participation of WUAs, financial support is needed to enable them to successfully execute their responsibilities. High retention of ISF fees by WUAs is one potential way to empower them financially through monetary incentives. This is observed in case of Rajasthan where WUAs retain 100% of the ISF and have deep involvement in irrigation management practices. Additionally, capacity building and technical training for WUAs are also important aspects, and can help ensure success of such participatory models.

As discussed earlier, the theme comprises of three indicators. The following section provides commentary on the indicator-level performance for these indicators assessed under the theme.

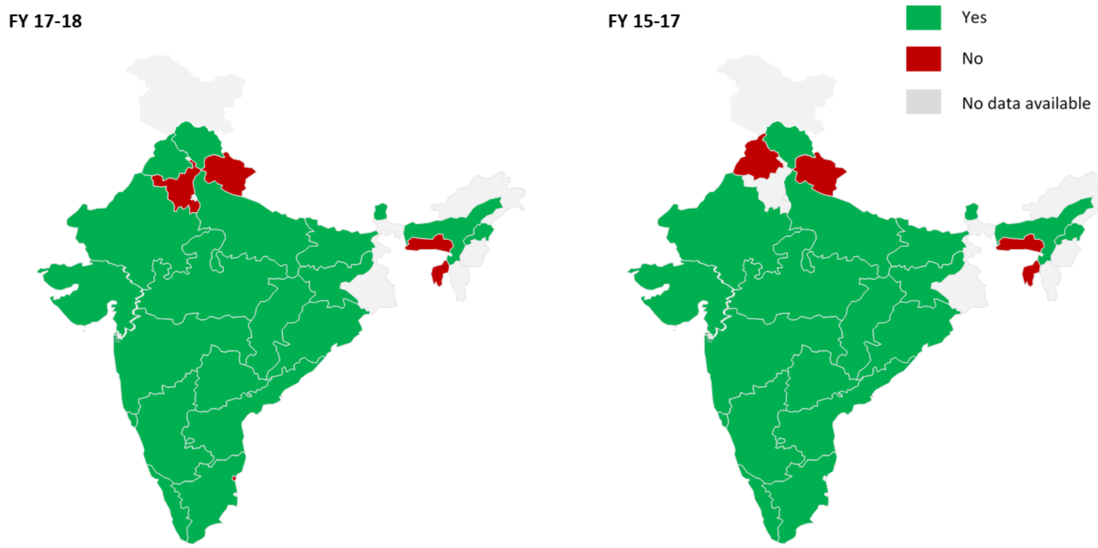
**Theme 5: Participatory irrigation practices—Demand side management**
***[10 points]***

| Indicator 13 | Indicator 14 | Indicator 15 |
|---|---|---|
| **Indicator 13: Has the State notified any law/ legal framework to facilitate Participatory Irrigation Management (PIM) through Water User Associations (WUAs)?** | Indicator 14: Percentage of irrigated command areas having WUAs involved in the O&M of irrigation facilities (minor distributaries and CAD&WM) as on the end of the given FY | Indicator 15: Percentage of Irrigation Service Fee (ISF) retained by WUAs as compared to the fee collected by WUAs during the FY |

Indicator 13 is a binary indicator specifying whether a state has established a legal framework to facilitate Participatory Irrigation Management (PIM) through Water User Associations (WUAs). A Water User Association (WUA) is a grouping of local water users, largely farmers, that pool together financial and operational resources for the maintenance of irrigation systems, and in some cases, negotiate water prices with the service providers and collect user fees. As described previously, WUAs have significant competitive advantages in the Operations and Management (O&M) and user fee collection for irrigation systems due to their local knowledge and direct incentives. Arunachal Pradesh and Delhi were unable to report data on the indicator and have been scored nil on the indicator in the Index calculation.

**Figure 29: Indicator 13: Has the state notified any law/ legal framework to facilitate Participatory Irrigation Management (PIM) through Water User Associations (WUAs)?**

*(FY 15-17, FY 17-18)*




**Similar to last year, 80% states and UTs have notified a legal framework for involving WUAs in participatory irrigation management.** 20 out of 25 reporting states and UTs reported having a framework in place, while only Haryana, Meghalaya, Uttarakhand, Tripura and Puducherry are yet to institute such a framework. Majority of states have drafted legislations to promote WUA involvement, but this has not been sufficient to drive improvement in participatory irrigation management at the ground level. This is reflected by the low theme median score of 4.15 points (out of 10), and poor performance of states and UTs scores on the remaining indicators under the theme (indicator 14 and 15) related to WUA participation in irrigation management.

**States can use these legislations strategically to enable effective functioning of WUAs.** Through adequate legal recognition, states can help WUAs define rights and duties of its members, its relationship with irrigation department, irrigation maintenance responsibilities, as well as potential income sources. Additionally, such legislations can help ensure accountability and support conflict resolutions in their functioning.[150] Outcomes from Participatory Irrigation Practices through WUAs in the Waghad region of Maharashtra have demonstrated notable success. Farmers have contributed up to INR 50 lakhs (cumulatively) to support development activities in the region. As a result, through this participatory approach, there has been increase in overall irrigation area by between ~1500 hectares between 2004 and 2014-15, improvement in adoption of drip irrigation amongst farmers (rising from 25% to 40% between the mentioned period), almost 100% recovery of water charges, 27% water saving, and rise in average farmer incomes from INR 60,000 to ~INR 2,90,000.[151]

---

[150] *Participatory Irrigation Management: Understanding the Role of Cooperative Culture* (International Commission on Irrigation and Drainage, 2013) page 5, https://www.un.org/waterforlifedecade/water_cooperation_2013/pdf/ICID_Paper_Avinahs_Tyagi.pdf.

[151] *Selected Best Practices in Water Management* (NITI Aayog, 2017), https://niti.gov.in/writereaddata/files/document_publication/BestPractices-in-Water-Management.pdf

**Case study**: Participatory Irrigation Management: WUA managing dam system operations in Uttar Pradesh[152]


*Overview*

Uttar Pradesh has demonstrated effective use of its Participatory Irrigation Management Act, and enabled the WUA to take charge of the Rohini Dam System in Bundelkhand region of the state. The state has undertaken capacity building activities for WUA in the region, through World Bank's support and handed over the charge of the system in 2018 post conducting necessary training activities.

This initiative, through timely execution of all planned activities, has also led to increased and equitable water availability in the region. Along with this, considerable amount of water saving is also being observed.

*Key actions*

1. The state conducted capacity building for the WUA in association with the World Bank, and handed over the responsibility of the system post the training activities.
2. Once the charge was handed over, the WUA members jointly developed a roaster to assign duties amongst themselves for ensuring timely execution of activities.
3. A Management Committee has also been formed as a part of the process for executive decision making.

*Impact*

The project activities have led to 1.13 TMC water being saved in the region. Tails of Chauka and Garauli Minor have received water after 27 years, due to the activities undertaken through this initiative. This has also led to equitable distribution of water through adoption of tail end irrigation principle. It has ensured that no disputes related to canal operation persist among farmers.

*Lessons for other states*

**Empower WUAs through capacity building**: States should invest in building capacity of its WUAs through adequate training and skill building workshops. This can enable WUA to take on larger responsibilities in irrigation management practices, as well as ensure successful execution of duties. Deeper involvement by WUAs can also help ensure regular maintenance and proper upkeep of systems, and increase longevity of irrigation assets.

---

152 As per case study shared by the state government with NITI Aayog

**Theme 5: Participatory irrigation practices—Demand side management**
***[10 points]***

| | | |
|---|---|---|
| Indicator 13: Has the State notified any law/ legal framework to facilitate Participatory Irrigation Management (PIM) through Water User Associations (WUAs)? | **Indicator 14: Percentage of irrigated command areas having WUAs involved in the O&M of irrigation facilities (minor distributaries and CAD&WM) as on the end of the given FY** | Indicator 15: Percentage of Irrigation Service Fee (ISF) retained by WUAs as compared to the fee collected by WUAs during the FY |

Indicator 14 measures the percentage of irrigated area that has WUAs involved in the O&M of irrigation facilities. The indicator essentially aims to measure the actualization of the principle/ framework for involving WUAs in participatory irrigation management. The contextual indicator provides a measure of the total irrigated command area in the state. Arunachal Pradesh and Delhi were unable to report data on the indicator and have been scored nil on the indicator in the Index calculation.

| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Madhya Pradesh | Meghalaya |
| **Bottom Performer** | Jharkhand | Nagaland, Sikkim, Uttarakhand, Tripura |
| **Median Score** | 58.14% | 0% |
| **1-year Median Change** | +1.27% | 0% |

**Figure 30: Indicator 14: Percentage of irrigated command areas having WUAs involved in the O&M of irrigation facilities (minor distributaries and CAD&WM) as on the end of the given FY**

*In % (FY 15-16, FY 16-17, FY 17-18)*

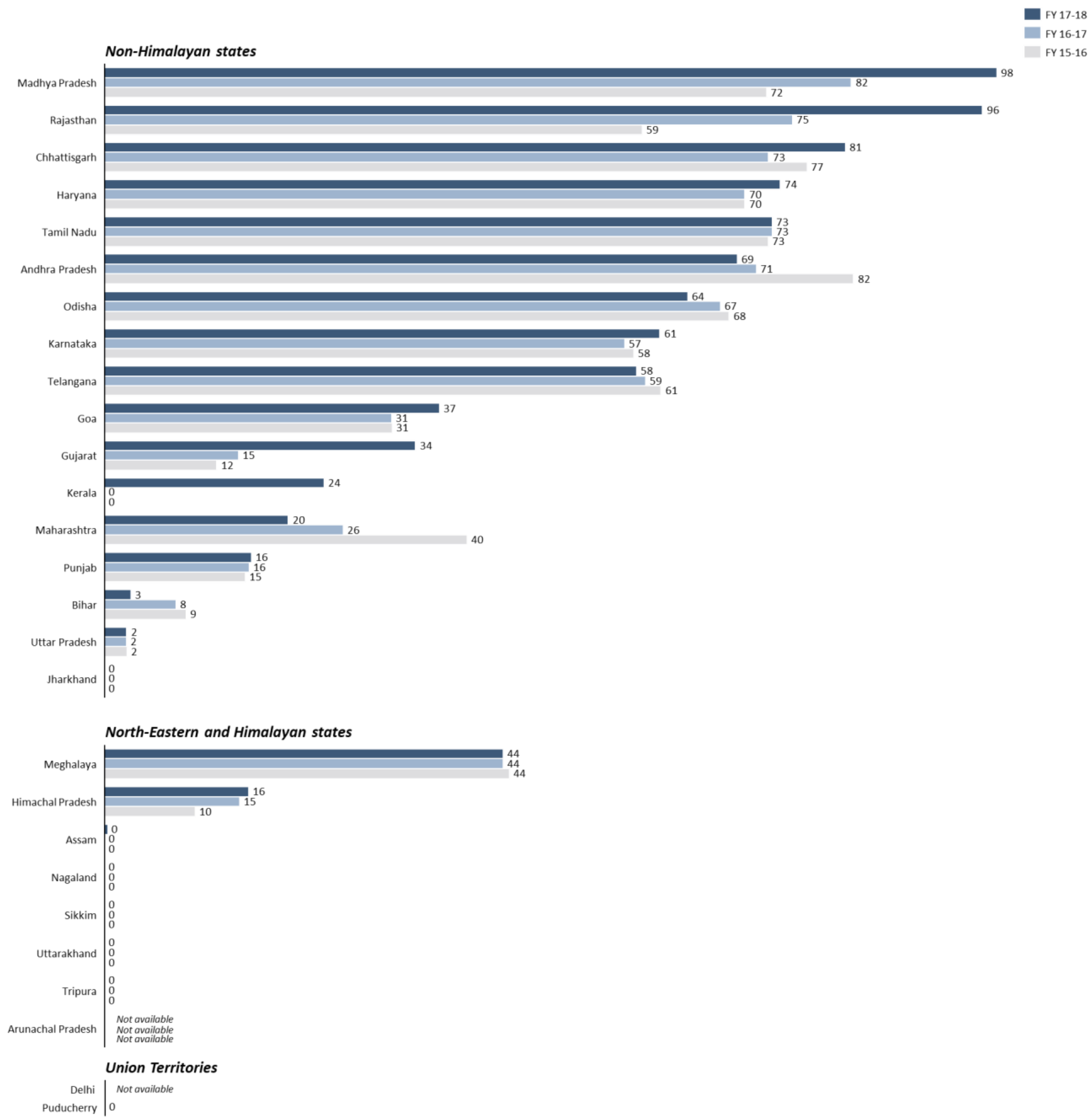
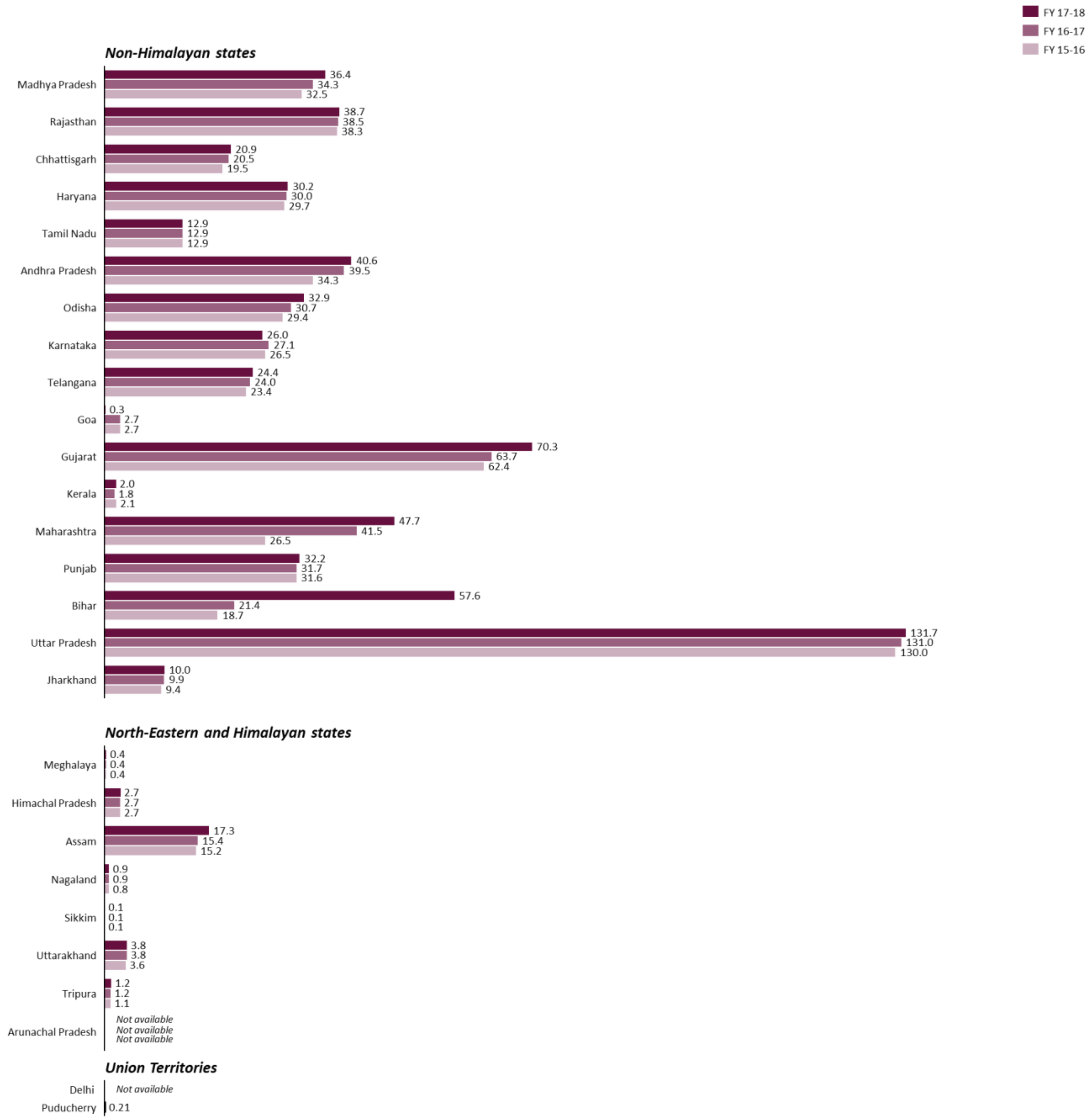


**Figure 31: Contextual indicator 14: Irrigated command area in the State as on the end of the given FY**

*In lakh hectares (FY 15-16, FY 16-17, FY 17-18)*




**States have not shown any significant progress on the existing low WUA participation in O&M and irrigation facilities at the overall level.** The overall median for reference year stands at 24%, rising by only 1 percentage point from the base year. At the category level, North-Eastern and Himalayan states have extremely low participation level, with no state reporting WUA participation levels greater than 50%. States with largest irrigation areas also demonstrate poor performance. Uttar Pradesh, Bihar, and Gujarat, which have irrigated command area over 50 lac hectares, have reported 2%, 3% and 34% WUA involvement rates, respectively, suggesting low participation by WUAs in O&M and irrigation facilities.

These low participation rates also suggest that despite 80% of states and UTs having instituted legislations for Participatory Irrigation Management through WUAs (Indicator 13), these laws have been unable to yield effective results on ground. Potential reasons include poor capacity of WUAs, lack of technical skills and know-how, and limited financial resources. Greater WUA participation can help states ensure better management and maintenance of its irrigation assets. Handing over control of O&M and minor repair activities to WUAs and rewarding them through financial incentives, can help states in effectively maintaining their irrigation facilities. While leveraging such mechanisms, states should also focus on building capacity of WUA members at inception to ensure adequate training and knowledge for successful execution of such responsibilities.

**The Water and Land Management Institute (WALMI), Aurangabad is a great example of institutionalizing a centre for capacity building activities.** WALMI, established in 1980, is a first of its kind institute that trains water managers on integrated approaches to water and land management in command areas of the irrigation projects. The institute enables capacity building through awareness initiatives as well as development of training modules for irrigation staff and farmers. Further, WALMI has developed advanced water management practices and prepared technical manuals to assist irrigation staff in their operations. WALMI has also set up a separate cell for PIM which assists irrigation department in setting up and running Water User Associations (WUAs). It trains irrigation officers and office bearers of WUAs in command area and guides irrigation departments on required organizational changes for implementation of PIM and development of command area. The institute has trained more than 44,000 farmers in last 10 years through off-campus and on-campus trainings, demonstrations on its own farm and organized study tours with more than 70,000 farmers visiting WALMI to learn about irrigation practices. As per an evaluation study by WALMI, this had led to an increase in the yield of major irrigated crops to the extent of 35 to 95%.[153]

---

153 "Achievements", *WALMI*, accessed May 6, 2019, http://www.walmi.org/Capabalities/Achivements.aspx.; *Evaluation Study on Command Area Development & Water Management Programme* (NITI Aayog, 2015), https://niti.gov.in/writereaddata/files/writereaddata/files/document_publication/report-CAD.pdf; Shivaswamy, M., *Report of The Study Committee on Functioning of CADA's and WALMI in the States of Andhra Pradesh*, *Maharashtra, Gujarat and Rajasthan* (Command Area Development Authorities, Government of Karnataka, 2014), http://waterresources.kar.nic.in/Study%20committee%20report%20of%20CADA.pdf.

Theme 5: Participatory irrigation practices—Demand side management
*[10 points]*

| Indicator 13: Has the State notified any law/ legal framework to facilitate Participatory Irrigation Management (PIM) through Water User Associations (WUAs)? | Indicator 14: Percentage of irrigated command areas having WUAs involved in the O&M of irrigation facilities (minor distributaries and CAD&WM) as on the end of the given FY | **Indicator 15: Percentage of Irrigation Service Fee (ISF) retained by WUAs as compared to the fee collected by WUAs during the FY** |
|---|---|---|

Indicator 15 measures the percentage of irrigation user fee that is retained by WUAs, while the contextual indicator specifies the total Irrigation Service Fees (ISF) collected from users in the state. Broadly, the collection of user fees is important to ensure the maintenance and improvement of irrigation systems, while also reducing excess use of water in practices such as flood irrigation. It is only if WUAs are allowed to retain a significant proportion of irrigation fees can they manage O&M effectively, and hence achieve true participatory irrigation management. Arunachal Pradesh and Delhi were unable to report data on the indicator and have been scored nil on the indicator in the Index calculation.

| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states**[154] |
| **Top Performer** | Rajasthan | *Not applicable* |
| **Bottom Performer** | Madhya Pradesh, Uttar Pradesh, Jharkhand, Odisha, Kerala, Punjab, Chhattisgarh, Telangana, Tamil Nadu, Haryana | *Not applicable* |
| **Median Score** | 0% | 0% |
| **1-year Median Change** | 0% | 0% |

[154] All North-Eastern and Himalayan states have reported '0%' on the indicator, and therefore the key highlights are not applicable for to the category for the indicator in this scenario

**Figure 32: Indicator 15: Percentage of Irrigation Service Fee (ISF) retained by WUAs as compared to the fee collected by WUAs during the FY**

*In % (FY 15-16, FY 16-17, FY 17-18)*

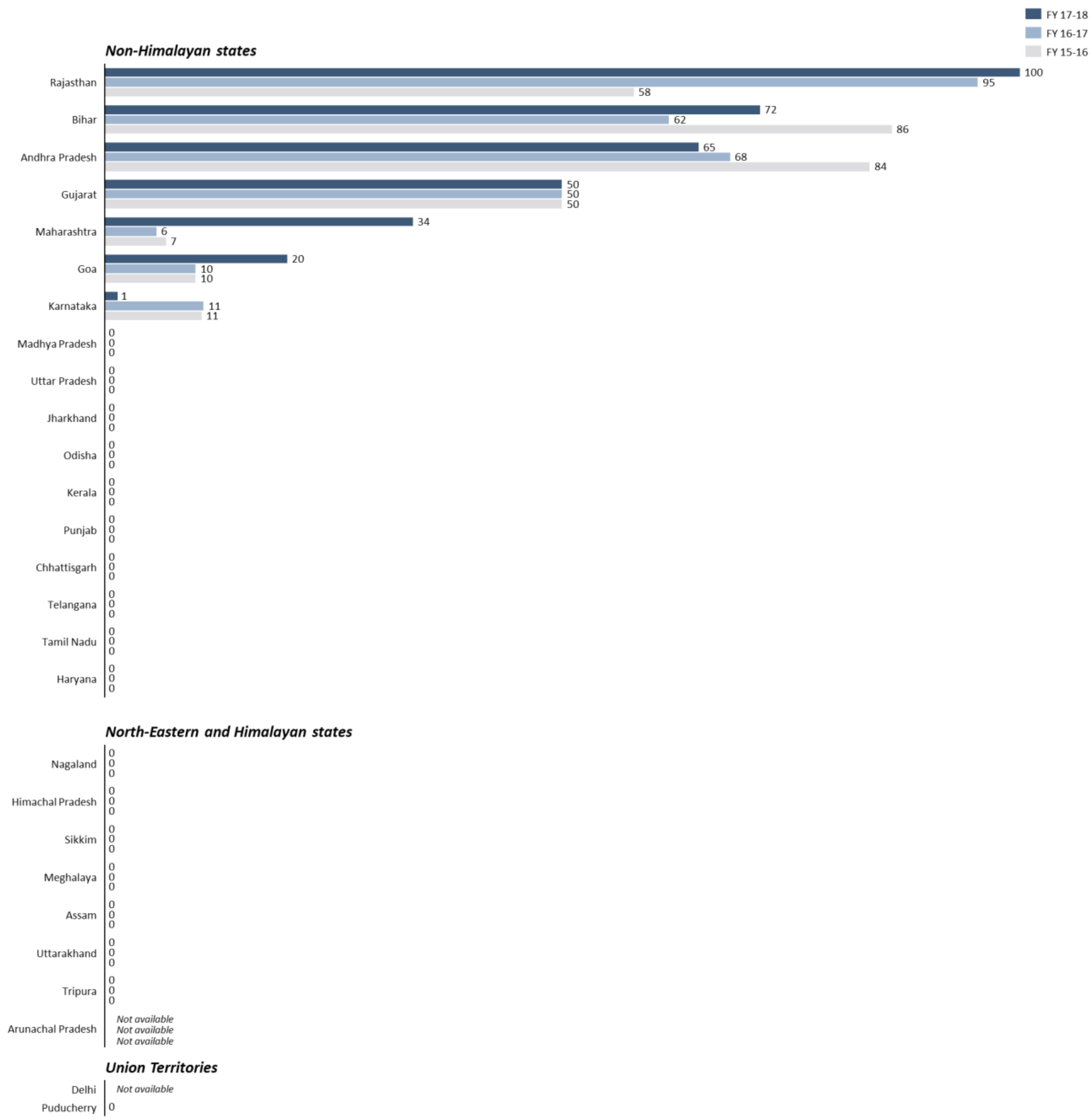
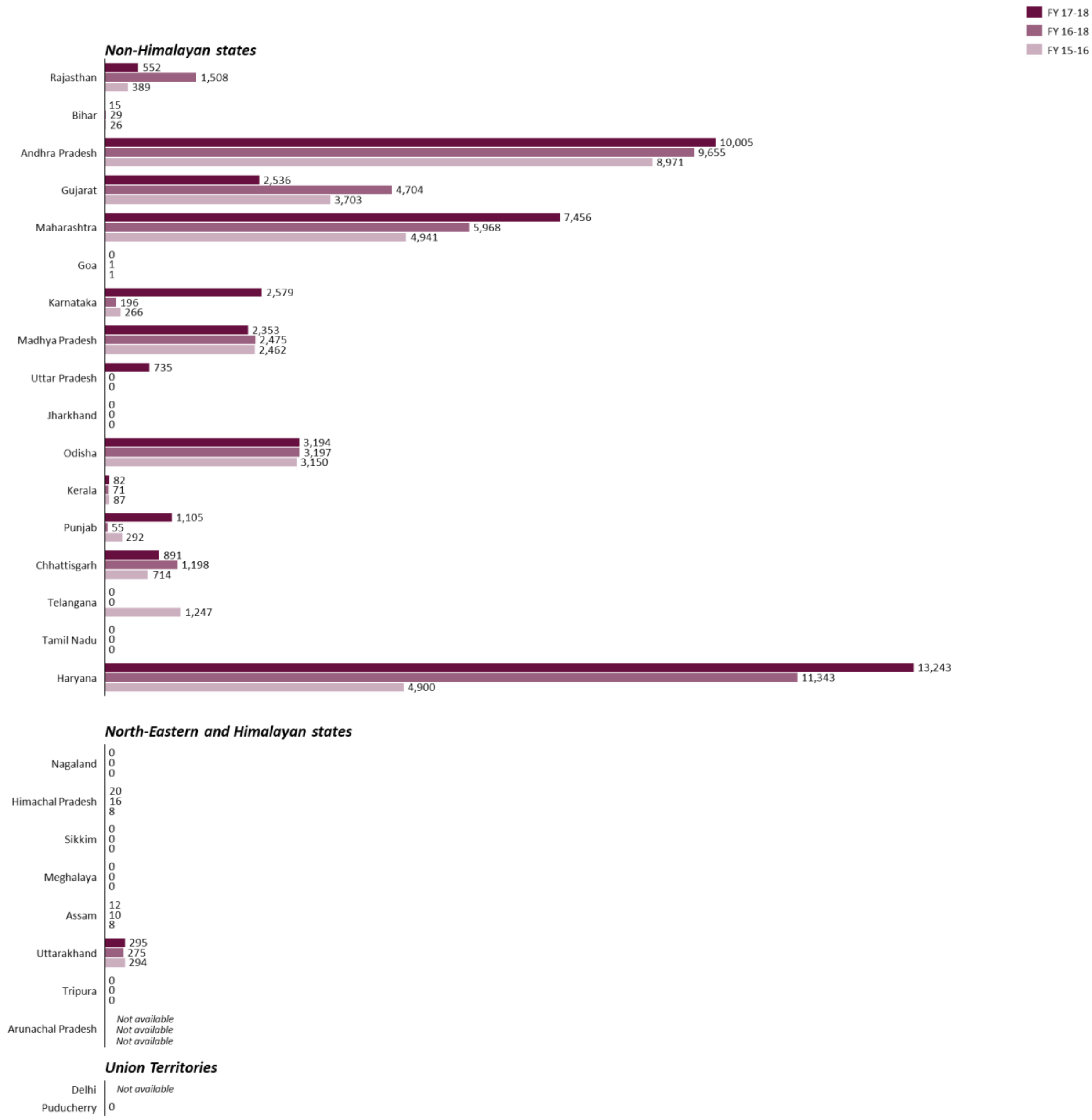


**Figure 33: Contextual indicator 15: Total Irrigation Service Fee (ISF) collected during the FY**

*In INR lakhs (FY 15-16, FY 16-17, FY 17-18)*




**Similar to the situation in previous years, WUAs in most states do not retain any portion of the collected irrigation service fees.** 18 out of the 25 reporting states and UTs do not share any percentage of the Irrigation Service Fee. This phenomenon is present across the board in case of North-Eastern and Himalayan states. In case of non-Himalayan states, only 4 states—Rajasthan, Bihar, Andhra Pradesh, and Gujarat—reported the retention share to be 50% or more. Additionally, the ISF collected by states itself remains low at the national level, with 8 states and UTs reporting no ISF being collected.

**Pricing water to reflect irrigation costs as well as water scarcity can be an effective model for water conservation in agriculture, as demonstrated by Israel's water pricing example.** The water prices in Israel are set by the National Water Authority, and account for delivery costs (infrastructure investment, O&M expenditure, treatment cost) as well as social costs (groundwater extraction fee tied to water availability) to signal the true price of water. Water tariffs are also differentiated based on the water type utilized (freshwater, brackish, and effluent) to reflect the scarcity of each of these resources. Through this water pricing approach, Israel has been able to reduce agricultural consumption of freshwater resources from 80% to ~30%, given the higher water charges for use of such resources. This has also allowed Israel to reduce pressure on its freshwater resources and sustainably meet the increasing water demand of its urban population, which has increased 10 times since 1948.[155]

[155] Yoav Kislev, *The Water Economy of Israel* (Taub Centre, 2011), http://taubcenter.org.il/wp-content/files_mf/thewatereconomyofisrael.pdf.

**Case study**: Rainwater harvesting: Andhra Pradesh's innovative dam construction approach[156]

*Overview*

Andhra Pradesh has introduced an innovative approach of constructing sub-surface dams using low-cost technologies in the YSR Kadapa district to tackle the groundwater replenishment issues owing to the complex geology of the district and erratic rainfall patterns. Sub-surface dams perform similar function of water storage but are suitable for areas with compact rock formation (as observed in case of YSR Kapada district), and regions subjected to variation in water levels of groundwater and local water bodies. Sub-surface dams use a cut off wall (part of the structure) to store water flow from groundwater channels, and create an alternate source of water for future use.

Construction of six sub-surface dams in the district has helped increase the region's water table, provide sustainable irrigation water, and stabilize crop production in the district. The project cost of INR 26 crores is expected to be recovered within one year of construction through increased crop production. The state also expects to reduce its expenditure on public health and power production as water availability increases in the district. This project also achieved national recognition and received the 'National Water Award 2018' under the 'Best Aspirational District – Revival of River category' from MoWR in 2019.

*Key actions*

1. As a pilot model, the state has constructed sub-surface dams in six locations on river Papagni, using the innovative 'Z' sheet piling technology.
2. The state has also installed piezometers to monitor water levels on project sites.

*Impact*

The project has led to revival of defunct borewells and recharge points, leading to increased groundwater availability and irrigation water for farmers in the region. This has also led to stabilization of the paddy crop during the Rabi and Kharif seasons. The increased water availability for paddy

[156] As per case study shared by the state government with NITI Aayog

production in ~7800 acres of land, enabled through the project, is also expected to support production worth INR 26 crores in the next year.

*Lessons for other states*

**Leverage innovation to meet local constraints**: States should look beyond traditional solutions, and identify new technologies and innovations that align with local conditions and constraints, and can enable improved water management.

## Theme 6: Sustainable on-farm water-use practices—Demand side management

**What does the theme comprise?** The sixth theme focuses on key water-related agricultural indicators across states, and accounts for 10 points (out of 100) in the Index. This is a particularly important theme, given the fact that agriculture accounts for 80% of all water demand in India.[157] The theme involves two broad segments. The *first* focuses on water efficiency in agriculture and includes indicators on cropping patterns as per agro-climatic zoning recommendations and the use of micro-irrigation systems. The *second* focuses on the problem of unchecked groundwater extraction, which is used for 62% of all irrigation.[158] Given the current legal framework that assigns almost unchecked groundwater rights to landowners, groundwater extraction in India can only be controlled through the proxy of the electricity required to operate groundwater pumps. Thus, the second segment focuses on the separation of agriculture power feeders and the pricing of electricity as the levers that states can use to control this extraction.

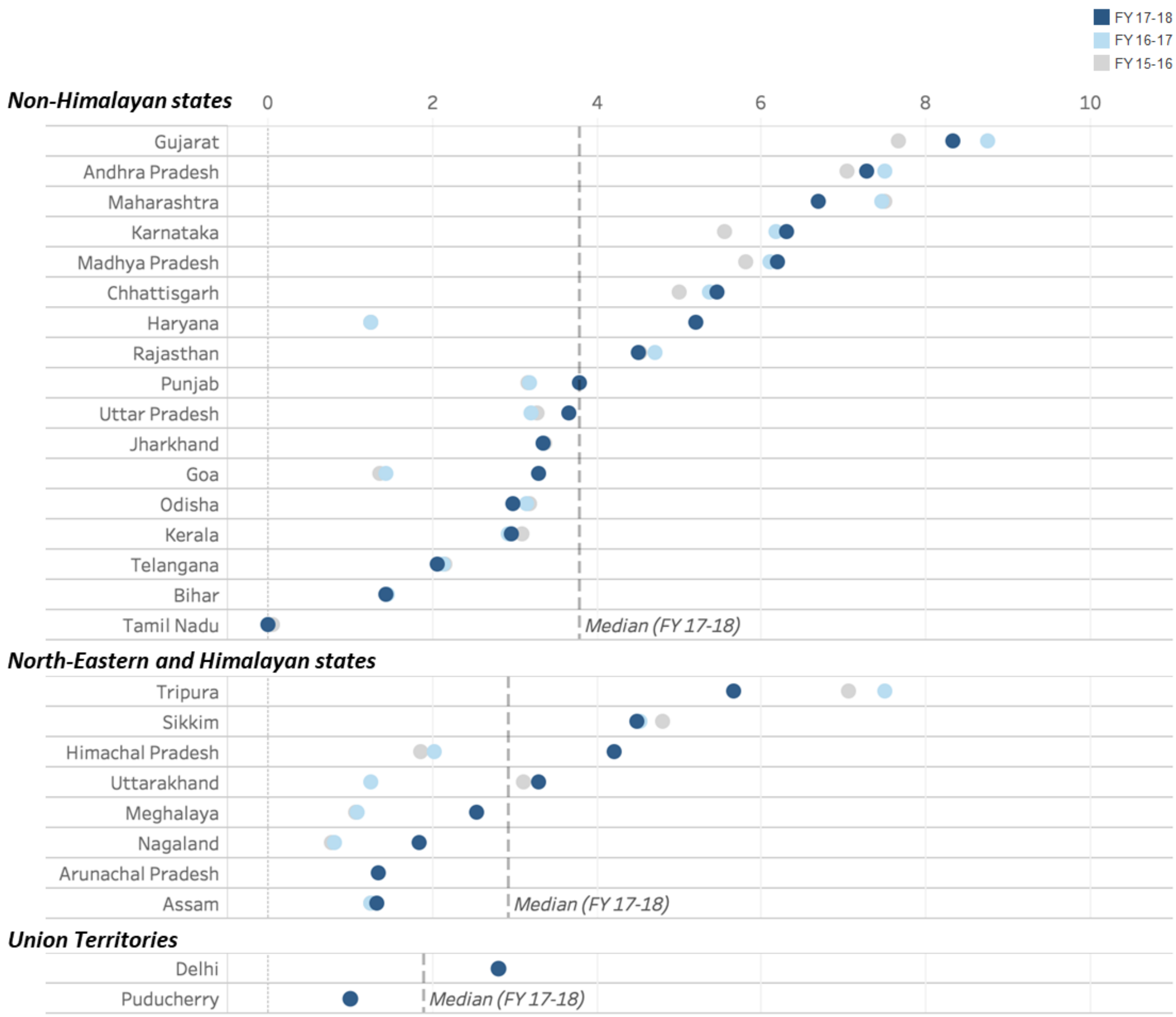
| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Gujarat | Tripura |
| **Bottom Performer** | Tamil Nadu | Assam, Arunachal Pradesh |
| **Median Score** | 3.79 | 2.92 |
| **1-year Median Change** | +0.60 | +1.67 |

[157] Ministry of Water Resources, *Withdrawal of Fresh Water* (Press Information Bureau, 2013), http://pib.nic.in/newsite/PrintRelease.aspx?relid=101519.

[158] *Dynamic Ground Water Resources of India* (Central Ground Water Board, 2017), page 1, http://cgwb.gov.in/Documents/Dynamic%20GWRE-2013.pdf.

**Figure 34: Performance of States and UTs on Theme 6 – Sustainable on-farm water use practices—Demand side management**

*Index scores, Range 0-10 (FY 15-16, FY 16-17, FY 17-18)*




**Overall, states and UTs have failed to show any significant improvement on the on-farm water use efficiency theme.** The theme median and mean currently stand at 3.35 and 3.78 points, which is less than 40% of the maximum score. Further, only 8 out of the 27 Index states and UTs have scores above 5 points (out of 10). At the category level as well, both non-Himalayan and North-Eastern and Himalayan states have averages below the 50% mark. UTs have the lowest averages, less than 2 points for both category median and mean. While most states have high proportion of land cultivated as per the agro-climatic zone-based cropping patterns, adoption of micro-irrigation techniques remains below 50% across the board. Additionally, majority states (16 out of 26 reporting states) are yet to segregate power feeders for agriculture and other consumers.

Improving on-farm water use efficiency is essential for India given that it is currently amongst the lowest in the world. Indian farmers utilize 3-5 times of water for producing the same amount of crops relative to Chinese, American and Israeli farmers.[159] Enhanced water use efficiency in agriculture can help reduce the volume of irrigation needs, and minimize the estimated demand-supply gap of 570 BCM expected to be faced by the sector in 2030.[160]

This theme comprises of four indicators. The following section provides commentary on the indicator-level performance for these indicators assessed under the theme.

**Theme 6: Sustainable on-farm water use practices—Demand side management**
***[10 points]***

| Indicator 16: Area cultivated by adopting standard cropping pattern as per agro-climatic zoning, to total area under cultivation as on the end of the given FY | Indicator 17: Has the State segregated agriculture power feeder? If yes—area in the state covered with segregated agriculture power feeder as compared to the total area under cultivation with power supply during the given FY | Indicator 18: Is electricity to tube wells/ water pumps charged in the State? If yes, then whether it is charged as per fixed charges or on the basis of metering? | Indicator 19: Area covered with micro-irrigation systems as compared to total irrigated area as on the end of the given FY |
|---|---|---|---|

Indicator 16 measures the proportion of area cultivated by farmers adopting cropping patterns as per agro-climatic zoning. Agro-climatic zoning involves the segregation of geographic areas based on factors such as climate, terrain, hydrological conditions, and other natural factors. By planting crops in line with the recommendations for each zone, farmers can ensure that inputs, such as water, are used efficiently. Tamil Nadu and Puducherry were unable to report data on the indicator and have been scored nil on the indicator in the Index calculation.

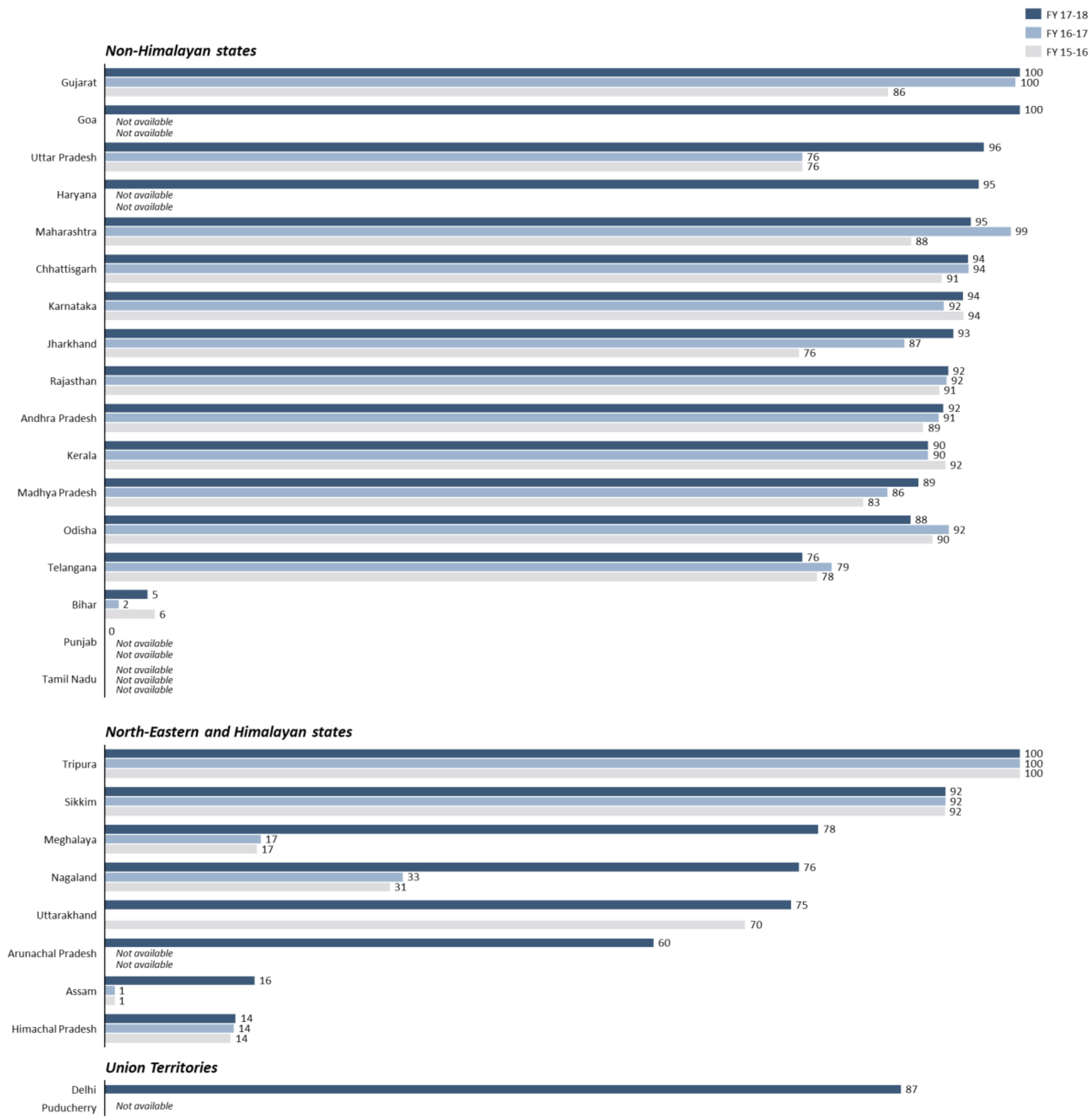
| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Gujarat, Goa | Tripura |
| **Bottom Performer** | Punjab | Himachal Pradesh |
| **Median Score** | 92.48% | 75.43% |
| **1-year Median Change** | +1.33% | +50.59% |

159 "AQUASTAT Database", *FAO*, accessed May 1, 2018, http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en.

160 "Investments worth $291 bn needed to plug water demand-supply gap in India: Study", *ASSOCHAM India*, accessed May 16, 2019, http://assocham.org/newsdetail.php?id=6357.

**Figure 35: Indicator 16: Area cultivated by adopting standard cropping pattern as per agro-climatic zoning, to total area under cultivation as on the end of the given FY**

*In % (FY 15-16, FY 16-17, FY 17-18)*




**As observed in previous years, most states have high proportion of cultivated area as per agro-climatic zoning, showcasing excellent performance at the national level.** ~75% of the reporting states and UTs (19 out of 25) cultivate more than three-fourth of agricultural area as per agro-climatic zoning. The overall median for reference year stands at 90%, a modest increase of 6 percentage points from the base year. Meghalaya and Nagaland have displayed significant improvement of 61 and 45 percentage points, respectively, during the last three years, majority of which was reported between FY 16-17 and FY 17-18. This has also contributed to the 51-percentage point boost in the category median for North-Eastern and Himalayan states between FY 16-17 and FY 17-18.

Punjab, Bihar, Himachal Pradesh and Assam have less than 20% of their cultivated area as per the agro-climatic zoning, and remain outliers on the indicator. This is particularly concerning in case of Punjab, given that groundwater resources are severely stressed in the region due to large-scale paddy production undertaken by farmers in the state.[161] Adhering to agro-climatic zoning recommendations can help states increase the cropping area as well as productivity, as observed in case of Pune district of Maharashtra. Pune has increased its sown area for fodder crops by 20% and improved productivity of multiple crops (in some cases up to 20%) by adhering to the agro-climatic zoning recommendations provided under the PMKSY scheme.[162]

**While most states perform well at the overall level, inconsistencies exist within states.** Production of ill-suited, water-intensive cash crops by farmers for short-term financial gains has been observed in water-scarce regions of some states. One stark example of such practice is production of 'Mentha' crop in Bundelkhand region of Uttar Pradesh, an area known to face droughts frequently. Mentha production requires 18-22 rounds of irrigation but is cultivated in the region despite the water shortages, for the high per-acre income received from the crop.[163] Such poor crop selection is likely to further worsen the water situation in the region. Sugarcane production in drought-prone regions of Maharashtra, even in face of water scarcities, is another well-documented example of such intra-state inconsistencies.[164] States should ensure that farmers give serious consideration to irrigation needs during crop selection and refrain from growing crops that are not suited to the present water situation of the region. Adjusting input subsidies and MSPs are potential levers for states to disincentivize farmers from growing crops that might not be suitable to the region.

---

[161] Punjab produces more than 10% of India's paddy and utilizes groundwater for meeting 80% of its paddy irrigation needs, as highlighted on page 20-21 in the 'Risk to Food Security' section

[162] *Best Practices: Pradhan Mantri Krishi Sinchayee Yojana (*Department of Administrative Reforms and Public Grievances), page 38, https://darpg.gov.in/sites/default/files/PMKSY%20-%20Best%20Practices_0.pdf.

[163] Manu Moudgil, "Crop Change for Better Yield?", *India Water Portal*, accessed May 4, 2019, https://www.indiawaterportal.org/articles/crop-change-better-yield.

[164] A. Narayanamoorthy, *Diagnosing Maharashtra's Water Crisis* (EPW, 2013), http://re.indiaenvironmentportal.org.in/files/file/Water_Crisis.pdf.

**Theme 6: Sustainable on-farm water use practices—Demand side management**
***[10 points]***

| Indicator 16: Area cultivated by adopting standard cropping pattern as per agro-climatic zoning, to total area under cultivation as on the end of the given FY | **Indicator 17: Has the State segregated agriculture power feeder? If yes—area in the state covered with segregated agriculture power feeder as compared to the total area under cultivation with power supply during the given FY** | Indicator 18: Is electricity to tube wells/ water pumps charged in the State? If yes, then whether it is charged as per fixed charges or on the basis of metering? | Indicator 19: Area covered with micro-irrigation systems as compared to total irrigated area as on the end of the given FY |
|---|---|---|---|

Indicator 17 is focused on measuring the segregation of electricity feeders for agriculture. It has two sub-parts: part (a) is a binary indicator specifying whether a state has begun the segregation process or not, while part (b) measures the percentage of cultivated area in the state that is covered by segregated power feeders. Agricultural feeder segregation means the separation of electricity infrastructure for agricultural and non-agricultural users (such as households) in rural areas. Feeder segregation has two key benefits. First, by allowing independent control of power supply to farms and to non-farm users (households, hospitals, etc.), it ensures that non-farm users are not affected by surges in agricultural demand. Since farm electricity can be switched-off and controlled without affecting non-farm users, households receive reliable, uninterrupted electricity throughout the day. Consequently, the second benefit is that farmers can be promised a window for reliable electric supply instead of erratic power throughout the day, allowing them to irrigate in a targeted and effective manner. Delhi was unable to report data on the indicators and has been scored nil on the indicators in the Index calculation.

| **Key highlights – Indicator 17 (b)[165]** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Andhra Pradesh, Gujarat, Punjab | Himachal Pradesh |
| **Bottom Performer** | Karnataka | Tripura |
| **Median Score** | 0% | 0% |
| **1-year Median Change** | 0% | 0% |

165 Key highlights table refers to indicator 17 (b), and includes only those states that reported having segregated agriculture power feeders in the state in indicator 17 (a); Karnataka is the bottom performer amongst the states that have segregated agriculture power feeders. Similar is the case for Tripura

**Figure 36: Indicator 17 (a): Has the state segregated agriculture power feeder?**

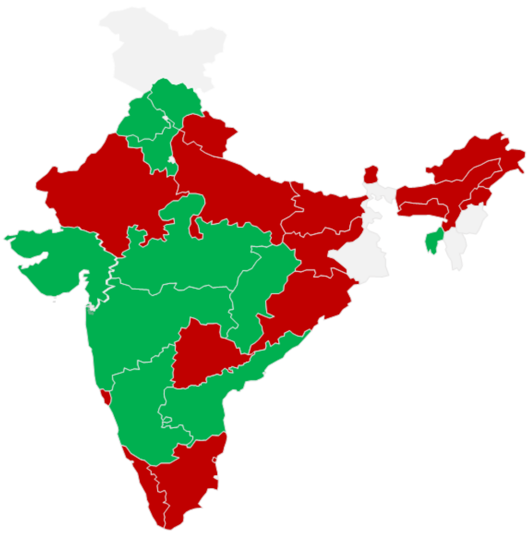
*(FY 15-17, FY 17-18)*

Yes

No

No data available

**FY 17-18**



**FY 15-17**

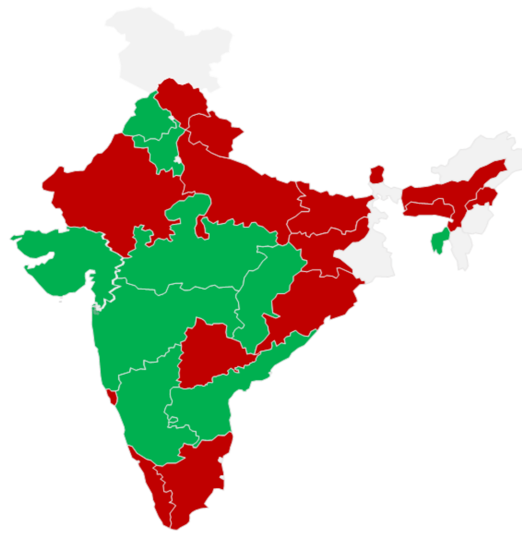
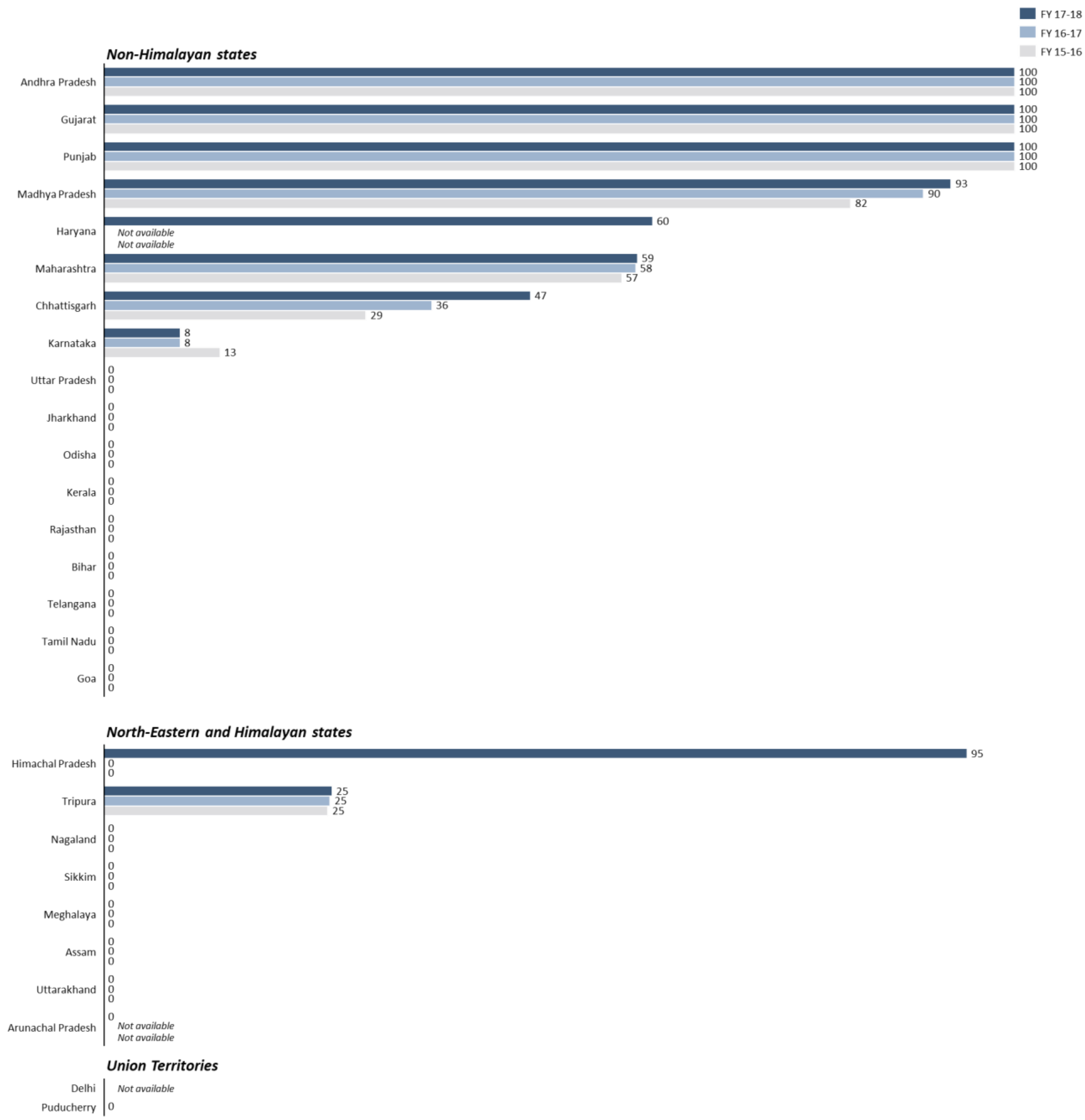


**Figure 37: Indicator 17 (b): Area in the state covered with segregated agriculture power feeder as compared to the total area under cultivation with power supply during the given FY**

*In % (FY 15-16, FY 16-17, FY 17-18)*




**The status of electricity feeder segregation remains similar to previous years, with only few states having segregated electricity feeders.** Only 10 out of 26 reporting states and UTs have segregated electricity feeders, compared to 9 states in FY 15-16.[166] The remaining 16 states and UTs collectively account for ~45% of India's food production,[167] and have not undertaken electricity feeder segregation

166 Himachal Pradesh is the additional state that has reported segregation of power feeders in FY 17-18

167 Analyses based on *Economic Survey 2017-18 Volume 2: Statistical Appendix* (Ministry of Finance, 2018), page A28 accessed at http://mofapp.nic.in:8080/economicsurvey/pdf/Annexures_Volume_2_Combine_25_jan_2018.pdf.

yet. This poor performance is also reflected in the category averages, with the median standing at 0% for both categories (due to majority states reporting 0% segregation), whereas the category mean stands at 33% and 15% for non-Himalayan and North-Eastern and Himalayan states, respectively. Amongst the 10 states that have segregated power feeders, 5 states—Andhra Pradesh, Gujarat, Punjab, Himachal Pradesh, and Madhya Pradesh—have achieved feeder segregation in 90% of the area or more, whereas Tripura and Karnataka have quite low coverage.

**Feeder segregation can help states tackle multiple electricity supply issues, including non-farm challenges.** Gujarat, which has 100% feeder segregation in the state as per reported data, has observed significant reduction in low voltage and power outages complaints by domestic customers post feeder segregation, in addition to higher satisfaction among agriculture consumers.[168] This highlights the wide range of benefits that can be achieved by states across sectors through feeder segregation. Segregation of electricity feeders, apart from ensuring improved power supply, can support states to limit continuous use of electrical equipment by farmers for extracting groundwater through controlled supply of electricity, which is a critical need of the hour for effective water management. The central government's *'Deen Dayal Upadhyaya Gram Jyoti Yojana'* entails feeder segregation as one of its key components and is a great impetus for states to begin segregation of agriculture power feeders.

**Theme 6: Sustainable on-farm water use practices—Demand side management**
***[10 points]***

Indicator 16: Area cultivated by adopting standard cropping pattern as per agro-climatic zoning, to total area under cultivation as on the end of the given FY

Indicator 17: Has the State segregated agriculture power feeder? If yes—area in the state covered with segregated agriculture power feeder as compared to the total area under cultivation with power supply during the given FY

**Indicator 18: Is electricity to tube wells/ water pumps charged in the State? If yes, then whether it is charged as per fixed charges or on the basis of metering?**

Indicator 19: Area covered with micro-irrigation systems as compared to total irrigated area as on the end of the given FY

Indicator 18 focuses on whether states are charging farmers for the electricity provided to tube/ bore wells that are used to extract groundwater for irrigation. It consists of three binary sub-parts: the *first* indicates whether a state is charging for the electricity at all, while the *second* and *third* parts check whether the charges are fixed (such as a fixed amount per month regardless of units used) or metered (implying a charge per unit used), respectively. This is a critical indicator as groundwater currently accounts for 62% of all irrigation water.[169] In fact, the unchecked extraction of groundwater by farmers is driving the country's groundwater crisis, with 61% of wells declining in levels due to extraction rates

---

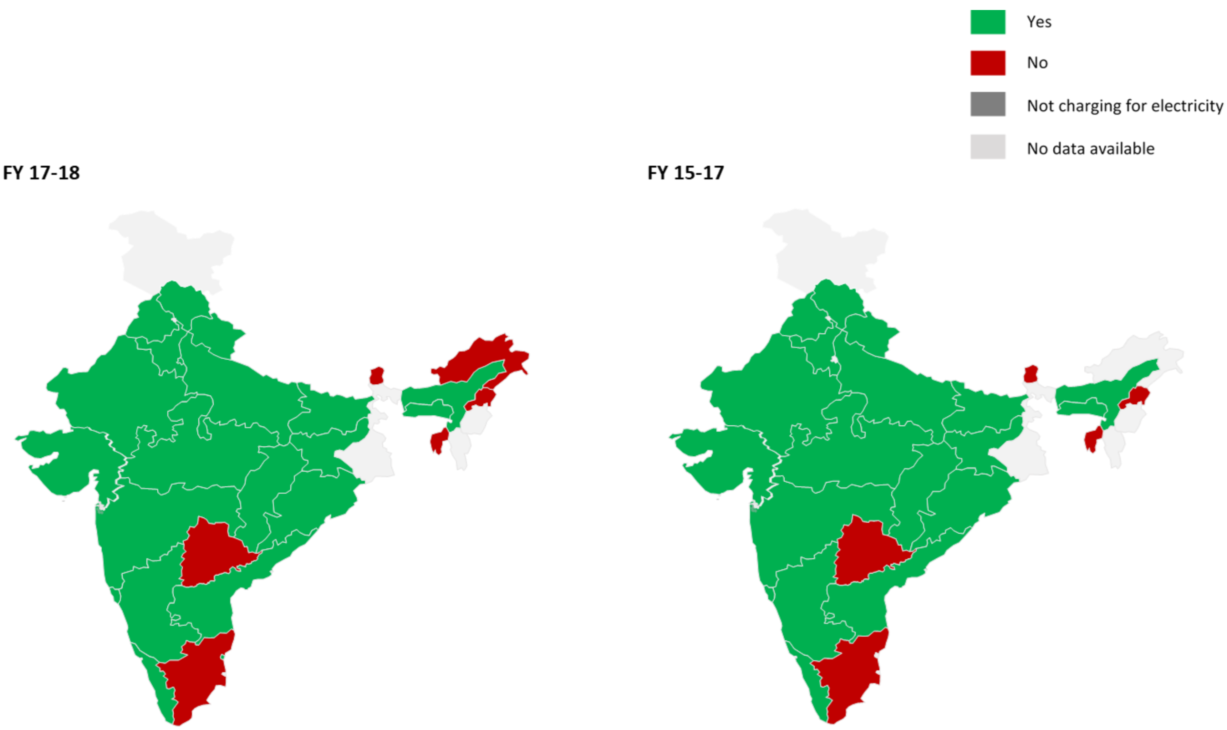
168 Ashish Khanna et al. *Lighting Rural India* (World Bank, 2014), http://documents.worldbank.org/curated/en/220801468042879882/pdf/814850REVISED00Box0379832B00PUBLIC0.pdf.

169 *Dynamic Ground Water Resources of India* (Central Ground Water Board, 2017), page 1, http://cgwb.gov.in/Documents/Dynamic%20GWRE-2013.pdf.

exceeding recharge rates.[170] This unchecked extraction is largely driven by two policies. *First*, the current legal framework for groundwater allows farmers to extract water unchecked from underneath their land. *Second*, low electricity prices for farmers incentivize overuse, i.e., running pumps for longer hours than actually required. Given the worsening groundwater crisis, states are slowly moving towards charging farmers for electricity.

**Figure 38: Indicator 18 (a): Is electricity to tube wells/ water pumps charged in the State?**

*(FY 15-17, FY 17-18)*




170 *Groundwater Scenario in India Pre Monsoon* (Central Ground Water Board, 2017), page 8, http://cgwb.gov.in/Ground-Water/GW%20Monitoring%20Report_PREMONSOON%202017.pdf.

**Figure 39: Indicator 18 (b): If yes, then whether it is charged as per fixed charges?**

*(FY 15-17, FY 17-18)*

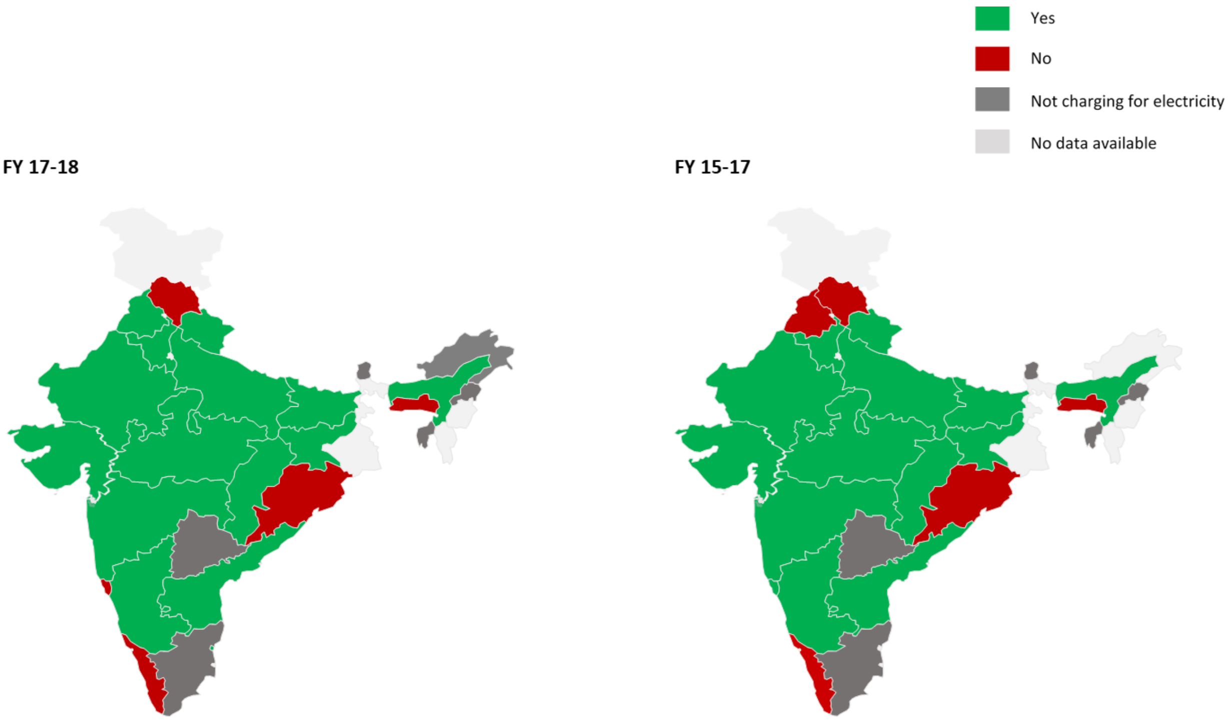
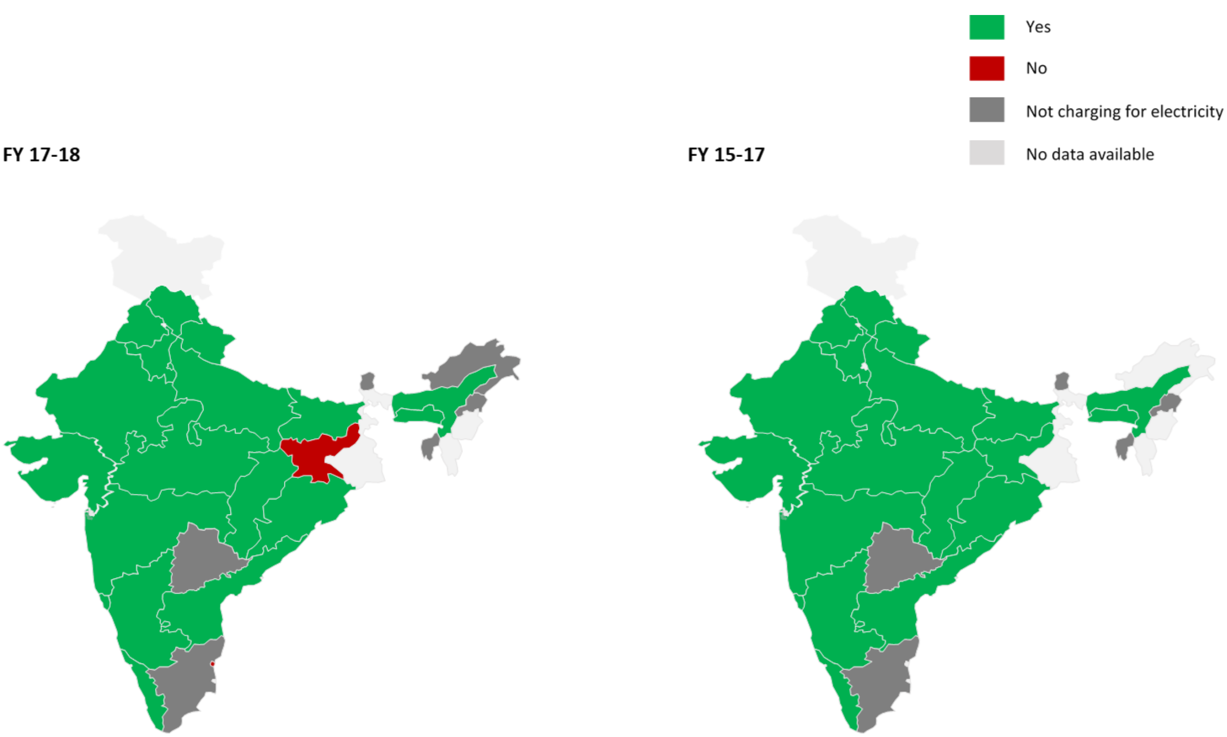



**Figure 40: Indicator 18 (c): If yes, then whether it is charged on the basis of metering?**

*(FY 15-17, FY 17-18)*



**Similar to last year, ~80% states and UTs charge for electricity to tube wells and water pumps, and majority states use a combination of fixed charges and metered pricing.** 21 out of 27 reporting states and UTs charge for electricity to tube wells and water pumps. Amongst these 21, 13 states reported using both fixed charges and metered pricing. This suggests that state might be using different methods in different regions. Out of the remaining 8 states and UTs, Jharkhand and Puducherry have fixed charges for electricity supplied to tube wells and water pumps, whereas Odisha, Kerala, Goa, Himachal Pradesh, and Meghalaya reported having metered pricing. Delhi charges on a metering basis, and did not report data on fixed charge pricing.

Going forward, the states should focus on increasing the number of consumers that are charged on a metering basis. This is likely to curtail electricity use (and water extraction), as farmers are charged higher amounts as their consumption rises, a critical aspect missing in the fixed pricing mechanism.

**Electricity pricing and subsidies continue to remain a challenge on ground.** Highly subsidized electricity has led to negative externalities such as over-extraction of groundwater, increased cultivation of water-intensive crops like sugarcane and cotton, and inefficient use of water and electricity across states. States are expected to take time to implement large-scale changes in their energy infrastructure and pricing given political and administrative hurdles of doing so for the agricultural sector. States can acknowledge this constraint and scale-up the deployment of on-ground technologies that mitigate (to some extent) the perverse effects of free electricity in this interim period. Adoption of micro-irrigation techniques such as sprinklers and drip irrigation at farm level can significantly reduce energy demand and increase water-use efficiency at the same time.[171] States should double-down on programme and initiatives that promote micro-irrigation techniques to enable adoption of such technologies and break this energy-water nexus in the agriculture sector.

[171] D Suresh Kumar, K Palanisami, *Managing the Water–Energy Nexus in Agriculture* (EPW, 2019), https://www.epw.in/journal/2019/14/special-articles/managing-water%E2%80%93energy-nexus-agriculture.html.

**Theme 6: Sustainable on-farm water use practices—Demand side management**
***[10 points]***

Indicator 16: Area cultivated by adopting standard cropping pattern as per agro-climatic zoning, to total area under cultivation as on the end of the given FY

Indicator 17: Has the State segregated agriculture power feeder? If yes—area in the state covered with segregated agriculture power feeder as compared to the total area under cultivation with power supply during the given FY

Indicator 18: Is electricity to tube wells/ water pumps charged in the State? If yes, then whether it is charged as per fixed charges or on the basis of metering?

**Indicator 19: Area covered with micro-irrigation systems as compared to total irrigated area as on the end of the given FY**

Indicator 19 measures the proportion of total irrigated area in the state that is covered by micro-irrigation systems, while the contextual indicator specifies the total irrigated area in the state. Micro-irrigation systems apply water to crops in a targeted manner, and not only use less water than traditional flood irrigation techniques, but also improve crop productivity, thereby significantly increasing water-efficiency in agriculture. The government has been pushing micro-irrigation for several years now, and recently as part of the 'More crop per drop' component of the PMKSY scheme, under which it provides subsidized micro-irrigation equipment to farmers from selected vendors. Tamil Nadu and Delhi were unable to report data on the indicator and have been scored nil on the indicator in the Index calculation.

| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Karnataka | Tripura |
| **Bottom Performer** | Uttar Pradesh | Arunachal Pradesh |
| **Median Score** | 5.18% | 1.56% |
| **1-year Median Change** | +2.38% | -3.64% |

**Figure 41: Indicator 19: Area covered with micro-irrigation systems as compared to total irrigated area as on the end of the given FY**

*In % (FY 15-16, FY 16-17, FY 17-18)*

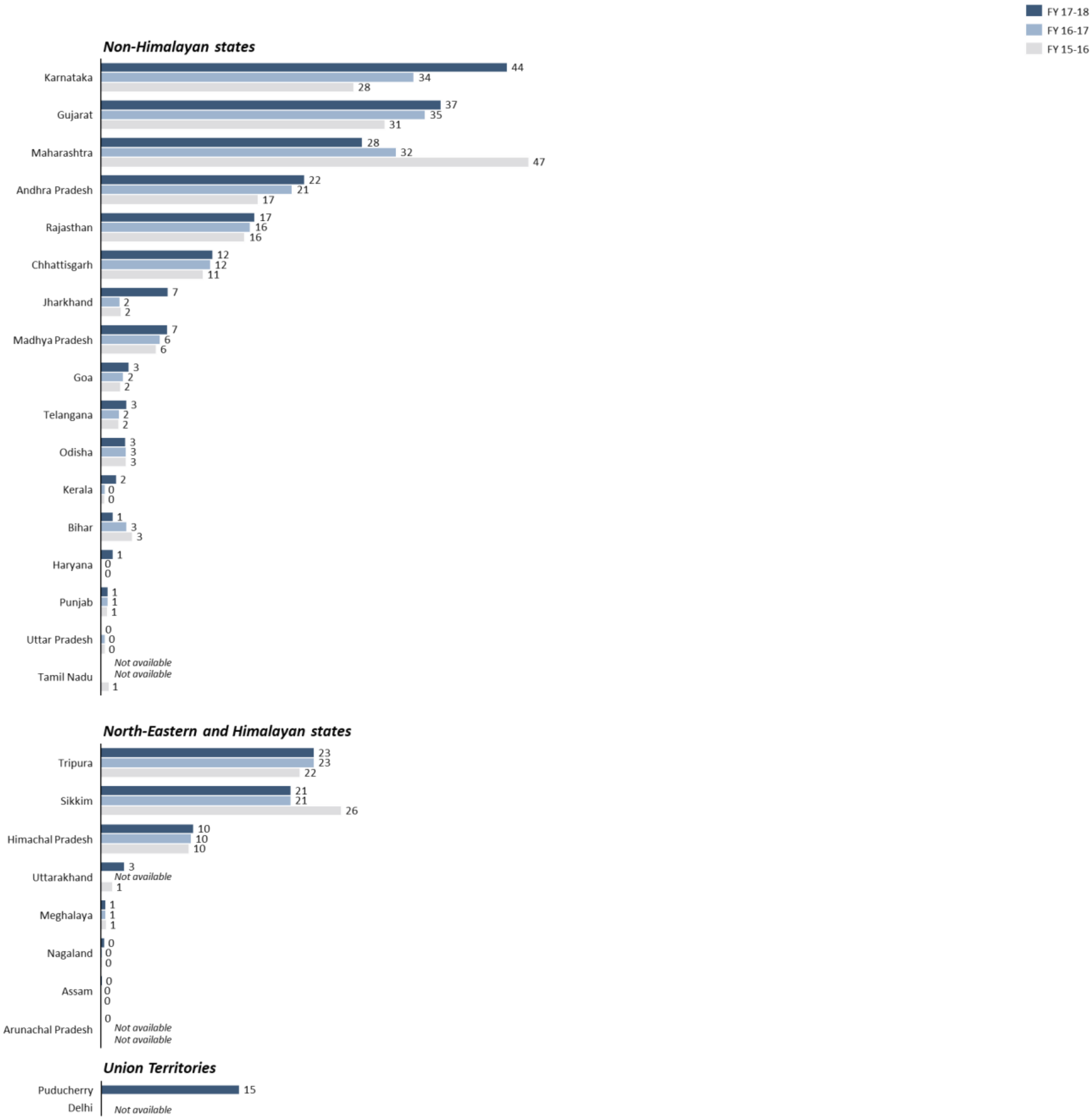
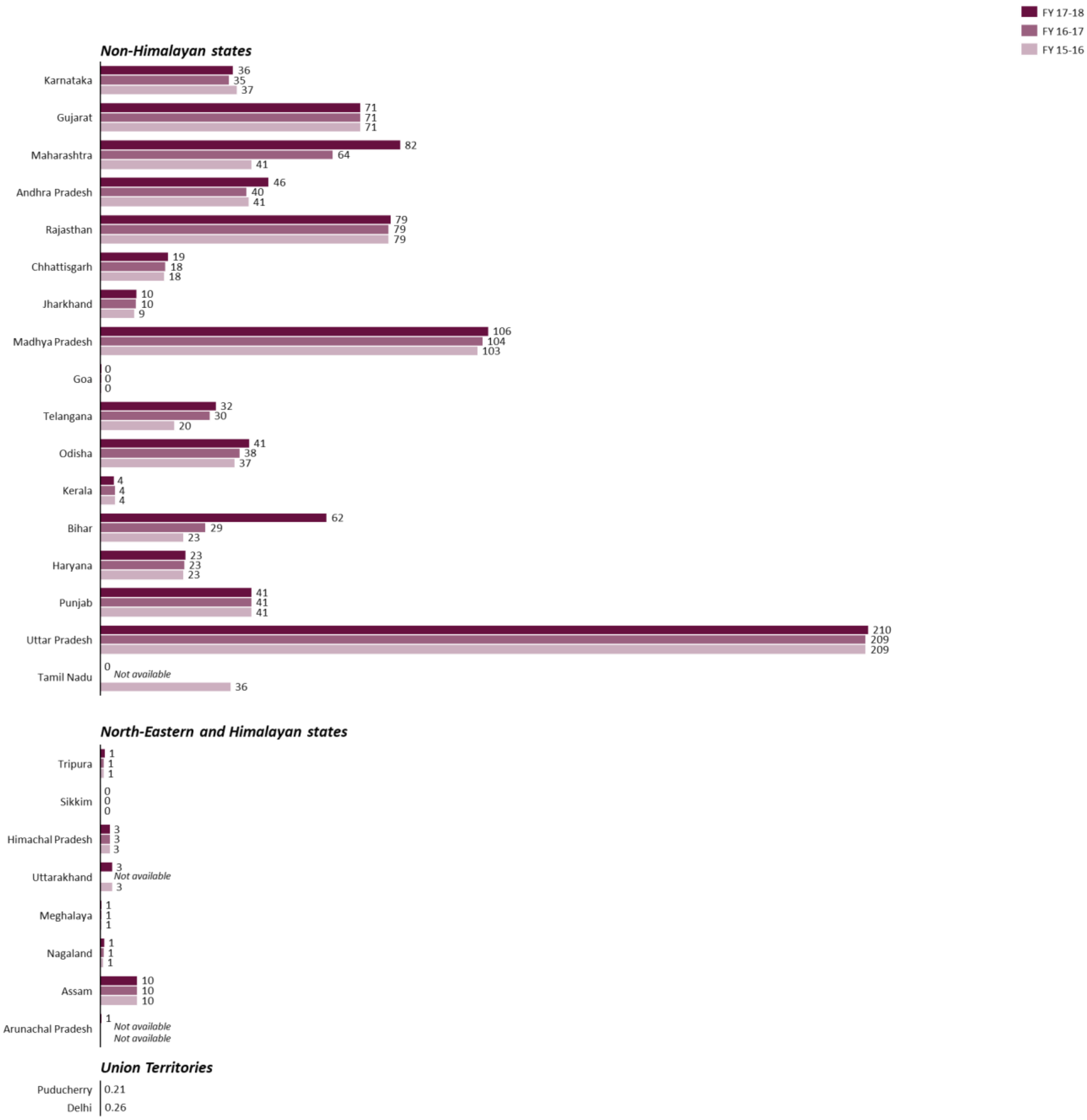


**Figure 42: Contextual Indicator 19: Total irrigated area in the state as on the end of the given FY**

*In lakh hectares (FY 15-16, FY 16-17, FY 17-18)*




**Micro-irrigation penetration remains low across states, with only 2 states having adoption of such techniques in more than one-third of irrigated area in the state.** Out of the 25 reporting states and UTs, only Karnataka and Gujarat reported more than 33% area being covered under micro-irrigation. The overall median and mean stand at staggering 3% and 10%, respectively for FY 17-18,[172] with no significant improvement amongst states in the last three years. Worryingly, even northern states, such

[172] The observed median is lower than the mean due to most states reporting coverage less than 5%

as Punjab, Haryana, and Uttar Pradesh, have negligible adoption of micro-irrigation technologies despite being large agriculture-focused states.

**Gujarat's Green Revolution Company, established by GoI and Government of Gujarat for promoting use of micro-irrigation systems, has shown great success in this domain**. Through its awareness programme and farmer education initiatives on scientific water management techniques, it has enabled adoption of micro-irrigation techniques by 6.4 lakh farmers covering more than 10 lakh hectares of land.[173]

Strong maintenance and after-sales service are the cornerstone of sustained adoption and use of new farm technologies. Therefore, in addition to promoting adoption of micro-irrigation equipment, states should also focus on encouraging equipment suppliers to provide continual support services for maintenance activities and long-term uptake. States can explore synergies between their water department and the state entrepreneurship/skills departments to create skilling and training programmes for technicians at the village-level.

173 *Selected Best Practices in Water Management* (NITI Aayog, 2017), page 16, https://www.google.com/search?q=niti+aayog+selected+best+practices&oq=niti+aay&aqs=chrome.0.69i59j69i60j0l3j69i60.1814j0j4&sourceid=chrome&ie=UTF-8.

## Theme 7: Rural drinking water

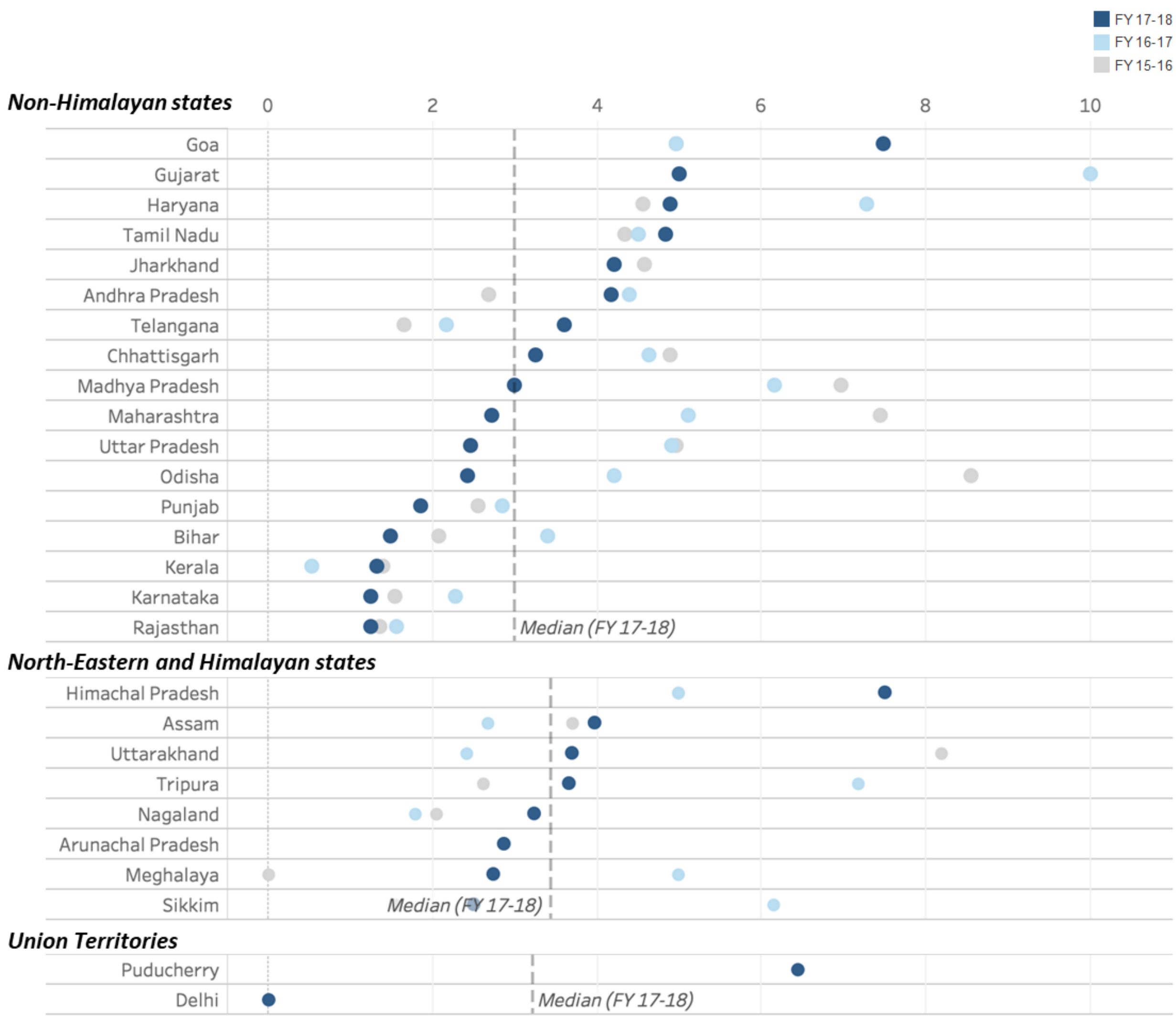
**What does the theme comprise?** This theme focuses on the service delivery of water to rural areas, and accounts for 10 points (out of 100) in the Index. This involves indicators measuring the proportion of rural habitations provided with drinking water supply in the state, villages with 24*7 piped water supply and individual household meters, as well as reduction in water quality issues in these supply systems. About 70% of India's population, approximately 800 million people, lives in rural areas, making this one of the largest service delivery challenges in the world in terms of scale. While access has improved markedly in recent years, with almost 85% of rural households having access to 'basic water',[174] the provision of safe water remains a large challenge. Currently, only half of the rural population has access to safely-managed drinking water[175] - far behind even our neighbors such as China and Bangladesh - resulting in one of the highest disease burdens due to water-borne diseases in the developing world, and about two lakh annual deaths from inadequate water, sanitation, and hygiene.[176]

| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Goa | Himachal Pradesh |
| **Bottom Performer** | Rajasthan | Sikkim |
| **Median Score** | 2.99 | 3.45 |
| **1-year Median Change** | -1.40 | -1.55 |

[174] "People Using At Least Basic Drinking Water Services, Rural (% of Rural Population) | Data", *World Bank*, accessed May 4, 2019, https://data.worldbank.org/indicator/SH.H2O.BASW.RU.ZS?locations=IN&view=chart.
[175] "JMP", *WHO UNICEF*, accessed May 5, 2019, https://washdata.org/data/household#!/table?geo0=country&geo1=IND.
[176] "GHO: By Category: Burden of Disease - Burden of Disease from Inadequate Water in Low- and Middle-Income Countries", *WHO*, accessed May 16, 2018, http://apps.who.int/gho/data/view.main.INADEQUATEWATERv?lang=en.

**Figure 43: Performance of States and UTs on Theme 7 – Rural drinking water**

*Index scores, Range 0-10 (FY 15-16, FY 16-17, FY 17-18)*




**Overall performance on the rural drinking water theme declined in FY 17-18 from an existing low status, largely due to poor performance on the new service delivery indicators introduced under the theme.** The theme median and mean declined to 3.24 and 3.40 in FY 17-18, from 4.45 and 4.31 in FY 16-17, and 4.03 and 3.86 in FY 15-16. Goa, Himachal Pradesh, Puducherry, and Gujarat are the only four states and UTs that have scores above or equal to the 50% mark. Large gaps remain in providing rural population with arsenic and fluoride contamination-free water for majority states and UTs, except for the 10 states that reported complete reduction in proportion of rural habitants affected by water quality problem in the previous years. Coverage of 24*7 piped water supply and individual household metering is extremely low, reflected by nil figures reported by most states. This contributed significantly in bringing down the overall performance score of states and UTs on this theme.

While states aim to develop infrastructure for ensuring the delivery of safe water in these regions, communities can also play a critical role in maintaining the water quality. Community level organizations such as panchayats can play a bigger role in planning, implementation and execution of state-led decentralized water programmes, and contribute through their deep knowledge of local needs and constraints. Community members can also help in maintaining water quality by ensuring hygienic conditions near local water bodies, and avoiding water contamination during collection and storage.[177]

Theme 7 comprises of two indicators. The following section provides commentary on the indicator-level performance for these indicators assessed under the theme.

**Theme 7: Rural drinking water**
***[10 points]***

| **Indicator 20: Proportion of total rural habitations fully covered with drinking water supply as on the end of the given FY \| Number of villages provided with 24*7 piped water supply as on end of given FY \| Number of villages having individual household water meters as on end of given FY** | **Indicator 21: Percentage reduction in rural habitations affected by Water Quality problems during the FY** |
|---|---|

Indicator 20 measures drinking water access as well as water infrastructure coverage at household level in rural areas. The indicator includes three sub-indicators which measure the proportion of rural habitations fully covered with drinking water supply,[178] villages receiving 24*7 piped water supply, and villages with individual household water meters. The latter two components are new inclusions in the Index, and have been included to assess the continuity of water supplied to rural households, and coverage of water meters for pricing. Indicator 20 (d) and 20 (f) have been normalized for all states & UTs and converted into percentages by dividing the state-provided absolute numbers by the total number of inhabited villages as per the 2011 census data.

Delhi was unable to provide data on indicator 20 (b) and 20 (d), Sikkim on 20 (d), and Uttarakhand and Arunachal Pradesh on 20 (d) and 20 (f). All these states have been scored nil on the respective indicators in the Index calculation

[177] *Drinking water quality in rural India: Issues and approaches* (Water Aid, 2008), https://www.indiawaterportal.org/sites/indiawaterportal.org/files/DrinkingWaterQuality_0.pdf.

[178] Full coverage means that a person in a rural area will have access to 70 litres per capita per day (lpcd) within their household premises or at a horizontal or vertical distance of not more than 50 meters from their household without barriers of social or financial discrimination. Individual states can adopt higher quantity norms, such as 100 lpcd.

| **Key highlights – Indicator 20 (b)** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Gujarat, Madhya Pradesh | Himachal Pradesh |
| **Bottom Performer** | Kerala | Sikkim |
| **Median Score** | 93.11% | 52.56% |
| **1-year Median Change** | +5.38% | +0.67% |

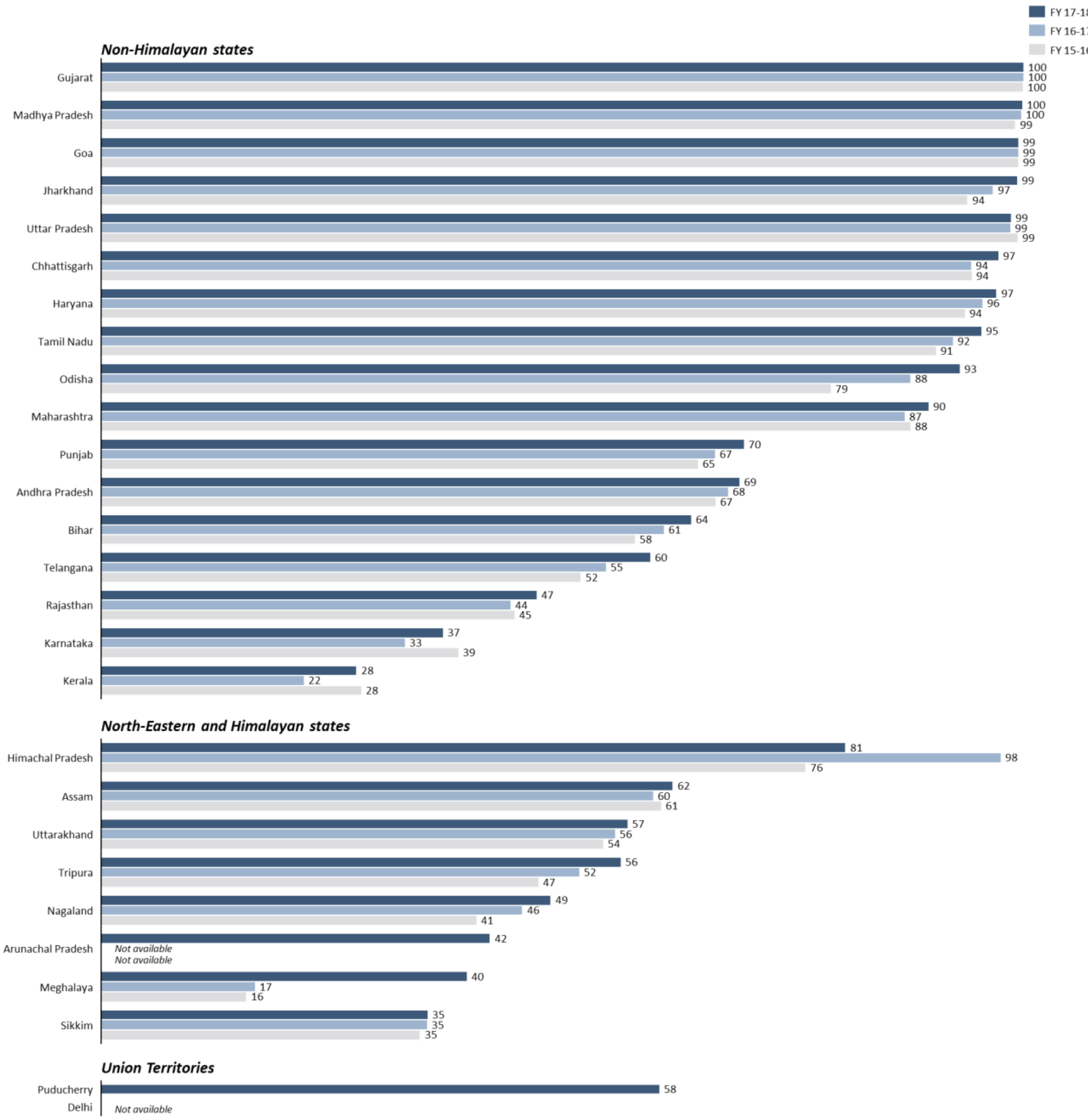
| **Key highlights - Indicator 20 (d)** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Andhra Pradesh | Himachal Pradesh |
| **Bottom Performer** | Uttar Pradesh, Jharkhand, Odisha, Kerala, Gujarat, Chhattisgarh, Rajasthan, Bihar, Telangana, Maharashtra, Karnataka, Tamil Nadu, Goa, Haryana | Nagaland, Meghalaya, Assam, Tripura |
| **Median Score** | 0% | 0% |
| **1-year Median Change** | *Not applicable* | *Not applicable* |

| **Key highlights – Indicator 20 (f)** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states**[179] |
| **Top Performer** | Goa | *Not applicable* |
| **Bottom Performer** | Madhya Pradesh, Uttar Pradesh, Jharkhand, Odisha, Kerala, Gujarat, Chhattisgarh, Rajasthan, Bihar, Telangana, Maharashtra, Karnataka, Tamil Nadu, Haryana | *Not applicable* |
| **Median Score** | 0% | 0% |
| **1-year Median Change** | *Not applicable* | *Not applicable* |

[179] All North-Eastern and Himalayan states have reported '0%' on the indicator, and therefore, the key highlights are not applicable for to the category for the indicator in this scenario

**Figure 44: Indicator 20 (b): Proportion of total rural habitations fully covered with drinking water supply as on the end of the given FY**

*In % (FY 15-16, FY 16-17, FY 17-18)*




**On average, 70% rural habitations are fully covered with drinking water supply, and non-Himalayan states display strong performance on the indicator.** The overall indicator median stands at 67% for FY 17-18, compared to 66% and 67% in FY 15-16 and FY 16-17, respectively, and 9 out of 17 non-Himalayan states have more than 90% rural habitation fully covered with drinking water. Most North-Eastern and Himalayan states lag on the indicator. The category median for non-Himalayan states stands at 93% for FY17-18, compared to 53% for North-Eastern and Himalayan states. Himachal Pradesh is the only Himalayan state that has over 80% coverage on the indicator, but this is lower compared to state's reported figure of 98% in FY 16-17.

**Figure 45: Indicator 20 (d): Number of villages provided with 24*7 piped water supply as on the end of given FY**

*In % (FY 17-18)*

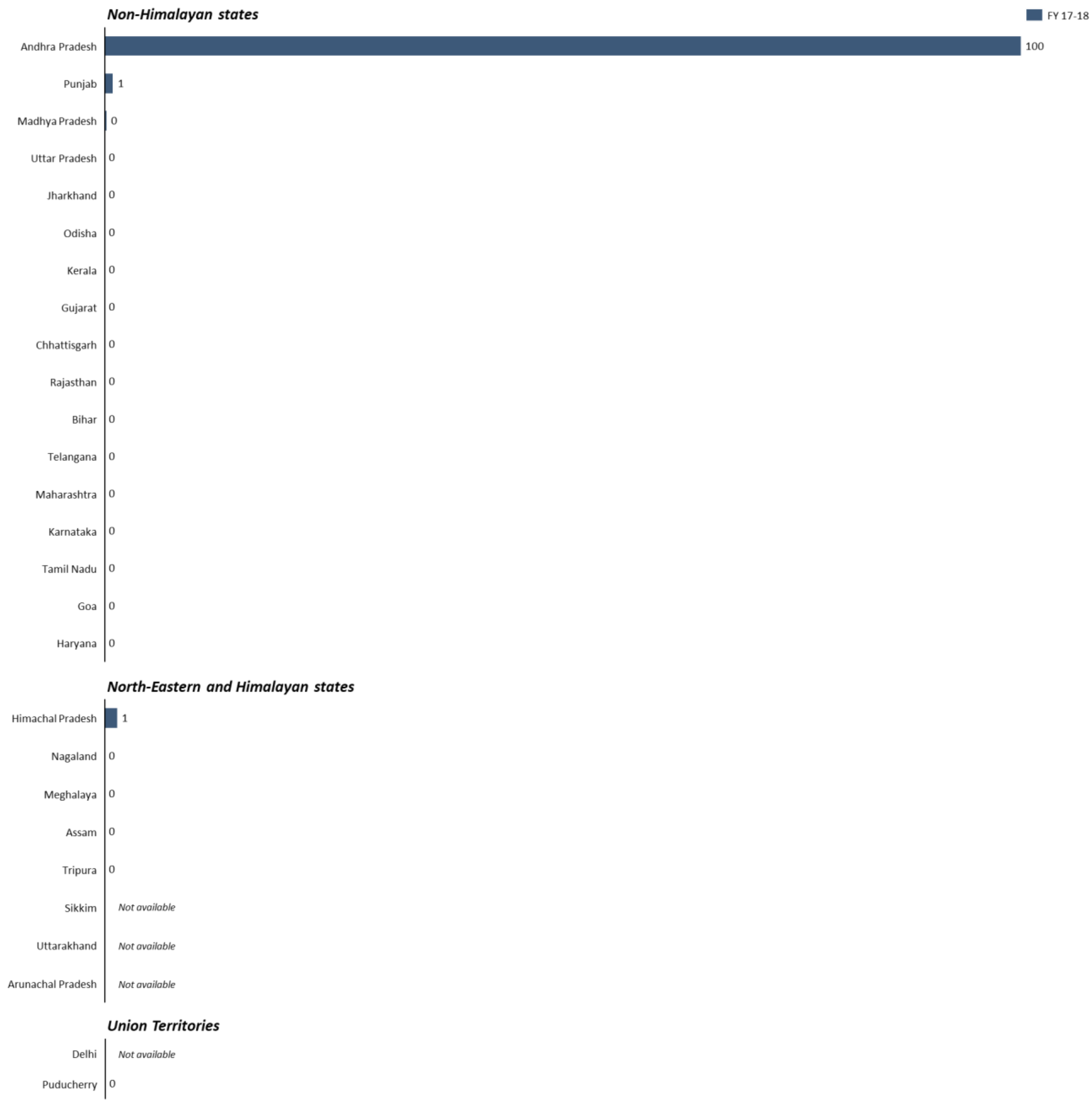
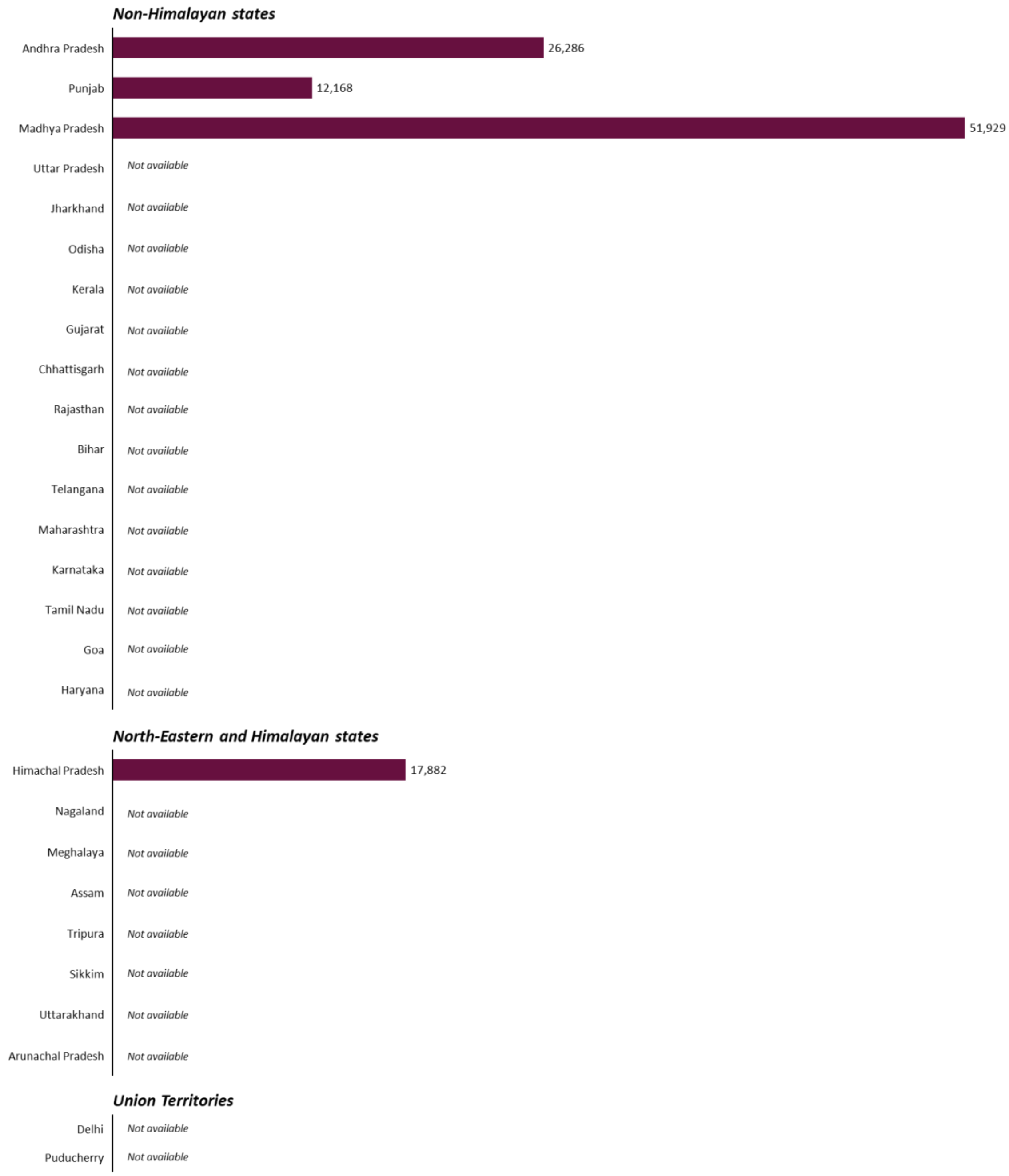


**Figure 46: Contextual Indicator 20 (d): Total Number of Inhabited Villages (as per Census 2011)**

*In units*




**Only 4 out of 23 reporting states and UTs have claimed non-zero coverage on the indicator, with Andhra Pradesh reporting 100% coverage.** Only Andhra Pradesh, Punjab, Madhya Pradesh, and Himachal Pradesh reported any villages being supplied with 24*7 piped water. Coverage amongst these states also remains close to nil, except for Andhra Pradesh, which reported 100% coverage. Remaining 19 out of 23 reporting states have 0% coverage on the indicator, while Sikkim, Uttarakhand, Arunachal Pradesh, and Delhi did not submit data.

Water delivery infrastructure remains in a poor state for rural India, and is also reflected by the fact that 82% rural households in India do not have individual piped water supply.[180] This is likely to have a disproportionate impact on the females of the households, who might be forced to travel long distances and spend hours in queues for collecting water for domestic use.

180 The reported statistic varies in case of other government sources. This is possibly due to other sources including piped water supply even through shared connections, while the reported statistics takes into account only individual households with piped water supply; presented number taken from "Number of Individual House Holds Covered With PWS", *National Rural Drinking Water Programme*, accessed May 16, 2019, https://indiawater.gov.in/IMISReports/Reports/Physical/rpt_CoverageIndividualHousePipConnection.aspx?Rep=0&RP=Y.

**Figure 47: Indicator 20 (f): Number of villages having individual household water meters as on the end of given FY**

*In % (FY 17-18)*

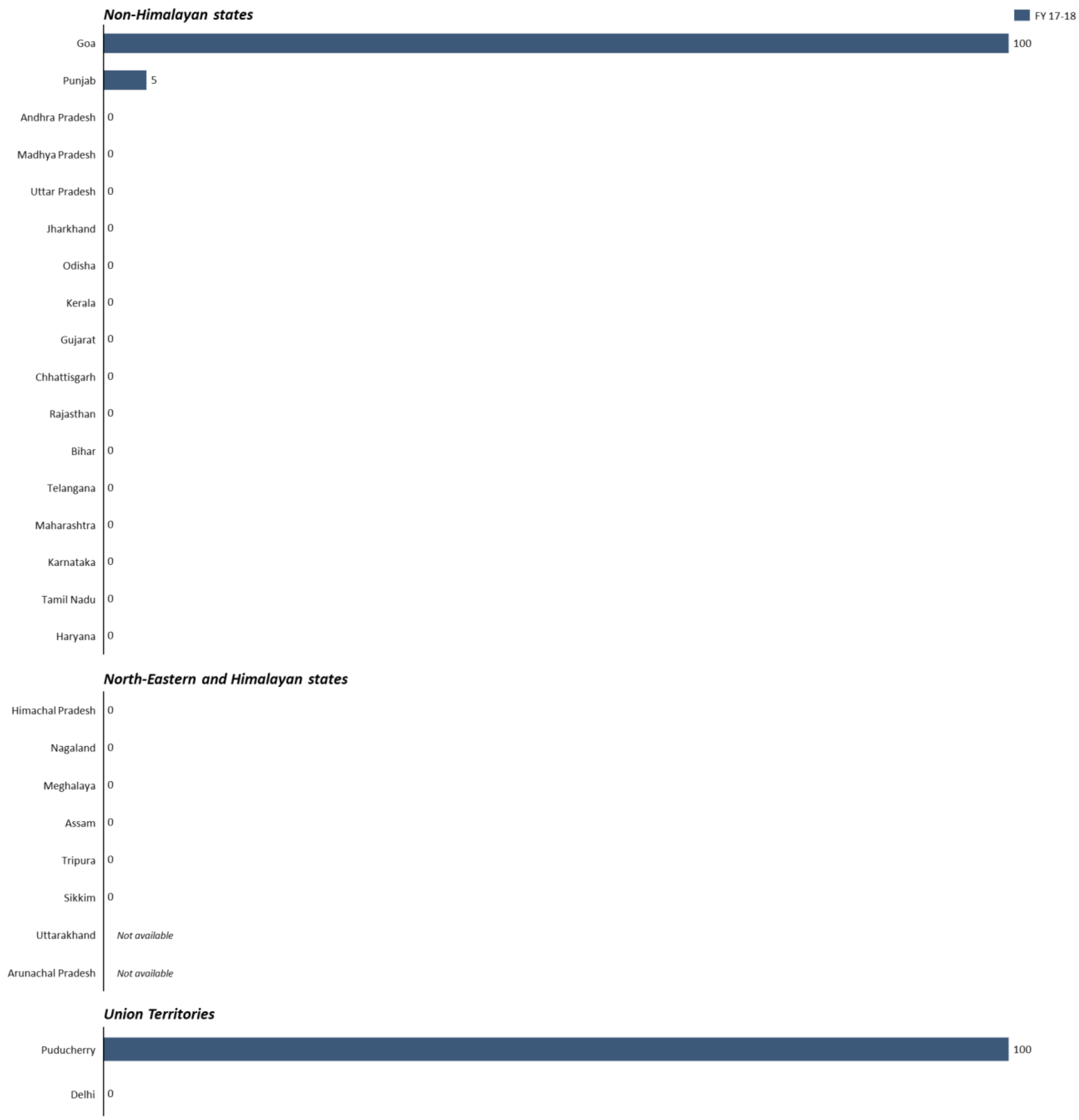
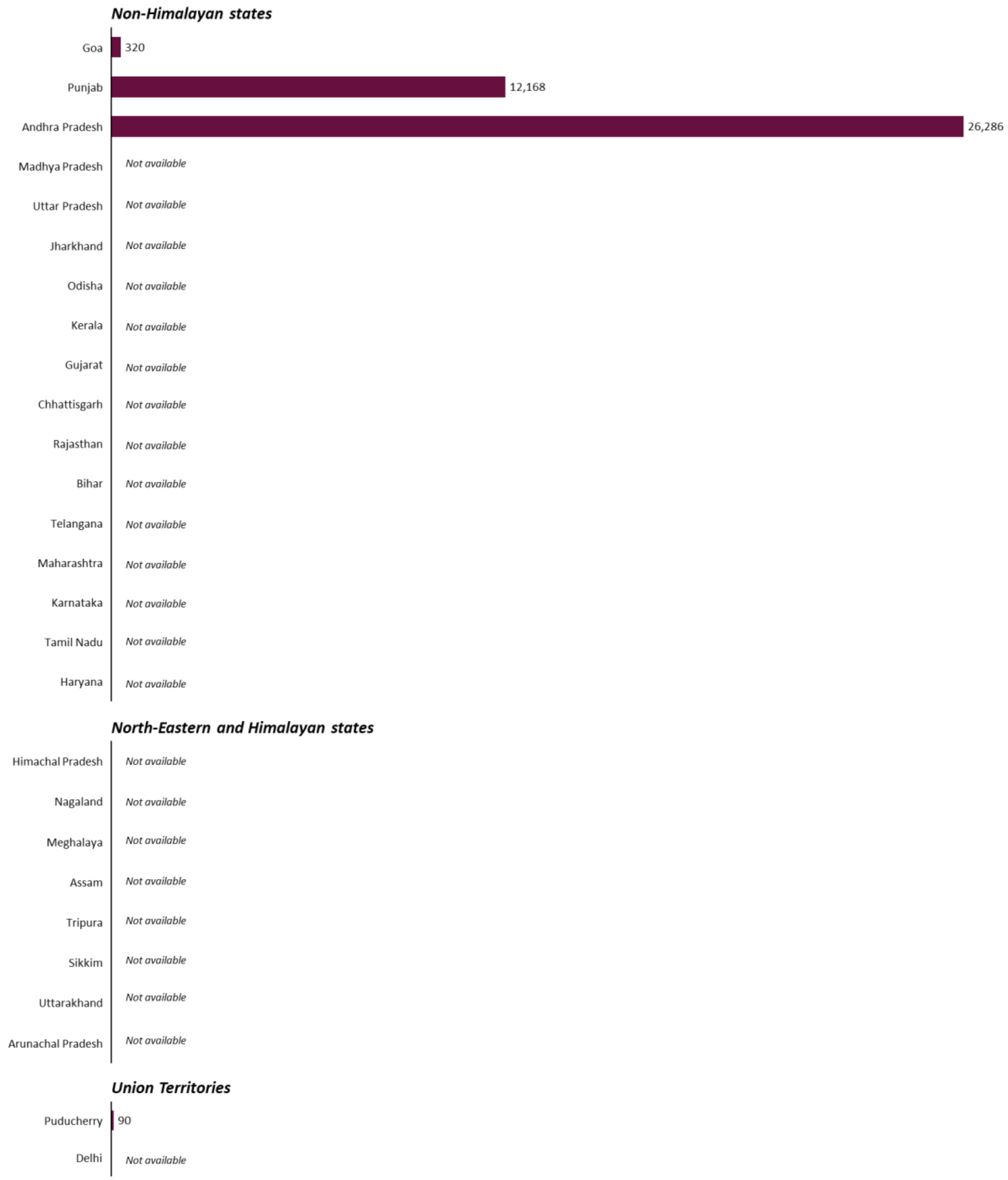


**Figure 48: Contextual Indicator 20 (f): Total Number of Inhabited Villages (as per Census 2011)**

*In units*




**Similar to results on the previous indicator, 85% of reporting states and UTs (21 out of 25) have 0% coverage on indicator 20 (f).** Out of the 4 states and UTs that reported data, Goa and Puducherry reported that 100% villages have individual household water meters in their state, whereas Punjab and Andhra Pradesh reported close to nil scores. This is also likely to be the state due to low levels of piped water connection in rural parts of the country, as suggested in case of indicator 20 (d). States need to expand their focus beyond irrigation water in rural areas, and make significant investments in upgrading the water delivery infrastructure for domestic households in rural areas to ensure provision of safe water on their premises.

**Gujarat's community managed water supply programme is a great example of local participation to improve rural water access.** The state's rural supply programme aims to supply village communities with adequate, regular, and safe water through household-level tap connectivity across all districts in the state. This is done through building capacity of village communities and empowering them to manage their water sources. A cost-sharing model has been adopted where the community members contribute 10% of the investment cost, and the remaining 90% is provided by state's Water and Sanitation Management Organisation (WASMO). Under the programme, Village Action Plans (VAP) are developed based on issues identified by community members as well as local NGOs, and a 'Pani Samiti' representative is nominated to execute these plans. Further, hand-holding and capacity building support is provided from WASMO and partner organizations to ensure technical and financial feasibility of the activities undertaken. As of 2013, Pani Samitis have been formed in almost all of ~18,400 villages and ~50% villages have completed schemes at an investment of INR 800 crores.[181]

[181] *Selected Best Practices in Water Management* (NITI Aayog, 2017), page 25, https://www.niti.gov.in/writereaddata/files/document_publication/BestPractices-in-Water-Management.pdf.

**Case study**: Rural drinking water: Enhancing rural water security in drought prone areas through spring-shed development, Sikkim[182]


*Overview*

Sikkim's Dhara Vikas Yojana is an innovative programme to revive and maintain drying springs by using rainwater harvesting, geohydrology, and Geographical Information Systems (GIS) techniques for tackling rural water security in drought-prone districts of the state. The programme involves reducing surface runoff of rainwater, which enables percolation of water to recharge underground aquifers, and this in turn allows increased discharge from springs. Capacity building of local community members has played a significant role in supporting project execution, while knowledge-sharing enabled by involvement of several government and private bodies in the project has helped ensure success of the programme.

The programme has led to significant improvement in cropping patterns, yields, community sanitation practices (through increased water access), and enabled development of a spring water atlas for the region as a knowledge resource. Stakeholders and organizations involved in the programme have achieved national level recognitions such as Prime Minister's Award for Excellence in Public Administration, and National Groundwater Augmentation Award for their contribution to the project.

*Key actions*

1. Initially, several capacity building measures were undertaken in coordination with NGOs to develop specialized knowledge & skills amongst local communities and create an in-house team of para-hydrogeologists.
2. Simultaneously, vulnerability assessment of villages was conducted and recharge areas for various springs and streams were identified based on local geohydrology.
3. Lastly, laying of contour trenches and pipes was undertaken to allow recharge of identified lakes.

[182] *Selected Best Practices in Water Management* (NITI Aayog, 2017), page 74, https://niti.gov.in/writereaddata/files/document_publication/BestPractices-in-Water-Management.pdf.

*Impact*

The project has enabled revival of upto 50 springs in the region through the project, and has also led to reforestation of seven hill- top forests. It has resulted in about 900 million litres of annual groundwater recharge and creation of the village spring atlas web portal which provides information on 700 springs. An average of 15% increase in crop yield and 25% increase in the cultivation of irrigated crops such as paddy, tomato and vegetables has also been observed. Another notable impact is the improvement in sanitation practices among local community members, enabled by better access to water.

*Lessons for other states*

**Combine scientific techniques with community efforts**: Equipping local community members with robust techniques can help boost efficacy of water conservation initiatives and allow implementation of sustainable water management practices

**Leverage expertise from across the ecosystem:** States can bring together expertise from multiple ecosystem stakeholders including government departments, civil society organizations, and private sector based on their experience to develop technically sound programmes for water management.

**Theme 7: Rural drinking water**
***[10 points]***

Indicator 20: Proportion of total rural habitations fully covered with drinking water supply as on the end of the given FY | Number of villages provided with 24*7 piped water supply as on end of given FY | Number of villages having individual household water meters as on end of given FY

**Indicator 21: Percentage reduction in rural habitations affected by Water Quality problems during the FY**

Indicator 21 measures the reduction in the percentage of households facing water quality problems (Arsenic and Fluoride problems) to glean the improvement in water quality for rural areas. As we have seen, access to water in rural areas has reached high levels in most states, but water quality remains a huge problem for the country. By 2015, only ~49% of the rural population has access to safely-managed water,[183] resulting in one of the highest disease burdens due to water-borne diseases in the developing world: about two lakh annual deaths from inadequate water, sanitation, and hygiene.[184] Gujarat, Tamil Nadu, Goa, Sikkim, Meghalaya, Tripura, Uttarakhand, Nagaland, Himachal Pradesh, and Arunachal Pradesh have reported that complete reduction has taken place in the previous years, and hence there is no further scope of reduction. Therefore, these states have been awarded a full-score on the indicator in the Index score calculation, and have not been represented on the indicator graphs. Additionally, Delhi was unable to report data on the indicator and has been scored nil on the indicator in the Index calculation.

| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states[185]** |
| **Top Performer** | Haryana, Telangana | *Not applicable* |
| **Bottom Performer** | Uttar Pradesh | *Not applicable* |
| **Median Score** | 22.91% | *Not applicable* |
| **1-year Median Change** | +12.38% | *Not applicable* |

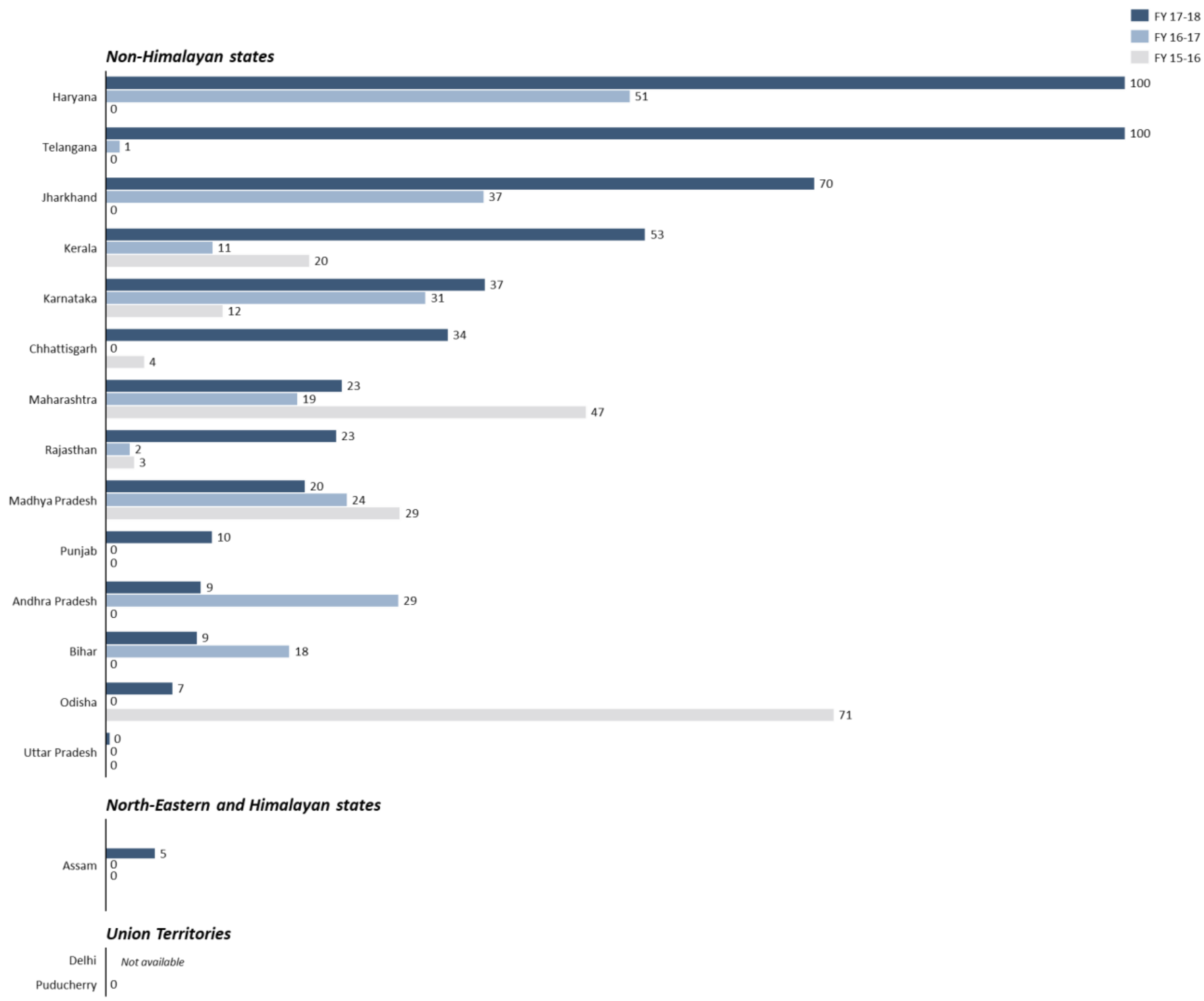
183 "People Using Safely Managed Drinking Water Services, Rural (% of Rural Population) | Data", *World Bank*, accessed May 4, 2019, https://data.worldbank.org/indicator/SH.H2O.SMDW.RU.ZS?locations=IN.

184 "GHO: By Category: Burden of Disease - Burden of Disease from Inadequate Water, Sanitation and Hygiene in Low- and Middle-Income Countries", *WHO*, accessed May 16, 2018, http://apps.who.int/gho/data/view.main.INADEQUATEWATERv?lang=en.

185 Assam is the only North-Eastern and Himalayan state that has reported data on the indicator, and therefore key highlights have not been provided for the indicator in this scenario.

**Figure 49: Indicator 21: Percentage reduction in rural habitations affected by water quality problems during the FY**

*In % (FY 15-16, FY 16-17, FY 17-18)*




**States displayed improvement in water quality in rural areas in FY 17-18 compared to FY 15-16 and FY 16-17, but performance in absolute terms remains unsatisfactory.** Overall, reduction by median state was 21%, compared to 6% in FY 16-17 and 0% in FY 15-16. But the improvement seems insufficient at an absolute level, and only 4 out of 16 reporting states and UTs achieved reduction greater than 50% in FY 17-18. As mentioned earlier, this analysis is independent of the 10 states that have reported that complete reduction in household water quality issues.

**Third-party evaluation of rural drinking water schemes can help ensure higher accountability of involved agencies and enhance performance at the overall level**. Maharashtra has displayed strong commitment towards the third-party evaluation model and has mandated technical inspection of Rural Water Supply Schemes in the state since 2014. Further, Chief Executive Officers of Zila Parishads have been made responsible for all third-party tests. To complement this decision with actual capacity, the state is also leveraging support under the Unnat Maharashtra Abhiyan (UMA), and the Water Supply and Sanitation department is engaging teachers and students of government engineering colleges to support with monitoring and evaluation of such rural schemes. Structured training programmes have been developed for imparting advanced concepts and practices related to planning, design, implementation, monitoring, and evaluation of rural water supply and sanitation schemes. The initiative is supported by UNICEF-Mumbai through financial and technical assistance. The state aims to increase transparency and accountability in the system through such monitoring initiatives, and as a result improve the overall performance in rural drinking water.[186]

[186] *Improving the Performance of Rural Water Supply and Sanitation Sector in Maharashtra* (Institute for Resource Analysis and Policy, Hyderabad & CTARA, IIT Bombay, 2018), page 4-6, http://irapindia.org/IRAP_RURAL_WATER_SUPPLY_compendium_180314.pdf.

## Theme 8: Urban water supply and sanitation

**What does the theme comprise?** This theme focuses on the supply and treatment of urban water and contributes 10 points (out of 100) to the Index. The indicators for the theme include access to drinking water in urban areas and the capacity for and the actual treatment of urban wastewater. By 2015, while, more than 90% of the urban population had access to 'basic drinking water',[187] only one-third of India's wastewater was treated,[188] leading to the high burden of water-borne diseases mentioned above.

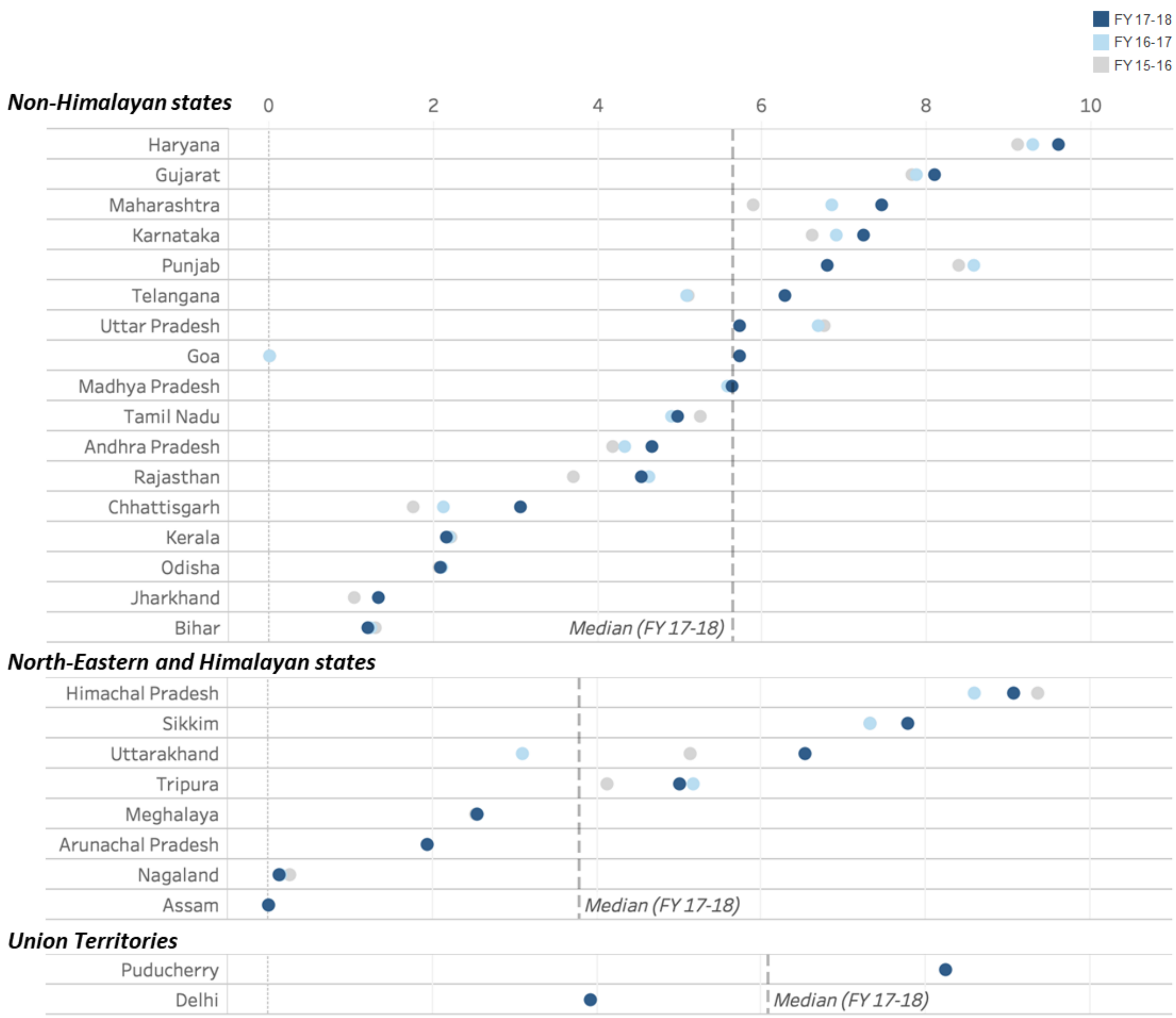
| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Haryana | Himachal Pradesh |
| **Bottom Performer** | Bihar | Assam |
| **Median Score** | 5.64 | 3.78 |
| **1-year Median Change** | +0.64 | +0.68 |

187 "JMP", *WHO UNICEF*, accessed May 5, 2019, https://washdata.org/data/household#!/table?geo0=country&geo1=IND.

188 Suresh Kumar Rohilla et al., *Urban Water Sustainability* (Centre for Science and Environment, 2017), page 15-16, http://cdn.cseindia.org/attachments/0.84020200_1505207729_Urban-water-sustainability-report.pdf.

**Figure 50: Performance of States and UTs on Theme 8 – Urban water supply and sanitation**

*Index scores, Range 0-10 (FY 15-16, FY 16-17, FY 17-18)*




**States failed to demonstrate any significant improvement on the theme in the last three years, and while access to water in urban areas remains high on average, significant gaps exist in wastewater treatment.** The theme median and mean stand at 5 and 4.9 points for the reference year, close to the base year averages of 5.1 and 4.6 points. States and UTs are almost equally split around the 50% mark, with 14 out of 27 reporting scores higher than 5 points, and remaining 13 scoring less than that. Most states provide drinking water to majority of their urban population, with the median state reporting drinking water supply access to 83% of its urban population, but wastewater treatment remains to be a challenge in the country. While only ~50% of the states and UTs (14 out of 27) have capacity to treat more than 50% of the wastewater generated, only a 33% of the actually do so. Haryana is the only state that has 100% wastewater treatment capacity and reporting 100% treatment rate as well.

It is estimated that by 2050, more than 50% Indians will be residing in urban areas,[189] which could put extreme stress on the existing water resources and infrastructure. Additionally, the household sector is likely to face a water demand-supply gap of 50 BCM by 2030, as demand becomes 2 times the present use.[190] Treating wastewater can provide additional water resources to water-stressed regions and help in meeting the water needs of growing India. Therefore, it is essential for states to invest in wastewater treatment capacity keeping this long-term vision in mind.

Theme 8 comprises of three indicators. The following section provides commentary on the indicator-level performance for these indicators assessed under the theme.

**Theme 8: Urban water supply and sanitation**
***[10 points]***

**Indicator 22: Percentage of urban population being provided drinking water supply as on the end of the given FY**

Indicator 23: Capacity installed in the state to treat the urban wastewater as a proportion of the total estimated waste water generated in the urban areas of the state as on the end of the given FY

Indicator 24: Percentage of wastewater treated during the given FY

Indicator 22 measures urban drinking water access as the percentage of urban population being supplied with drinking water. Although 93% of India's urban population has access to 'basic water',[191] there are still sharp inter-city and intra-city inequities. Further, supply gaps are causing city dwellers to depend on privately extracted ground water, bringing down local water tables.

Delhi was unable to report data on the indicator and has been scored nil on the indicator in the Index calculation.

| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Madhya Pradesh, Gujarat, Goa | Himachal Pradesh, Uttarakhand |
| **Bottom Performer** | Bihar | Assam |
| **Median Score** | 83% | 73.5% |
| **1-year Median Change** | +8.35% | +2.13% |

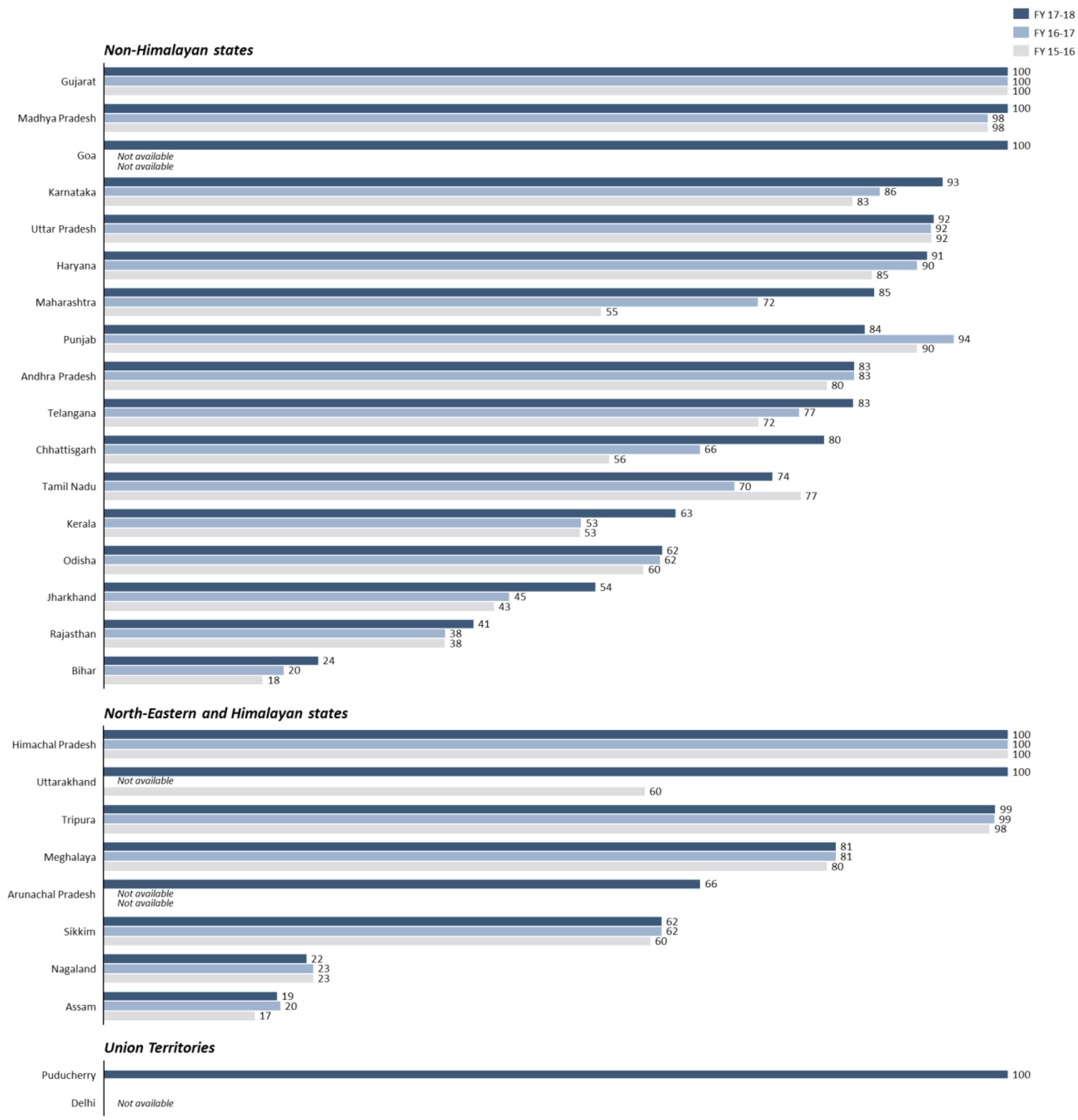
189 "World Urbanization Prospects 2018 - Population Division", *United Nations*, accessed May 6, 2019, https://population.un.org/wup/Download/.

190 "Investments worth $291 bn needed to plug water demand-supply gap in India: Study", *ASSOCHAM India*, accessed May 16, 2019, http://assocham.org/newsdetail.php?id=6357.

191 "JMP", *WHO UNICEF*, accessed May 5, 2019, https://washdata.org/data/household#!/table?geo0=country&geo1=IND.

**Figure 51: Indicator 22: Percentage of urban population being provided drinking water supply as on the end of the given FY**

*In % (FY 15-16, FY 16-17, FY 17-18)*




**Improvement on this indicator can be noticed across states and UTs during the last 3 years.** ~85% states and UTs (18 out of 21)[192] reported higher scores in FY 17-18 compared to FY 15-16. The overall indicator median also increased from 72% in FY 15-16 to 75% in FY 16-17 and 83% in FY 17-18. Strong performance is also reflected by the fact that ~60% of the states and UTs provide more than 80% of its

192 This computation does not include states and UTs for which data is not available from current or previous years, as well as states that have reported 100% coverage on the indicator across the last three years

urban population with drinking water supply. Uttarakhand, followed by Maharashtra, reported the maximum improvement on indicator, of 40 and 30 percentage points, respectively, across the three years. But, on the other end, states such as Rajasthan, Bihar, Nagaland, and Assam provide less than 50% of its urban population with drinking water supply, and need to make significant improvements.

**Urban poor in cities remain the single-most affected segment by lack of water access.** Providing piped water supply to these households is a challenge due to land ownership and titling issues in informal urban settlements. As India becomes more urbanized, the urban poor segment is likely to grow disproportionately. Alternate solutions need to be leveraged to ensure that a critical mass of population residing in Indian cities does not remain devoid of drinking water facilities. Delhi and Hyderabad are experimenting with Water Kiosks and ATMs to provide safe drinking water to citizens residing in areas without piped water supply. The national capital launched pilots in 2012 under the design-finance-build-operate-transfer model, but has received mixed response, particularly due to low willingness to pay amongst slum dwellers.[193] Such concepts are also being explored by the Greater Hyderabad Municipal Corporation, in association with Safe Water Network, USAID, and Honeywell Inc., and challenges remain similar to the ones observed in Delhi.[194] Going forward, states should continue to identify drinking water solutions that align with the situational constraints these communities live in, and complement them with IEC activities to drive behaviour change.

193 *Drinking Water Supply for Urban Poor*: *City of New Delhi* (Safe Water Network, 2016), page iv, https://www.safewaternetwork.org/sites/default/files/Safe%20Water%20Network_Delhi%20City%20Report.PDF.

194 *Drinking Water Supply for Urban Poor: City of Hyderabad* (Safe Water Network, 2016), page iii, https://www.safewaternetwork.org/sites/default/files/Safe%20Water%20Network_Hyderabad%20City%20Report.pdf.; "Honeywell, USAID, Hyderabad Corporation to Launch 50 Water Kiosks", *The Hindu Business Line*, accessed May 5, 2019, https://www.thehindubusinessline.com/news/national/honeywell-usaid-hyderabad-corporation-to-launch-50-water-kiosks/article9977502.ece.

**Case study:** Urban drinking water: Nagpur's PPP project for city-wide water supply[195]


*Overview*

Nagpur's Orange City Water Project is an initiative undertaken by the Nagpur Municipal Corporation's (NMC) to supply 24x7, safe water to all its citizens, including the slum dwellers in the city. The project has been developed under a PPP model, wherein a private consortium is responsible for ensuring continuous water supply across the city, while tackling issues of inequitable and intermittent supply, inconsistent pressure, and high non-revenue water losses. Under this arrangement, the asset ownership remains with NMC, investment has been undertaken by GoI and Government of Maharashtra through JnNURM funding, and operations and management is the private consortium's responsibility, institutionalized through a 25-year O&M contract.

The project has helped the city improve water access, enhance efficiency, as well as reduce losses attributable to non-revenue water, enabled by involvement of private sector experts. This initiative has received recognition for its success even at the international level through awards such as 'Best Water Management Practices' and 'Best Peoples Initiative' presented by World Water Leadership Congress & Awards.

*Key Action*

1. Initially, NMC launched a pilot with 15000 water connections to understand the key issues and potential pathways for solving the problems. This pilot demonstrated tangible benefits under a

---

195 *Nagpur: PPP in city-wide water supply* (Smart Cities Mission), http://smartcities.gov.in/upload/uploadfiles/files/Nagpur_water_PPP_Final_case.pdf; *Selected Best Practices in Water Management* (NITI Aayog, 2017), page 36, https://niti.gov.in/writereaddata/files/document_publication/BestPractices-in-Water-Management.pdf.

PPP model, and helped in aligning with political and administrative bodies for a city-wide PPP model.

2. Next, NMC passed a resolution to supply 24x7 safe water to the entire city, and using a transparent bidding process, contracted a private consortium in 2011, through a 25-year performance management contract to implement its vision.
3. The initial 5-years of the contract, referred as the transition period, involved operating the existing network while undertaking infrastructure upgradation activities including consumer household connections.
4. Post the transition period, the private consortium is responsible for operating and maintaining the city's water supply system for the next 20 years, and their performance is supposed to be tracked against set of performance parameters, while remuneration is based on metered volume that is billed and collected.

*Impact*

The private consortium has taken over water supply in the city and replaced 85000 out of 321,000 connections along 450 km of the pipeline coverage. Close to 100,000 unauthorized connections have been identified during rehabilitation phase, and commercial losses have reduced and NMC revenues have increased. Service delivery issues are being tackled through infrastructure augmentation and increase in capacity of Elevated Service Reservoirs. 24x7 water supply has ensured better standards of living for Nagpur residents. Consumer grievances are being addressed through round the clock call centre, and bill payments are being managed through zone level-kiosks set up under the project.

*Lessons for other states*

- **Leverage private sector expertise**: Private sector expertise can be leveraged by state and city departments to support efficient management of resources, given access to latest technologies and professional experience. Performance-linked remuneration models, along with adequate monitoring by authorities can help ensure financial sustainability of the project as well as satisfactory service delivery for end-users.
- **Validate concepts through a pilot-based approach:** States can initially launch pilots before implementation of large-scale initiatives and innovative projects to test and validate concepts and project ideas with a small proportion of the total target audience. This can help in identifying and addressing potential implementation challenges and risks early on in the project in a resource-efficient and timely manner.

**Theme 8: Urban water supply and sanitation**
***[10 points]***

| Indicator 22: Percentage of urban population being provided drinking water supply as on the end of the given FY | **Indicator 23: Capacity installed in the state to treat the urban wastewater as a proportion of the total estimated waste water generated in the urban areas of the state as on the end of the given FY** | Indicator 24: Percentage of wastewater treated during the given FY |
|---|---|---|

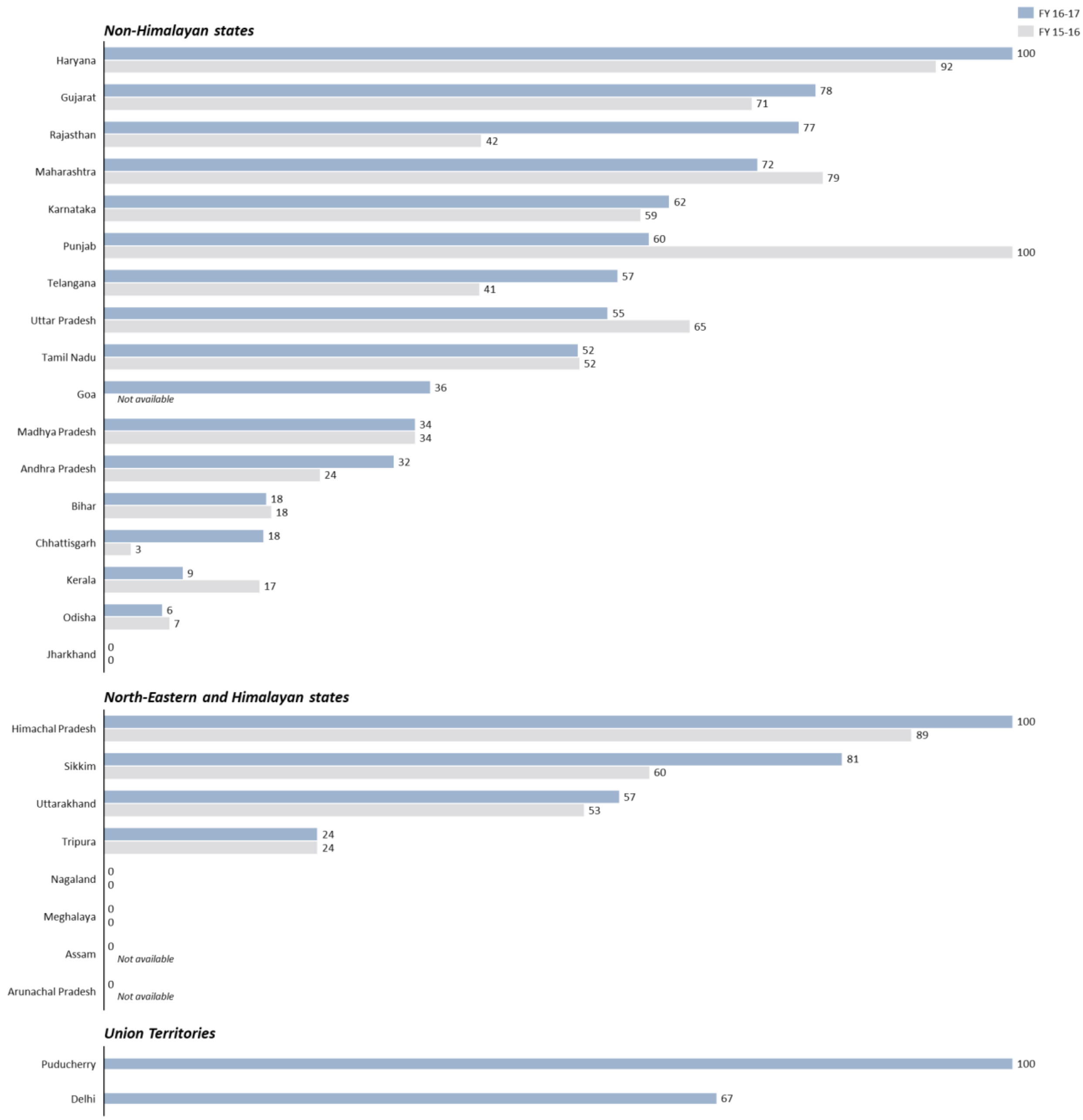
Indicator 23 measures the ability of states to treat urban wastewater by examining the percentage of total urban wastewater that can be treated with the currently installed capacity. The contextual indicator specifies the total wastewater generated in urban areas of the state, signifying the scale of the service challenge. Treating wastewater is important as water contamination is a significant challenge for India, and contributes to two lakh annual deaths from inadequate water, sanitation, and hygiene.[196]

| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Haryana | Himachal Pradesh |
| **Bottom Performer** | Jharkhand | Nagaland, Meghalaya, Assam, Arunachal Pradesh |
| **Median Score** | 52.17% | 11.77% |
| **1-year Median Change** | +10.73% | -26.43% |

[196] "GHO | By Category | Burden of Disease - Burden of Disease from Inadequate Water in Low- and Middle-Income Countries", *WHO*, accessed May 16, 2018, http://apps.who.int/gho/data/view.main.INADEQUATEWATERv?lang=en.

**Figure 52: Indicator 23: Capacity installed in the state to treat the urban wastewater as a proportion of the total estimated wastewater generated in the urban areas of the state as on the end of the given FY**[197]

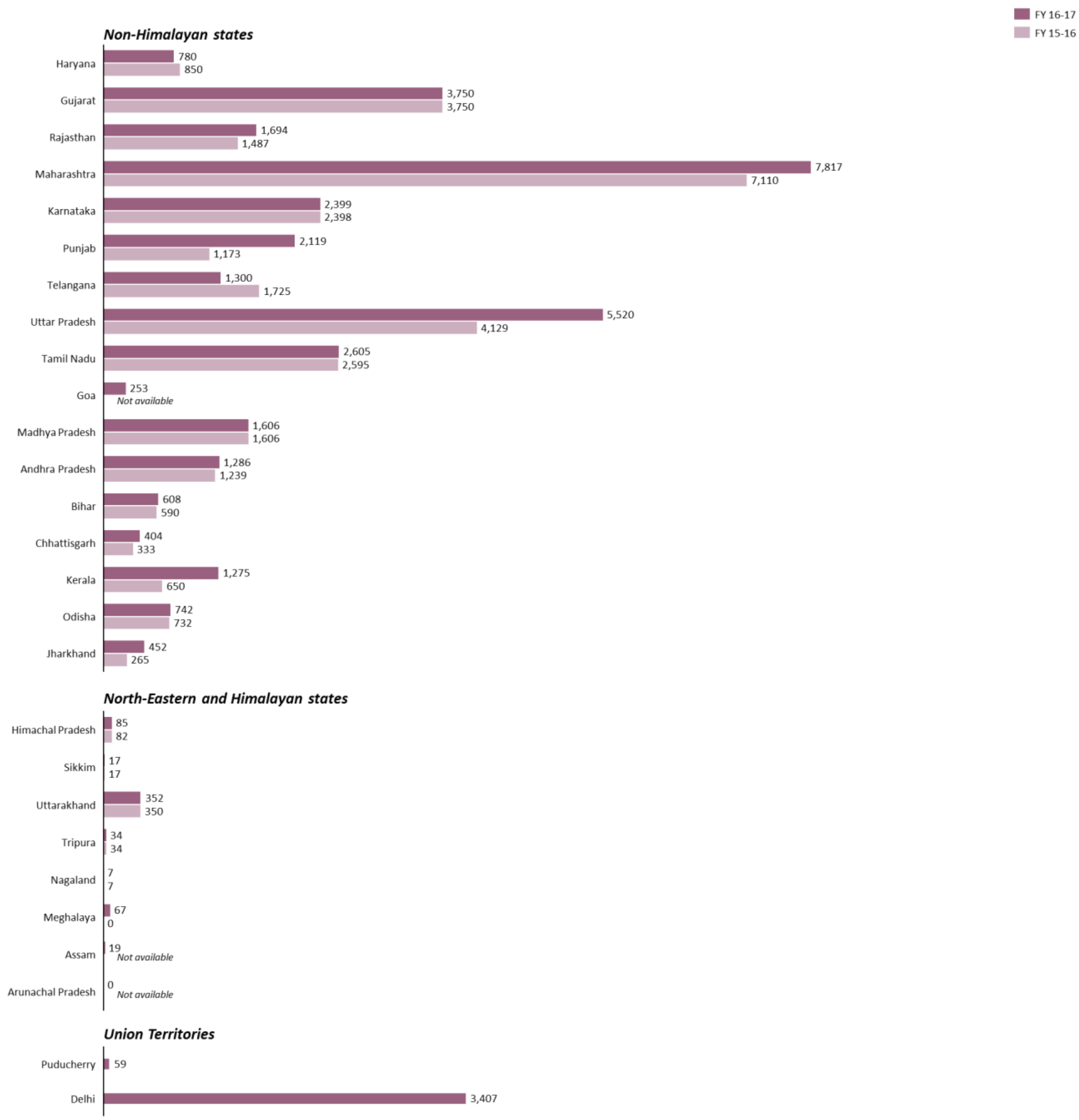
*In % (FY 15-16, FY 16-17)*




197 Data on the indicator has been collected only till FY 16-17 and therefore has not been highlighted for FY 17-18

**Figure 53: Contextual indicator 23: Total estimated generation of wastewater in urban areas as on the end of the given FY**

*In million litres per day (MLD) (FY 15-16, FY 16-17)*




**Overall, states and UTs display mixed performance, with the median state reporting capacity to treat 52% of its wastewater.** The wastewater treatment capacity for median state increased by 11 percentage points, from 41% in FY 15-16 to 52% in FY 16-17. Haryana, Himachal Pradesh, and Puducherry are top performers, and have installed capacity to treat 100% of generated wastewater. On the other end, 5 non-Himalayan and 4 North-Eastern and Himalayan states have less than 20% wastewater treatment capacity. The large urban wastewater generating states and UTs such as Maharashtra, Uttar Pradesh, Gujarat, and Delhi have over 50% capacity.

**Decentralized treatment models such as bulk Fecal Sludge Treatment Plants (FSTPs) are alternate approaches that can be explored by states to manage waste generated in cities.** Decentralized approaches can help states effectively treat waste generated in their cities, given the limited capacity and coverage of sewage treatment plants in the country. Fecal sludge management pilots, built on this decentralized approach, are being implemented in Devanahalli, Karnataka through funding from Bill and Melinda Gates Foundation and Consortium for Decentralized Wastewater Treatment Systems (DEWATS) Dissemination (CDD) Society. Fecal sludge treatment plant (FSTP) technology, operations and maintenance, policy, and stakeholder capacity building are key components of this model. IEC activities also form a critical part of the programme, focused on sensitizing residents about the approach and gaining buy-in. The communities are also being educated about use of by-products such as treated wastewater and compost through these IEC initiatives.[198]

**Theme 8: Urban water supply and sanitation**
***[10 points]***

Indicator 22: Percentage of urban population being provided drinking water supply as on the end of the given FY

Indicator 23: Capacity installed in the state to treat the urban wastewater as a proportion of the total estimated waste water generated in the urban areas of the state as on the end of the given FY

**Indicator 24: Percentage of wastewater treated during the given FY**

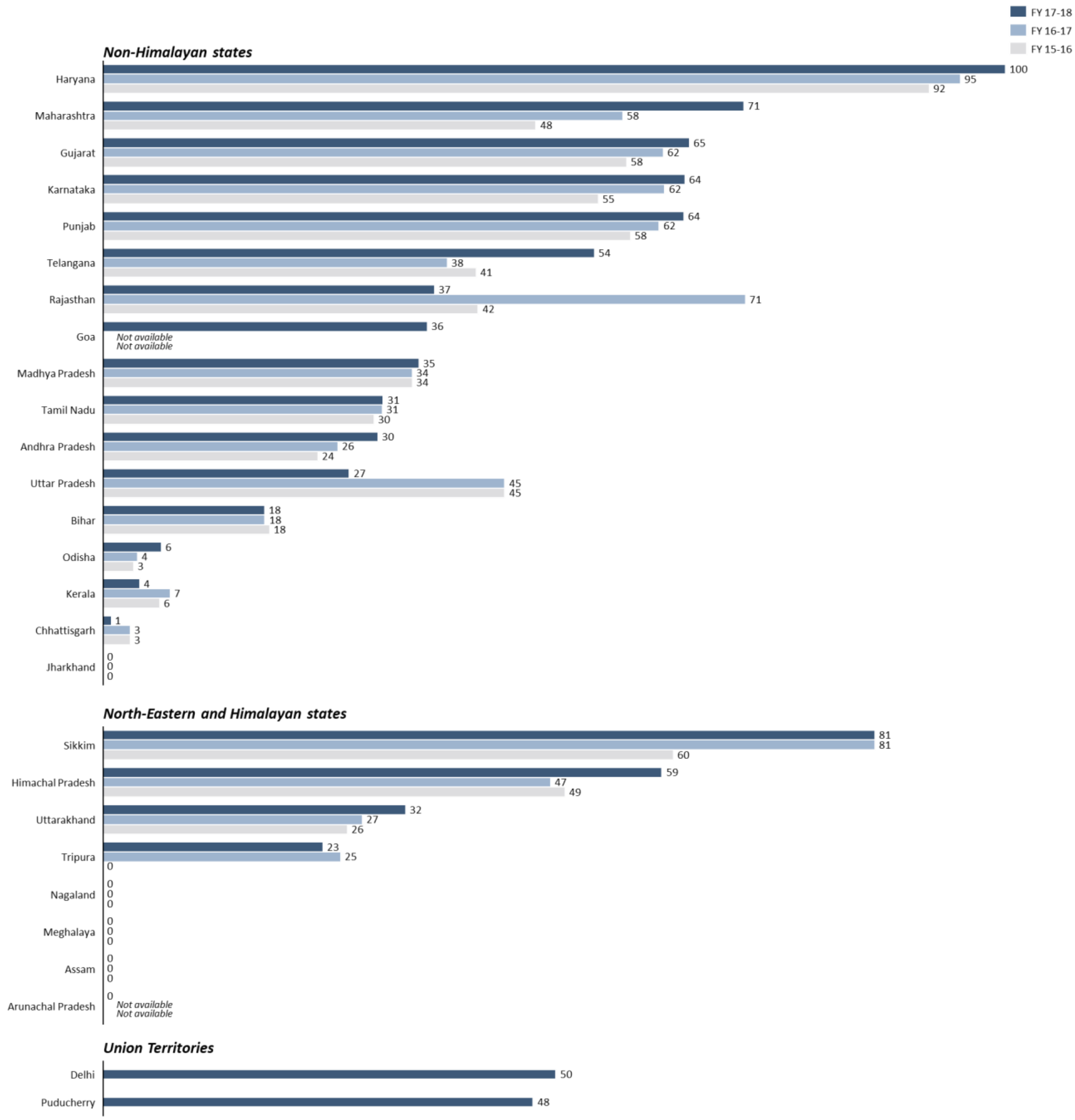
Indicator 24 narrows down on the actual proportion of urban wastewater treated. This data is also available for FY 17-18, and thus some states report higher treatment percentages than the installed capacity would indicate in Indicator 23, reflecting new capacity coming online/ being reported in FY 17-18.

| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Haryana | Sikkim |
| **Bottom Performer** | Jharkhand | Nagaland, Meghalaya, Assam, Arunachal Pradesh |
| **Median Score** | 35.01% | 11.57% |
| **1-year Median Change** | -1.19% | -13.44% |

198 C.L. Scott, *Community Engagement: An Important Part of Successful FSM* (Sustainable Sanitation Alliance), https://www.susana.org/_resources/documents/default/3-2733-7-1488368801.pdf.

**Figure 54: Indicator 24: Percentage of wastewater treated during the given FY**

*In % (FY 15-16, FY 16-17, FY 17-18)*




**Installed treatment capacity and actual treatment rates differ, highlighting under-utilization of treatment capacity by states.** While ~50% states and UTs claimed having capacity to treat more than half of their urban wastewater in FY 16-17 (Indicator 23), only ~33% of them reported doing so in FY 17-18.[199] Additionally, states have also been unable to show any significant improvement on the indicator, and the overall median has increased only by 2 percentage points between the base and reference year,

199 Indicator 23, which captures wastewater treatment capacity of a state, reports data for FY 16-17, while Indicator 24, which captures actual proportion of wastewater treated, reports data from FY 17-18

currently standing at 32%. Haryana is the only state that has installed as well as utilized 100% capacity for treating wastewater. Treated wastewater can help reduce the supply-demand gap that is likely to arise in the future. Treated water can help meet irrigation needs of the country as well as support the increasing demand from industries and households, reducing the burden on the already-diminishing freshwater resources. Israel provides a perfect example – it treats 94% of the water and reuses 88% of it.[200] Singapore is another leading global example, and plans to meet up to 30% of its future water needs by 2060 through desalinated water.[201]

**One way for states to improve incentives for treatment of wastewater, and the economics behind it, is to develop forward market linkages for treated water** i.e. design policies that mandate utilization of treated wastewater for non-potable uses. One such example is Maharashtra's 2017 decision to reuse treated wastewater for cooling thermal power plants, serving industrial estates, and servicing other non-potable purposes.[202] Gujarat has also launched its wastewater treatment and reuse policy in 2018, with aim of increasing reuse of its treated wastewater and reducing dependence on freshwater resources. As stated in the policy, the state aims to achieve minimum 80% coverage and collection of sewerage in all municipal towns, and treat 100% of it. As a long-term vision, the state has set an objective to reuse 70% of its treated wastewater by 2025 and 100% by 2030.[203] While actual implementation through municipal action plans and commissioning of related infrastructure will take more time, the public declaration of such missions is a commendable step taken by states to promote the treatment and use of wastewater.

200 Guy Reshef, *Quality of Israel water sources* (Israel Water Authority, 2018), https://eni-seis.eionet.europa.eu/south/communication/events/project-related-events/country-visit-to-israel/presentations/the-water-system-in-israel/at_download/file.

201 "Singapore Water Story", *PUB, Singapore's National Water Agency*, accessed May 16, 2019, https://www.pub.gov.sg/watersupply/singaporewaterstory.

202 "Maharashtra Mandates Reuse of Wastewater", *India Water Portal*, accessed May 4, 2019, https://www.indiawaterportal.org/articles/maharashtra-mandates-reuse-wastewater.

203 Policy for Reuse of Treated Wastewater (Government of Gujarat, 2018), page 3, https://gwssb.gujarat.gov.in/downloads/Policy_Reuse_Of_WasteWaterA.pdf.

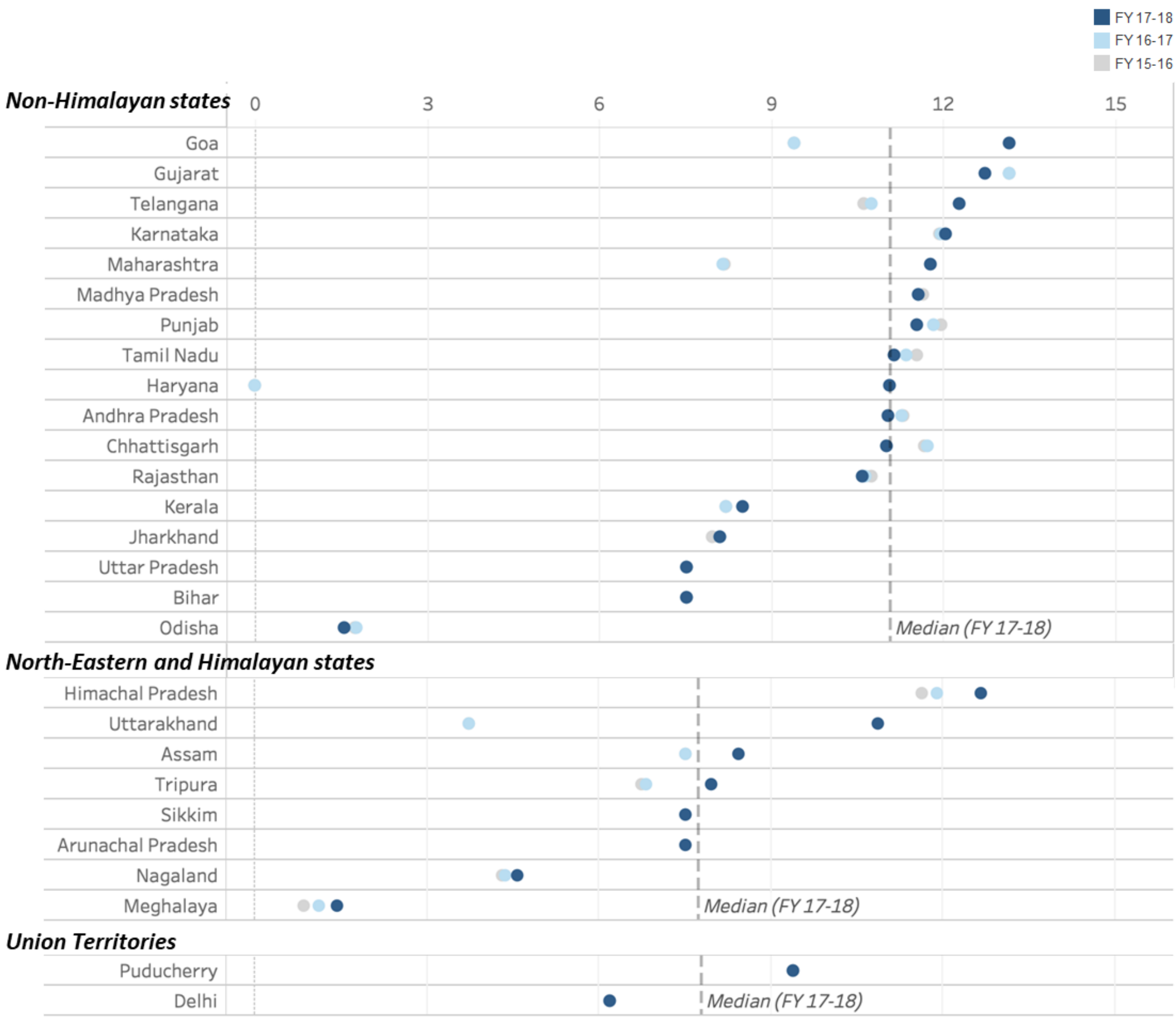
## Theme 9: Policy and Governance

**What does the theme comprise?** The final theme focuses on a variety of policies put in place by the state governments to enable effective water resource management and contributes 15 points (out of 100) to the Index. This is one of the only three categories to have such a high weightage, indicating the critical nature of effective policymaking and governance in the management of a common, finite resource like water. Water's position on the State List in the Constitution means that state governments are the ultimate custodians of the resource, with the centre limited to an advisory and coordinating role. This theme is critical for identifying achievements and practices around state policies, which form the basis for outcomes across many of the indicators described in the Index. The theme includes four main indicators covering a broad range of water management practices, including legislation for the protection and restoration of water bodies, a framework for water harvesting in buildings, the pricing of urban water, and the existence of regularly validated dataset for water resources in the state. Three of these are binary and provide a snapshot of the policy and legislation status in a state.

| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Goa | Himachal Pradesh |
| **Bottom Performer** | Odisha | Meghalaya |
| **Median Score** | 11.06 | 7.73 |
| **1-year Median Change** | +0.44 | +0.90 |

**Figure 55: Performance of States and UTs on Theme 9 – Policy and governance**

*Index scores, Range 0-15 (FY 15-16, FY 16-17, FY 17-18)*




**Increase in theme averages suggests growing focus by states on water as a subject as well as use of regulatory frameworks for better resource management.** The theme median and mean increased from 8.19 and 8.22 to 10.58 and 9.24 respectively between the base year and reference year. Most of this improvement is observed in the reference year's data, with the median and mean increasing by 2.4 and 1 point(s) compared to FY 16-17. 85% states and UTs (23 out of 27) scored greater than or equal to 7.5 points, the 50% mark, suggesting strong emphasis by states on policy and governance. This is higher compared to the ~75% states (18 out of 24) achieving this feat in FY 15-16 and FY 16-17. At the category level, non-Himalayan states achieved a median and mean of 11.06 and 10.17 points in FY 17-18, higher than 7.73 and 7.62 in case of North-Eastern and Himalayan states and 7.79 and 7.79 respectively for UTs. Despite the overall good performance on the theme, Odisha, Meghalaya, and Nagaland's performances are worrying, given less than one-third of the maximum points scores achieved by these states.

**Water pricing and data centres remain improvement areas for most states.** ~45% of reporting states and UTs (11 out of 25) charge less than 50% households for water. On the data front, ~40% reporting states and UTs (11 out of 26) are yet to set up an integrated data centre for water resources. Encouragingly though, out of the 15 states that have set up a data centre, 13 states reported regularly updating the data centre, but the quality and accuracy is yet to be established. Improved data availability can support data-driven planning & policymaking by states. Additionally, data access in public domain can also support programme design for civil society actors as well as encourage and enable a pathway for private sector organizations to develop concrete solutions.

Theme 9 comprises of four indicators. The following section provides commentary on the indicator-level performance for these indicators assessed under the theme.

| Theme 9: Policy and governance *[15 points]* | | | |
|---|---|---|---|
| **Indicator 25: Whether the State has enacted any legislation for protection of waterbodies and water-supply channels and prevention of encroachment into/on them?** | **Indicator 26: Whether the State has any framework for rain water harvesting in public and private buildings?** | Indicator 27: Percentage of households being provided water supply and charged for water in the urban areas as on the end of the given FY | Indicator 28: Does the State have a separate integrated Data Centre for water resources? If yes, then is the data being updated on the integrated data centre on a regular basis? |

Indicators 25 and 26 are binary measures, indicating whether states have put in place appropriate legislation for water conservation, focusing on the restoration of water bodies and the implementation of rainwater harvesting in buildings.

**Figure 56: Indicator 25: Whether the state has enacted any legislation for protection of water bodies and water-supply channels and prevention of encroachment into/on them?**

*(FY 15-16, FY 17-18)*

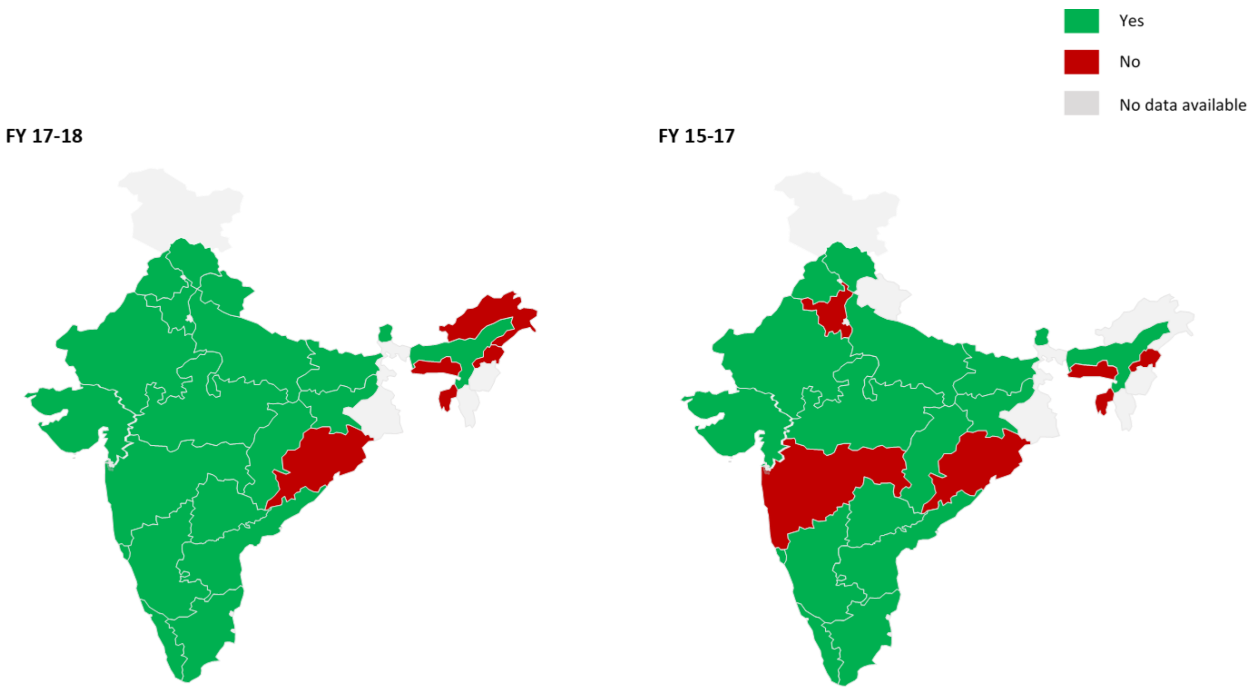
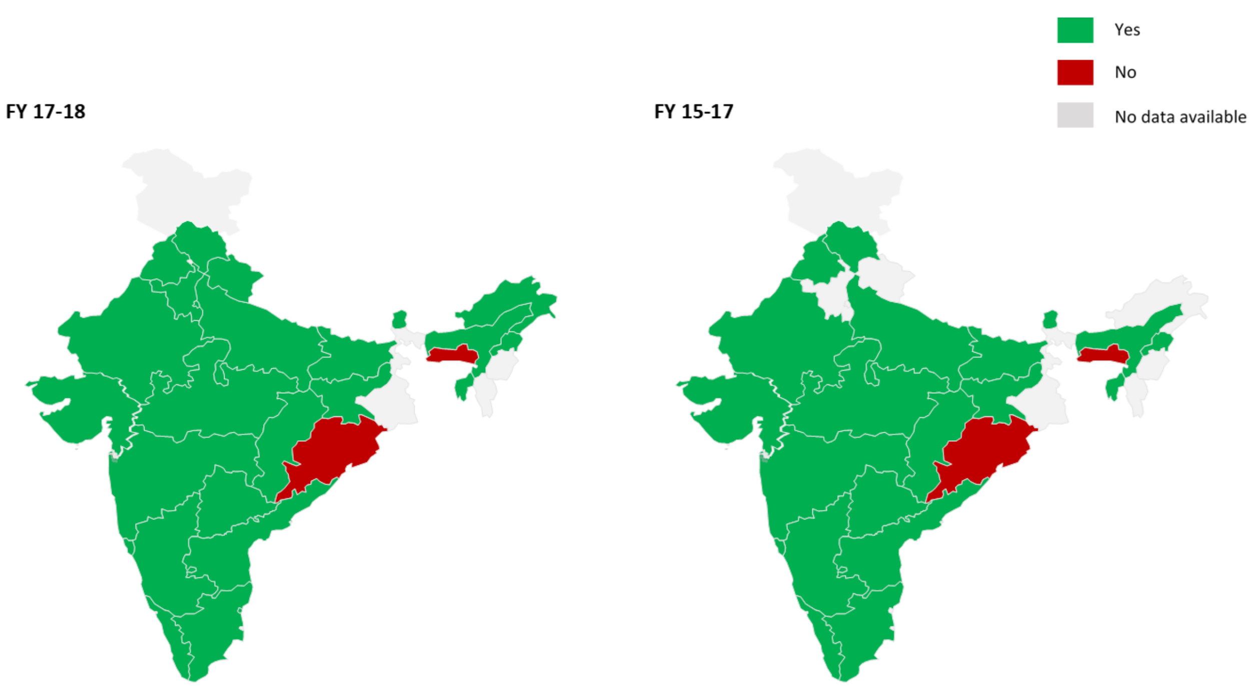



**Figure 57: Indicator 26: Whether the state has any framework for rain water harvesting in public and private buildings?**

*(FY 15-16, FY 17-18)*



**As observed in previous years, most states have established appropriate legal frameworks for water conservation.** 80% of reporting states and UTs (20 out of 25) have enacted legislations for supporting protection and preventing encroachment of water bodies, while ~90% states and UTs (25 out of 27) have legal frameworks for rain-water harvesting in public and private buildings. All non-Himalayan states have enacted legislations for both indicators, except Odisha. Among North-Eastern and Himalayan states, only 4 states have enacted legislations for protection of water bodies, whereas all states except Meghalaya have a framework for rain-water harvesting.

As population rises, habitation on water banks is likely to intensify, increasing pollution and encroachment risk for water bodies. Similarly, with green cover in urban areas declining due to urbanization and commercial activities, avenues for rainwater seepage to support groundwater recharge are also reducing. Legal frameworks that counter the above phenomenon can positively contribute towards water conservation. Although regulatory frameworks provide a great start for the states, ensuring effective implementation and strict compliance is critical.

**Moving beyond individual legislations, Maharashtra has moved towards an evolved approach to water management, and launched a state-wide programme for water conservation.** The state launched 'Jalyukt Shivar Abhiyaan' in 2015-16 with the mission to make Maharashtra drought-proof by 2019, and aim of 5000 villages being water scarcity free, every year. The project interventions focus on harvesting rainwater in villages to increase groundwater levels, and include activities such as deepening and widening of streams, construction of cement and earthen stop dams, work on *nullahs* and digging of farm ponds. Additionally, the programme also involves geo-tagging of these water bodies and use of a mobile application to enable web-based monitoring.[204] Such holistic approaches can be emulated by other states to create an effective platform for tackling the multi-faceted challenges faced in water management.

[204] "Jalyukt-Shivar", *Maharashtra Remote Sensing Applications Centre*, accessed May 16, 2019, http://mrsac.maharashtra.gov.in/jalyukt/.; "Maharashtra Aims to Be Drought-Free By 2019, Launches New Programme", *@Businessline*, last modified 2019, accessed May 9, 2019, https://www.thehindubusinessline.com/news/national/maharashtra-aims-to-be-droughtfreeby-2019-launches-new-programme/article6975358.ece.

**Theme 9: Policy and governance**
***[15 points]***

| Indicator 25: Whether the State has enacted any legislation for protection of waterbodies and water-supply channels and prevention of encroachment into/on them? | Indicator 26: Whether the State has any framework for rain water harvesting in public and private buildings? | **Indicator 27: Percentage of households being provided water supply and charged for water in the urban areas as on the end of the given FY** | Indicator 28: Does the State have a separate integrated Data Centre for water resources? If yes, then is the data being updated on the integrated data centre on a regular basis? |
|---|---|---|---|

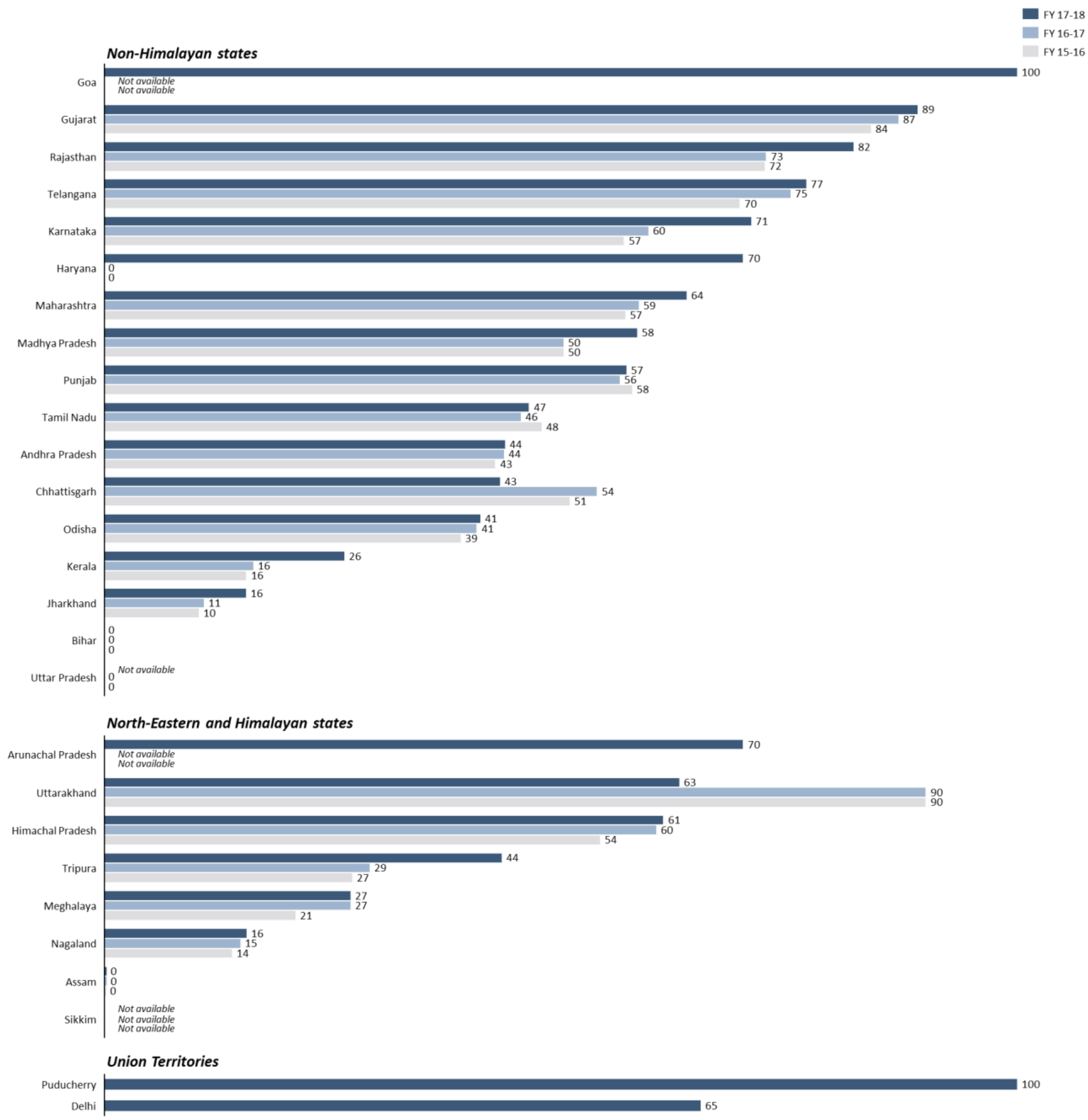
Indicator 27 measures the percentage of urban households being charged for water supply across states. This indicator is important because pricing of water not only ensures sustainability and improvement of water infrastructure and utilities, but also encourages efficient water use by households in an increasingly water scarce environment.

Uttar Pradesh and Sikkim were unable to report data on the indicator and have been scored nil on the indicator in the Index calculation.

| **Key highlights** | | |
|---|---|---|
| | **Non-Himalayan states** | **North-Eastern and Himalayan states** |
| **Top Performer** | Goa | Arunachal Pradesh |
| **Bottom Performer** | Bihar | Assam |
| **Median Score** | 57.80% | 43.55% |
| **1-year Median Change** | +9.79% | +15.51% |

**Figure 58: Indicator 27: Percentage of households being provided water supply and charged for water in the urban areas as on the end of the given FY**

*In % (FY 15-16, FY 16-17, FY 17-18)*




**Overall, the proportion of households charged for water supply has increased between the base year and reference year, with the median state charging 58% households for water supply.** The overall median increased from 45% in FY 15-16 to 58% in FY 17-18, while it remained constant between FY 15-16 and FY 16-17. Further, 14 out of 25 reporting states have more than 50% of urban household paying for water supplied to their premises as per FY 17-18 data. Goa and Puducherry reported 100% urban households being charged for water supply. While the indicator trend looks positive, states such as Bihar and Assam have reported negligible proportion of households being charged for the water supplied, while Jharkhand and Nagaland reported figures below 20% on the indicator. Additionally, Uttarakhand has reported a decline of 27 percentage points on the indicator between the base and reference year.

**Water pricing can be powerful tools to control water demand, as demonstrated by Sao Paulo's hybrid water pricing structure.** Sao Paulo's water and sewage management company, post the 2014-15 droughts, introduced water pricing incentives which included subsidies as well as taxation provisions to influence consumer behaviour and tackle the city's water crisis. The programme involved rewarding customers that displayed a decrease in average consumption through discount on water price and sewage tariffs, while imposing a contingency fee on customers consuming higher quantities of water compared to previous levels, through taxes, fees, and higher per unit charges. This hybrid water pricing approach enabled a 25% reduction in the water consumption in the city.[205]

Some Indian cities such as Hyderabad and Indore have also taken initiatives for improving billing and collection. In Hyderabad, bills are raised on a bi-monthly basis for domestic users and payments can either be made online or at e-centres across the city that have designation cash collection counters. In Indore, the municipal corporation has introduced penalties on illegal water connections since 2007, where any non-registered user who is tracked, is required to pay a charge for legalization, in addition to payment of one year's water tariff. States can learn from such examples to widen their customer base as well as improve their revenues.[206]

**Theme 9: Policy and governance**
***[15 points]***

| Indicator 25: Whether the State has enacted any legislation for protection of waterbodies and water-supply channels and prevention of encroachment into/on them? | Indicator 26: Whether the State has any framework for rain water harvesting in public and private buildings? | Indicator 27: Percentage of households being provided water supply and charged for water in the urban areas as on the end of the given FY | **Indicator 28: Does the State have a separate integrated Data Centre for water resources? If yes, then is the data being updated on the integrated data centre on a regular basis?** |
|---|---|---|---|

Indicator 28 measures the performance of states in establishing and updating water data systems. It has two binary sub-parts—part (a) specifies whether the state has established an integrated data centre for water resources, and part (b) specifies whether this data is being updated regularly. Water data is critical to adequately assess and solve the water problems in the country through targeted policymaking and broader ecosystem innovation. Delhi was unable to report data on both the sub-indicators and has been scored nil on the indicators in the Index calculation.

205 Paula Soto Rios et al., "Explaining Water Pricing Through A Water Security Lens", *Water* 10, no. 9 (2018): 1173, accessed May 9, 2019, https://www.mdpi.com/2073-4441/10/9/1173/htm.

206 *Cost Recovery in Urban Water Services: Select Experiences in Indian Cities* (Water and Sanitation Programme, 2011), https://www.wsp.org/sites/wsp/files/publications/WSP-Cost-Recovery-Urban-Water-Services.pdf.

**Figure 59: Indicator 28 (a): Does the state have a separate integrated Data Centre for water resources?**

*(FY 17-18)*

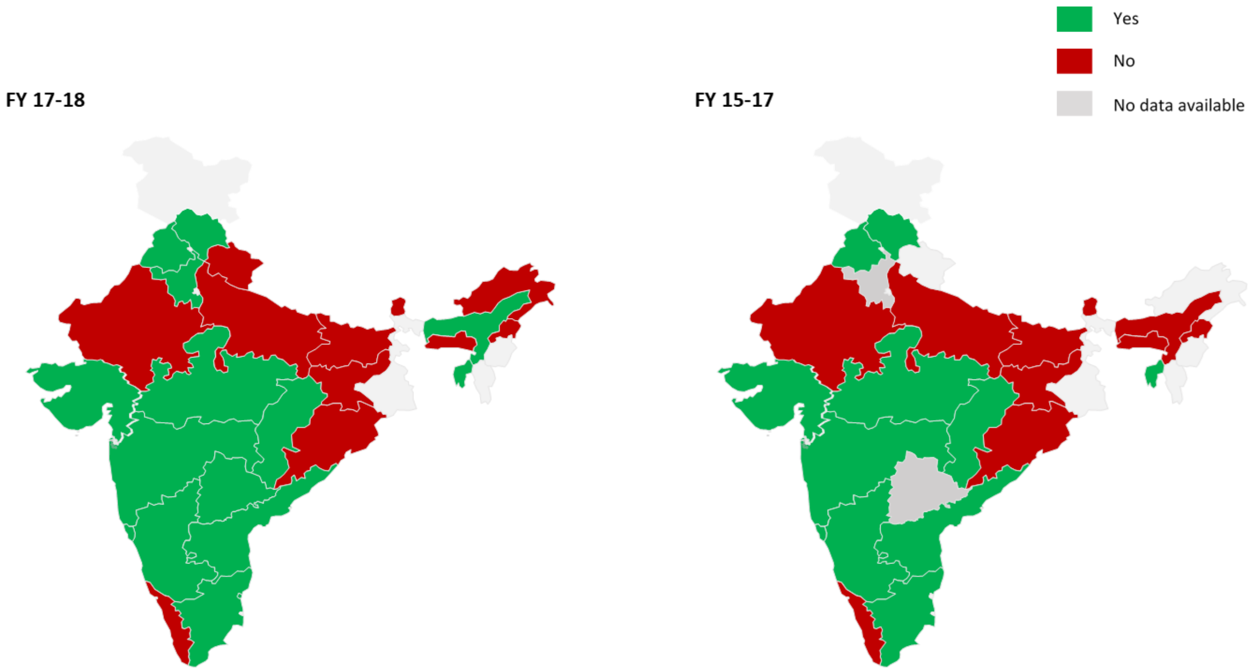
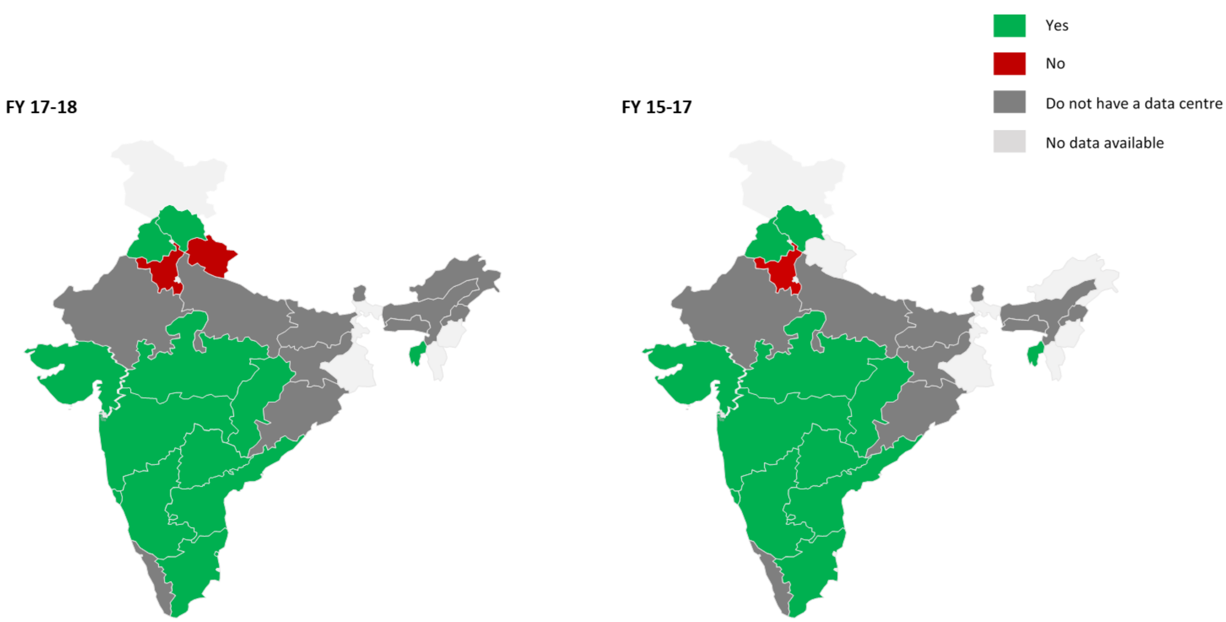



**Figure 60: Indicator 28 (b): Whether the data is being updated on the integrated data centre on a regular basis?**

*(FY 17-18)*




**Overall, ~60% states and UTs have established integrated water data centres and majority states update data on these centres regularly.** 15 out of 26 reporting states and UTs have integrated data centres, out of which 13 reported updating them regularly. Large non-Himalayan states such as Uttar

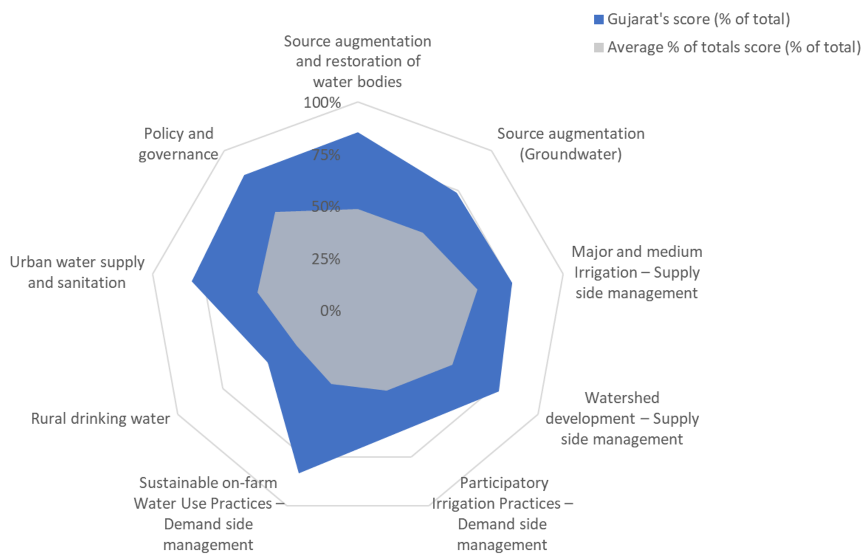
Pradesh, Rajasthan, and Bihar are yet to institute water data centres, suggesting that data for a significant population proportion is still unavailable. Amongst the North-Eastern and Himalayan states, Himachal Pradesh, Assam, and Tripura have established integrated water data centres, and regular data updates are a practice in Himachal Pradesh and Tripura. Delhi did not report data on both these indicators.

While data collection seems to be becoming a priority for states, the robustness and frequency of this data is yet to be ascertained. Further, enabling application of this data by decision-makers, is another aspect states should focus on. Water data can play a critical role in supporting state and central government with effective policymaking, and is the one of the key principles promoted by the Index.

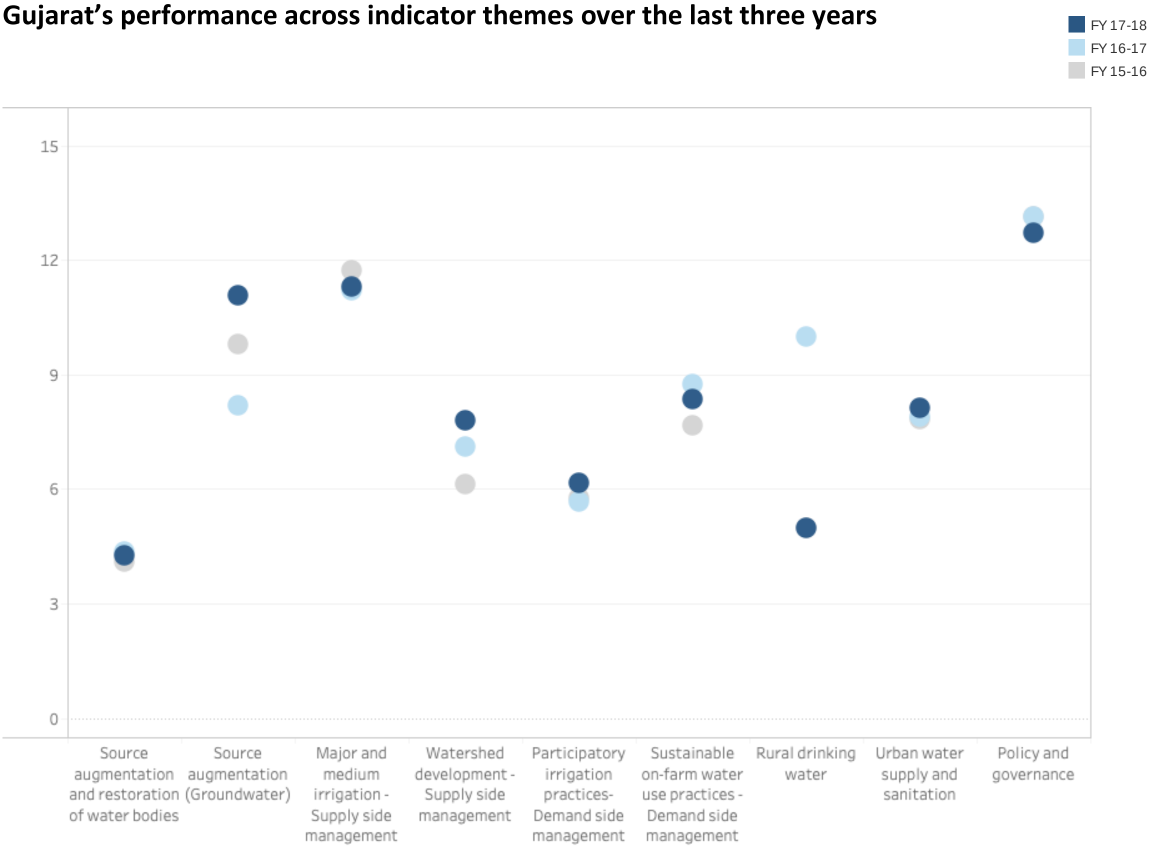
### *Highest and lowest-performing states*

The performance of the highest and lowest performing states across the themes is displayed below, with thematic performance for each state detailed out in the annex.

**Figure 61: Highest performing state – Gujarat's performance across indicator themes**



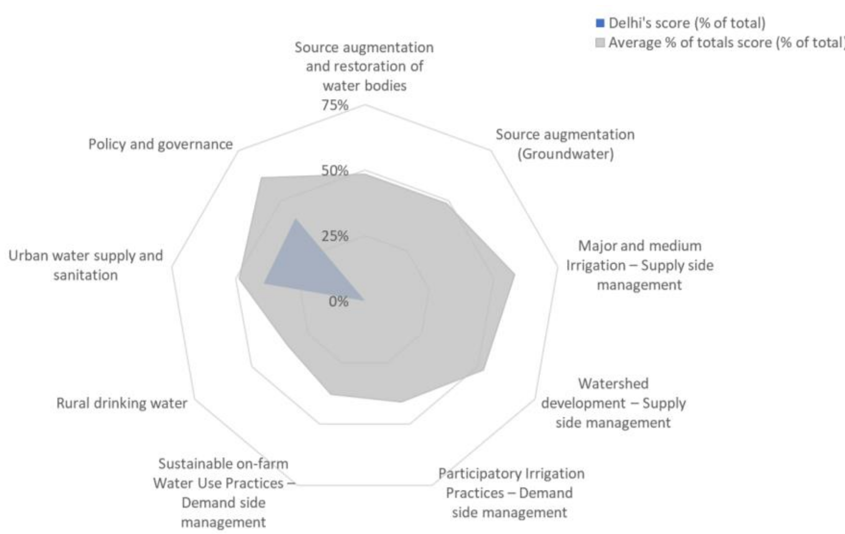

**Gujarat's performance across indicator themes over the last three years**



**Gujarat continues to be the highest scoring state in FY 17-18, with strong performance across majority indicators.** Gujarat scored 74.77 points in FY 17-18 and maintained its top position on the Index from FY 15-16 and FY 16-17. This score is higher compared to its score of ~71 points in FY 15-16, but lower than its FY 16-17 score of ~76 points. The state displays solid performance across all 9 themes, demonstrated through above-average scores in all of them. It also ranked among the top 3 states in its category in 6 out of 9 themes in FY 17-18. Additionally, Gujarat has improved its scores on 6 out of 9 themes between FY 15-16 and FY 17-18, although its performance slipped on the rural drinking water theme by 5 points. This was due to poor performance of the state on the 2 new indicators related to water delivery service included under the theme in FY 17-18.

As reported by print media, incidents of droughts and water shortages are increasing in the state.[207] Gujarat should focus on further optimizing use of its water resources. Increasing pressure from such incidents is falling on the farmers in the state and threatening industrial operations in the state. Given such circumstances, the state should focus on further solidifying it water management practices. A Comptroller and Auditor General of India (CAG) report recommends that the state should look into development of long-term water conservation plans, water audits of irrigation projects, adoption of modern technologies for minimizing water losses, and drafting guidelines for maintenance works such as silting,[208] all of which can help improve water management further in the state.

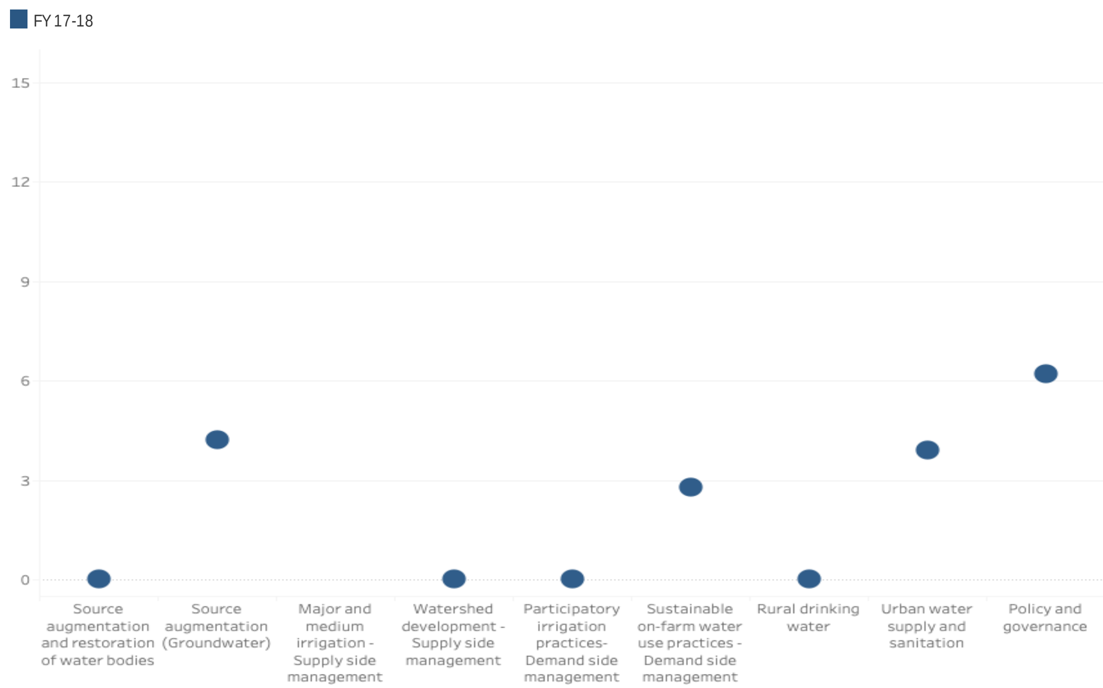
**Figure 62: Lowest performing state – Delhi's performance across indicator themes**




[207] "Severe Water Crisis: With Water Crisis Looming, Gujarat to Cut Supply to Cities | Ahmedabad News", *The Times of India*, accessed May 8, 2019, https://timesofindia.indiatimes.com/city/ahmedabad/with-water-crisis-looming-gujarat-to-cut-supply-to-cities/articleshow/62733553.cms.; Himanshu Kaushik, "Drought Hits Gujarat Every 3 Years: Report ", *The Times of India*, accessed May 1, 2019, https://timesofindia.indiatimes.com/india/Drought-hits-Gujarat-every-3-years-Report/articleshow/49264062.cms?.

[208] *Report of the Comptroller and Auditor General of India on Economic Sector for the year ended 31 March 2016* (Principal Accountant General*)*, http://paggujarat.nic.in/Reports/Economic_sector_2016_English.pdf

**Delhi's performance across indicator themes over the last three years** [209]




**Delhi's data reporting challenges land the national capital as the bottom performer for FY 17-18 with 20.16 points.** Delhi, one of the two UTs included in the Index, ranks at the bottom but poor data reporting is a substantial reason behind it. Delhi failed to report data on 12 indicators and reported nil figures on few other. As a result, it scores zero points on 4 themes which collectively make up a little more than 40% of the maximum score in Delhi's case. This limits the potential to understand Delhi's water management performance through the Index and compare it with other state UTs.

Looking beyond the Index, Delhi faces several water-related challenges such as water access for the urban poor residing in slums and discharge of untreated sewage and industrial waste into river bodies such as the Yamuna. It also ranked second in the list of 20 largest water stressed cities in the world in 2015,[210] highlighting serious water management concerns for the national capital.

Given the need and importance of data-driven policymaking and governance for tackling the constantly evolving water challenges, it is essential for the national capital to improve its water data practices. Establishing an integrated data-centre for water resources can potentially help in institutionalizing these practices as a beginning step, and the state can further utilize such platforms to design targeted policies and programmes to manage its water resources better.

---

209 Delhi was not assessed on the Index for FY 15-16 and FY16-17, and has not been assessed on the Medium and major irrigation theme in FY 17-18. Therefore, scores for the mentioned years and above-mentioned theme have not been represented

210 Robert I. McDonald et al., "Water on An Urban Planet: Urbanization and The Reach of Urban Water Infrastructure", *Global Environmental Change* 27 (2014): pages 96-105, https://reader.elsevier.com/reader/sd/pii/S0959378014000880?token=E775C73DFB24216D6ABC44F469E2B8E0094A6A66185643AB1F6D63F82A38F60B5AC1202C5D444D2C9C78C851EFB1C4B3.

# CONCLUSION

**The establishment of the Composite Water Management Index (CWMI) in 2017 was a landmark achievement in the context of India's water management.** The large-scale reception of the report and its findings is indicative of its impact. Since the publication of the first report in 2018, the report has received over 33,000 media mentions[211], and been cited by top media houses and publications including The Economic Times, India Today, Huffington Post, The Wire, The Hindu, Live Mint, Hindustan Times, Business Standard, Financial Express, and Down to Earth, among others. These headline stories have spurred debate and discussion on India's water crisis at a regional and national level and brought India's water crisis and needed remedies to the center-stage of civic and policy discussions. These conversations are a core component of a strong and health democracy and how it approaches crisis of national importance that affects citizens across the board.

**In order to tackle the multi-faceted drivers and impacts of water scarcity, states must adopt a water lens into policy making and planning across sectors.** This year's report highlights the major risks to India's social, economic, and environmental health due to the water crisis**,** over and above the findings on state performance, that help establish the case for urgent improvements in our water management. This macro-view and cross-sectoral view of India water problems are intended to help state administrators take a more holistic view of water in their policy making. These risks, together with the findings of the report, make it clear that federal and state institutions must use a water lens in policy making across all water-related sectors including agriculture, industry, energy, urban and rural development, and environment. Without this, the root causes of the water problem (such as from agricultural, industrial, and urban water use), and their multi-dimensional impacts, will not be addressed. Importantly, states must supplement urgent top-down water legislations with a grassroots management approach that involves local community organizations, NGOs, farmer groups, and industry bodies in ideation and implementation of water related policies and projects.

**The Index and its annual reporting are one step in a long journey towards improved water management**, and focus on setting the necessary foundation of a high-quality data culture within federal and state water institutions. The Index and its associated activities seek to evolve as states build on this foundation of a rigorous water data culture. This process of evolution includes building in a strong focus on advocacy efforts with states to help them understand the results and their implications on state policy making and water administration.

---

211 Based on Google search results for "Composite Water Management Index" as on May 15, 2019

# INDIA'S WATER SITUATION: AT GLANCE

**India is suffering a very significant water crisis with economic growth, livelihoods, human well-being, as well as ecological sustainability at stake.** We feel and know this anecdotally when the rains falter, when we see long lines of people waiting to get water from tankers in our cities, or when we see pictures of farmers and their crops devastated due to a lack of adequate water.

**The macro-water availability and numbers are unsettling - India is home to ~17% of world's population but has only 4% of the world's freshwater resources**,[212] and managing these disproportionately small resources for a huge population is a herculean task. About two lakh people die every year due to inadequate water, sanitation and hygiene,[213] and ~820 million people[214] of India - living in twelve river basins across the country have per capita water availability close to or lower than 1000m$^3$ – the official threshold for water scarcity as per the Falkenmark Index.[215] ~60% of this population (~495 million)[216] belongs to the Ganges river basin which generates nearly 40 percent of the country's GDP[217]. According to a study,[218] the Ganges has witnessed unprecedentedly low levels of water in several lower reaches in the last few summer seasons, and for the next 30 years, groundwater contribution to the river will continue decreasing. The dwindling of the Ganges river would severely affect water available for surface water irrigation, with potential future decline in food production. Consequently, by 2050, nearly 1/5th (~115 million) of the ~500 million inhabitants in the Ganga Basin would not have adequate access to carbohydrate-based food essential for survival.

**The annual utilizable water resources in the country are 690 BCM from surface sources and 447 BCM from groundwater.[219]** In spite of possessing surface water resources, India is highly dependent on groundwater resources for day to day survival. The per capita water storage capacity in India is about 209 m$^3$ which is meagre in comparison to per capita storage capacities in countries like Australia (3223 m$^3$), The USA (2193 m$^3$), Brazil (2632 m$^3$) and China (416 m$^3$).[220] According to Central Groundwater Board (CGWB), contribution of groundwater is nearly 62% in irrigation, 85% in rural water supply and 45% in

---

212 *Climate Change Impacts on Water Resources in India* (Indian Institute of Tropical Meteorology, 2014), page 2, http://www.indiaenvironmentportal.org.in/files/india-climate-5-water-DEFRA.pdf

213 "3 Maps Explain India's Growing Water Risks", *World Resources Institute*, accessed May 16, 2019, https://www.wri.org/blog/2015/02/3-maps-explain-india-s-growing-water-risks.; "GHO | By Category | Burden of Disease - Burden of Disease from Inadequate Water in Low- and Middle-Income Countries", *WHO*, accessed May 16, 2018, http://apps.who.int/gho/data/view.main.INADEQUATEWATERv?lang=en.

214 *Water and Related Statistics* (Central Water Statistics, 2015), page 31, http://www.indiaenvironmentportal.org.in/files/file/Water%20&%20Related%20Statistics%202015.pdf.

215 Simon Damkjaer and Richard Taylor, "The Measurement Of Water Scarcity: Defining A Meaningful Indicator", Ambio 46, no. 5 (2017): page 513-531, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5547033/.

216 *Water and Related Statistics* (Central Water Statistics, 2015), page 31, http://www.indiaenvironmentportal.org.in/files/file/Water%20&%20Related%20Statistics%202015.pdf.

*217* *The National Ganga River Basin Project, The World Bank*, https://www.worldbank.org/en/news/feature/2015/03/23/india-the-national-ganga-river-basin-project

218 Abhijit Mukherjee, Soumendra Nath Bhanja and Yoshihide Wada, "Groundwater Depletion Causing Reduction of Baseflow Triggering Ganges River Summer Drying", *Scientific Reports* 8, no. 1 (2018): pages 1-9, https://www.nature.com/articles/s41598-018-30246-7.pdf.

219 *Dynamic Ground Water Resources of India* (Faridabad: Central Ground Water Board, 2017), http://cgwb.gov.in/Documents/Dynamic%20GWRE-2013.pdf.

220 Ministry of Water Resources, *Water Storage Capacity* (Press Information Bureau, 2012), http://pib.nic.in/newsite/PrintRelease.aspx?relid=83836.

urban water supply.[221] The entire green revolution in the country was based on the development of groundwater resources. There are over 20 million wells pumping water with power supply provided by the Government.[222] This has been depleting groundwater, while encouraging wastage of water in many states. A comparison of depth to water level of pre-monsoon 2018 with decadal mean pre-monsoon (2008-2017) reveals that about 52% wells are showing decline in water level.[223]

**Of all the sectors and human activities, agriculture and food security are most intimately tied to water, and also affect water the most**. India's population is expected to increase to 1.66 billion by 2050.[224] At the same time, per capita income is estimated to increase by 5.5% per annum.[225] With increasing population and purchasing power, the annual food requirement in the country will exceed 250 million tons by 2050.[226] The total demand for grains will increase to 375 million tons including grain for feeding livestock by 2050.[227] This will increase the demand for food. While the per capita consumption of cereals will decrease by 9%, 47% and 60%, with respect to rice, coarse cereals and maize, the per capita consumption of sugar, fruits and vegetables will increase by 32%, 65% and 78% respectively.[228] The surge in demand for these water-intensive crops will, ceteris paribus, multiply our current agricultural consumption of water. The requirement of water for livestock will rise from 2.3 BCM in 2000 to 2.8 BCM in 2025 and 3.2 BCM in 2050.[229]

**A closer look at cropping patterns in the Indian states reveals a frightening inefficiency and sub-optimal planning that is causing most water related problems, including depletion of the ground water tables at an alarming rate**. According to an ICRIER study,[230] water guzzling crops like sugarcane and paddy are grown in states like Maharashtra, Uttar Pradesh (UP) and Punjab, using up lakhs of litres of irrigation water per hectare. Despite the intensive water requirement, Maharashtra grows 22% of the total sugarcane output in the country, whereas Bihar grows only 4% of the total sugarcane output. In addition, nearly 100% of the sugarcane crop in Maharashtra is grown through irrigated water, while parts of the state are already facing severe water crisis. Similarly, Punjab, which is the third largest producer of rice in India, grows paddy using nearly 100% irrigation cover. As a result, while Punjab tops the table in land productivity, it uses more than three times the water than Bihar and more than twice the amount of water than West Bengal, to produce one kg of rice. What is more alarming is that 80% of the water used for irrigating the paddy fields in Punjab is drawn from groundwater source.[231]

---

221 Dynamic Ground Water Resources of India (Central Ground Water Board, 2017), page 1, http://cgwb.gov.in/Documents/Dynamic%20GWRE-2013.pdf.

222 Reassessment of Water Availability India Using Space Inputs (Central Water Commission, 2017), page 4 http://www.indiaenvironmentportal.org.in/files/file/Reassessment%20of%20Water%20Availability%20-Main%20Report.pdf.

223 As per data submitted by Central Ground Water Board.

224 Reassessment of Water Availability India Using Space Inputs (Central Water Commission, 2017), page 4 http://www.indiaenvironmentportal.org.in/files/file/Reassessment%20of%20Water%20Availability%20-Main%20Report.pdf.

225 Ibid.

226 Ibid.

227 Ibid.

228 Ibid.

229 Ibid.

230 Ashok Gulati and Gayathri Mohan, Towards Sustainable, Productive and Profitable Agriculture: Case of Rice and Sugarcane, Working Paper 38 (Indian Council for Research on International Economic Relations, 2018), page 6, http://icrier.org/pdf/Working_Paper_358.pdf.

231 "Misaligned Agriculture: A Major Source of India's Water Problems", *Forbes India*, last modified 2018, accessed May 6, 2019, http://www.forbesindia.com/article/iim-bangalore/misaligned-agriculture-a-major-source-of-indias-water-problems/50693/1.

**Further, our international trade in agricultural commodities & industrial produce is contributing to large quantities of virtual water loss through the export of water-intensive crops**. As an illustration, India exported more than 10 trillion litres of embedded or virtual water through the export of ~37 lakh tonnes Basmati rice in 2014-15, alone, which could have been used to grow much larger quantities of other crops such as wheat or millet that have far less water requirements.[232] Similarly, our industrial exports are not regulated based on the amount of virtual water export they end up causing.

**The scarcity of water resources has many cascading effects including desertification, risk to biodiversity, industry, energy sector and risk of exceeding the carrying capacity of urban hubs**. The increased scarcity of water affects the broad spectrum of economic, social and developmental activities of the nation. It not only affects Gross Domestic Product (GDP) directly in the form of loss of productivity of agriculture, industrial and service sector (including infrastructure) but also decreases the ability of the population to think, invent and produce which indirectly hampers the growth of the nation.

**30% of Indian land is degraded or faces desertification, and this outcome is strongly linked to poor water management.**[233] Extensive groundwater extraction contributes to loss of vegetation cover, which eventually leads to desertification. Increasing desertification and land degradation diminishes green cover, which reduces the land's capacity to recharge groundwater and regional water tables. According to the United Nations Convention to Combat Desertification (UNCCD), land degradation can also cause up to 4% losses in Agricultural Domestic Product in the future for India.[234]

**Another aspect of water which needs to be addressed urgently is the management of waste water.** The per person disease burden due to unsafe water and sanitation was 40 times higher in India than in China and 12 times higher than in Sri Lanka in 2016.[235] With a country generating 140 BCM of waste water annually[236], mismanagement of waste water which also contaminates groundwater, lack of liquid waste management, poor sanitation conditions and poor hygiene habits has contributed to a major portion of population suffering from water-borne diseases. Water borne diseases are now a common phenomenon in both rural and urban areas. The growing population of Indian cities due to natural growth of population and migration has made our cities unsustainable and mindless urban expansion along with overexploitation of existing water resources has adversely affected the carrying capacity of the cities. According to a study,[237] 5 of the 20 world's largest cities under water stress are in India, with Delhi being 2$^{nd}$ on the list.

**Water shortages in the country can also hamper industrial operations and other economic activity, and threaten India's aspirations to become an economic superpower.** Water shortages are already

---

232 "Export of Rice Export from India", *Directorate of Rice Development*, accessed May 6, 2019, http://drdpat.bih.nic.in/.

233 *Economics of Desertification, Land Degradation and Drought in India: Vol I: Macroeconomic Assessment of The Costs of Land Degradation in India* (The Energy and Resources Institute (TERI), 2018), page 4, https://www.teriin.org/sites/default/files/2018-04/Vol%20I%20-%20Macroeconomic%20assessment%20of%20the%20costs%20of%20land%20degradation%20in%20In.

234 *Desertification: The Invisible Frontline* (UNCCD, 2014), page 8, https://www.unccd.int/publications/desertification-invisible-frontline-second-edition.

235 *India: Health of the Nation's States-The India State-level disease burden initiatives* (ICMR, PHFI, IHME, 2017), page 200, https://www.healthdata.org/sites/default/files/files/policy_report/2017/India_Health_of_the_Nation%27s_States_Report_2017.pdf.

236 *Strategy for New India@75* (NITI Aayog, 2018), page 102, https://niti.gov.in/writereaddata/files/Strategy_for_New_India.pdf

237 Robert I. McDonald et al., "Water on An Urban Planet: Urbanization and The Reach of Urban Water Infrastructure", *Global Environmental Change* 27 (2014): pages 96-105, https://reader.elsevier.com/reader/sd/pii/S0959378014000880?token=E775C73DFB24216D6ABC44F469E2B8E0094A6A66185643AB1F6D63F82A38F60B5AC1202C5D444D2C9C78C851EFB1C4B3

impacting and will continue to impact the sector in the form of erratic and insufficient water supply, hampering production processes and efficiency. Worst affected industries are likely to include water-intensive sectors such as Food & Beverages, Textiles, and Paper & Paper Products. Amongst these, the Textiles industry alone contributes 4% toward India's GDP, 14% to the national industrial production, and accounts for 17% of the country's foreign exchange earnings.[238] The thermal power sector which constituted more than 83% of India's total utility power generation in 2016 and remains a major source of energy for all commercial activities is also adversely affected due to water shortage.[239] 70% of India's thermal power plants will face high water stress by 2030,[240] and will severely hamper India's energy production and economic activity. This critical source of energy will be threatened as freshwater resources decline, since 90% of thermal power plants in India rely on freshwater sources for cooling,[241] an essential process in thermal energy production. 40% of India's thermal power plants are in water-scarce regions and already beginning to face operational challenges. 14 of India's 20 largest thermal utilities faced at least one shut down between 2013-16 due to water scarcity, which cost companies and investors USD 1.4 billion.[242]

**Water scarcity can seem difficult to full grasp, given the dichotomous ways in which water is affecting habitations**. On the one hand, the low-lying areas are getting submerged due to rise in ocean water and on the other hand, droughts are becoming a common phenomenon in highly populated regions. In India, during 1996-2015, nearly 19 million and 17.5 million people annually were simultaneously affected by floods and droughts, respectively.[243] In a curious irony, both scarcity and excess of water are affecting habitations.

To tackle the complex water challenge facing India, it is imperative to take a holistic view of water, starting with the hydrological system, the interactions of this system with climate change on the one hand, and with human factors across agriculture, industrial, and energy production activity on the other.

There is an imminent need to deepen our understanding of the limited available water resources and their usage, and put in place interventions that make water use efficient and sustainable. The entire country needs to act now and take radical steps to manage and use water more responsibly.

It is hoped that the CWMI provides a source of comprehensive and meaningful truths around water in India and catalyzes greater action across regions to a more water-secure India.

---

238 WWF-India and Accenture Services, *Water Stewardship for Industries: The Need for a Paradigm Shift in India* (WWF-India, 2013), page 18, http://www.indiaenvironmentportal.org.in/files/file/water%20stewardship%20for%20industries_0.pdf

239 Luo Tianyi, Deepak Krishnan and Shreyan Sen, *Parched Power: Water Demands, Risks, and Opportunities for India's Power Sector* (World Resources Institute, 2018), pages 1-7, https://wriorg.s3.amazonaws.com/s3fs-public/parched-power-india-0130.pdf?_ga=2.47442850.464575563.1557999082-1758852555.1556721696.

240 Ibid.

241 Ibid.

242 Supra note 56.

243 World Water Assessment Programme, *The United Nations World Water Development Report 2019: Leaving No One Behind* (UNESCO, 2019), page 16, https://unesdoc.unesco.org/ark:/48223/pf0000367306.

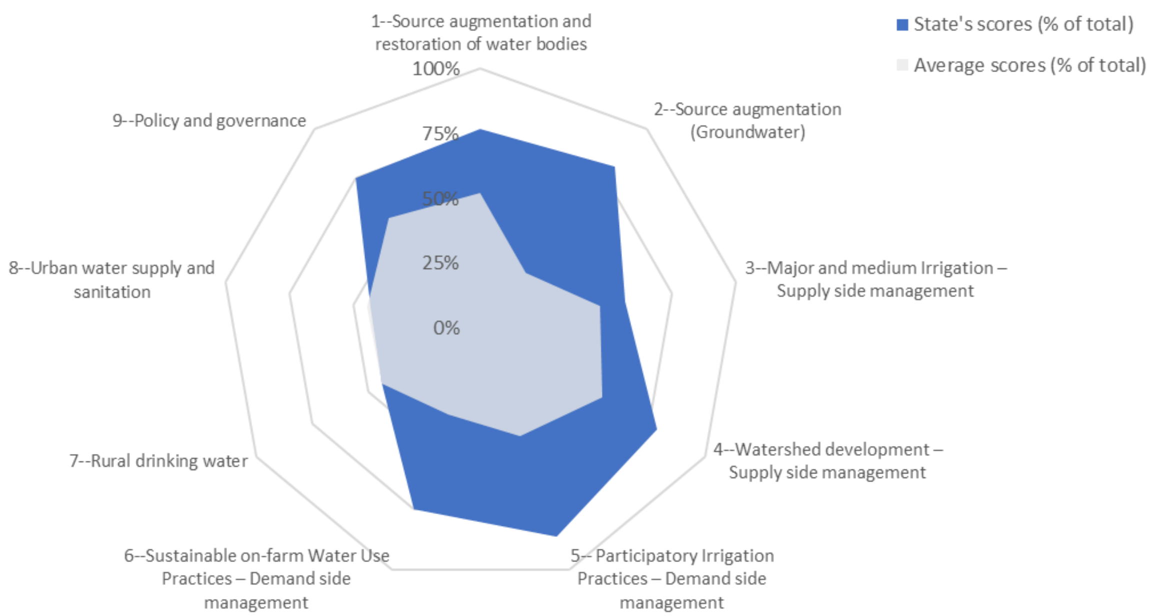
# ANNEXURE

## State profiles

This section contains an overview of CWMI performance for all states and UTs, categorized as 'non-Himalayan states' 'North-Eastern and Himalayan states', and 'Union Territories'.

The legend diagram below specifies the numbers corresponding to different themes in the thematic performance diagrams in the overviews, and the representation of a state's performance vs. the average performance.

**Figure 63: Legend diagram for thematic performance specifying theme numbers and with sample data displays**



## Non-Himalayan states: Andhra Pradesh

### Figure 64: Overview of Andhra Pradesh's CWMI performance

**STATE**

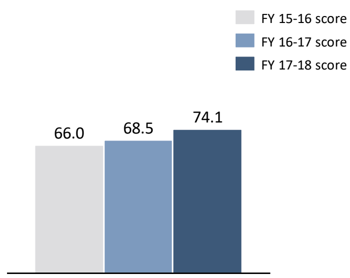
**ANDHRA PRADESH**

**KEY INDICATORS**

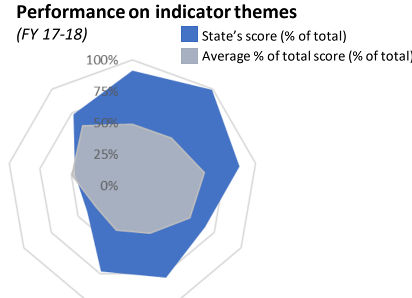
- **Population:** 8.5 crore
- **Proportion of national economic output[1]:** 4.5%
- **Proportion of national agri. output[2]:** 3.7%
- **Proportion of national rainfall[3]:** 1.4%
- **Proportion of national GW[4]:** 4.6%

**PERFORMANCE**

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




**LEARNINGS**

**Things going well**

- *Surface water restoration:* The state has restored ~90% of the irrigation potential of identified water bodies
- *Groundwater restoration:* All over-exploited wells in the state have been mapped and have recharging infra, enabling rise in water table for ~75% such units
- *Participatory irrigation:* ~70% of irrigated area is maintained by WUAs, which retain a large portion of the service fee

**Things to improve**

- *Rural drinking water:* Less than 10% reduction in rural habitations affected by water quality issues
- *Wastewater treatment:* <33% of wastewater is treated due to low installed capacity
- *Urban water pricing:* More than 50% of urban households are not charged for water, leading to overuse

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

## Non-Himalayan states: Bihar

### Figure 65: Overview of Bihar's CWMI performance

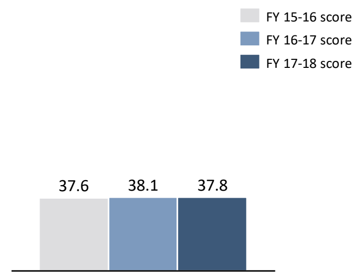
| STATE | PERFORMANCE | LEARNINGS |
|---|---|---|

**BIHAR**

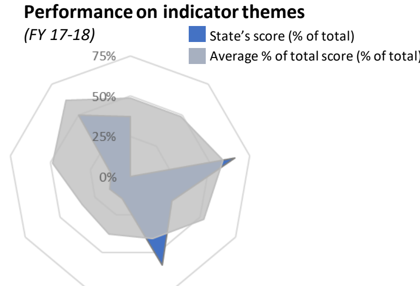
**KEY INDICATORS**

- **Population:** 10.4 crore
- **Proportion of national economic output[1]:** 2.9%
- **Proportion of national agri. output[2]:** 4.8%
- **Proportion of national rainfall[3]:** 1.8%
- **Proportion of national GW[4]:** 7%

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




**Things going well**

- *Irrigation utilization:* 80% of the irrigation potential, created by the state's >100 MMI projects, is utilized, and over 95% projects have been assessed for utilization gaps

**Things to improve**

- *On-farm water use:* Only 5% of area is cultivated as per agro-climatic zoning, and electricity feeder segregation has not begun
- *Participatory irrigation:* Only 3% area in the state has WUA involvement in irrigation O&M activities
- *Urban water supply:* <25% of the urban population has access—one of the lowest in India

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

## Non-Himalayan states: Chhattisgarh

## Figure 66: Overview of Chhattisgarh's CWMI performance

**STATE**

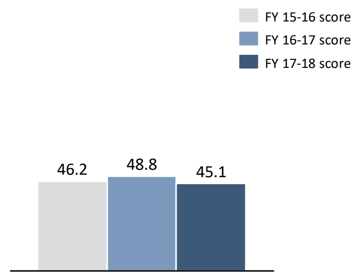
**CHATTISGARH**

**KEY INDICATORS**

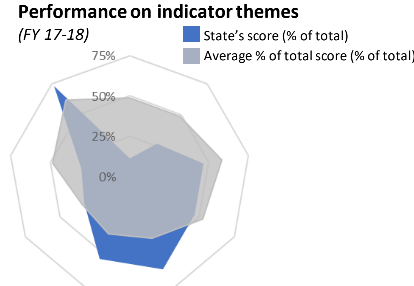
- **Population:** 2.6 crore
- **Proportion of national economic output[1]:** 1.9%
- **Proportion of national agri. output[2]:** 1.5%
- **Proportion of national rainfall[3]:** 1.9%
- **Proportion of national GW[4]:** 2.9%

**PERFORMANCE**

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




**LEARNINGS**

**Things going well**

- *Participatory irrigation:* >80% of irrigated area in the state is maintained by WUAs
- *On-farm water use:* 95% land is cultivated as per agro-climatic zoning
- *Rural drinking water*: 98% rural population is fully covered with drinking water supply
- *Policy & data:* The state has enacted legislation for conservation, and regularly updates its data centre

**Things to improve**

- *Groundwater restoration:* <20% of the over-exploited and critical units have been mapped and have recharging infrastructure
- *Irrigation access:* The state has >60% of cultivated area that is rain-fed, and has constructed only ~40% of target water harvesting structures
- *Wastewater treatment:* The state has negligible treatment rates, even with increasing capacity

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

## Non-Himalayan states: Goa

### Figure 67: Overview of Goa's CWMI performance

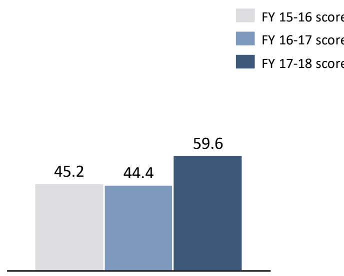
**STATE** | **PERFORMANCE** | **LEARNINGS**

**GOA**

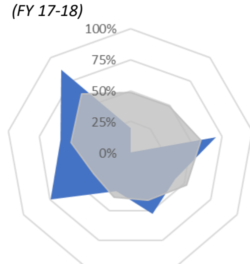
**KEY INDICATORS**

- **Population:** 0.1 crore
- **Proportion of national economic output[1]:** 0.4%
- **Proportion of national agri. output[2]:** <1%
- **Proportion of national rainfall[3]:** 4.6%
- **Proportion of national GW[4]:** 0.1%

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




**Things going well**

- *Rural drinking water:* The state has covered all of its rural habitations, and no water quality issues exist
- *Urban water:* The state provides drinking water to its entire urban population, and utilizes 100% of its wastewater treatment capacity
- *Policy & data:* The state has enacted legislations for water conservation, charges 100% urban households for water, and regularly updates its data centre

**Things to improve**

- *On-farm water use:* The state has not segregated power feeders for agriculture
- *Surface water restoration:* Only 20% of irrigation potential has been restored from identified water bodies

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

## Non-Himalayan states: Gujarat

### Figure 68: Overview of Gujarat's CWMI performance

**STATE**

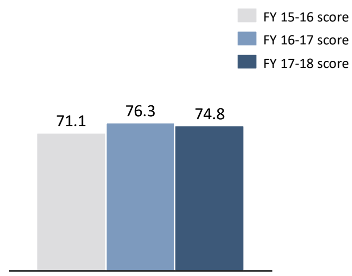
**GUJARAT**

**KEY INDICATORS**

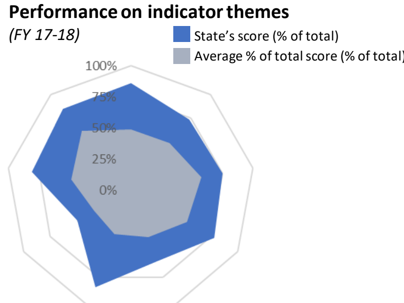
- **Population:** 6 crore
- **Proportion of national economic output[1]:** 7.4%
- **Proportion of national agri. output[2]:** 4.5%
- **Proportion of national rainfall[3]:** 1.3%
- **Proportion of national GW[4]:** 4.7%

**PERFORMANCE**

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




**LEARNINGS**

**Things going well**

- *Groundwater restoration:* All over-exploited wells in the state have been mapped and have recharging infra, enabling water table rise for ~75% units
- *On-farm use:* 100% cultivation happens as per agro-climatic zoning, 100% power feeders segregation exists, and >35% area is irrigated using micro-irrigation
- *Urban water:* 100% of the urban population is fully covered with drinking water, and ~90% urban population is charged for water supply

**Things to improve**

- *Participatory irrigation:* WUAs' role in O&M is currently limited to ~35% of command area and can be further improved
- *Rural drinking water:* The state reported nil figures for villages having 24*7 piped water supply and individual household meters, and has brought down theme score by 50% between FY 16-17 and FY 17-18

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

## Non-Himalayan states: Haryana

### Figure 69: Overview of Haryana's CWMI performance

**STATE**

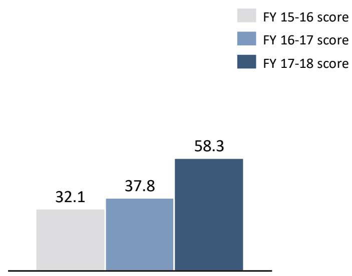
**HARYANA**

**KEY INDICATORS**

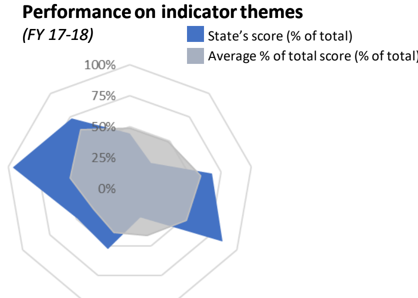
- **Population:** 2.5 crore
- **Proportion of national economic output[1]:** 3.6%
- **Proportion of national agri. output[2]:** 4.3%
- **Proportion of national rainfall[3]:** 0.7%
- **Proportion of national GW[4]:** 2.5%

**PERFORMANCE**

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




**LEARNINGS**

**Things going well**

- *Irrigation utilization & O&M:* The state utilizes ~80% irrigation potential, has 2nd highest per unit irrigation O&M expenditure, and has lined >85% of identified canals
- *Rural drinking water:* Haryana provides drinking water to close to 100% of it rural population, and has achieved 100% decline in water quality related issues
- *Wastewater treatment:* Haryana's treats 100% of its urban wastewater, the only state to do so

**Things to improve**

- *Groundwater restoration:* <20% of the identified wells in the state have experienced rise in water table
- *On-farm use:* The large agriculture producing state has less than 2% area covered with micro irrigation systems

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

## Non-Himalayan states: Jharkhand

### Figure 70: Overview of Jharkhand's CWMI performance

**STATE**

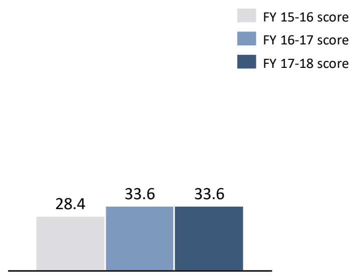
**JHARKHAND**

**KEY INDICATORS**

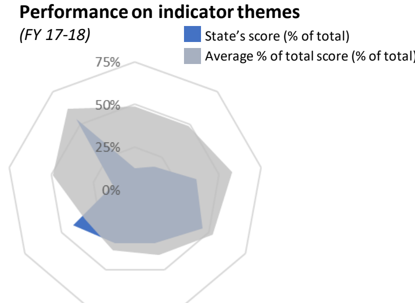
- **Population:** 3.3 crore
- **Proportion of national economic output[1]:** 1.7%
- **Proportion of national agri. output[2]:** 1%
- **Proportion of national rainfall[3]:** 1.9%
- **Proportion of national GW[4]:** 1.5%

**PERFORMANCE**

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




**LEARNINGS**

**Things going well**

- *On-farm water use:* 93% of the area is cultivated as per agro-climatic zoning in the state
- *Rural drinking water:* Jharkhand has fully covered almost all of its rural habitations, and achieved a 70% decline in water quality incidents

**Things to improve**

- *Groundwater restoration:* The state has <33% area mapped for groundwater recharge, covered <10% mapped area with recharge structures, and doesn't have any groundwater management regulation
- *Wastewater treatment:* Jharkhand is the only 'Non-Himalayan state' with zero treatment capacity

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

## Non-Himalayan states: Karnataka

## Figure 71: Overview of Karnataka's CWMI performance

**STATE**

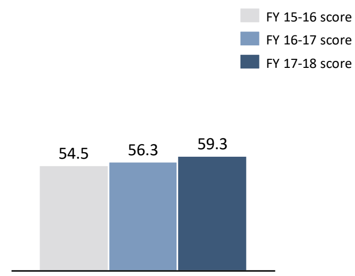
**KARNATAKA**

**KEY INDICATORS**

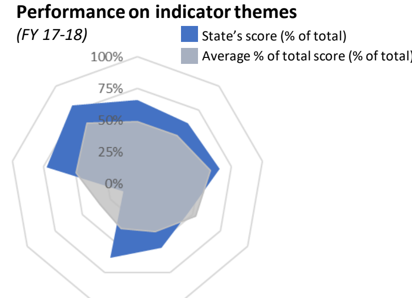
- **Population:** 6.1 crore
- **Proportion of national economic output[1]:** 7.5%
- **Proportion of national agri. output[2]:** 6.8%
- **Proportion of national rainfall[3]:** 1.8%
- **Proportion of national GW[4]:** 3.8%

**PERFORMANCE**

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




**LEARNINGS**

**Things going well**

- *Irrigation utilization:* Karnataka utilizes ~90% of the potential created by its 115 MMI projects
- *On-farm use:* The state has >90% of its cultivated area as per agro-climatic zoning, and the highest micro-irrigation coverage in the country at ~44%
- *Urban water:* The state supplies water to >90% of the urban population, charges ~70% of them, and treats 65% of its urban wastewater

**Things to improve**

- *Participatory irrigation:* While WUAs are involved in irrigation O&M activities in ~60% of command areas, ISF retention by WUAs is <2%
- *Rural drinking water:* >60% of rural habitations are not covered by state for drinking water

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

## Non-Himalayan states: Kerala

## Figure 72: Overview of Kerala's CWMI performance

**STATE**

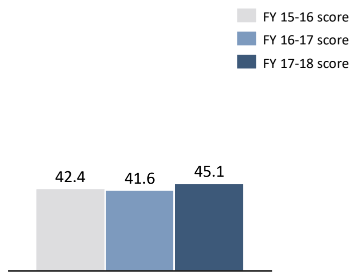
**KERALA**

**KEY INDICATORS**

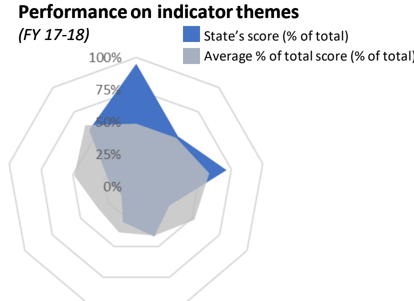
- **Population:** 3.3 crore
- **Proportion of national economic output[1]:** 4.1%
- **Proportion of national agri. output[2]:** 0.1%
- **Proportion of national rainfall[3]:** 4.4%
- **Proportion of national GW[4]:** 1.4%

**PERFORMANCE**

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




**LEARNINGS**

**Things going well**

- *Surface water restoration:* The state has restored 95% of the irrigation potential of identified water bodies
- *Irrigation utilization:* Kerala utilizes 80% of its irrigation potential

**Things to improve**

- *Groundwater restoration:* <30% major groundwater recharge areas have been mapped, and only 5% of such mapped areas are covered with recharge infra
- *Drinking water access:* More than two-third of rural population and one-third of urban population remain uncovered under drinking water supply

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

## Non-Himalayan states: Madhya Pradesh

## Figure 73: Overview of Madhya Pradesh’s CWMI performance

### STATE

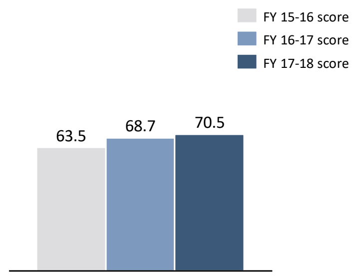
**MADHYA PRADESH**

**KEY INDICATORS**

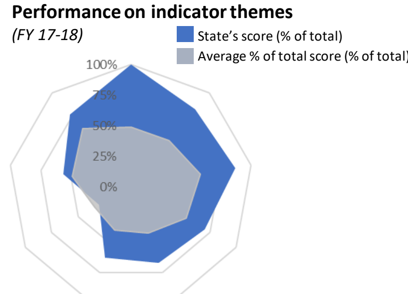
- **Population:** 7.3 crore
- **Proportion of national economic output[1]:** 4%
- **Proportion of national agri. output[2]:** 8.8%
- **Proportion of national rainfall[3]:** 1.3%
- **Proportion of national GW[4]:** 8.1%

### PERFORMANCE

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




### LEARNINGS

**Things going well**

- *Surface and groundwater restoration:* The state has restored ~100% of the irrigation potential of identified bodies, and constructed recharge infra for 100% of mapped groundwater areas
- *Participatory irrigation:* 98% of irrigated area is maintained by WUAs—the highest in the country
- *Urban drinking water:* The state covers 100% urban habitants with drinking water & charges 60% of them for water supply

**Things to improve**

- *Rural drinking water infra:* The state has reported nil figures on villages having 24*7 piped water supply and individual household meters, driving the ~50% decline in state’s theme score between FY 16-17 and FY 17-18
- *Wastewater treatment:* The state treats only ~35% of its urban wastewater due to low installed capacity

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, ‘Rainfall Statistics of India’, 2017; CGWB, ‘Groundwater Year Book’, 2016-17; Statistical Year Book India, 2018

## Non-Himalayan states: Maharashtra

### Figure 74: Overview of Maharashtra's CWMI performance

**STATE**

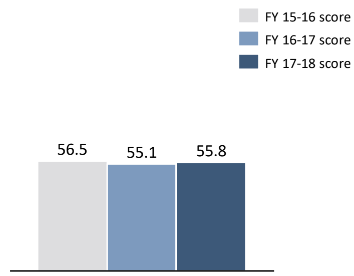
**MAHARASHTRA**

**KEY INDICATORS**

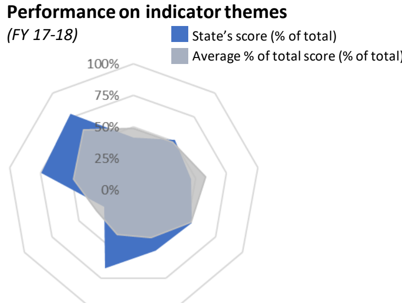
- **Population:** 11.2 crore
- **Proportion of national economic output[1]:** 14.3%
- **Proportion of national agri. output[2]:** 10.3%
- **Proportion of national rainfall[3]:** 1.9%
- **Proportion of national GW[4]:** 7.4%

**PERFORMANCE**

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




**LEARNINGS**

**Things going well**

- *Irrigation utilization:* The state utilizes 88% of its irrigation potential created
- *Rural drinking water:* The state has covered 90% of its rural habitants under drinking water supply
- *Urban water:* The state charges 64% of households for water supply and treats 71% of its wastewater

**Things to improve**

- *Irrigation O&M:* The state expenditure on irrigation O&M activities is low, and it has lined only ~15% of the identified canals
- *Participatory irrigation:* WUAs are involved in only 20% of command area for O&M activities

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

## Non-Himalayan states: Odisha

### Figure 75: Overview of Odisha's CWMI performance

**STATE**

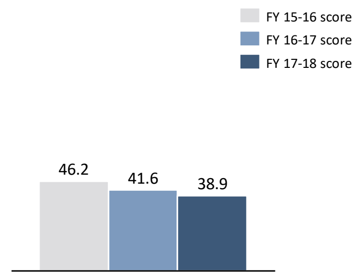
**ODISHA**

**KEY INDICATORS**

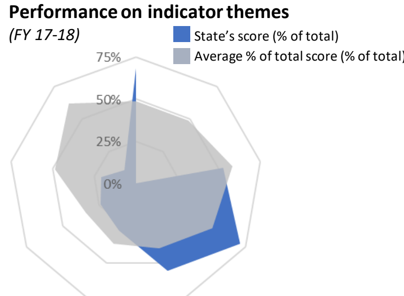
- **Population:** 4.2 crore
- **Proportion of national economic output[1]:** 2.5%
- **Proportion of national agri. output[2]:** 1.5%
- **Proportion of national rainfall[3]:** 2.2%
- **Proportion of national GW[4]:** 4%

**PERFORMANCE**

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




**LEARNINGS**

**Things going well**

- *Rural drinking water:* Odisha supplies drinking water to >90% of its rural population
- *Watershed development:* The state has constructed >90% of its targeted water harvesting structures, and geo-tagged 90% of them

**Things to improve**

- *Irrigation utilization and O&M:* Odisha has assessed <10% projects for IPU-IPC gaps, lined ~25% of canals, & reduced its O&M expense by >50% from FY 16-17
- *On-farm water use:* The state is yet to segregate power feeders
- *Policy & data:* Odisha has not enacted any conservation legislation and is yet to set up an integrated water data centre

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

## Non-Himalayan states: Punjab

## Figure 76: Overview of Punjab’s CWMI performance

### STATE

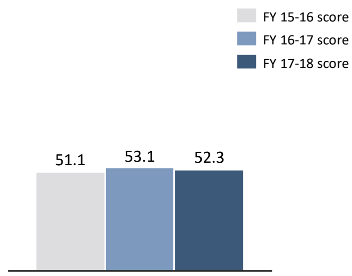
**PUNJAB**

**KEY INDICATORS**

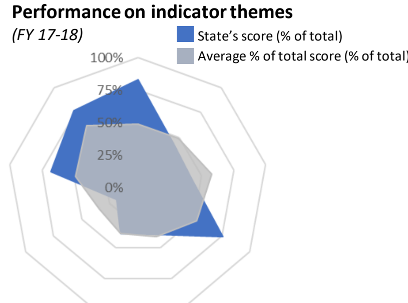
– **Population:** 2.8 crore
– **Proportion of national economic output[1]:** 2.9%
– **Proportion of national agri. output[2]:** 6.4%
– **Proportion of national rainfall[3]:** 0.8%
– **Proportion of national GW[4]:** 5.8%

### PERFORMANCE

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




### LEARNINGS

**Things going well**

- *Irrigation access:* Only 2% of the state’s cultivated area is rain-fed, and the state has restored 83% irrigation potential of identified water bodies
- *Urban water:* The state charges ~60% of urban households supplied with water, and treats ~65% of the generated wastewater

**Things to improve**

- *Groundwater restoration:* <3% of over-exploited and critical wells improved over the last year
- *Irrigation O&M:* Punjab has amongst the lowest O&M expenditure & >50% canals have not been lined
- *On-farm water use:* Micro irrigation adoption is <1%
- *Rural drinking water:* Access remains at 70% with no significant reduction in habitants affected by water quality issues

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, ‘Rainfall Statistics of India’, 2017; CGWB, ‘Groundwater Year Book’, 2016-17; Statistical Year Book India, 2018

## Non-Himalayan states: Rajasthan

### Figure 77: Overview of Rajasthan's CWMI performance

**STATE**

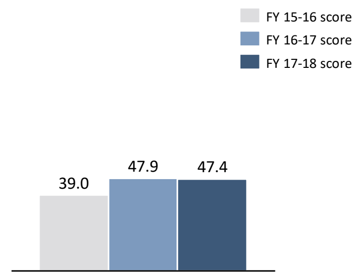
**RAJASTHAN**

**KEY INDICATORS**

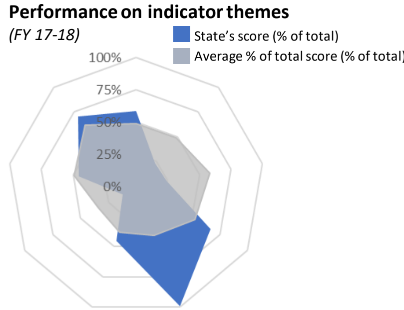
- **Population:** 6.9 crore
- **Proportion of national economic output[1]:** 4.9%
- **Proportion of national agri. output[2]:** 5.6%
- **Proportion of national rainfall[3]:** 0.8%
- **Proportion of national GW[4]:** 2.8%

**PERFORMANCE**

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




**LEARNINGS**

**Things going well**

- *Participatory irrigation:* >95% of irrigated area is maintained by WUAs, which retain 100% of fee
- *Watershed development:* The state has constructed ~100% of its targeted water harvesting structures
- *Policy & data:* The state has enacted conservation legislations and charges 82% of urban households for water

**Things to improve**

- *Groundwater restoration:* The state has not enacted any groundwater regulation and <30% critical GW units experienced improvement
- *Irrigation utilization & O&M:* Only 14% MMI projects have been assessed for IPU-IPC gaps, & O&M expenditure is lowest in India
- *Drinking water:* ~50% rural and ~60% urban habitants are not covered with drinking water supply by the state

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

## Non-Himalayan states: Tamil Nadu

### Figure 78: Overview of Tamil Nadu’s CWMI performance

**STATE**

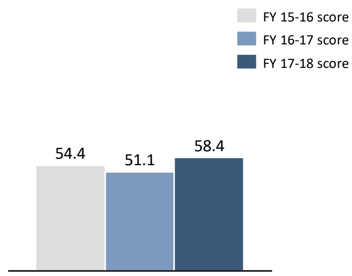
**TAMIL NADU**

**KEY INDICATORS**

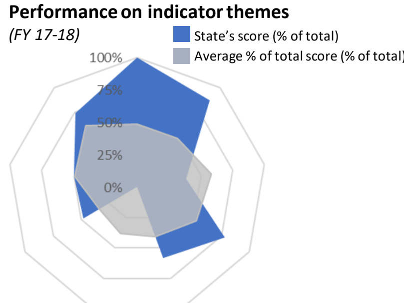
- **Population:** 7.2 crore
- **Proportion of national economic output[1]:** 8.5%
- **Proportion of national agri. output[2]:** 5.6%
- **Proportion of national rainfall[3]:** 1.6%
- **Proportion of national GW[4]:** 4.6%

**PERFORMANCE**

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




**LEARNINGS**

**Things going well**

- *Surface and groundwater restoration:* The state has restored 100% of the irrigation potential of identified bodies, and 78% of critical wells have improved
- *Watershed development:* The state has constructed >95% of its targeted water harvesting structures
- *Rural drinking water:* >95% rural habitations have access and no water quality issues exist

**Things to improve**

- *Irrigation utilization and O&M:* Tamil Nadu has assessed only 33% projects for IPU-IPC gaps, and lined 16% of the identified canals
- *On-farm use:* The state has not begun the process of power feeder segregation, and is one of the few states to not charge for borewell electricity

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, ‘Rainfall Statistics of India’, 2017; CGWB, ‘Groundwater Year Book’, 2016-17; Statistical Year Book India, 2018

## Non-Himalayan states: Telangana

## Figure 79: Overview of Telangana's CWMI performance

### STATE

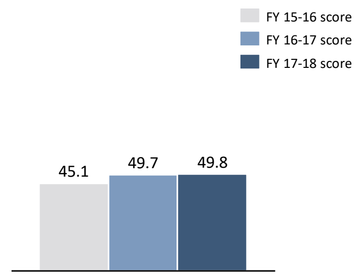
**TELANGANA**

**KEY INDICATORS**

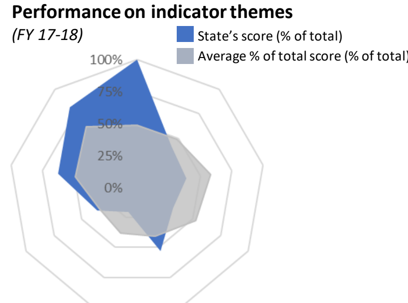
- **Population:** 3.5 crore
- **Proportion of national economic output[1]:** 4.2%
- **Proportion of national agri. output[2]:** 1.9%
- **Proportion of national rainfall[3]:** 1.3%
- **Proportion of national GW[4]:** 3.3%

### PERFORMANCE

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




### LEARNINGS

**Things going well**

- *Surface water restoration:* The state has restored 100% of the irrigation potential of identified water bodies
- *Rural drinking water quality:* While access is limited to 60%, water quality issues have reduced in 100% rural habitations
- *Urban water:* >80% of urban households have drinking water access, with >75% of them being charged for the supply

**Things to improve**

- *Groundwater restoration:* The state has mapped only 12% major groundwater recharge areas, of which 5% are covered with recharge infra
- *On-farm use:* The state has not begun the process of power feeder segregation, is one of the few states to not charge for borewell electricity; micro irrigation adoption remains negligible

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

## Non-Himalayan states: Uttar Pradesh

### Figure 80: Overview of Uttar Pradesh's CWMI performance

**STATE**

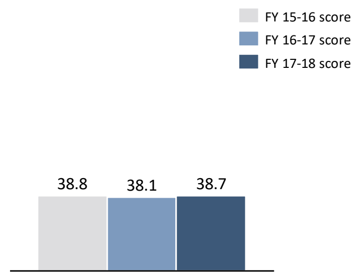
**UTTAR PRADESH**

**KEY INDICATORS**

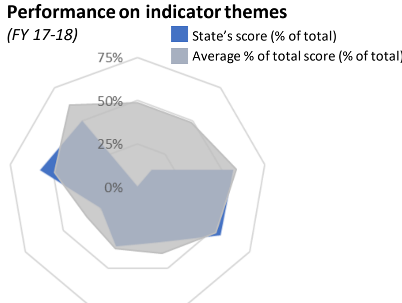
- **Population:** 20 crore
- **Proportion of national economic output[1]:** 8.1%
- **Proportion of national agri. output[2]:** 23.6%
- **Proportion of national rainfall[3]:** 1.1%
- **Proportion of national GW[4]:** 17.1%

**PERFORMANCE**

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




**LEARNINGS**

**Things going well**

- *Irrigation access:* <15% of the state's cultivated area is rain-fed, and 84% water harvest structure targets have been met
- *Rural drinking water:* The state has fully covered its rural habitations—a massive achievement given its huge population
- *Urban drinking water access:* UP provides drinking water to 92% of its urban population

**Things to improve**

- *Groundwater restoration:* The state has mapped only ~20% of over-exploited and critical wells, and constructed no recharge infrastructure—this is critical given that the state has ~17% of the country's groundwater
- *On-farm use:* The state has no feeder segregation and negligible micro-irrigation coverage, a worrying fact for its efficiency as the largest agricultural producer

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

## North-Eastern and Himalayan states: Arunachal Pradesh

### Figure 81: Overview of Arunachal Pradesh's CWMI performance

**STATE**

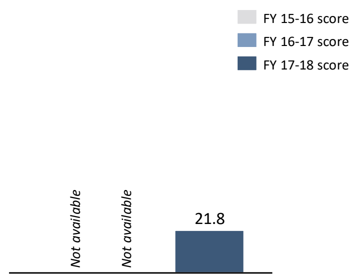
**ARUNACHAL PRADESH**

**KEY INDICATORS**

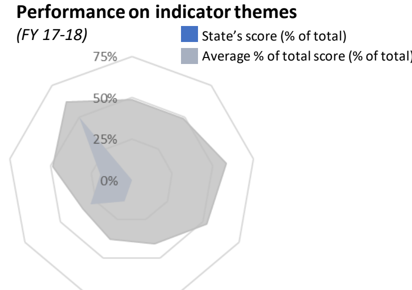
- **Population:** 0.14 crore
- **Proportion of national economic output[1]:** 0.2%
- **Proportion of national agri. output[2]:** <1%
- **Proportion of national rainfall[3]:** 4.5%
- **Proportion of national GW[4]:** 1%

**PERFORMANCE**

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




**LEARNINGS**

**Things going well**

- *Urban water:* 70% of urban households being supplied with water, are charged for it

**Things to improve**

- *Rural and urban drinking water:* ~60% rural and 34% urban population is not covered by state for drinking water
- *Data:* The state has not reported data on several indicators

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

## North-Eastern and Himalayan states: Assam

### Figure 82: Overview of Assam's CWMI performance

**STATE**

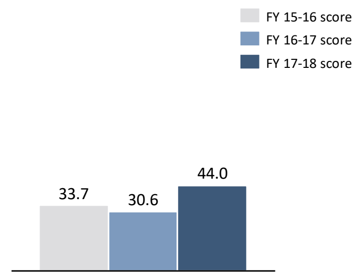
**ASSAM**

**KEY INDICATORS**

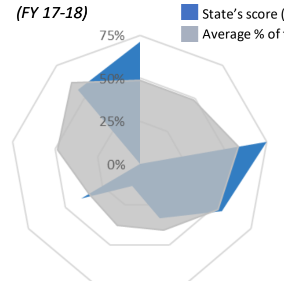
– **Population:** 3.1 crore
– **Proportion of national economic output[1]:** 1.6%
– **Proportion of national agri. output[2]:** 1.5%
– **Proportion of national rainfall[3]:** 4%
– **Proportion of national GW[4]:** 7.2%

**PERFORMANCE**

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




**LEARNINGS**

**Things going well**

- *Surface water restoration:* Assam has restored 70% of the irrigation potential of identified water bodies
- *Irrigation maintenance:* The state has assessed 100% projects for IPU-IPC gaps, lined ~90% of identified canals, and has high irrigation O&M expenditure
- *Data and Policy:* The state has enacted conservation legislations and established integrated data centre

**Things to improve**

- *On-farm use:* The state has agro-climatic zoning based cultivation on only 16% land, no feeder segregation, and negligible micro-irrigation coverage
- *Rural drinking water:* Only ~62% of rural habitations have been fully covered, and there has been negligible reduction in water quality issues
- *Urban water:* Only 20% of urban population has access, and no wastewater is treated

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

## North-Eastern and Himalayan states: Himachal Pradesh

### Figure 83: Overview of Himachal Pradesh's CWMI performance

**STATE**

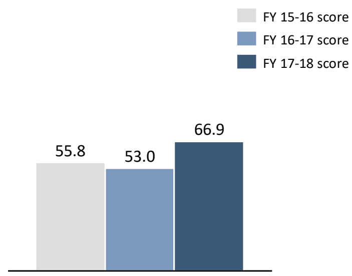
**HIMACHAL PRADESH**

**KEY INDICATORS**

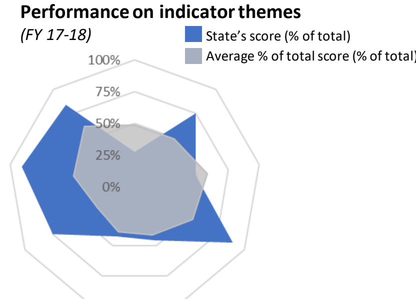
- **Population:** 0.7 crore
- **Proportion of national economic output[1]:** 0.8%
- **Proportion of national agri. output[2]:** 0.4%
- **Proportion of national rainfall[3]:** 2%
- **Proportion of national GW[4]:** 0.1%

**PERFORMANCE**

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




**LEARNINGS**

**Things going well**

- *Rural drinking water:* The state has achieved complete reduction in habitants facing water quality issues
- *Urban water:* HP provides drinking water to 100% of its urban population, charges 60% for supply, and has installed capacity to treat ~100% of its wastewater
- *Policy & data:* The state has enacted conservation legislation, and has set up an integrated data centre

**Things to improve**

- *Participatory irrigation:* WUAs are involved in O&M in only 16% of the command area and retain no fee
- *On-farm use:* The state has on 15% area cultivated as per agro-climatic zoning, and micro-irrigation coverage is negligible

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

## North-Eastern and Himalayan states: Meghalaya

## Figure 84: Overview of Meghalaya's CWMI performance

### STATE

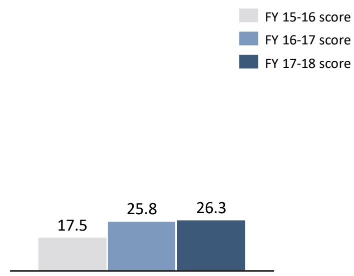
**MEGHALAYA**

**KEY INDICATORS**

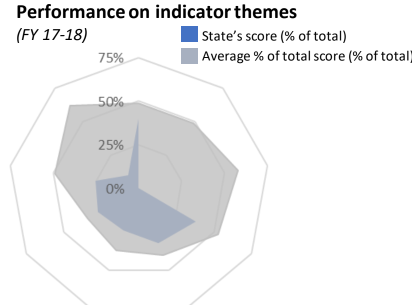
– **Population:** 0.3 crore
– **Proportion of national economic output[1]:** 0.2%
– **Proportion of national agri. output[2]:** <1%
– **Proportion of national rainfall[3]:** 7.4%
– **Proportion of national GW[4]:** 0.7%

### PERFORMANCE

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




### LEARNINGS

**Things going well**

- *Rural water quality:* While access remains low, the state has achieved complete reduction in habitants facing water quality issues

**Things to improve**

- *Rural drinking water access:* Only ~40% of rural habitations have been fully covered by water supplies
- *Wastewater treatment:* The state has not installed any capacity to treat its wastewater
- *Policy & data:* The state has neither enacted any conservation legislation nor set up an integrated data centre

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

## North-Eastern and Himalayan states: Nagaland

### Figure 85: Overview of Nagaland's CWMI performance

**STATE**

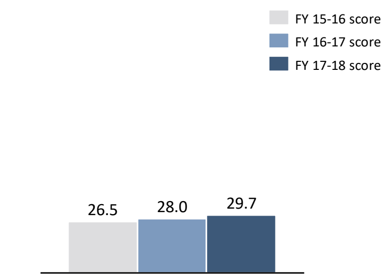
**NAGALAND**

**KEY INDICATORS**

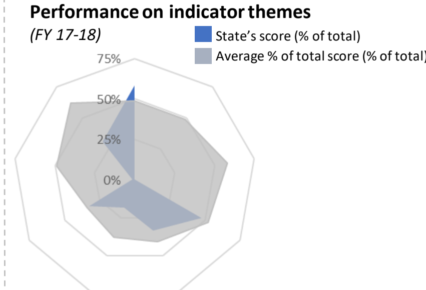
- **Population:** 0.2 crore
- **Proportion of national economic output[1]:** 0.1%
- **Proportion of national agri. output[2]:** <1%
- **Proportion of national rainfall[3]:** 2.8%
- **Proportion of national GW[4]:** 0.4%

**PERFORMANCE**

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




**LEARNINGS**

**Things going well**

- *Watershed development:* Nagaland has constructed 55% of its targeted water harvesting structures and has geo-tagged 74% of IWMP assets
- *Rural water quality:* While access remains low, the state has achieved complete reduction in proportion of habitants facing water quality issues

**Things to improve**

- *Rural drinking water: <50%* of rural habitations have been fully covered
- *Urban water:* Only 22% of the urban population is covered with drinking water supply, and the state has not installed any capacity to treat its wastewater
- *Policy & data:* The state has not enacted legislation for the conservation of water bodies, and is yet to set up an integrated data centre

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

## North-Eastern and Himalayan states: Sikkim

## Figure 86: Overview of Sikkim's CWMI performance

**STATE**

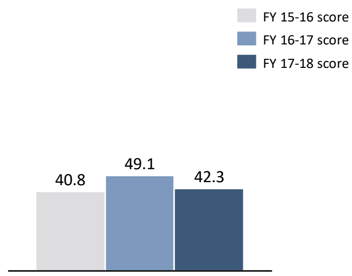
**SIKKIM**

**KEY INDICATORS**

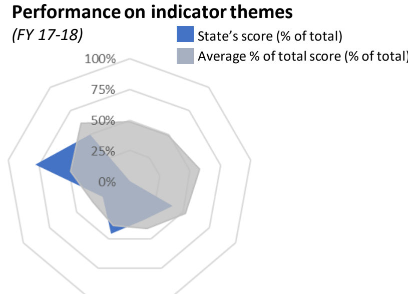
- **Population:** 0.06 crore
- **Proportion of national economic output[1]:** 0.1%
- **Proportion of national agri. output[2]:** <1%
- **Proportion of national rainfall[3]:** 4.8%
- **Proportion of national GW[4]:** NA

**PERFORMANCE**

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




**LEARNINGS**

**Things going well**

- *Watershed development:* Sikkim has constructed ~80% of its targeted water harvesting structures
- *Rural water quality:* While access remains low, the state has achieved complete reduction in habitants facing water quality issues
- *Wastewater treatment:* The state treats 81% of its urban wastewater—the highest proportion across 'Himalayan states'

**Things to improve**

- *Surface water restoration:* The state has not restored any of the irrigated area of identified water bodies
- *Rural drinking water access:* Only ~35% of rural habitations have been fully covered
- *Data:* The state is yet to establish an integrated water data centre

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

## North-Eastern and Himalayan states: Tripura

### Figure 87: Overview of Tripura's CWMI performance

**STATE**

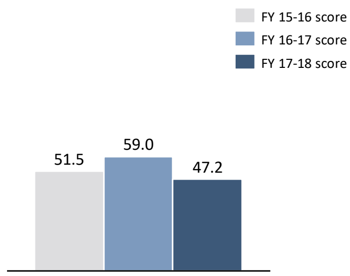
**TRIPURA**

**KEY INDICATORS**

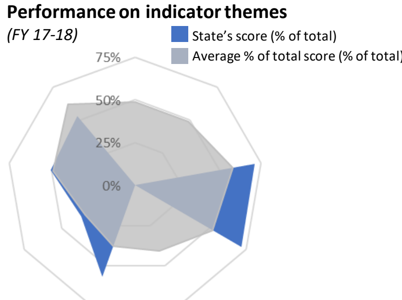
- **Population:** 0.4 crore
- **Proportion of national economic output[1]:** *Not available*
- **Proportion of national agri. output[2]:** <1%
- **Proportion of national rainfall[3]:** 5.5%
- **Proportion of national GW[4]:** 0.6%

**PERFORMANCE**

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




**LEARNINGS**

**Things going well**

- *Irrigation utilization and O&M:* Tripura utilizes ~65% of its irrigation potential, has assessed 100% project for IPU-IPC gaps, & has above average O&M expenditure
- *On-farm water use:* The state has 100% agro-climatic zoning based cultivation, and highest micro irrigation adoption, at 23%, in its category
- *Urban water:* Close to 100% urban population is covered under drinking water, and 40% of them are charged

**Things to improve**

- *Surface water restoration:* The state has not restored any of the irrigation potential of identified water bodies
- *Participatory irrigation:* The state has not established a framework for involving WUAs in O&M
- *Wastewater treatment*: Wastewater treatment capacity is <25%

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

## North-Eastern and Himalayan states: Uttarakhand

### Figure 88: Overview of Uttarakhand's CWMI performance

**STATE**

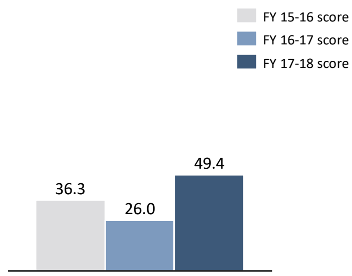
**UTTARAKHAND**

**KEY INDICATORS**

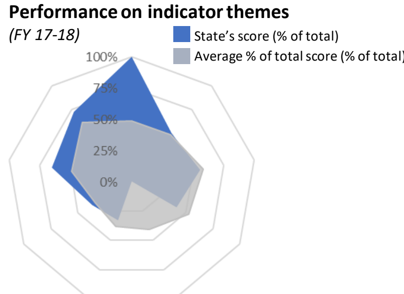
- **Population:** 1 crore
- **Proportion of national economic output[1]:** 1.3%
- **Proportion of national agri. output[2]:** 1%
- **Proportion of national rainfall[3]:** 2.4%
- **Proportion of national GW[4]:** 0.4%

**PERFORMANCE**

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




**LEARNINGS**

**Things going well**

- *Surface and groundwater restoration:* The state has restored irrigation area of >95% of water bodies, and 100% critical and overexploited units have improved
- *Rural water quality:* While access remains low, the state has achieved complete reduction in habitants facing water quality issues
- *Urban water:* 100% of urban households are covered with drinking water supply and 63% are charged

**Things to improve**

- *Rural drinking water:* Only 57% of rural habitations are fully covered with drinking water supply
- *Data:* The state has not established an integrated water data centre

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

## Union Territories: Delhi

### Figure 89: Overview of Delhi's CWMI performance

**STATE**

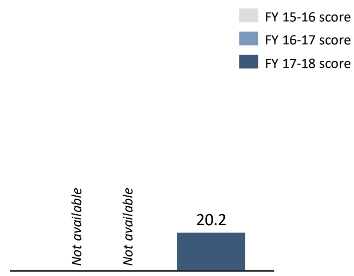
**DELHI**

**KEY INDICATORS**

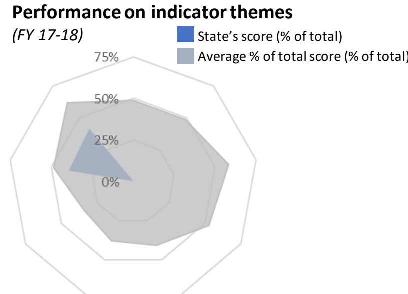
- **Population:** 1.7 crore
- **Proportion of national economic output[1]:** 4.1%
- **Proportion of national agri. output[2]:** <1%
- **Proportion of national rainfall[3]:** 0.9%
- **Proportion of national GW[4]:** 0.1%

**PERFORMANCE**

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




**LEARNINGS**

**Things going well**

- *Urban water pricing:* 65% urban households are charged for their water supply

**Things to improve**

- *Groundwater restoration:* Only 13% of the over-exploited and critical units have improved, and no major groundwater recharge areas have been mapped
- *Data:* Delhi has not reported data on majority indicators

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

## Union Territories: Puducherry

### Figure 90: Overview of Puducherry's CWMI performance

**STATE**

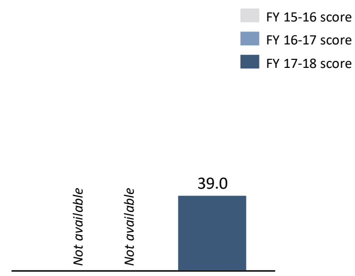
**PUDUCHERRY**

**KEY INDICATORS**

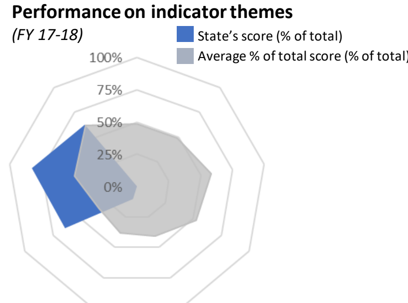
- **Population:** 0.12 crore
- **Proportion of national economic output[1]:** 0.2%
- **Proportion of national agri. output[2]:** <1%
- **Proportion of national rainfall[3]:** 2.6%
- **Proportion of national GW[4]:** <0.1%

**PERFORMANCE**

**State index scores**
*(FY 15-16, FY 16-17, FY 17-18)*




**Performance on indicator themes**
*(FY 17-18)*




**LEARNINGS**

**Things going well**

- *Urban water:* The UT has fully covered its urban population with drinking water supply, and charges 100% of them
- *Wastewater treatment capacity:* Puducherry has installed 100% capacity to treat its wastewater

**Things to improve**

- *Rural drinking water:* Only ~58% of rural habitations have been fully covered, and there has been no significant reduction in water quality issues
- *Data:* The UT has not reported data on majority indicators

Notes: 1. Measured as % of Net Domestic Product at Current Prices (2011-12 series) for FY 2015-16 2. Measured as % of principal crops produced for FY 2015-16 3. Measured as % of annual rainfall for 2017 4. Measured as % of annual replenishable groundwater resources (2013) 5. Indicator themes are: 1-Source augmentation and restoration of water bodies 2-Source augmentation (GW) 3-Major and medium irrigation 4-Watershed development 5-Participatory irrigation practices 6-Sustainable on-farm water use practices 7-Rural drinking water 8-Urban water supply and sanitation 9-Policy and governance

Source: Census of India, 2011; Economic Survey 2017-18, Statistical Appendix; IMD, 'Rainfall Statistics of India', 2017; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2018

| DATA VALIDATION | COMMENTARY, NARRATION, AND ANALYSIS | PORTAL DEVELOPMENT |
|---|---|---|
| IPE GLOBAL | Dalberg | Silver Touch TECHNOLOGIES |