सत्यमेव जयते
NITI Aayog

COMPOSITE

ACKNOWLEDGEMENT

The study was sponsored with financial support of NITI Aayog, Government of India and conducted by Dalberg Development Advisors Pvt. Ltd, New Delhi.

FOREWORD

It is my firm belief that the objective of *Sabka Saath Sabka Vikas* can be fully achieved once the benefits of the interventions reach the last mile. In this context, the renewed emphasis of the Government on outcomes has proved to be a potential tool and the same is also being included as part of the Union Budget. As a step beyond the measurement of outcomes, NITI Aayog has come out with various indices that not only fulfill its mandate of cooperative and competitive federalism but also challenge States and Union Territories (UTs) to meet the aspirations of the new India. NITI Aayog has recently launched an Index of Health that seeks to capture the annual progress of States/ UTs on a variety of health indicators. As a major leap in this direction, NITI Aayog has come out with a Composite Water Management Index as a useful tool to assess and improve the performance in efficient management of water resources.

It's a matter of concern that 600 million people in India face high to extreme water stress in the country. About three-fourth of the households in the country do not have drinking water at their premise. With nearly 70% of water being contaminated, India is placed at 120th amongst 122 countries in the water quality index. It's a fact that water is a State subject and its optimal utilization and management lies predominantly within the domain of the States. This index is an attempt to budge States and UTs towards efficient and optimal utilization of water and recycling thereof with a sense of urgency.

In view of 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 also for the concerned Central Ministries/Departments, enabling them to formulate and implement suitable strategies for better management of water resources. It has been finalized after an elaborate exercise including seeking feedback from the States and consultation with reputed experts.

I would like to acknowledge the continuous support and guidance provided by Dr. Rajiv Kumar, Vice Chairman, NITI Aayog; Dr. Arvind Panagariya, former V.C. NITI Aayog; Dr. Ramesh Chand, Member, NITI Aayog; Shri Parameswaran Iyer, Secretary, Ministry of Drinking Water Supply and Sanitation; Dr. Amarjeet Sinha, Secretary Ministry of Rural Development; Shri U.P. Singh, Secretary, Ministry of Water Resources, River Development & Ganga Rejuvenation; and Dr. Amarjit Singh, former Secretary (Water Resources), Government of India.

I would appreciate the work in index conceptualization, progress monitoring and pursuance with the State Governments by Shri Yaduvendra Mathur, Additional Secretary, Dr. Yogesh Suri, Adviser, Water & Land Resources, and Shri Jitendra Kumar, former Adviser, Water Resources, NITI Aayog.

I would like to acknowledge the effort in concept framing, developing, compilation and uploading of data on the portal by Shri Avinash Mishra, Joint Adviser, NITI Aayog and his team of officials , Shri N. Kumar Vel, Scientist D, Shri Gopal Saran, Scientist C, and Ms. Namrata Singh Panwar, Young Professional.

I wish to also convey my sincere thanks to Nirat Bhatnagar, Kanishka Bhattacharya, and Anubhav Gupta from Dalberg Advisors for commentary, data analysis, and narration; Daljeet Kaur, Sheena Kapoor, Priya Chabbra, and Aishwarya Tuli from IPE Global for third-party data review and validation; and Surbhi Singhal and her team from Sliver Touch Limited for online portal development.

This pioneering work of NITI Aayog in developing a Composite Water Management Index is perhaps the first of its kind in the world. This would not have been completed without the hard work put in by a large number of State and UT 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 will continue to pursue such interventions that play an important role in developing cooperative and competitive federalism. I am sure this index will provide much needed inputs to the States and encourage them to improve their water management in all its facets viz. irrigation, drinking water or industrial use.

AMITABH KANT

Dated: 12th June 2018 **CEO, NITI Aayog**

CONTENTS

KEY ABBREVIATIONS

Abbreviation	Expanded version
APFMGS	Andhra Pradesh Farmer Managed Groundwater Systems
API	Application Programming Interface
CAD	Command Area Development
CGWB	Central Ground Water Board
CWMI	Composite Water Management Index
DBT	Direct Benefit Transfer
DDUGJY	Deen Dayal Upadhyaya Gram Jyoti Yojana
FAO	Food and Agriculture Organisation
FY	Financial Year
GIS	Geographic Information System
GO	Government Officer
GW	Groundwater
IPC	Irrigation Potential Created
IPU	Irrigation Potential Utilized
ISF	Irrigation Service Fee
IVA	Independent Validating Agency
IWMP	Integrated Watershed Management Programme
KPI	Key Performance Indicator
LPG	Liquified Petroleum Gas
MDWS	Ministry of Drinking Water and Sanitation
MIS	Management Information System
MMI	Major and Medium Irrigation
MNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MNREGS	Mahatma Gandhi National Rural Employment Guarantee Scheme
MOWR	Ministry of Water Resources, River Development, and Ganga Rejuvenation
NGO	Non-governmental organisation
NIMF	National Irrigation Management Fund
O&M	Operations and Maintenance
PIM	Participatory Irrigation Management

PMKSY	Pradhan Mantri Krishi Sinchayee Yojana
RKVY	Rashtriya Krishi Vikas Yojana
SCADA	Supervisory Control and Data Acquisition
SNO	State Nodal Officer
UT	Union Territory
WUA	Water User Association

List of Tables

LIST OF FIGURES

EXECUTIVE SUMMARY

BACKGROUND

KEY RESULTS

THE WAY FORWARD

EXECUTIVE SUMMARY

India is suffering from the worst water crisis in its history and millions of lives and livelihoods are under threat. Currently, 600 million Indians face high to extreme water stress and about two lakh people die every year due to inadequate access to safe water[1]. The crisis is only going to get worse. By 2030, the country's water demand is projected to be twice the available supply, implying severe water scarcity for hundreds of millions of people and an eventual ~6% loss in the country's GDP[2]. As per the report of National Commission for Integrated Water Resource Development of MoWR, the water requirement by 2050 in high use scenario is likely to be a milder 1,180 BCM, whereas the present-day availability is 695 BCM. The total availability of water possible in country is still lower than this projected demand, at 1,137 BCM. Thus, there is an imminent need to deepen our understanding of our water resources and usage and put in place interventions that make our water use efficient and sustainable.

The National Institute for Transforming India (NITI) Aayog has developed the Composite Water Management Index (CWMI) to enable effective water management in Indian states in the face of this growing crisis.

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 competition among 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.

Data and centre-state and inter-state cooperation are some of the key levers that can help address the crisis. Data systems related to water in the country are limited in their coverage, robustness, and efficiency. First, data is often not available at the adequate level of detail. For example, water use data for domestic and industrial sectors is available at only the aggregate level, and thus provides very little information to relevant policymakers and suppliers. Second, where data is available, it is often unreliable due to the use of outdated collection techniques and methodologies. For example, groundwater data in India is based on an inadequate sample of ~55,000 wells out of a total ~12 million[3] in the country. Finally, siloed information collection and sharing, especially between states, adds significantly to costs and inefficiencies.

There is also an opportunity to improve centre-state and inter-state cooperation across the broader water ecosystem. Water management is often currently viewed as a zero-sum game by states due to limited frameworks for inter-state and national management. This has resulted in seven major disputes regarding the country's rivers, involving 11 states[4], as well as limited policy coordination on issues like agricultural incentives, pump electricity pricing, etc. These issues can be addressed by boosting cooperation at a federal and inter-state level.

1 Source: WRI Aqueduct; WHO Global Health Observatory
2 Source: McKinsey & WRG, 'Charting our water future', 2009; World Bank; Times of India
3 Source: Fifth MI Census
4 Source: ClearIAS

The Index is a novel, data-backed approach to water management that will be transformative

The Composite Water Management Index (CWMI) is 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 CWMI is the first comprehensive collection of country-wide water data in India. It is aimed at promoting competitiveness among states, driving them toward effective water governance, and incentivizing improved water management across the country. Further, the close centre-state collaboration involved in the creation and annual updating of the Index is expected to lead to increased federal cooperation in the water sector.

The Index promotes inter-state collaboration and coordination

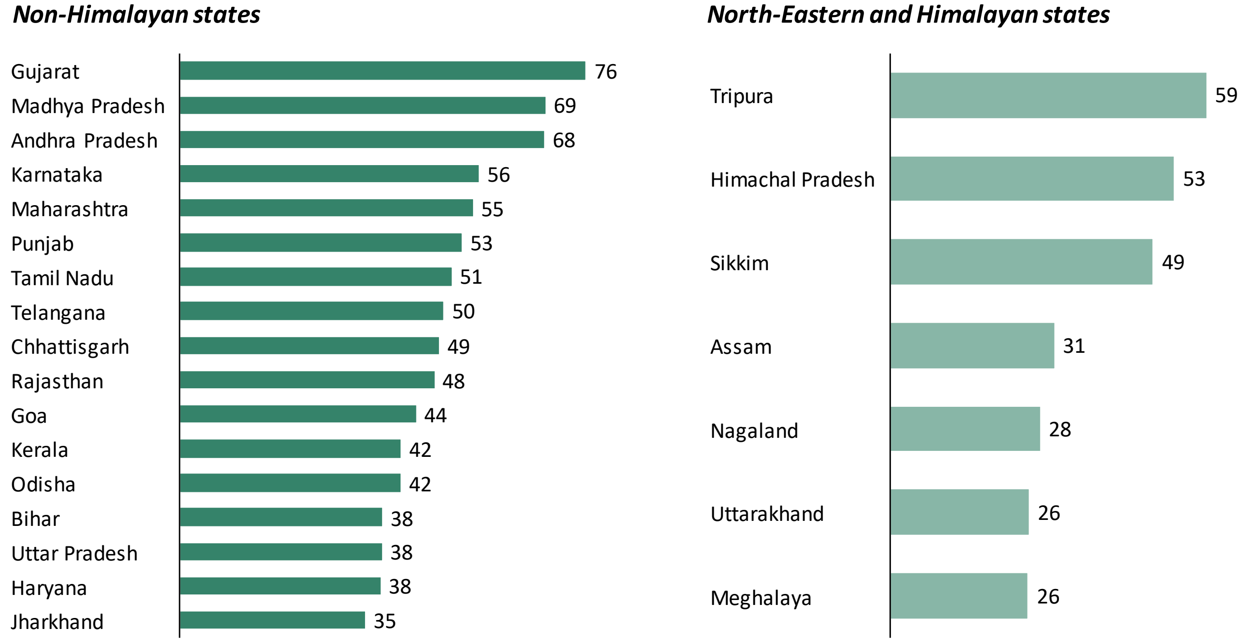
The Index was developed in close collaboration with multiple national and state stakeholders and involved a robust data validation process. The Index uses water data from both central and state sources. The data was collected for two years—the base year of FY 15-16, and FY 16-17—thereby enabling not only a benchmarking of the current water performance of states, but also the study of the evolution of this performance across the last two years. States were required to fill out the necessary data on a public NITI Aayog portal. This data provision involved a massive data compilation exercise across 24 states in the country, including a complex process of liaising between multiple agencies and departments within a state itself. Data for several indicators—covering groundwater restoration, irrigation management, on-farm water use, rural and urban drinking water supply, water policy frameworks, and other areas—was triangulated and compiled for the first time in the country's history and involved contributions across all levels—from union and state water ministers to department engineers and local authorities. The coordination exercise was led by NITI Aayog, Water Resource Vertical. The collected 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. They 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 six states to ensure a robust validation process. Finally, the observations and results were shared with the states' nodal officers post the review exercise. Additionally, the Senior Officers at NITI Aayog also facilitated a disclosure conference covering all 29 states and 7 UTs. During these conferences, the IVA presented the validation results, data gaps and discrepancies, validation decisions, and indicator-wise comparative analysis of initial results.

The compilation and collection of data from 24 states proved to be a tedious but rewarding exercise, where the data against the CWMI was gathered from nine to ten different state departments. NITI Aayog appreciates the commendable work, cooperation and suggestions of State Governments in this regard.

KEY RESULTS

All states can do better

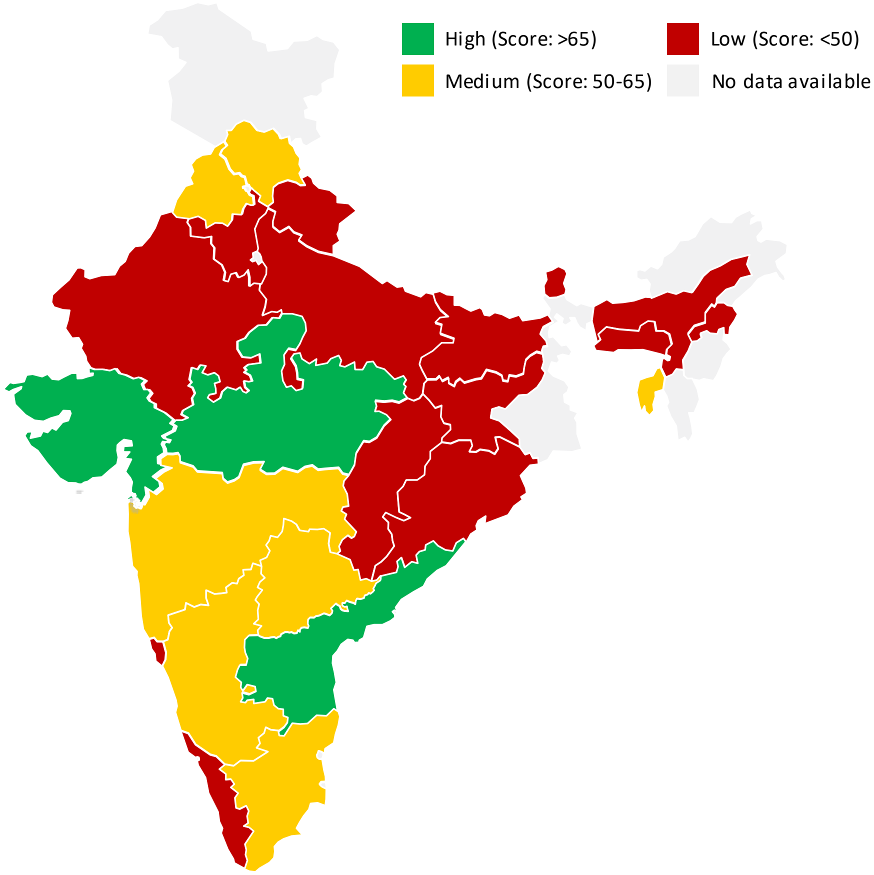
Figure 1: State-level performance on water resource management[5]
Ranking of states according to Composite Water Index Scores (FY 16-17)



Water Index scores vary widely across states, but most states have achieved a score below 50% and could significantly improve their water resource management practices. The Water Index scores for FY 16-17 vary from 76 (Gujarat) to 26 (Meghalaya), with the median score being ~49 for Non-Himalayan states and ~31 for North-Eastern and Himalayan states (*Figure 1)*. Gujarat is the highest performer, closely followed by other High performers such as Madhya Pradesh and Andhra Pradesh. Seven states have scores between ~50-65 (including two North-Eastern and Himalayan states) and have been classified as Medium performers. Alarmingly, ~60% of states (14 out of 24) have achieved scores below 50 and have been classified as Low performers (*Figure 2*). Low performers are concentrated across the populous agricultural belts of North and East India, and among the North-Eastern and Himalayan states.

5 The scores for 'Non-Himalayan' and 'North-Eastern and Himalayan' states were calculated separately, by using only the range of scores in the given category in the calculations. Thus, 'North-Eastern and Himalayan' states' scores were scaled considering only the range of scores in the 'North-Eastern and Himalayan' category, to account for the different hydrological conditions in these states 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.

Figure 2: High-, medium-, and low-performing states on water resource management
Classification according to Composite Water Index Scores (FY 16-17)



Scarcity and need are driving positive action

Encouragingly, several water-scarce states are the leaders in Index performance. Several of the high and medium performers—Gujarat, Madhya Pradesh, Andhra Pradesh, Karnataka, Maharashtra, Telangana—are states that have suffered from severe droughts in recent years[6,7]. The action taken by these states, and their subsequent good performance on the Index, are likely driven by necessity in the face of looming water shortages. This correlation shows, positively, that corrective action is starting in some of the areas that need it the most.

Water management is improving across-the-board

In addition, about 60% (15 out of 24) of the states included in the Index have improved their scores in FY 16-17 (*Figure 3*). The average change in scores from FY 15-16 to FY 16-17 has been a modest gain of ~1.8 points. Eight states achieved impressive gains of five points or more in a single year—despite the slow-moving nature of several indicators (such as irrigation potential utilized and area under rain-fed agriculture). Most gains have been led by improvements in restoration of surface water bodies, watershed

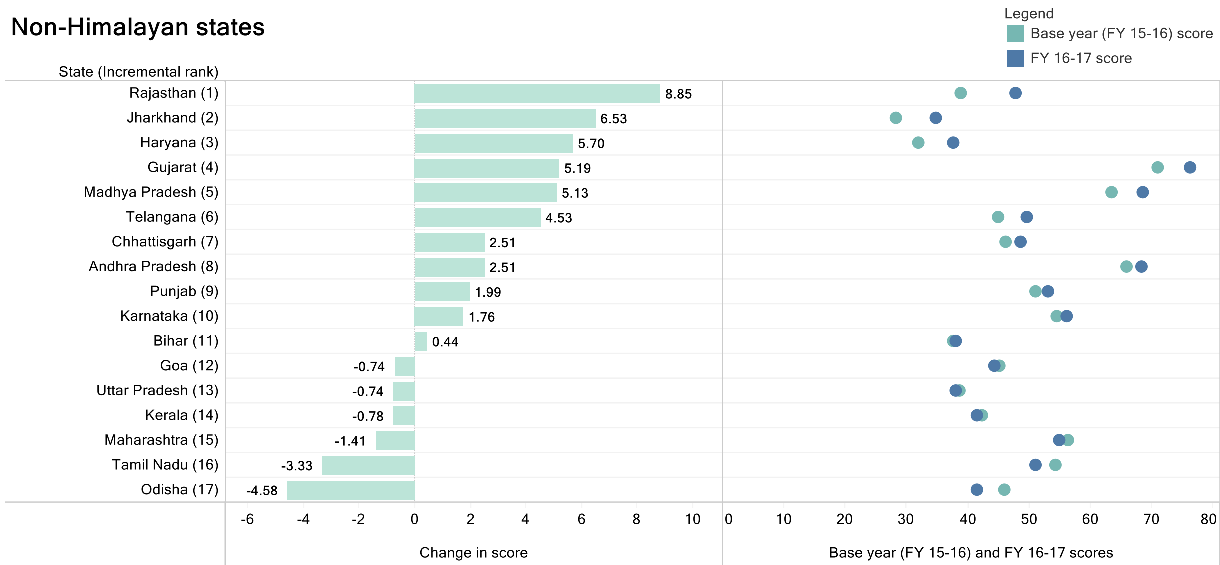
---

6 Source: https://www.firstpost.com/india/in-june-maharashtra-gujarat-jharkhand-and-4-other-drought-hit-states-short-of-water-2859758.html

7 Source: https://economictimes.indiatimes.com/news/economy/policy/8-states-declared-drought-affected-centre-allows-them-to-offer-50-days-of-extra-work-under-nregs/articleshow/58037760.cms development activities, and rural water supply provision. The North-Eastern and Himalayan states of Meghalaya, Sikkim, and Tripura are, in fact, all among the top five improvers, gaining more than 7.5 points each. This is particularly impressive given the low ranks of the first two of these states and Tripura's already exceptional overall performance, and might signal increasing water policy action in this state category.

Figure 3: Change in state-level performance over time—Non-Himalayan states and North-Eastern and Himalayan states

Change in Composite Water Index scores (Base year (FY 15-16), FY 16-17)



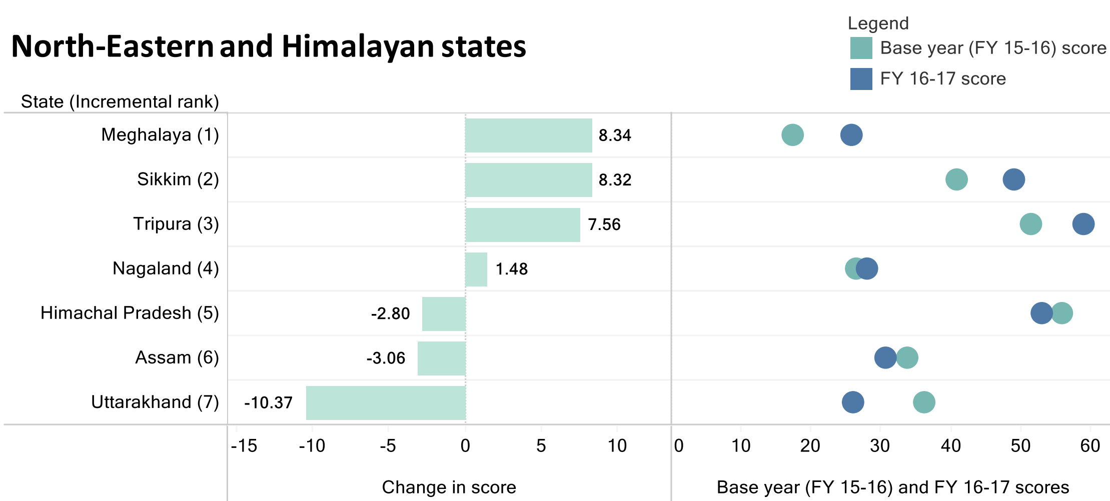
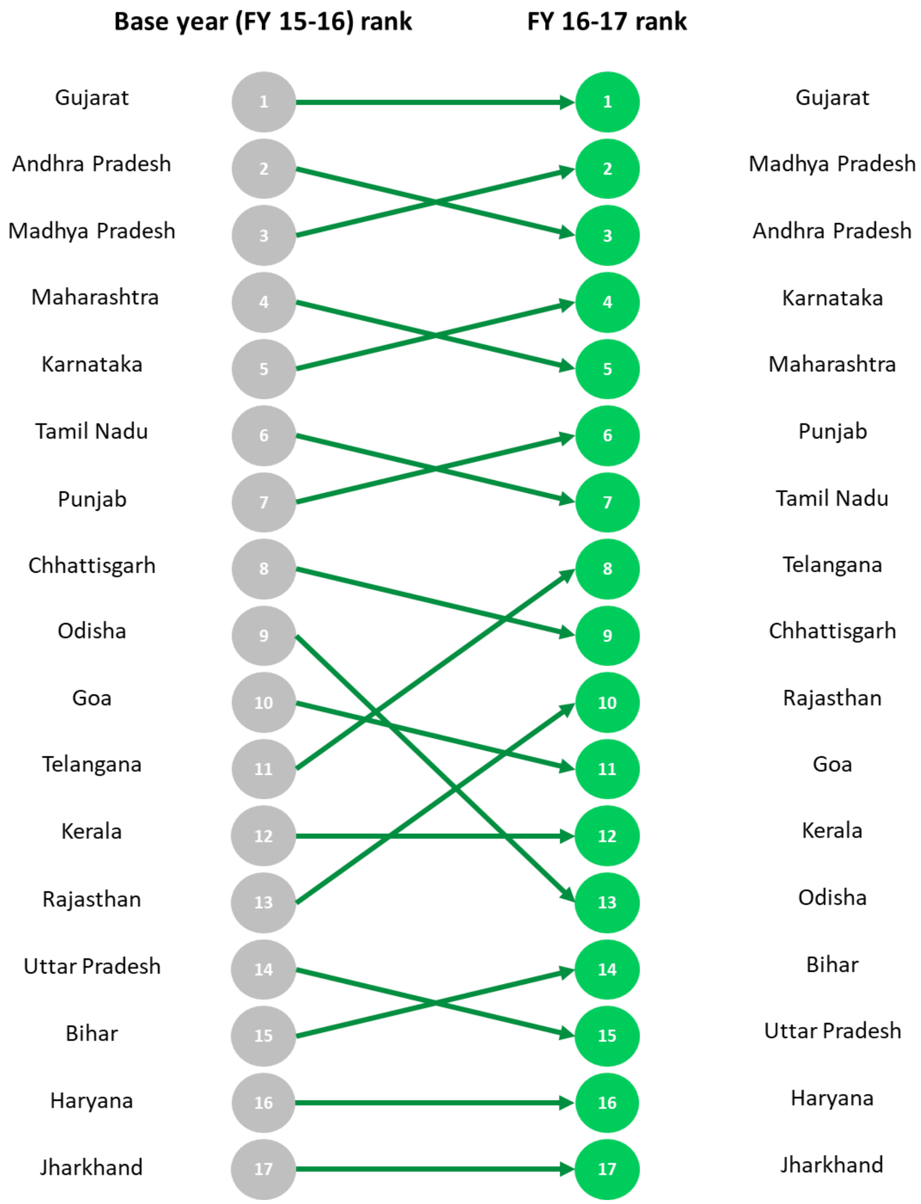
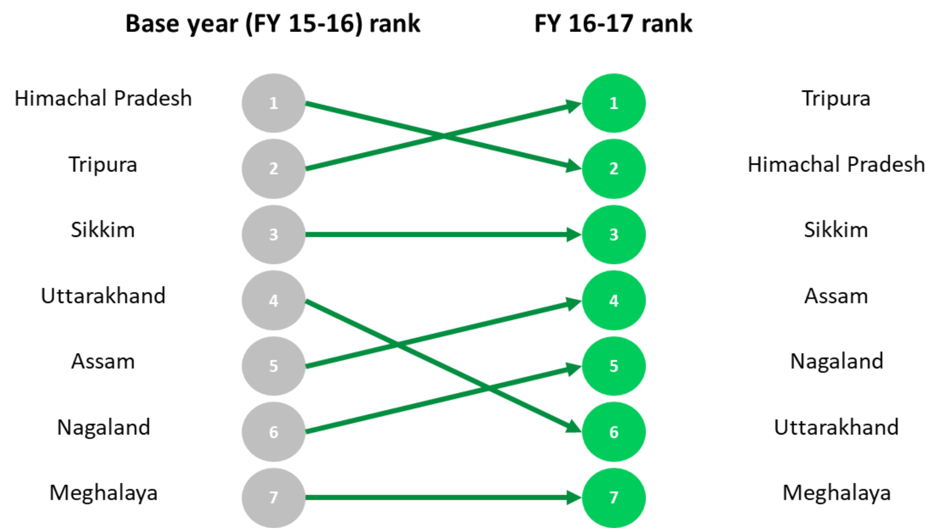


Figure 4: Evolution of state rankings over time for Non-Himalayan states and North-Eastern and Himalayan states
Based on Water Index composite scores (Base Year (FY 15-16), FY 16-17)

Non-Himalayan states



North-Eastern and Himalayan states



But, food security is at risk

However, the country faces significant risks as the low performers on the Water Index are home to ~50% of the country's population and its agricultural baskets. The low performers are, worryingly, comprised of the populous northern states of UP, Bihar, Rajasthan, Haryana, and others, and are home to over 600 million people[8]. The poor performance of these states on the Index highlights a significant water management risk for the country going forward. Further, these states also account for 20-30% of India's agricultural output[9]. Given the combination of rapidly declining groundwater levels and limited policy action (as indicated by the low Index score), this is also likely to be a significant food security risk for the country going forward.

Significant improvements are required in key areas

The indicators in the Water Index have been grouped into nine broad themes, which are:

i. Source augmentation and restoration of water bodies
ii. Source augmentation (Groundwater)
iii. Major and medium irrigation—Supply side management
iv. Watershed development—Supply side management,
v. Participatory irrigation practices—Demand side management
vi. Sustainable on-farm water use practices—Demand side management
vii. Rural drinking water
viii. Urban water supply and sanitation, and
ix. Policy and governance

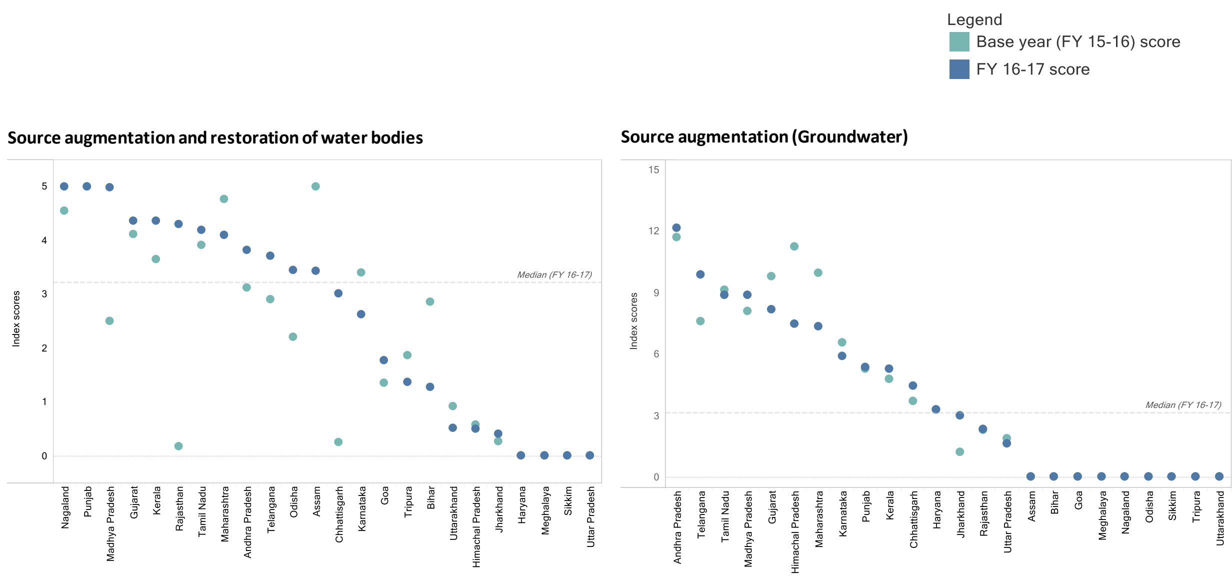
High-level commentary on theme-level performance of states follows.

---

8 Source: 2011 Census of India
9 Source: Planning Commission Databook 2014; India Energy Statistics 2015

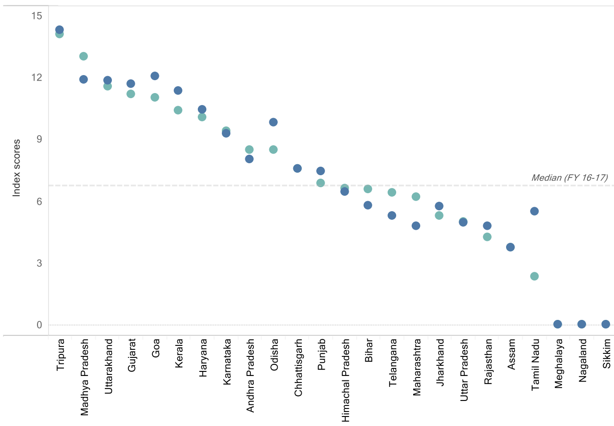
Significant improvements are required in states' performance across critical indicator themes. The performance of states has varied widely at the level of the nine indicator themes. Most of the states have done well in the infrastructure-heavy themes of 'Major and medium irrigation' and 'Watershed development' and have also enacted policies corresponding to the recommendations within the 'Policy and governance' theme. However, the critical themes of 'Source augmentation (Groundwater), 'Sustainable on-farm water use practices', and 'Rural drinking water' are lagging behind (*Figure 5*). Most states have achieved less than 50% of the total score in the augmentation of groundwater resources, highlighting the growing national crisis—54% of India's groundwater wells are declining, and 21 major cities are expected to run out of groundwater as soon as 2020, affecting ~100 million people[10]. Further, 70% of states have also achieved scores of less than 50% on managing on-farm water effectively. Given the fact that agriculture accounts for 80% of all water use[11], this underperformance, as discussed in the analysis of low performers above, poses significant water and food security risks for the country. Finally, states have also performed averagely on providing safe drinking water to rural areas. With 800 million people, or ~70% of the country's population, living in rural areas, and about two lakh people in the country dying each year due to a lack of access to safe water[12], this is one of the most critical service delivery challenges in the world. Performance across each of these themes, as well as indicator-level analyses, are explored further in the '*Results and commentary*' section of the report.

Figure 5: State performance across indicator themes
Index scores (Base year (FY 15-16), FY 16-17)

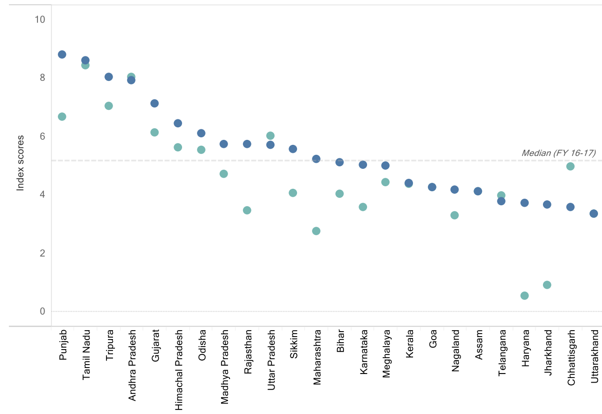


10 Source: WRI; World Bank (Hindustan Times, The Hindu)
11 Source: National Commission for integrated Water Resource Development, MoWR
12 Source: WHO Global Health Observatory; 2011 Census of India

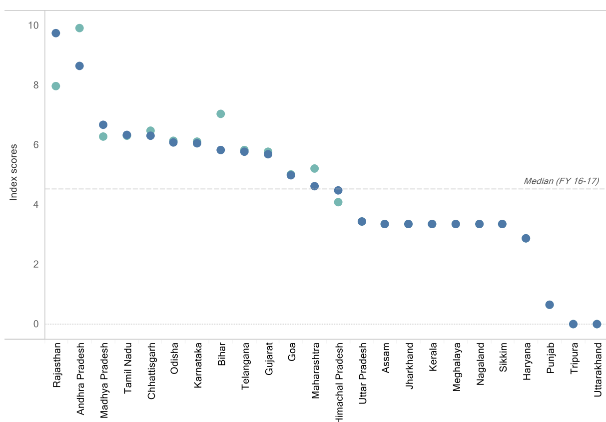
Major and medium irrigation – Supply side management



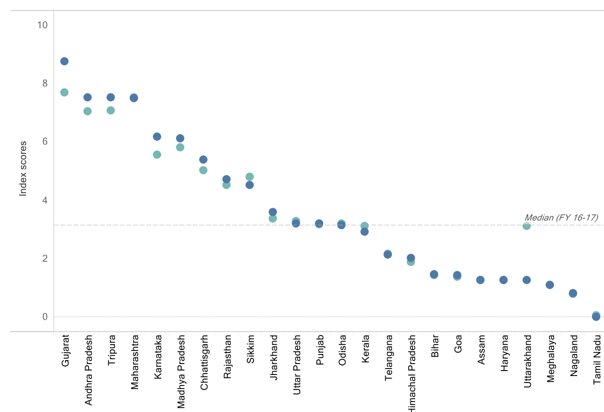
Watershed development – Supply side management



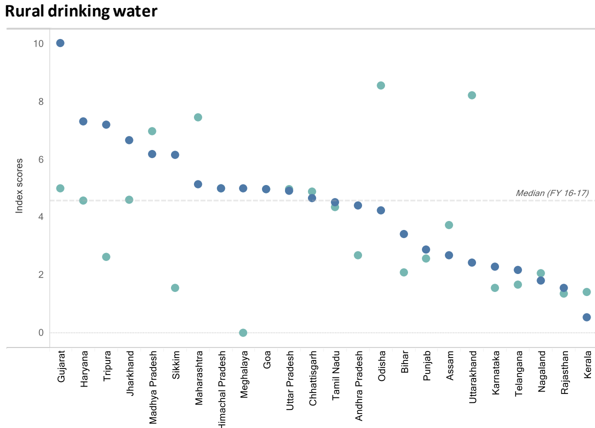
Participatory irrigation practices – Demand side management



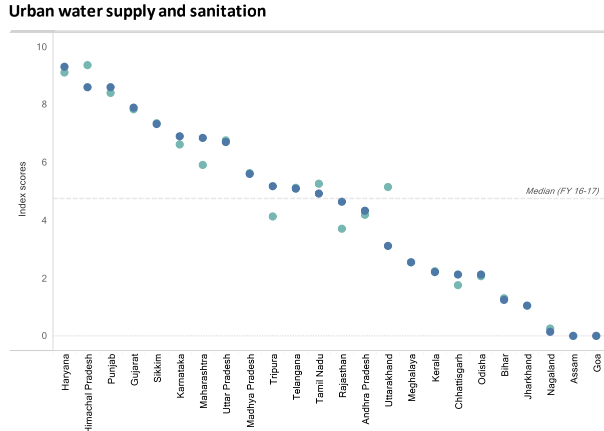
Sustainable on-farm water use practices – Demand side management



Rural drinking water



Urban water supply and sanitation



Policy and governance

THE WAY FORWARD

The Composite Water Management Index (CWMI) is a first-of-its-kind, comprehensive scorecard for identifying, targeting, and solving problems in the water sector across the country. Its ranking and scoring system across states, as well as the collaborative process of Index design and updates, will ensure that the principle of *'competitive and cooperative federalism'* is actualized in the country's water management system. As the Index goes through multiple iterations, its ability to capture the fundamental drivers of water in India will increase, and it is likely to emerge as the definitive dataset for understanding India's water sector.

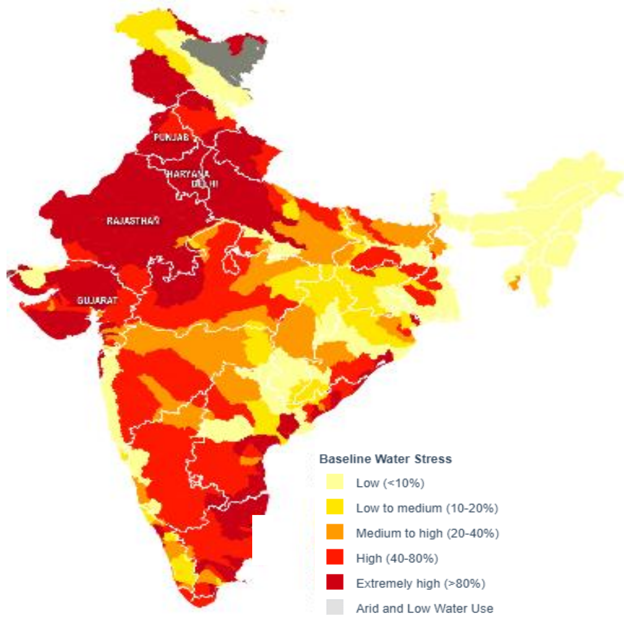
Going forward, the government can amplify the impact of the Index by developing a platform that can be accessed by researchers, NGOs, entrepreneurs and policymakers to enable innovation in the broader water ecosystem.

BACKGROUND

1. BACKGROUND

India is undergoing the worst water crisis in its history. Already, more than 600 million people[13] are facing acute water shortages. Critical groundwater resources – which account for 40% of our water supply – are being depleted at unsustainable rates.

Figure 6: Baseline water stress in India[14,15,16]
Ratio of total withdrawals and total flow (2010)



Facts: Water supply is limited, quality is poor

600 million people face high-to-extreme water stress.

75% of households do not have drinking water on premise. **84%** rural households do not have piped water access.

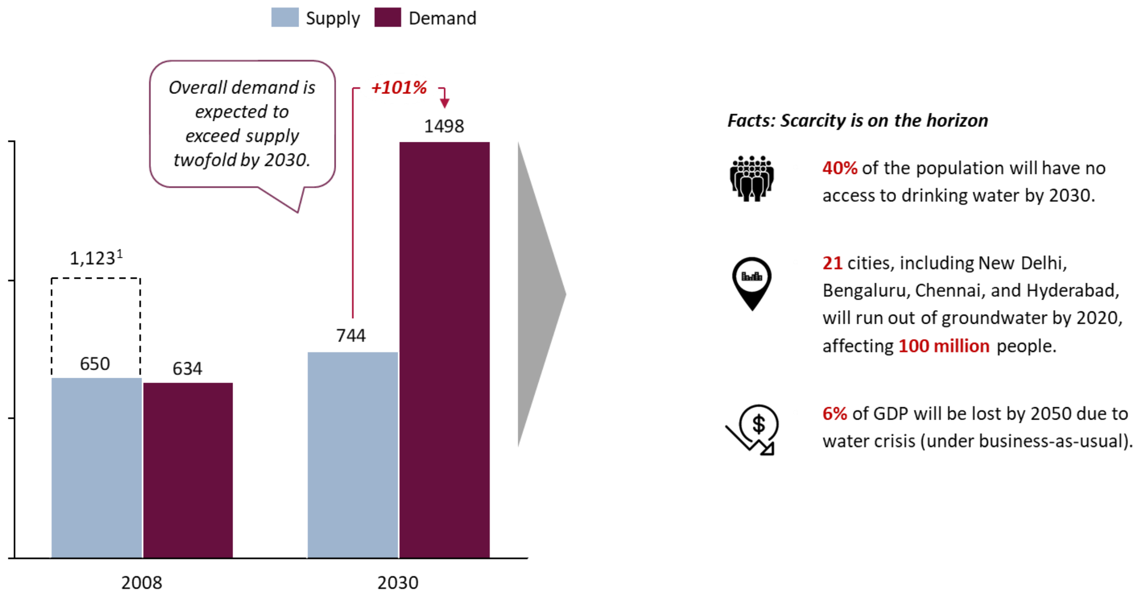
70% of our water is contaminated; India is currently ranked 120 among 122 countries in the water quality index.

Droughts are becoming more frequent, creating severe problems for India's rain-dependent farmers (~53% of agriculture in India is rainfed[17]). When water is available, it is likely to be contaminated (up to 70% of our water supply), resulting in nearly 200,000 deaths each year[18]. Interstate disagreements are on the rise, with seven major disputes currently raging, pointing to the fact that limited frameworks and institutions are in place for national water governance[19].

---

13 Source: World Resource Institute
14 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
15 Source: WRI Aqueduct; https://www.hindustantimes.com/india-news/6-3-crore-indians-do-not-have-access-to-clean-drinking-water/story-dWIEyP962FnM8Mturbc52N.html; https://en.reset.org/blog/water-borne-diseases-india
16 Source: Census 2011
17 Source: State of Indian Agriculture, 2015-16
18 Source: WHO Global Health Observatory
19 Source: ClearIAS

Figure 7: Demand and supply of water in India (forecast)[20,21]
In BCM (2008, 2030)



Notes: 1. Water supply for 2008 is Narsimhan's estimate of 650, while the planning commission estimate is 1,123, as represented by the dashed portion of the graph 2. Demand for 2008 is based on the planning commission's estimates 3. Supply and demand for 2030 are projections by McKinsey and Water Resources Group (WRG)
Source: Dalberg analysis; CWC Water & Related Statistics 2013; FAO & UNICEF, Water in India, 2013; McKinsey & WRG, 'Charting our water future', 2009; World Bank; Times of India

Indeed, if nothing changes, and fast, things will get much worse: 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 hundreds of millions.

One of the key challenge levers driving this crisis is the lack of water data. Data systems related to water in the country are limited in their coverage, robustness, and efficiency. The sector suffers from the following key data problems[22]:

- *Limited coverage:* Detailed data is not available for several critical sectors such as for domestic and industrial use, for which data is only available at the aggregate level and lacks the level of detail required to inform policies and allocations.
- *Unreliable data:* The data that is available can often be of inferior quality, inconsistent, and unreliable due to the use of outdated methodologies in data collection. For example, estimates on groundwater are mostly based on observation data from 55,000 wells, while there are 12 million wells[23] in the country.

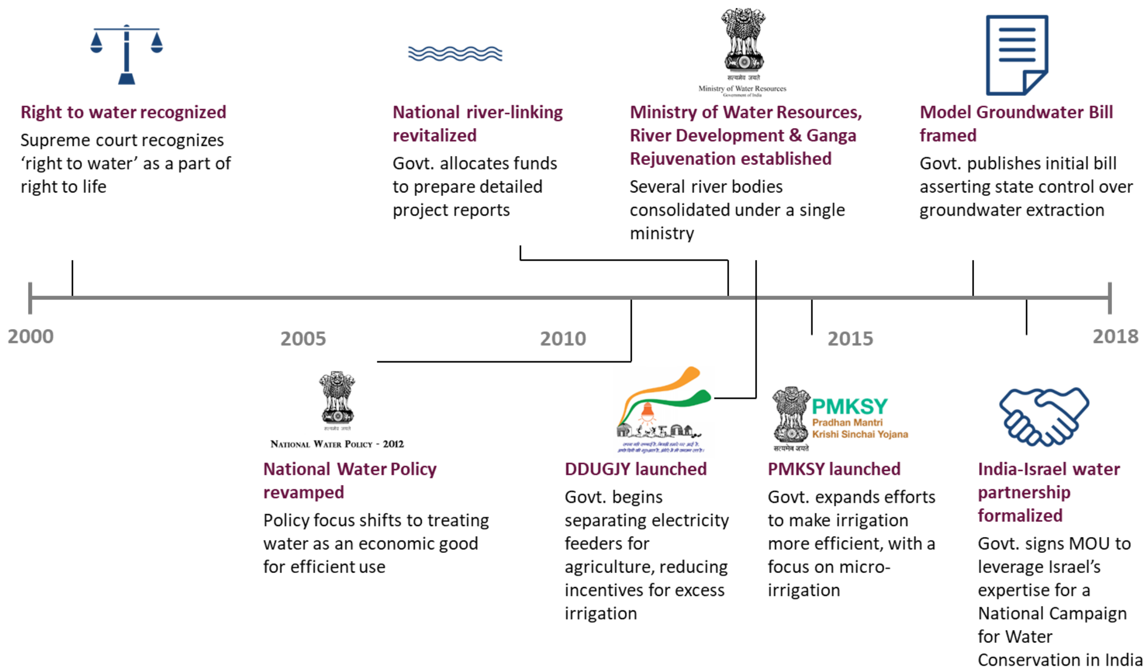
20 1. Water supply for 2008 is Narsimhan's estimate of 650, while the planning commission estimate is 1,123, as represented by the error bar 2. Demand for 2008 is based on the planning commission's estimates 3. Supply and demand for 2030 are projections by McKinsey and Water Resources Group (WRG)
21 Source: CWC, 'Water & Related Statistics', 2013; FAO & UNICEF, Water in India, 2013; McKinsey & WRG, 'Charting our water future', 2009; World Bank; Times of India
22 Source: CWC; CGWB; CPCB
23 Source: 5th MI Census, India

- *Limited coordination and sharing:* Data in the water sectors exists in silos, with very little inter-state or centre-state sharing, 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 crisis in the country and significant challenges, there is room for optimism, with water management receiving increased policy attention over the past few years. From 2014 onwards, the Indian government has taken several steps to move the country further along the path to effective water governance, with the key policy decisions detailed in the timeline below.

Figure 8: Water policy timeline in India (not exhaustive)[24]



Some of the key policy highlights include:

- *Basin-level Governance:* The consolidation of several river authorities into the central Ministry of Water Resources, to enable better decision-making for surface water projects and allocation.
- *Groundwater Bill:* The drafting and discussion of a model groundwater bill that defines groundwater as being held 'in trust' by the government and specifies a decentralized structure for its governance.
- *Innovative Irrigation:* 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 Partnerships:* The formalization of a partnership with Israel, the world leader in water governance and conservation, to leverage Israeli experience and knowledge for water conservation in India.

24 Source: MOWR, PMKSY, DDUGJY websites

Further, global events and examples have highlighted both the potential implications of water scarcity and the pathways to achieve water security. 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 Bangalore[25]. These crises, combined with the global examples of countries managing water effectively in a long-term sustainable manner, such as that of Israel[26], 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 has sought to establish a 'Composite Water Management Index' for the country. This Index is expected to establish a public, national platform providing information on key water indicators across states. This platform will help in monitoring performance, improving transparency, and encouraging competition, thereby boosting the country's water achievements by fostering the spirit of *'competitive and cooperative federalism'* among the states. Further, the data can also be used by researchers, entrepreneurs, and policymakers to enable broader ecosystem innovation for water in India.

---

25 Source: The Guardian; The Atlantic
26 Highlighted in the visit of the Israeli Prime Minister Benjamin Netanyahu to India in 2018 as a potential area for long-term strategic partnership. Source: India Today, 'India, Israel working on 5-year cooperation plan for agriculture, water', 2018

OBJECTIVES AND SCOPE

OBJECTIVES OF THE INDEX

SCOPE AND STRUCTURE OF THE INDEX

SCOPE OF THIS REPORT

2. Objectives and scope

Objectives of the Index

The CWMI is envisioned to bring about much-required improvements in water resource management and conservation in India in a coherent and collaborative manner. The Index will be a public platform that provides an annual snapshot of the water sector status and the water management performance of the different states and UTs in India. The Index will measure both the overall progress made by states in water management and the incremental improvement in performance across time. The results of the entire exercise will be used to propel action in the states to improve water outcomes, besides improving data collection and performance monitoring mechanisms. The Index is expected to promote the spirit of *'competitive and cooperative federalism'* in the country, and ensure sustainable and effective management of water resources. The data included in the Index will be made publicly available to researchers and entrepreneurs to drive innovation in the sector. The collection and compilation of this strategic dataset is a big step towards addressing the country's projected water risk and shortfall.

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*). The themes are further sub-divided into 28 indicators, which are also listed below (*Table 2*).

It should be highlighted that the data collection exercise necessary to develop and populate the Index was unprecedented. Not only was data on several indicators collected for the first time, but the exercise also involved deep collaboration among 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 2015-16 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 2016-17 as a percentage of the irrigation potential area of total number of waterbodies identified for restoration.	%
2(a)	Number of overexploited and critical assessment units that have experienced a rise in water table in pre-monsoon 2016 as compared to water levels in pre-monsoon 2015 (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 overexploited and critical assessment units.	%
2(b)	Number of overexploited 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 overexploited and critical assessment units.	%
3(a)	Percentage of areas of major groundwater re-charging identified and mapped for the State as on 31.03.2016.	%
3(b)	Percentage of areas of major groundwater re-charging identified and mapped for the State as on 31.03.2017.	%
4(a)	Percentage of mapped area covered with infrastructure for re-charging groundwater to the total mapped area as on 31.03.2016.	%
4(b)	Percentage of mapped area covered with infrastructure for re-charging groundwater to the total mapped area as on 31.03.2017.	%
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 31.03.2016.	%
6(b)	Irrigation Potential Utilized (IPU) as a percentage of Irrigation Potential Created (IPC) as on 31.03.2017.	%
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 2016-17.	₹/hectare
9(a)	The length of the canal and distribution network lined as on 31.03.2016 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 31.03.2017 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 31.03.2016 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 2016-17.	%
12(a)	Assets created under IWMP.	Number
12(b)	Geo-tagged assets as a percentage of total assets created under IWMP as on 31.03.2016.	%
12(c)	Geo-tagged assets as a percentage of total assets created under IWMP as on 31.03.2017.	%
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 31.03.2016.	Hectare
14(b)	Percentage of irrigated command areas having WUAs involved in O&M of irrigation facilities (minor distributaries and CAD&WM) as on 31.03.2016.	%
14(c)	Irrigated command area in the state as on 31.03.2017.	Hectare
14(d)	Percentage of irrigated command areas having WUAs involved in O&M of irrigation facilities (minor distributaries and CAD&WM) as on 31.03.2017.	%
15(a)	Total irrigation service fee collected during the financial year 2015-16.	₹
15(b)	Percentage of Irrigation Service Fee (ISF) retained by WUAs as compared to the fee collected by WUAs during the financial year 2015-16.	%
15(c)	Total irrigation service fee collected during the financial year 2016-17	₹
15(d)	Percentage of Irrigation Service Fee (ISF) retained by WUAs as compared to the fee collected by WUAs during the financial year 2016-17.	%
16(a)	Area cultivated by adopting standard cropping pattern as per agro-climatic zoning as a percentage of total area under cultivation as on 31.03.2016.	%
16(b)	Area cultivated by adopting standard cropping pattern as per agro-climatic zoning as a percentage of total area under cultivation as on 31.03.2017.	%
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 2015-16.	%
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 2016-17.	%
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 31.03.2016.	Hectare
19(b)	Area covered with micro-irrigation systems as a percentage of total irrigated area as on 31.03.2016.	%
19(c)	Total irrigated area in the State as on 31.03.2017.	Hectare
19(d)	Area covered with micro-irrigation systems as compared to total irrigated area as on 31.03.2017.	%

20(a)	Percentage of total rural habitations fully covered with drinking water supply as on 31.03.2016.	%
20(b)	Percentage of total rural habitations fully covered with drinking water supply as on 31.03.2017.	%
21(a)	Percentage reduction in rural habitations affected by water quality problems during the financial year 2015-16.	%
21(b)	Percentage reduction in rural habitations affected by water quality problems during the financial year 2016-17.	%
22(a)	Percentage of urban population being provided drinking water supply as on 31.03.2016.	%
22(b)	Percentage of urban population being provided drinking water supply as on 31.03.2017.	%
23(a)	Total estimated generation of waste water in the urban areas as on 31.03.2016.	Million lit/Day
23(b)	Capacity installed in the state to treat the urban waste-water as a percentage of the total estimated waste water generated in the urban areas of the state as on 31.03.2016.	%
24(a)	% waste-water treated during financial year 2015-16.	%
24(b)	% waste-water treated during financial year 2016-17.	%
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 31.03.2016.	%
27(b)	Percentage of households being provided water supply and charged for water in urban areas as on 31.03.2017.	%
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

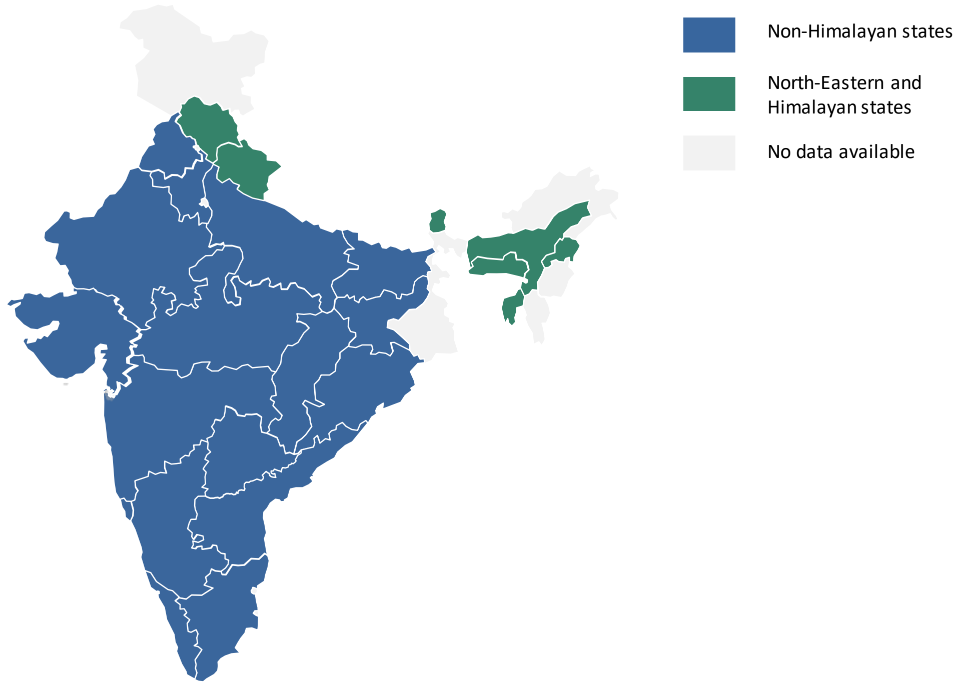
For the CWMI, the reporting states were also divided into two special groups – Non-Himalayan states and North-Eastern and Himalayan states, to account for the different hydrological conditions across these groups.

Table 3: Classification of states into Non-Himalayan and North-Eastern and Himalayan

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

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

Figure 9: 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

SCORING METHODOLOGY

LIMITATIONS

3. Methodology

Data collection and validation

The Independent Validation Agency (IVA)—IPE Global—reviewed the data (indicator-wise) entered for each state/UT 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 is 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 following these guidelines: (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) checks 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 water sector domain, (2) rapid primary validation by visiting select field location (where possible), and (3) feedback from key stakeholders.

Review methodology

The review process was initiated by the IVA in the first week of September 2017. 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 on the discrepancies was undertaken in consultation with concerned stakeholders. Field visits across six states—Madhya Pradesh, Uttar Pradesh, Nagaland, Kerala, Gujarat, and Rajasthan—were also conducted to carry out physical verification of the data and understand the reporting methodology used by the states to collect, collate, and present data against specific indicators.

Table 4: Review methodology for indicators[27]

No.	Indicators	Data sources	Methodology
A.	**Source Augmentation - Restoration of Water Bodies**		
1	Area irrigated by water bodies restored during the financial year 2015-16 & 2016-2017 as compared to the irrigation potential area of total number of water bodies identified for restoration.	Central Water Commission / Water Resources Department / State Reports/ Water MIS	1. Review of formulas and calculations of the final value - errors documented, resolved and submitted. 2. Review of supporting documents (list of water bodies restored) to ensure accuracy. 3. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s). 4. Documentation submitted to NITI Aayog.
B.	**Source Augmentation - Ground Water**		
2	Percentage of overexploited 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 2016/17 in comparison to pre-monsoon 2015/16	Central Ground Water Board (CGWB)/ Water Resources Department (MIS if available)	1. Review of supporting documents provided by SNOs against the portal entries. 2. Counter-checks with CGWB data on critical and over exploited AU. 3. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s). 4. Documentation submitted to NITI Aayog.
3	Percentage of areas of major groundwater re-charging identified and mapped for the State as on 31.3.2016 & 31.3.2017	State 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. 2. Review of state portal for updated information on area to be re-charged, mapped and structures constructed. 3. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s). 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 31.03.2016 & 31.3.2017	State Report/ Central Ground Water Board	

27 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. 2. Documentation submitted to NITI Aayog.
C.	**Supply Side Management – Major and Medium Irrigation**		
6	% of Irrigation Potential Utilized (IPU) to Irrigation Potential Created (IPC) as on 31.03.2016 & 31.3.2017	State Report/Ministry of Agriculture or Water Resources Department	1. Review of supporting documents provided by SNOs against the portal entries. 2. Calculations checked for accuracy. 3. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s). 4. Documentation submitted to NITI Aayog.
7a	Total number of major and medium irrigation projects in the State	State Report/Ministry of Agriculture or Water Resources Department / State Portal	1. Review of projects/state reports and water portal developed by the state for updated information. 2. Review of supporting documents provided by SNOs against the portal entries. 3. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s). 4. Documentation submitted to NITI Aayog.
7b	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 2016-17	State Report/Water Resources Department	1. Review of supporting documents provided by SNOs against the portal entries. 2. Calculations checked – based on total command area and individual components. 3. Supporting documents such as project details, water resource annual reports, reports from the irrigation department, etc., reviewed. 4. Sample states selected for Second Level Verification. 5. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s). 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 Report/ Collect Project details / Project details on Portal	
D.	**Supply Side Management – Watershed Development**		

No.	Indicators	Data sources	Methodology
10	Area under rain-fed agriculture as a percentage of the net cultivated area as on 31.3.2016 or previous year	State Report/Agriculture Statistics – Annual report/ Ministry of Agriculture / Any other report available in the public domain State Report/ Collect Project details	1. Review of supporting documents provided by SNOs against the portal entries. 2. Calculations checked – Total projects under IWMP, RKVY and MGNREGS checked for completeness. 3. Supporting documents, such as project details, water annual reports, updated information state portal, Bhuvan website, etc., reviewed. 4. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s). 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 2016-17		
12	Assets created under IWMP & Percentage of assets created under IWMP geo-tagged as on 31.03.2016 & 31.03.2017	IWMP Report	
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 Report/ Water Resource Department/ Government Order/Framework	1. Review of supporting documents provided by SNOs against the portal entries. 2. Sample states selected for Second Level Verification. 3. Any other document available in the public domain reviewed. 4. State declaration/letters from competent authorities collected. 5. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s). 6. Documentation submitted to NITI Aayog.
14	Irrigated Command Area in the State as on 31.03.2016 & 31.03.2017		
	Percentage of irrigated command areas having WUAs involved in the O&M of irrigation facilities (minor distributaries and CAD&WM) as on 31.3.2016 & 31.03.2017		
15a,c	Total irrigation service fee collected during the financial year 2015-16 & 2016-17	State Report/ Water Resource Department	
15b,d	Percentage of Irrigation Service Fee (ISF) retained by WUAs as compared to the fee collected by WUAs during the Financial Year 2015-16 & 2016-17		
F.	**Demand Side Management - Sustainable on-farm Water Use Practices**		

No.	Indicators	Data sources	Methodology
16	Area cultivated by adopting standard cropping pattern as per agro-climatic zoning, to total area under cultivation as on 31.03.2016 & 31.03.2017	State Report/Ministry of Agriculture (Cropping pattern – area under each crop as against the recommended)	1. Review of supporting documents provided by SNOs against the portal entries. 2. Calculations checked for consistency. 1. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s). 2. Documentation submitted to NITI Aayog.
17a	Has the State segregated agriculture power feeder?	Power Department / Ministry of Agriculture (state report)	
17b	Area in the state covered with segregated agriculture power feeder as compared to the total area under cultivation with power supply during 2015-16.		
18a	Is electricity to tube wells/ water pumps charged in the State?	State Report/ Ministry of Power and Agriculture (Budget, revenue documents)	1. Review of supporting documents provided by SNOs against the portal entries. 2. Any information available online on electricity charges for the state, sample field visit and discussions with Power / Agriculture department reviewed. 3. Documentation submitted to NITI Aayog.
18b	If yes, then whether it is charged as per fixed charges?		
18c	If yes, then whether it is charged on the basis of metering?		
19 a, c	Total Irrigated Area in the State as on 31.03.2016 and on 31.03.2017	Annual report, Ministry of Agriculture; Agriculture output and crop yield; State Reports	1. Review of supporting documents provided by SNOs against the portal entries. 2. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s). 3. Documentation submitted to NITI Aayog.
19 b, d	Area covered with micro-irrigation systems as compared to total irrigated area as on 31.03.2016 and on 31.03.2017	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 31.03.2016 and on 31.3.2107	State report; data available on National drinking water supply and	1. Counter checked with data available on the national drinking water supply and sanitation portal.

No.	Indicators	Data sources	Methodology
21 a, b	% reduction in rural habitations affected by Water Quality problems during the Financial Year 2015-16 and 2016-17	sanitation report – specific years	2. Review of state submission against accepted norms w.r.t provision of water supply in rural areas (~40 lpcd). 3. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s). 4. Documentation submitted to NITI Aayog.
H.	**Urban Water Supply and Sanitation**		
22 a, b	% of urban population being provided drinking water supply as on 31.03.2016 and as on 31.03.2017	State 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. 2. Review of state submission against accepted norms w.r.t provision of water supply in urban areas (~ 135 lpcd). 3. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s). 4. Documentation submitted to NITI Aayog.
23 a	Total estimated generation of waste water in the urban areas as on 31.03.2016		
23 b	Capacity installed in the state to treat the urban waste-water as a proportion of the total estimated waste water generated in the urban areas of the state as on 31.03.2016	State report; List of waste water treatment facilities with capacities; State Urban Department – reports	1. Review of supporting documents (list of waste water facilities, their capacities and the output). 2. Sample field visits to review waste water treatment facilities/check estimations with available norms on waste water (80% of water supplied). 3. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s). 4. Documentation submitted to NITI Aayog.
24 a, b	% waste-water treated during FY 2015-16 & FY 2016-17		
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. 2. Outliers/inconsistencies in the data identified and resolved with the State nodal officer(s). 3. Documentation submitted to NITI Aayog.
26	Whether the State has any framework for rain water		

No.	Indicators	Data sources	Methodology
	harvesting in public and private buildings?		
27	Percentage of households being provided water supply and charged for water in the urban areas as on 31.3.2016 and as on 31.3.2017	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 pre-filled data was checked for data entry and calculation errors for the estimated figures. 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 waste water 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 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 were then requested to review the validation report and provide their feedback on the validated values. Subsequently, the IVA also presented the validation results in a conference held at NITI Aayog on 17th January 2018, to the 21 states 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.

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.

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.

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 the base year (FY 15-16) and FY 16-17 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 two 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 2011 and 2013, 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 of relevant evidence and supporting documents.

Change in nodal officers at the state water resource department/irrigation department: The assigned nodal officers appointed 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.

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 2015-16 & 2016-2017 as compared to the irrigation potential area of total number of water bodies identified for restoration	Central Water Commission / 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, Jharkhand, 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 overexploited 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	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. As informed by the nodal officers of the states, the readings are calibrated at the block level, however, it is not a regular

No.	Indicators	Data sources	Observations
	purpose) and CGWB] to total number of assessment units in pre-monsoon 2016/17 in comparison to pre-monsoon 2015/16		practice. States such as Madhya Pradesh, Rajasthan, Jharkhand, Himachal 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 31.3.2016 & 31.3.2017	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, Odisha, Bihar, Tripura, Meghalaya and Sikkim have not identified any area for mapping. States also did not have relevant data on area covered with infrastructure. Andhra Pradesh, Karnataka, Chhattisgarh, Gujarat, Jharkhand, Kerala, Madhya Pradesh, and Assam are the only 8 states which 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 use/ management?	Copy of Act/ Government Order (GO)	No observation.
	C. Supply Side Management – Major and Medium Irrigation		
6	% of Irrigation Potential Utilized (IPU) to Irrigation Potential Created (IPC) as on 31.03.2016 & 31.3.2017	State Report/Ministry of Agriculture or Water Resources Department	IVA had to explain the particular IPC and IPU figures required to some of the states as most of them use different nomenclature to define irrigation potential created, such as Culturable Command areas (CCA) and Gross Irrigated Area.
7a	Total number of major and medium irrigation projects in the State	State 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.
7b	Number of projects assessed and identified for the IPC-IPU gap in the State		

No.	Indicators	Data sources	Observations
8	Expenditure incurred on works (excluding establishment expenditure) for maintenance of irrigation assets per hectare of command area during the Financial Year 2016-17	State 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 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 31.3.2016 or previous year	State Report/Agriculture Statistics – Annual report/ Ministry of Agriculture / Any other report available in the public domain	Except for Haryana, all states have provided the 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 Haryana 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 Year 2016-17	State Report/ Collect Project details	Data was collected separately for different schemes and then added later. States, such as Jharkhand, Chhattisgarh, and Himachal Pradesh, provided detailed list of structures w.r.t each scheme.
12	Assets created under IWMP & Percentage of assets created under IWMP geo-tagged as on 31.03.2016 & 31.03.2017	IWMP Report	The IVA used Bhuvan maps[28] 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	State Report/ Water Resource Department/	No observation.

28 Source: http://bhuvan.nrsc.gov.in/projects/iwmp/

No.	Indicators	Data sources	Observations
	Irrigation Management (PIM) through Water User Associations (WUAs)?	Government Order/Framework	
14 a,c	Irrigated Command Area in the State as on 31.03.2016 & 31.03.2017		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 31.3.2016 & 31.03.2017		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 2015-16 & 2016-17	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 2015-16 & 2016-17		Despite the presence of WUAs and the collection of irrigation service fee facilitated by them, states like Chhattisgarh, Madhya Pradesh do not let the WUAs retain a component of the fee. The fees are 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 per agro-climatic zoning, to total area under cultivation as on 31.03.2016 & 2017	State Report/Ministry of Agriculture (Cropping pattern – area under each crop as against the recommended)	There is enough literature in the public domain on different Agro-Climatic 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

No.	Indicators	Data sources	Observations
			grown in the state, except for states such as Chhattisgarh and Jharkhand.
17a	Has the State segregated agriculture power feeder?	Power Department / Ministry of Agriculture (state report)	Only states such as Andhra 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[29], the IVA has accepted the number of feeder connections and not area.
17b	Area in the state covered with segregated agriculture power feeder as compared to the total area under cultivation with power supply during 2015-16.		
18a	Is electricity to tube wells/ water pumps charged in the State?	State 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 rates but metered connections. States like Maharashtra, Andhra Pradesh, Karnataka[30], Bihar, Chhattisgarh[31], 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.
18b	If yes, then whether it is charged as per fixed charges?		
18c	If yes, then whether it is charged on the basis of metering?		
19 a, c	Total Irrigated Area in the State as on 31.03.2016 and on 31.03.2017	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.

29 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.

30 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.

31 The State Government of Chhattisgarh under Kishan 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
19 b, d	Area covered with micro-irrigation systems as compared to total irrigated area as on 31.03.2016 and on 31.03.2017	List of micro-irrigation systems with area – Annual reports, Ministry of Agriculture	Further, several states did not have documented information against the area under micro-irrigation.
G.	**Rural Drinking Water – Supply**		
20 a,b	Proportion of total rural habitations fully covered with drinking water supply as on 31.03.2016 and on 31.3.2107	State report; Data available on National drinking water supply and sanitation report – specific years	No observation *(the data was available in the public domain).*
21 a,b	% reduction in rural habitations affected by Water Quality problems during the Financial Year 2015-16 and 2016-17		
H.	**Urban Water Supply and Sanitation**		
22 a,b	% of urban population being provided drinking water supply as on 31.03.2016 and as on 31.03.2017	State report; Data available on National drinking water supply and sanitation report, UDPFI Norms/State planning guidelines	Several states struggled to collect data against this indicator. States like Madhya Pradesh 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. The IVA used counter-calculations to verify the state submissions against this indicator.
23 a	Total estimated generation of waste water in the urban areas as on 31.03.2016		
23 b	Capacity installed in the state to treat the urban waste-water as a proportion of the total estimated waste water generated in the urban areas of the state as on 31.03.2016	State report; List of waste water treatment facilities with capacities; State Urban Department – reports	Again, most states did not provide the IVA with details on capacity installed to treat waste water. States such as Himachal Pradesh, Jharkhand, provided the IVA with detailed data on the treatment plants in each city and their respective installed capacity. The information available in the public domain[32] also doesn't match with the submitted data. Further, the percentage of waste water 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 2015-16 & 2016-17		
I.	**Policy and Governance**		

32 Source: http://www.sulabhenvis.nic.in/Database/STST_wastewater_2090.aspx

No.	Indicators	Data sources	Observations
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 31.3.2016 and as on 31.3.2017	State Reports, annual report, National drinking water supply and sanitation data	No observation.
28 a	Does the State have a separate integrated Data Centre for water resources?	Online portal link/ Departments incorporation and GO	Only a few states have developed an integrated data centre for water 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?		

RESULTS AND COMMENTARY

OVERALL ANALYSIS

THEMATIC ANALYSIS

INDICATOR-WISE ANALYSIS

CASE STUDIES ON BEST PRACTICES

4. RESULTS AND COMMENTARY

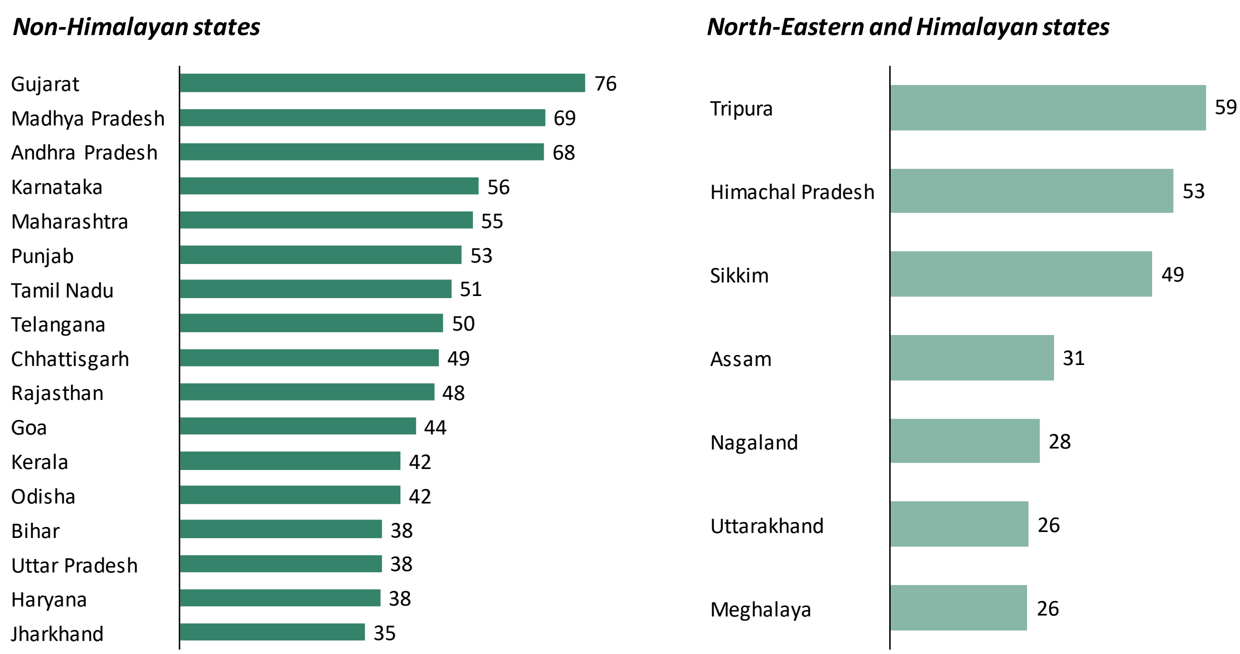
Overall analysis

What's in this section?

In this section, the report assesses states' composite performance on water resource management. This involves an analysis of Water Index ranks and scores for states (that have submitted the relevant data) in FY 16-17, with separate analyses of performance across Non-Himalayan states and North-Eastern and Himalayan states due to the substantially different hydrological conditions, challenges, and monetary resources in these states, and the classification of states as high/ medium/low performers. Further, the section provides an overview of the evolution of state rankings and scores from the base year of FY 15-16 to FY 16-17, examining the changes in the ranks across different states. It is important to emphasize that the Water 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.

Figure 10: State-level performance on water resource management[33]

Ranking of states according to Composite Water Index Scores (FY 16-17)



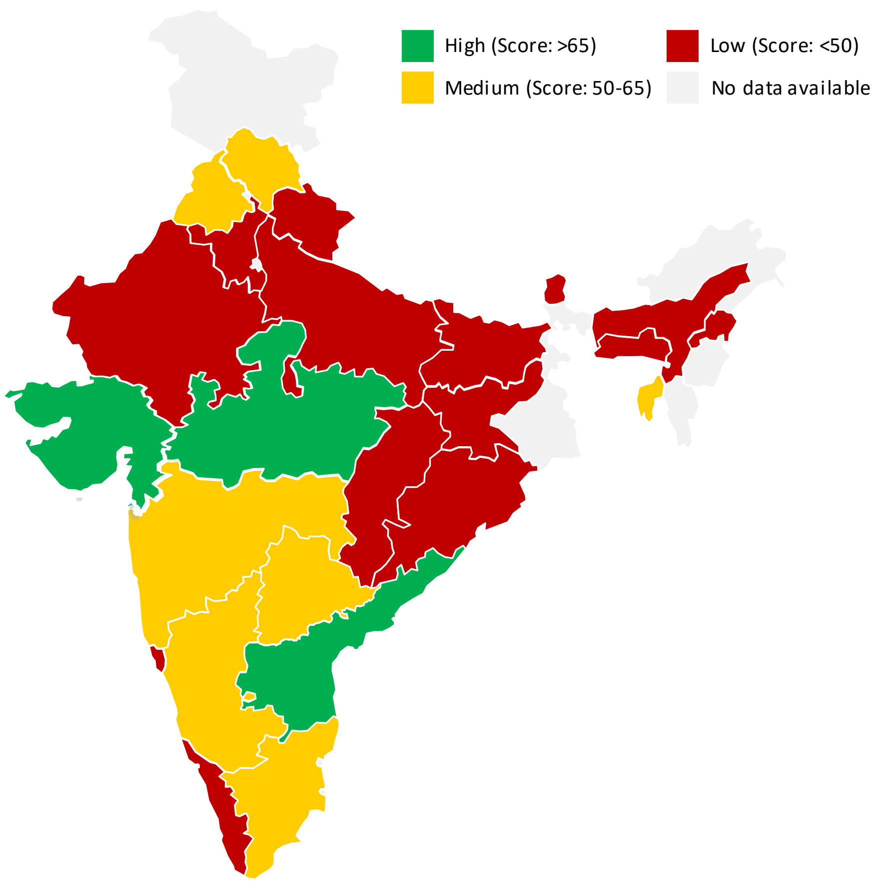
Overall, there is large inter-state variation in Water Index scores, but most states have achieved a score below 50 (out of 100) and need to significantly improve their water resource management practices. The Water Index scores for FY 16-17 vary from ~76 (Gujarat) to ~26 (Meghalaya), with the median score being ~49 for Non-Himalayan states and ~31 for North-Eastern and Himalayan states. Gujarat is the highest performer, closely followed by other high performers such as Madhya Pradesh and Andhra

33 The scores for 'Non-Himalayan' and 'North-Eastern and Himalayan' states were calculated separately, by using only the range of scores in the given category in the calculations. Thus, 'North-Eastern and Himalayan' states' scores were scaled considering only the range of scores in the 'North-Eastern and Himalayan' category, to account for the different hydrological conditions in these states 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.

Pradesh. Most other states are clustered around the 40-60 band. Seven states have scores between ~50-65 (including two North-Eastern and Himalayan states) and have been classified as Medium performers. However, ~60% of states (14 out of 24) have achieved scores below 50 and have been classified as Low performers (*Figure 11*).

Most North-Eastern and Himalayan states are the lowest performers on the Index, but a few have scores that are comparable to or better than most of the larger states. Assam, Nagaland, Uttarakhand, and Meghalaya have the lowest Index scores (in FY 16-17) out of all states, ranging from ~26 to 31. This low performance involves low scores across almost all indicator themes, with several states scoring zeroes or not submitting data for as many as seven indicators (out of 28). This is possibly due to a combination of high water availability, which reduces the imminence for water management and policy action, and the limited availability of monetary resources for investment-heavy programmes such as micro-irrigation. On the other hand, Tripura and Himachal Pradesh have high scores, with both performing well in supply-side management (irrigation and watershed development) and water-supply provision (rural and urban).

Figure 11: High-, medium-, and low-performing states on water resource management
Classification according to Composite Water Index Scores (FY 16-17)



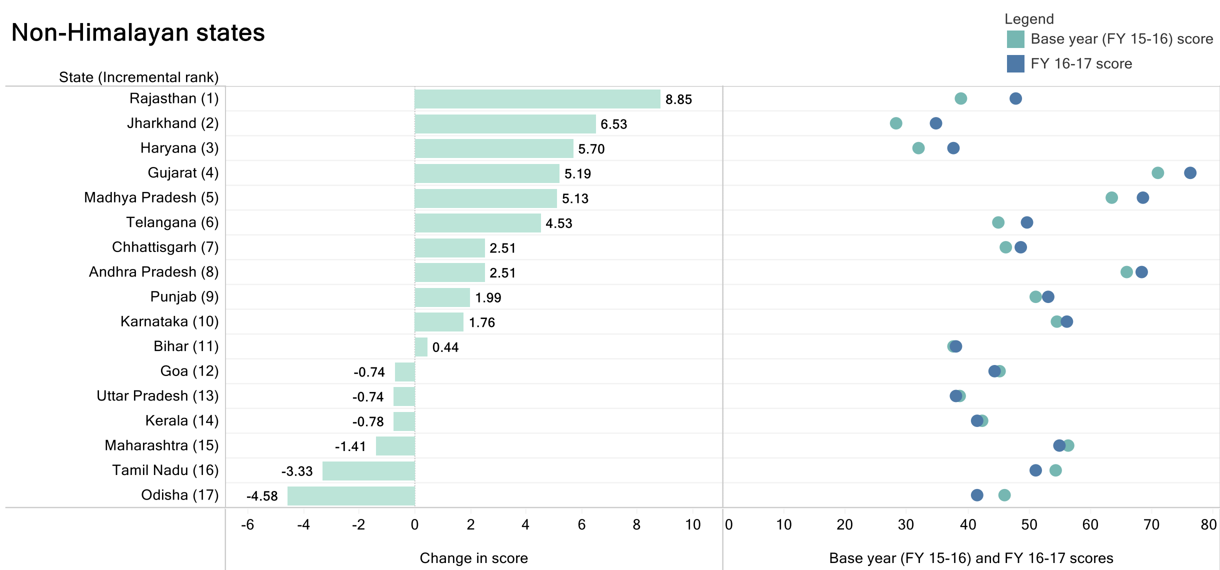
Encouragingly, several water-scarce states are the leaders in Index performance. Several of the high and medium performers—Gujarat, Madhya Pradesh, Andhra Pradesh, Karnataka, Maharashtra, Telangana—

are states that have suffered from severe droughts in recent years[34,35]. The action taken by these states, and their subsequent good performance on the Index, are likely driven by necessity in the face of looming water shortages. This correlation shows, positively, that corrective action is starting in at least some of the areas that need it the most.

More worryingly, the low performers on the Water Index are home to ~50% of the country's population, thereby highlighting the significant water risk faced by the country. The low performers are, worryingly, comprised of the populous northern states of UP, Bihar, Rajasthan, Haryana, and others, and are home to over 600 million people[36]. The poor performance of these states on the Index highlights a significant water management risk for the country going forward. Further, these states also account for 20-30% of India's agricultural output[37]. Given the combination of rapidly declining groundwater levels and limited policy action (as indicated by the low Index score), this is also likely to be a significant food security risk for the country going forward.

Figure 12: Change in state-level performance over time—Non-Himalayan states and North-Eastern and Himalayan states

Change in Composite Water Index scores (Base year (FY 15-16), FY 16-17)

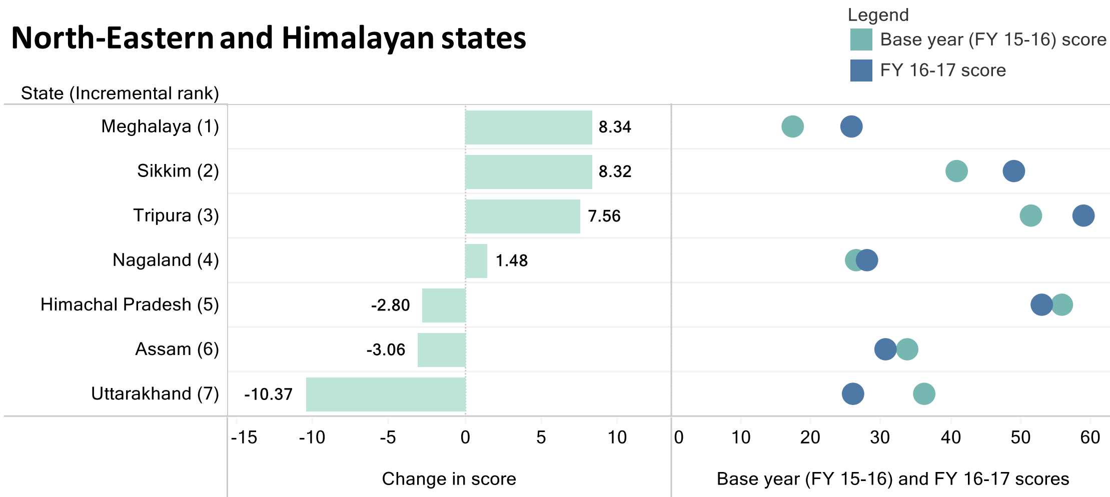


34 Source: https://www.firstpost.com/india/in-june-maharashtra-gujarat-jharkhand-and-4-other-drought-hit-states-short-of-water-2859758.html

35 Source: https://economictimes.indiatimes.com/news/economy/policy/8-states-declared-drought-affected-centre-allows-them-to-offer-50-days-of-extra-work-under-nregs/articleshow/58037760.cms

36 Source: 2011 Census of India

37 Source: Planning Commission Databook 2014; India Energy Statistics 2015



Promisingly, about 60% (15 out of 24) of the states included in the Index have improved their scores in FY 16-17 (*Figure 12*). The average change in scores from FY 15-16 to FY 16-17, however, has been a modest gain of ~1.8 points. Eight states achieved impressive gains of five points or more in a single year—despite the slow-moving nature of several indicators (such as irrigation potential utilized and area under rain-fed agriculture). Most gains have been led by improvements in restoration of surface water bodies, watershed development activities, and rural water supply provision. Rajasthan (among the Non-Himalayan states) and Meghalaya, Tripura, and Sikkim (among the North-Eastern and Himalayan states) have improved the most, increasing their scores by more than 7.5 points.

Rajasthan has improved scores across the indicator themes, including the provision of a greater role to Water User Associations (WUAs)[38] in irrigation, and the restoration of surface water bodies. Building on this momentum, Rajasthan has received a $100 million loan from the New Development Bank (NDB) in 2018 to improve the Indira Gandhi Canal system, with WUA strengthening and water body restoration expected to be key activities in the proposed plan[39].

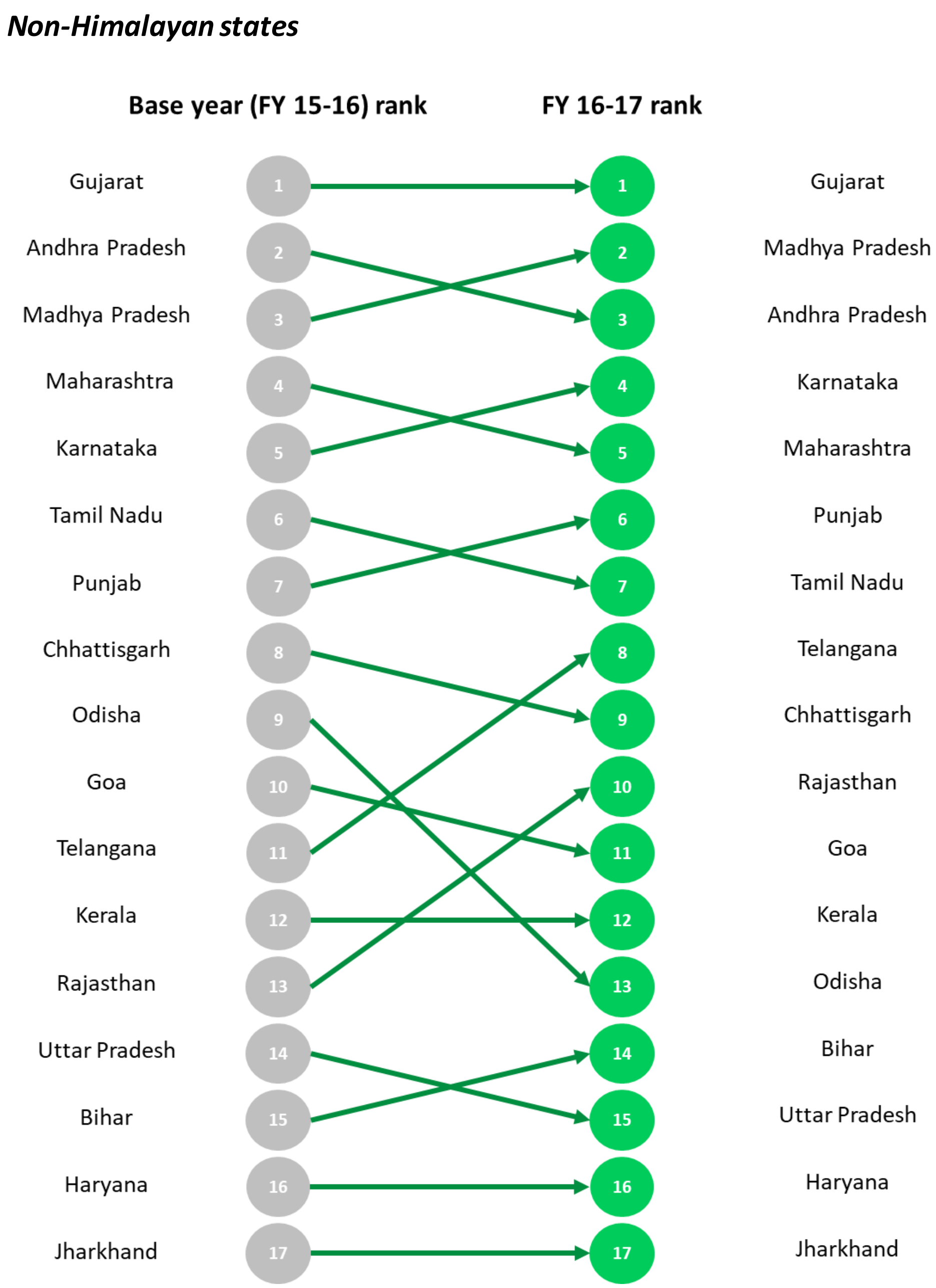
The performance of the North-Eastern and Himalayan states of Meghalaya, Sikkim, and Tripura—all among the top five improvers—is particularly impressive given the low ranks of the first two of these states and Tripura's already exceptional performance and might signal increasing water policy action in this category.

On the other hand, nine states have experienced a decline in scores (from ~0.7 to ~10.3 points). These declines have been concentrated in groundwater augmentation (seven states losing about nine points collectively), major and medium irrigation (12 states losing nine points collectively), and rural drinking water (10 states losing 15 points collectively). Uttarakhand was the major loser, with a ~10-point decline largely driven by a decline in agro-climatic zone-based cultivation on the farm, and a fall in the reach and quality of provision of rural and urban drinking water. Other states such as Odisha and Tamil Nadu have

38 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.
39 Source: http://pib.nic.in/newsite/PrintRelease.aspx?relid=176564

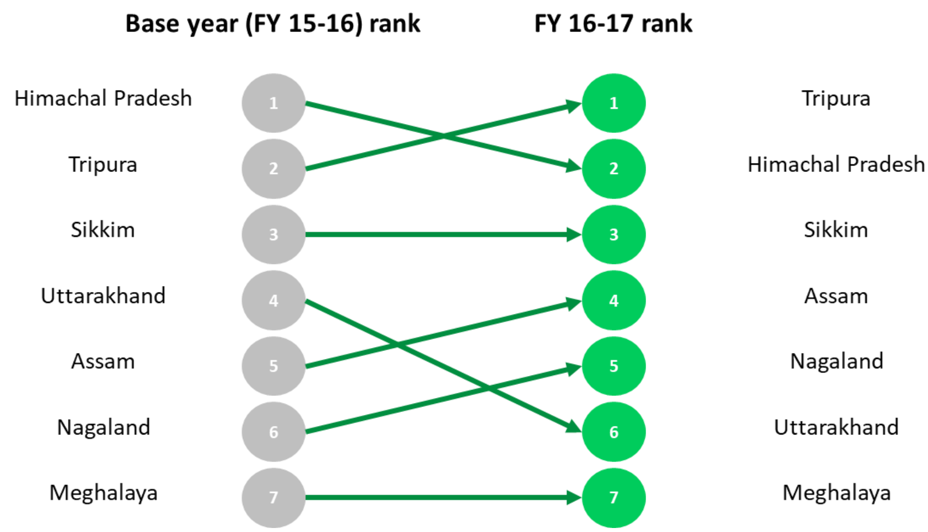
seen scores decline due to a fall in irrigation achievement, with Odisha missing its canal lining targets and Tamil Nadu failing to utilize the potential of its irrigation assets[40].

Figure 13: Evolution of state rankings over time for Non-Himalayan states and North-Eastern and Himalayan states
Based on Water Index composite scores (Base Year (FY 15-16), FY 16-17)



40 Odisha's decline has also involved a decline in rural water quality

North-Eastern and Himalayan states



In terms of state rankings, there have been only a few major shifts from the base year (FY 15-16) to FY 16-17, with most states staying roughly within the same performance classification. On average, a state has moved about two places across the two years. At the top and the bottom of the lists for the two categories, rankings have not changed significantly between FY 15-16 and FY 16-17 (*Figure 13*). In the middle of the lists, most states have moved up or down by just one or two places, in line with the nature of indicators—irrigation projects, area under rainfed agriculture, electricity provision—that are unlikely to change significantly in a single year.

Rajasthan and Tripura are some of the gainers, with Rajasthan moving up by three places, and Tripura going up to the top of the North-Eastern and Himalayan states. Tripura's rise has been driven by an increase in the quality of rural water supply and improved geo-tagging of watershed conservation structures under the Integrated Watershed Management Programme (IWMP)[41]. Rajasthan has improved scores across the indicator themes of participatory irrigation and source restoration, as discussed above.

On the other hand, Odisha has exhibited the largest drop, losing four places in a single year, due to limited improvement in quality of rural water supply and non-achievement of canal lining targets. Uttarakhand has also dropped by two places, due to a decline in the reach and quality of urban and rural water supply provision (vis-à-vis the performance of other states).

41 The IWMP involves the construction of water harvesting structures, the increase of area under irrigation, supporting afforestation and horticulture, and other watershed development activities.

Thematic analysis

What's in this section?

*This section focuses on the analysis of indicators aggregated at the thematic level, presented separately for Non-Himalayan states and North-Eastern and Himalayan states. State scores across nine themes, covering **resource augmentation**, **supply infrastructure**, **demand management**, **watershed development**, **water supply and sanitation in rural and urban areas**, and **policy and water governance** (Table 6)**,** and the ensuing patterns/ clusters, are analyzed to identify the themes that are doing well at a national level, and those that could benefit from a greater policy push. It is important to emphasize that the Water 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 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**

Theme 1: Source augmentation and restoration of water bodies

What does the theme mean? The first theme focuses on the restoration of surface water bodies, such as rivers, ponds, and tanks, to boost irrigation potential in the state 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.

Figure 14: Performance of Non-Himalayan states on Theme 1 – Source augmentation and restoration of water bodies

Index scores (from 0-5) (Base year (FY 15-16), FY 16-17)

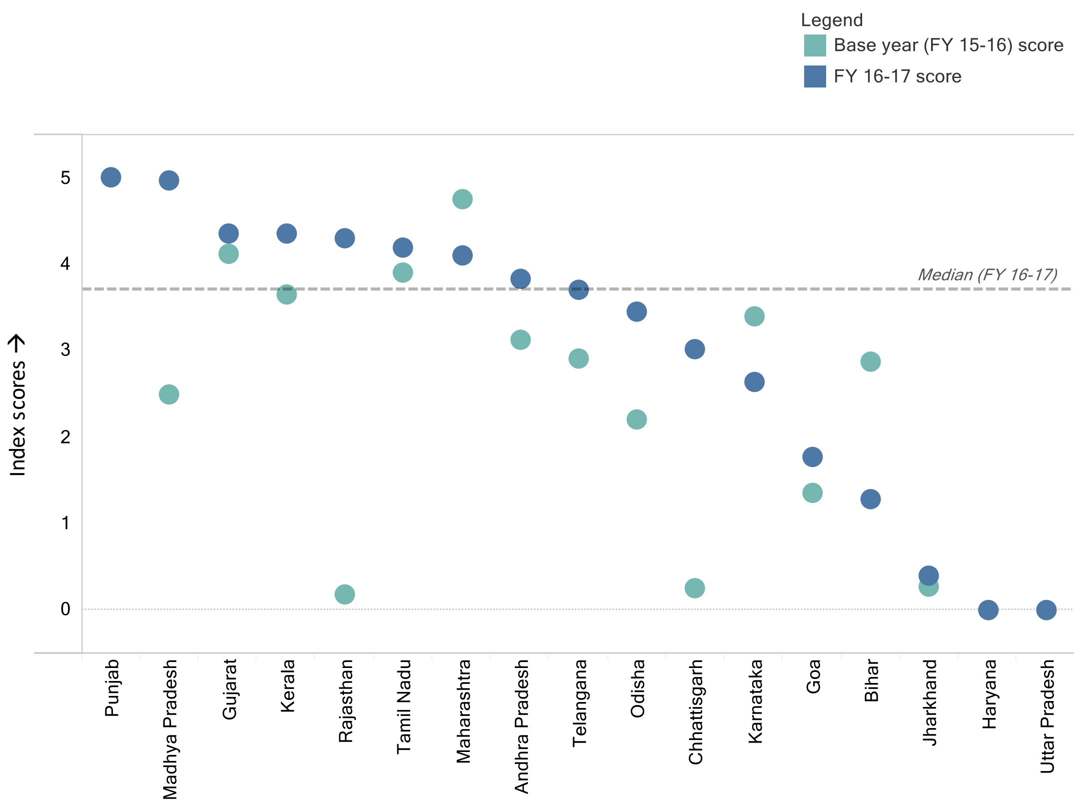
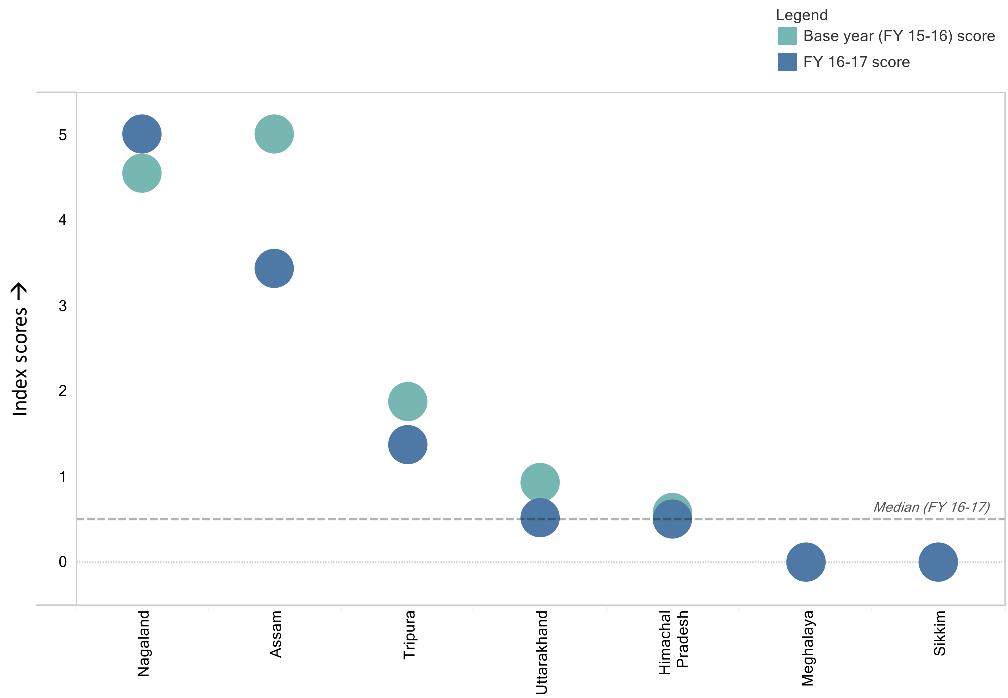


Figure 15: Performance of North-Eastern and Himalayan states on Theme 1 – Source augmentation and restoration of water bodies

Index scores (from 0-5) (Base year (FY 15-16), FY 16-17)



50% of states have improved their performance in the restoration of water bodies from FY 15-16 to FY 16-17, but there is wide variation in scores. The median score for the theme has increased by ~40%, from 2.35 in FY 15-16 to 3.22 in FY 16-17, with 12 states improving their scores year-on-year. There are two broad clusters of state scores—one set has scores that are greater than three points, while the other set has scores that are either 0 or below one. North-Eastern and Himalayan states and the larger northern states, who are also the worst performers in the overall Index, are the lowest scores on this theme. The low performers can benefit from the strategic prioritization of restoring water bodies that have a large irrigation potential, and by developing stronger community management institutions in irrigation.

Theme 2: Source augmentation (Groundwater)

What does the theme comprise? This theme focuses on the identification and recharging of 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 specifying state achievement in CGWB (Central Ground Water Board) mandated tasks 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 increases in the water table 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.

Figure 16: Performance of Non-Himalayan states on Theme 2 – Source augmentation (Groundwater)
Index scores (from 0-15) (Base year (FY 15-16), FY 16-17)

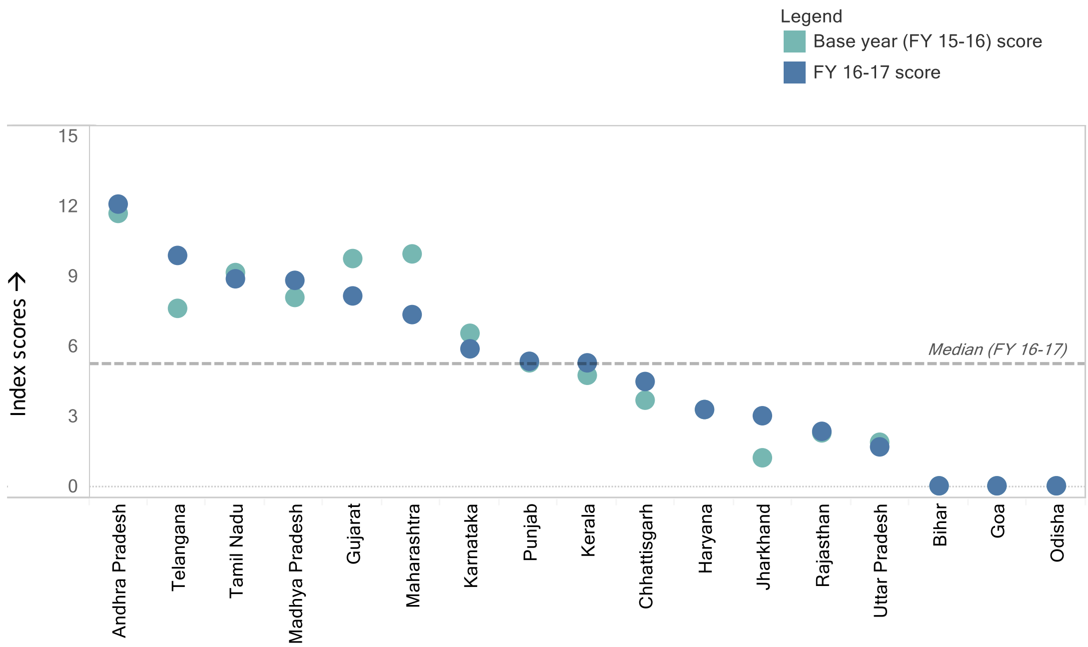
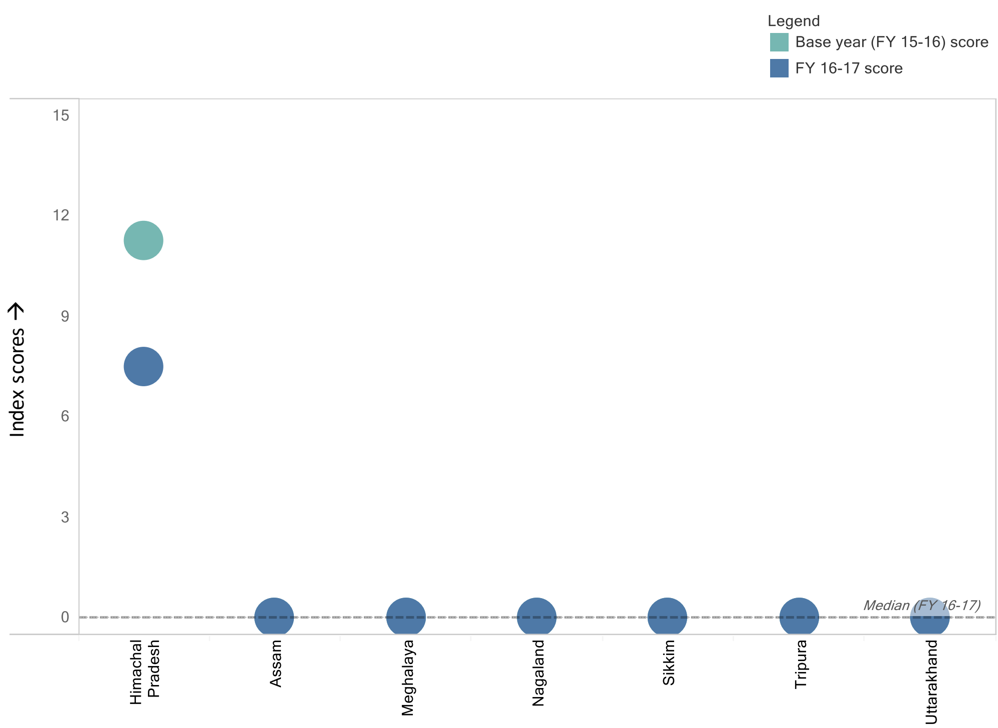


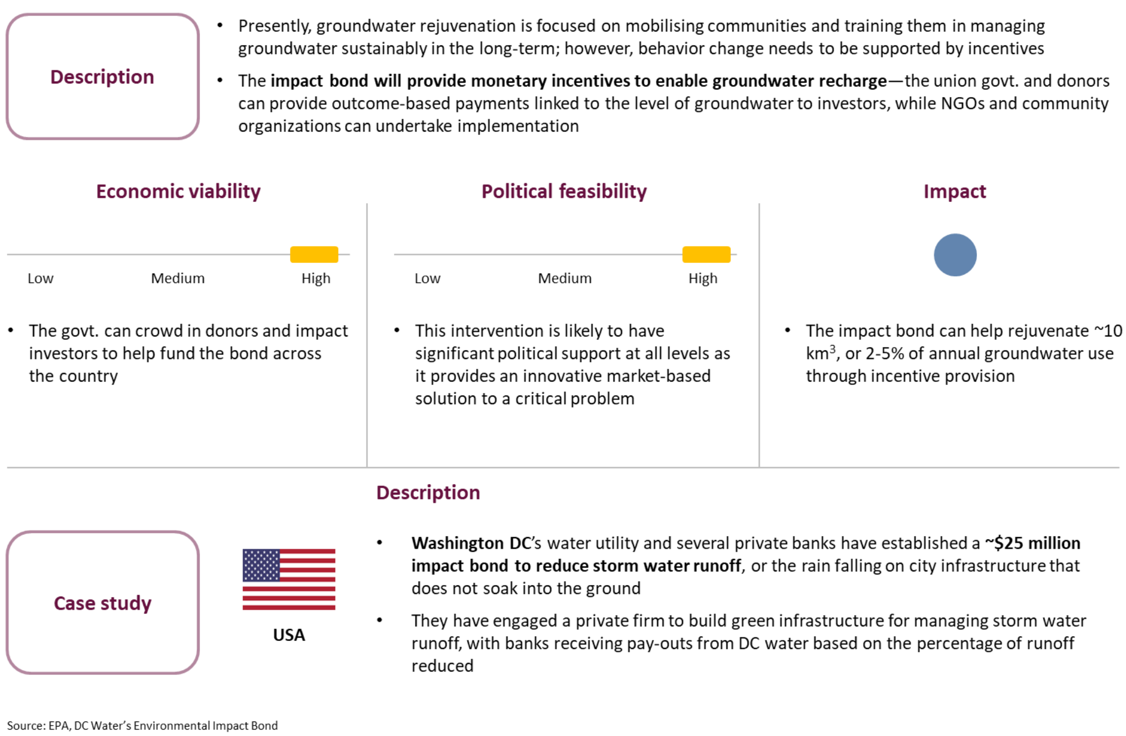
Figure 17: Performance of North-Eastern and Himalayan states on Theme 2 – Source augmentation (Groundwater)
Index scores (from 0-15) (Base year (FY 15-16), FY 16-17)



Most states have achieved less than 50% of the total score in the augmentation of groundwater resources, highlighting a growing national crisis. The median score for the theme in FY 16-17 for states that possess over-exploited or critical groundwater units was only 5.89, which is ~40% of the total achievable score of 15. This excludes eight states that reported having no over-exploited or critical groundwater units. Of the other 16 states, 10 achieved a score below 7.5, the 50% score mark, in FY 16-17. Further, only 50% of states have enacted a regulatory framework for the management of groundwater. These results highlight the growing national crisis of groundwater—54% of India's groundwater wells are declining in level due to extraction rates exceeding recharge rates and 21 major cities are expected to run out of groundwater as soon as 2020, affecting ~100 million people[42]. This crisis is further driven by a poorly defined legal framework for groundwater that rests ownership with landowners and leads to unchecked extraction. This crisis is most acute in the Indian agriculture sector, where groundwater accounts for 63% of all irrigation water[43].

Given the poor performance of several states on this theme, it is important to explore incentive-based mechanisms for groundwater restoration, such as an innovative water impact bond that pays out funds to community organizations/ NGOs on achieving groundwater recharge targets (see case study below).

Figure 18: Case study: Developing an impact bond for groundwater rejuvenation



Theme 3: Major and medium irrigation—Supply side management

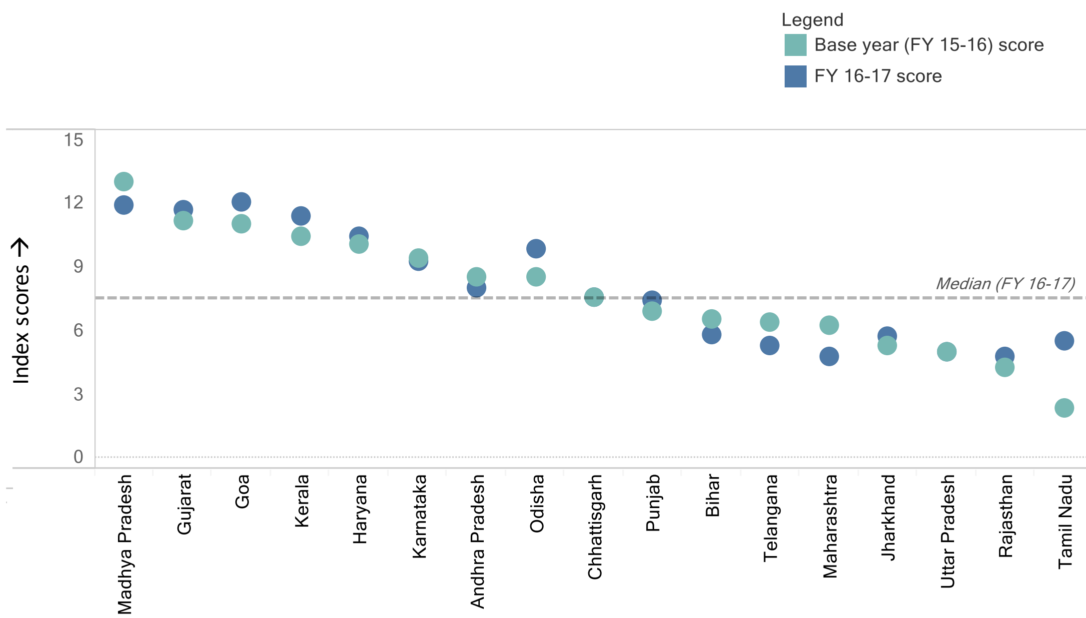
What does the theme comprise? This theme focuses on irrigation systems and utilization across states, and accounts for 15 points (out of 100) in the Index. The high weightage emphasizes the government's continued policy focus on ensuring that irrigation systems are utilized and maintained, one of the major

42 Source: WRI; World Bank (Hindustan Times, The Hindu)
43 Source: FAO AQUASTAT database

challenge areas identified in the 12th 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 12th Plan[44].

Figure 19: Performance of Non-Himalayan states on Theme 3 – Major and medium irrigation—Supply side management

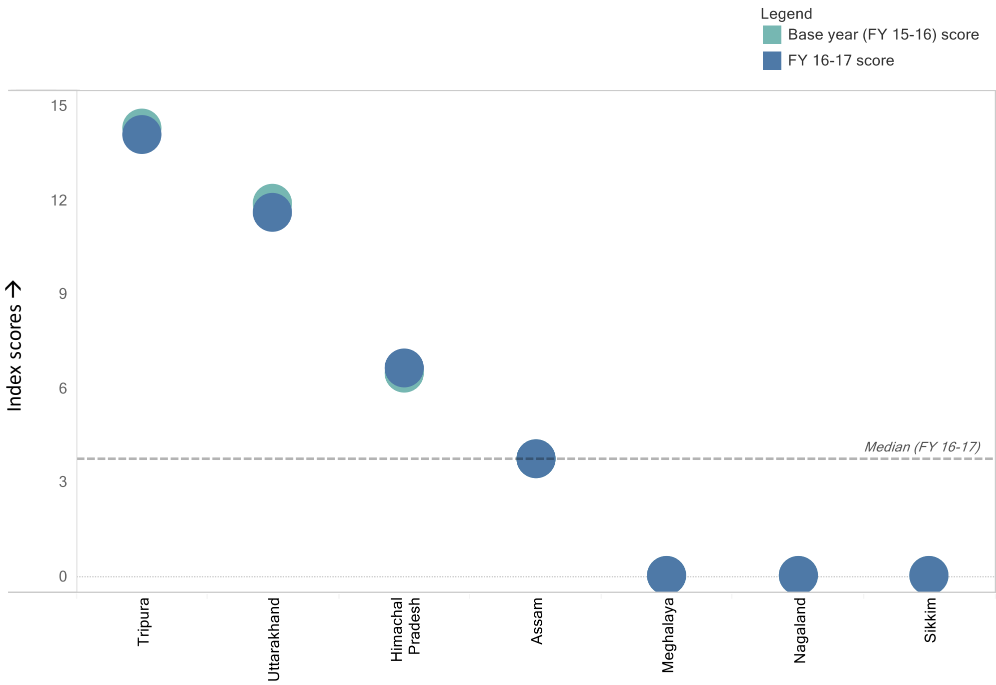
Index scores (from 0-15) (Base year (FY 15-16), FY 16-17)



44 Source: Dr. Mihir Shah, EPW, 'Water: Towards a paradigm shift in the Twelfth Plan', 2013

Figure 20: Performance of North-Eastern and Himalayan states on Theme 3 – Major and medium irrigation—Supply side management

Index scores (from 0-15) (Base year (FY 15-16), FY 16-17)



At the overall level, states have performed moderately in irrigation management, with just about a majority of reporting states achieving a score greater than 50% of the maximum possible score. The median score for the 21 states that reported data was 7.57 for FY 16-17, with 11 states reporting scores higher than the 50% score mark of 7.5. Despite good overall performance, there is still significant variation in scores, with several large states such as Maharashtra performing poorly. In fact, Maharashtra has the highest number of large dams in the country (2,354[45]), but only 18% of the state is irrigated[46], indicating a wide gap between irrigation potential created (IPC) and irrigation potential actually utilized (IPU).

The central government can provide financial incentives to states to improve performance in irrigation management. The erstwhile Planning Commission identified the IPC-IPU gap and inadequate maintenance as the most pressing challenges in the irrigation sector in the country. These were driven by a lack of capacity in state departments and inadequate collection of user fees to ensure maintenance of irrigation assets. The Commission proposed the creation of a National Irrigation Management Fund (NIMF) that would incentivize efficient irrigation management by allocating funds to state irrigation departments in a 1:1 ratio of the irrigation service fee collected from users by each department, with bonus funds

45 Source: https://sandrp.in/2017/10/17/indias-national-register-of-large-dams-shows-how-little-we-know-about-our-dams/
46 Source: https://www.firstpost.com/india/marathwada-drought-maha-has-the-most-dams-in-the-country-but-the-least-effective-irrigation-network-leaving-lakhs-in-the-lurch-2721434.html and also ***Land Use Statistics at a Glance May, 2015, Directorate of Economics & Statistics, Ministry of Agriculture***

awarded for fees collected from Water User Associations (WUAs)[47]. The fund has not been set up yet. Such a fund's potential impact and a global example to draw from are detailed in the case study below.

Figure 21: Case study: Establishing a national irrigation fund for India

Description

- Currently, **water is a state subject**, resulting in frequent inter-state disputes and limited policy control by the union govt.; further, funding to states is not linked to performance in water metrics
- By establishing this National Water Fund under the union water ministry, the **centre can bypass the state list issue and incentivize adherence to national policy** guidelines by providing funding for water infrastructure and conservation to high-performing states

Economic viability

Low Medium High [High]

- The cost of setting this up is expected to be low as existing funds can be consolidated into this structure

Political feasibility

Low Medium High [High]

- This intervention is likely to have significant political support at the centre as it incentivizes state adherence to national guidelines

Impact

- This is likely to save ~50 km^3 of water annually by enabling state buy-in for pricing and allocation guidelines

Case study

Australia

Description

- Australia has set up **National Water Infrastructure Development Fund** to provide financing to states for building water infrastructure such as damns, pipelines, or for aquifer recharge
- The funding is awarded on the merit of EOIs and **~$450 million has already been allocated to various states** in the form of capital and feasibility support for water projects

Source: Australian Government, Department of Infrastructure, Regional Development and Cities website

Theme 4: Watershed development—Supply side management

What does the theme comprise? The fourth theme examines states' performances 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.

47 Source: Dr. Mihir Shah, EPW, 'Water: Towards a paradigm shift in the Twelfth Plan', 2013

Figure 22: Performance of Non-Himalayan states on Theme 4 – Watershed development—Supply side management

Index scores (from 0-10) (Base year (FY 15-16), FY 16-17)

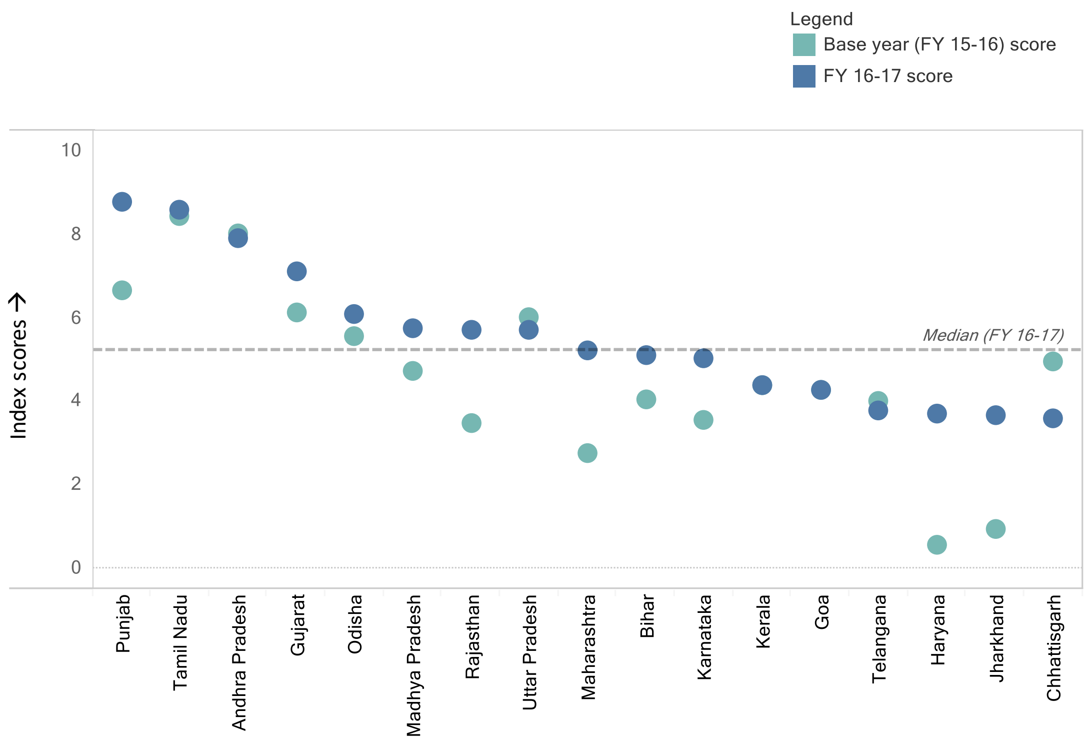
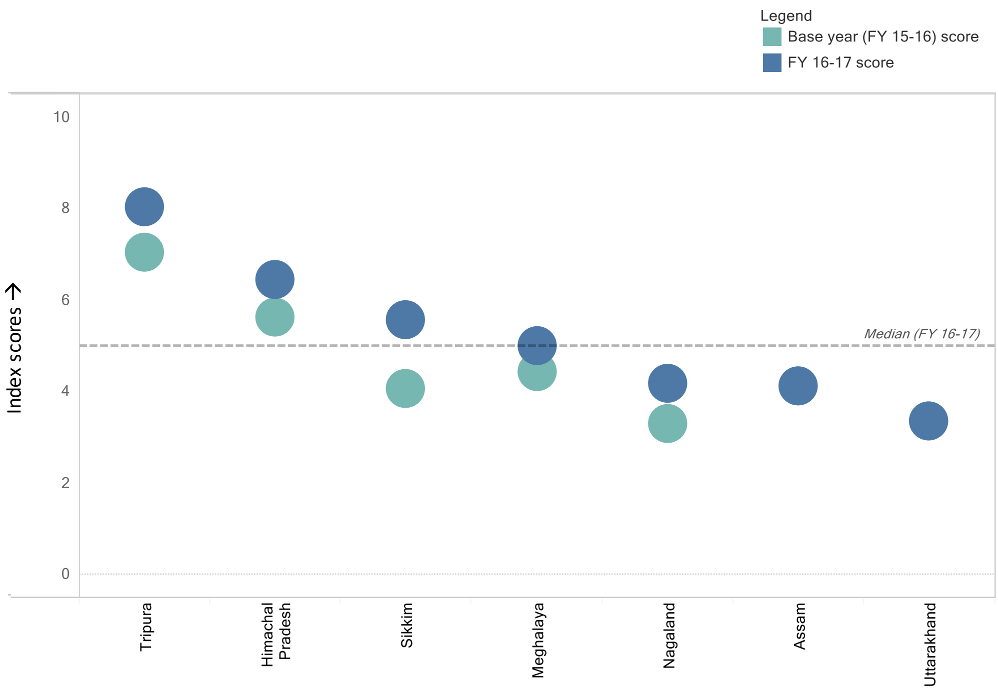


Figure 23: Performance of North-Eastern and Himalayan states on Theme 4 – Watershed development—Supply side management

Index scores (from 0-10) (Base year (FY 15-16), FY 16-17)



Almost all states have middling scores; overall performance is improving. Several states are clustered around the 50% scoring mark, with 70% of states (17 out of 24) having scores between 3.5 and 6.5, and the median score being 5.16 in FY 16-17. There are four states—Punjab, Tamil Nadu, Tripura, and Andhra Pradesh—that have performed exceptionally well, achieving scores of about eight or higher. Further, the median score has risen from 4.3 in the base year (FY 15-16) to 5.16 in FY 16-17. The rise has been driven by an across the board improvement in geo-tagging of water harvesting structures created under the IWMP scheme. Geo-tagging and the construction of harvesting structures are easily attainable achievements that can be pursued further, along with increased incentives and monitoring.

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 12th 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.

Figure 24: Performance of Non-Himalayan states on Theme 5 – Participatory irrigation practices—Demand side management

Index scores (from 0-10) (Base year (FY 15-16), FY 16-17)

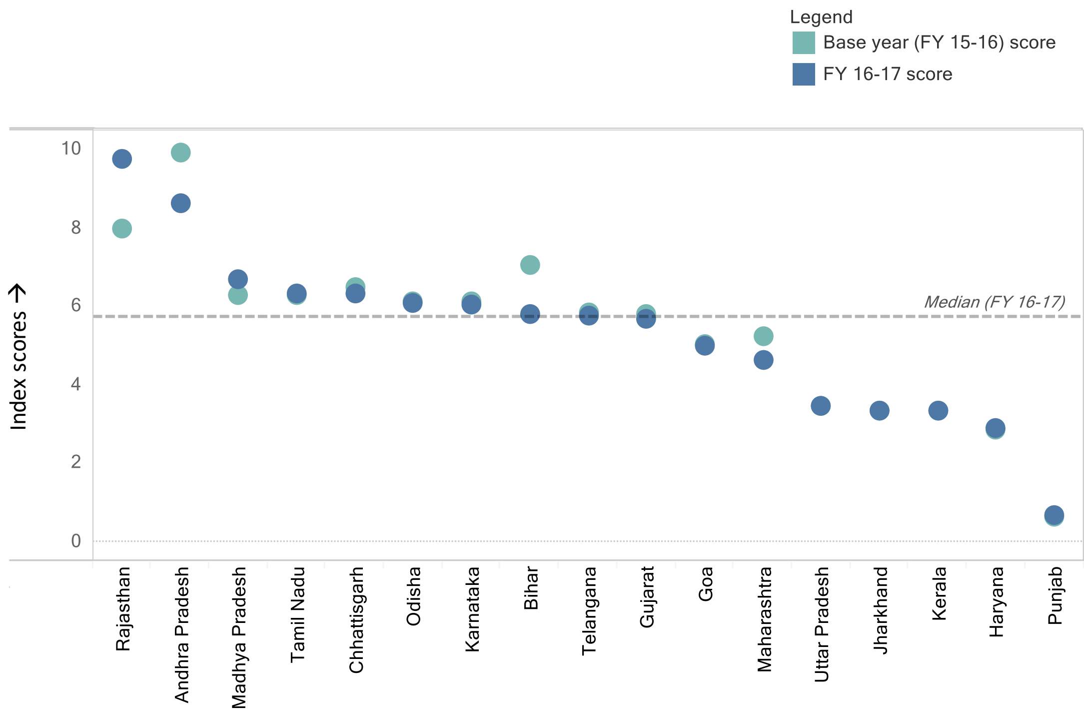
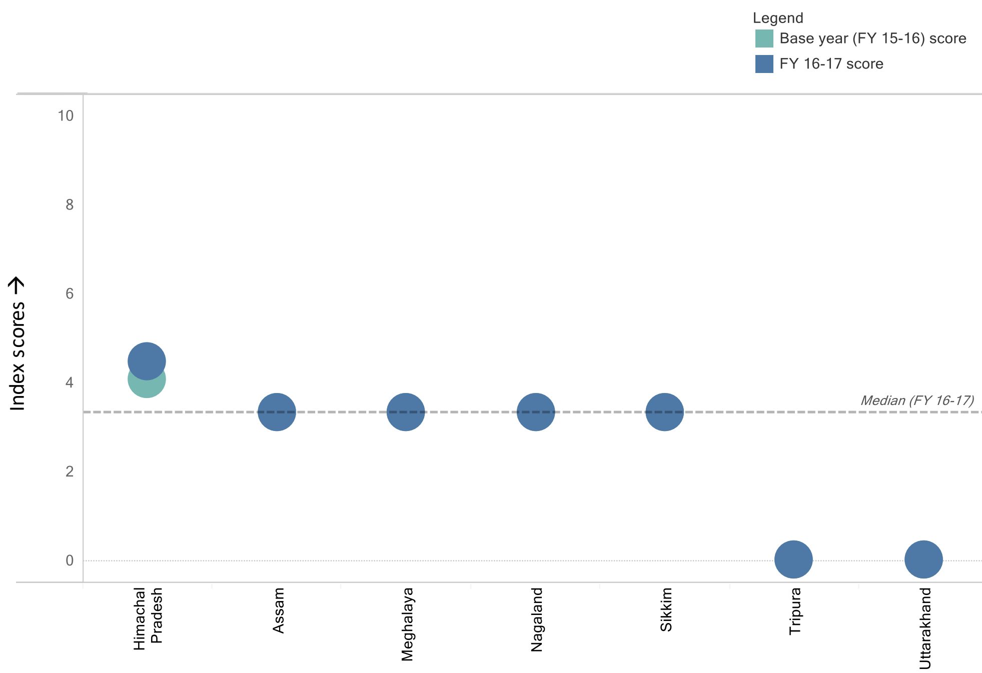


Figure 25: Performance of North-Eastern and Himalayan states on Theme 5 – Participatory irrigation practices—Demand side management
Index scores (from 0-10) (Base year (FY 15-16), FY 16-17)



Almost all states have created legal frameworks for Participatory Irrigation Management (PIM), but the actualization of these frameworks varies considerably across states. More than 80% of states (20 out of 24) have established a legal and regulatory framework for PIM through WUAs. However, progress on the ground varies significantly. In states such as Rajasthan and Madhya Pradesh, more than 75% of the irrigation command area has WUAs involved in maintenance activities, while 10 states have figures below 20%. Further, the percentage of irrigation service fees (ISF) retained by WUAs, a proxy for the level of decentralization of irrigation O&M and the power of the WUAs, remains low, with WUAs in only seven states retaining any fees at all.

Rajasthan has emerged as the leader in participatory irrigation, with 75% of the irrigation area having WUAs involved in O&M, and about 95% of all user fees being retained by the associations. This has led to the state achieving a near perfect score in the theme in FY 16-17, with improved PIM accounting for 25% of the state's eight-point increase in the overall Index score from the base year (FY 15-16). As discussed previously, the state is building on its progress by providing WUAs a prominent role in the $100 million redevelopment of the Indira Gandhi Canal.

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[48]. The theme involves two

[48] Source: National Commission for integrated Water Resource Development, MoWR

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 63% of all irrigation[10]. Given the current legal framework that assigns almost unchecked groundwater rights to landowners, groundwater extraction in India can only be controlled by 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.

Figure 26: Performance of Non-Himalayan states on Theme 6 – Sustainable on-farm water-use practices—Demand side management

Index scores (from 0-10) (Base year (FY 15-16), FY 16-17)

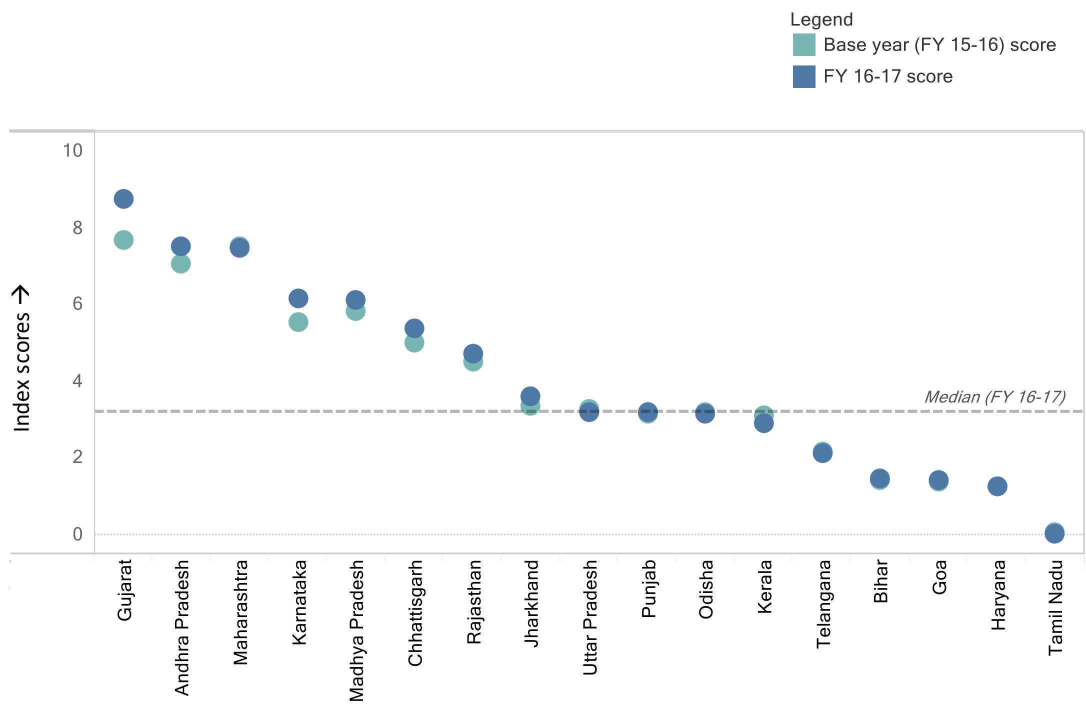
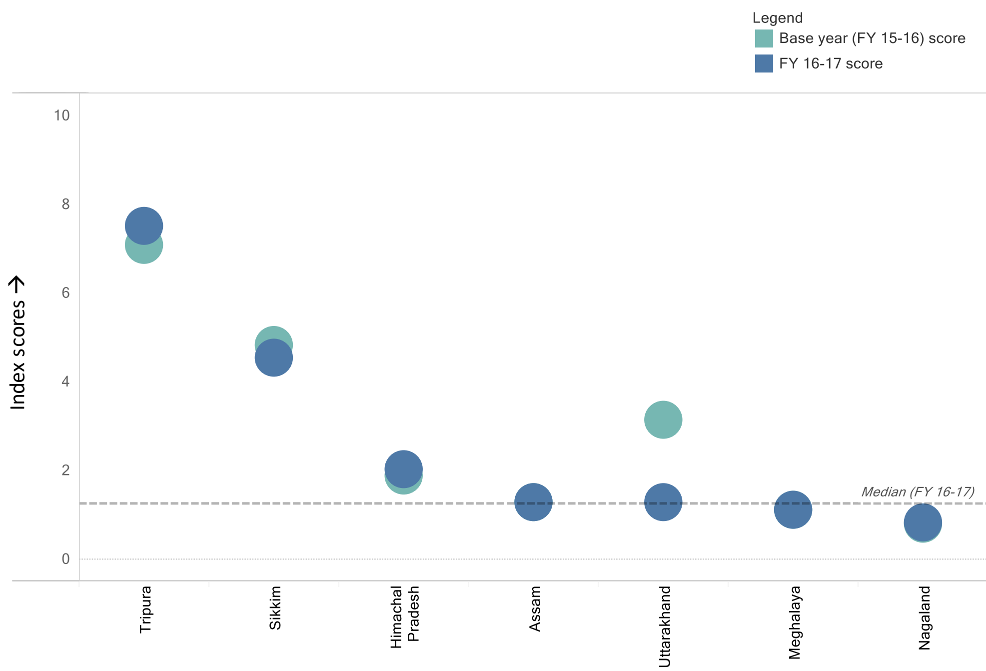


Figure 27: Performance of North-Eastern and Himalayan states on Theme 6 – Sustainable on-farm water-use practices—Demand side management
Index scores (from 0-10) (Base year (FY 15-16), FY 16-17)



A majority of states perform poorly on this critical theme, highlighting a growing water and food security risk for the country. Overall, about 70% of states (17 out of 24) scored below five points, the 50% mark, in FY 16-17 with a median score of only 3.16 (unchanged from the base year). While several states, except for the North-Eastern and Himalayan states, reported having a sizable percentage of area being cultivated in line with agro-climatic zone-based cropping patterns, micro-irrigation performance was poor (below 40%) across the board. This highlights the difficult task of improving the water-efficiency of Indian farmers, which is currently among the lowest in the world—on average, Indian farmers use 3-5X of water for producing the same amount of crops relative to Chinese, American and Israeli farmers[49]. Similarly, only nine states reported having segregated agricultural power feeders, a task that is crucial to both check groundwater extraction and provide reliable household rural electricity. While most states reported pricing electricity to tube wells and pumps, either through fixed payments or metered connections, high subsidies remain an entrenched problem.

It is critical to move agricultural water use towards a more efficient and sustainable path. Currently, the populous northern states, which account for ~20-30% of India's agricultural output, face high to extreme water stress, posing a significant food security and livelihood risk for the country. The government can mitigate this risk and improve the country's water-efficiency in agriculture by accelerating the proposed DBT scheme for micro-irrigation subsidies, as highlighted in the case study below.

49 Source: FAO AQUASTAT database, World Bank data

Figure 28: Case study: Accelerating the adoption of micro-irrigation through DBTs

Description

- Until recently, micro-irrigation subsidies were provided at select vendors of the equipment, leading to price inflation by these vendors, taking advantage of the monopoly power conferred upon them; in 2018, the govt. has outlined plans to provide the subsidy in the form of direct benefit transfers (DBTs) to farmers
- The govt. should **accelerate the process of providing cash subsidies for micro-irrigation** so that market competition and innovation can bring down the equipment cost and enable greater adoption

Economic viability	Political feasibility	Impact
Low / Medium / High	Low / Medium / High	
• High subsidies required across the next few years to enable widespread adoption across the country	• The intervention has been a govt. priority for some years, and is likely to be well supported	• Groundwater usage for agriculture is estimated to be ~600 km^3, out of which 20%, or ~100 km^3 can easily be saved using micro-irrigation techniques

Case study

India

Description

- India's shift to the direct benefit transfer (DBT) methods for providing LPG subsidies is estimated to have reduced leakages by 24% and is expected to spur market competition and innovation in the LPG space

Source: Expert interviews; FAO AQUASTAT database; www.dbtbharat.gov.in; The Indian Express, 'Clearing the air on LPG', 2016; The Economic Times, 'How subsidies under DBT will help poor, exchequer', 2015

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, as well as the 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 87% of rural households having access to 'basic water'[50], the provision of safe water remains a large challenge. Currently, only half of the rural population has access to safely-managed water[51]—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 (or unsafe) drinking water[52].

50 Source: WASHwatch.org
51 Source: WHO/ UNICEF Joint Monitoring Programme (JMP)—washdata.org
52 Source: WHO, Global Health Observatory data repository

Figure 29: Performance of Non-Himalayan states on Theme 7 – Rural drinking water
Index scores (from 0-10) (Base year (FY 15-16), FY 16-17)

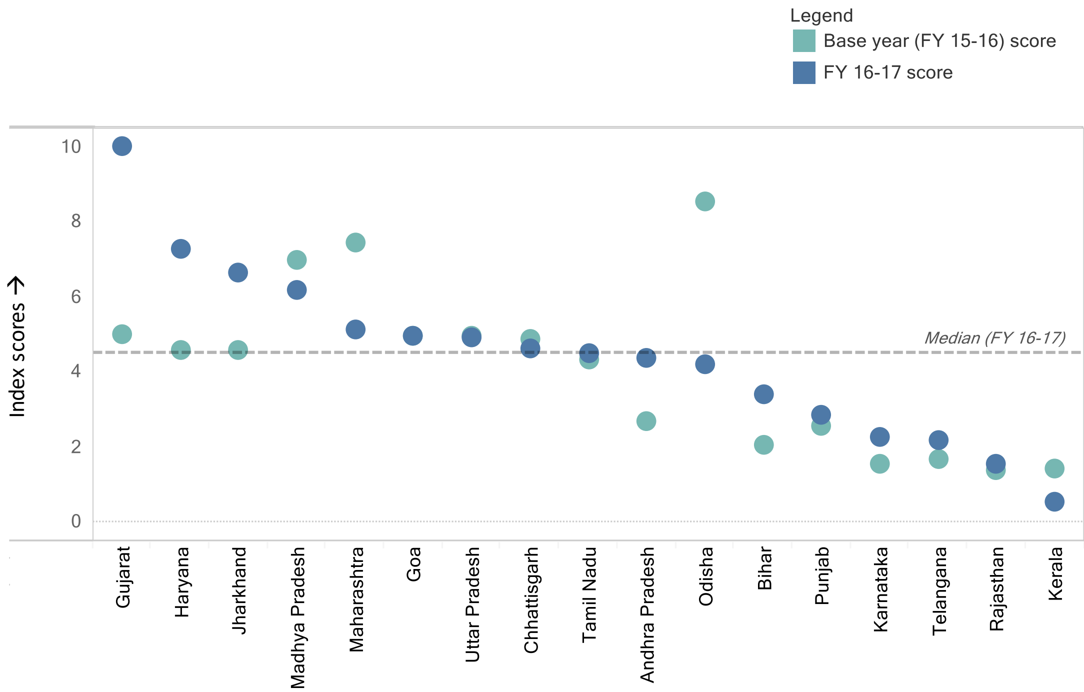
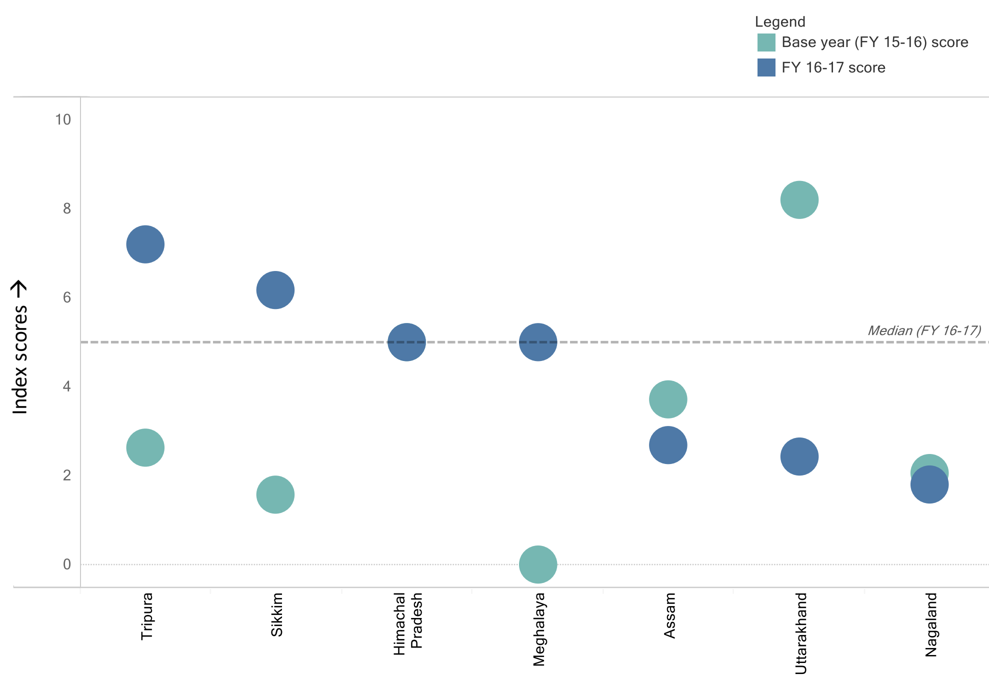


Figure 30: Performance of North-Eastern and Himalayan states on Theme 7 – Rural drinking water
Index scores (from 0-10) (Base year (FY 15-16), FY 16-17)



There is large variation in states' performance in the provision of rural drinking water, with water quality being the major challenge. State scores for FY 16-17 vary from almost 0.53 for Kerala[53] to a 10 for Gujarat, with a median score of 4.57. Overall performance has improved from the base year (FY 15-16) as evidenced by 13-15% increases in the average and median scores. Most of the Non-Himalayan states report high access percentages, with 70-90% of rural habitations having drinking water supplies. These figures are lower for North-Eastern and Himalayan states, but steadily improving, with Himachal Pradesh registering a 21% increase in access in a single year. Himachal is also planning to launch a new INR ~3,200 crore scheme to boost rural drinking water access further[54]. In terms of the reduction in rural areas affected by quality problems, several of the North-Eastern and Himalayan states, along with Gujarat, reported a 100% decline, while several larger states such as UP, Punjab, and Bihar reported zero or low reductions.

Improving water quality in the rural areas of some of India's largest states remains the major challenge. Several organizations in India are experimenting with decentralized technologies for measuring and improving water quality, and state governments can benefit from partnering with these organizations to pilot and scale promising technologies.

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 actual treatment of urban waste water. More than 90% of the urban population has had access to 'basic water' since 2000[55], but only one-third of India's waste water is currently treated[56], leading to the high burden of water-borne diseases mentioned above.

---

53 Other sources (Indian Journal of Economics and Development, *'Access to water and drinking water supply coverage: Understanding water security in Kerala'*, 2015) indicate that Kerala achieved 100% coverage in 2008

54 Source: https://timesofindia.indiatimes.com/india/rs-3267-cr-scheme-for-supply-of-drinking-water-to-rural-areas-of-himachal-pradesh-soon-minister/articleshow/62664960.cms

55 Source: WHO/ UNICEF Joint Monitoring Programme (JMP)—washdata.org

56 Source: FAO AQUASTAT database

Figure 31: Performance of Non-Himalayan states on Theme 8 – Urban water supply and sanitation
Index scores (from 0-10) (Base year (FY 15-16), FY 16-17)

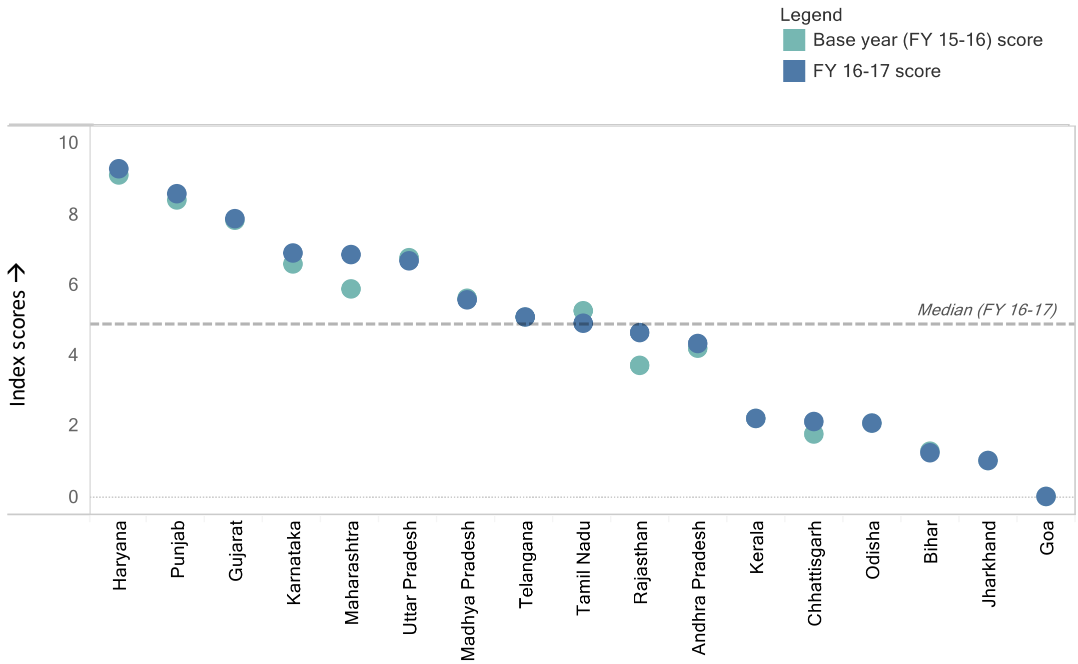
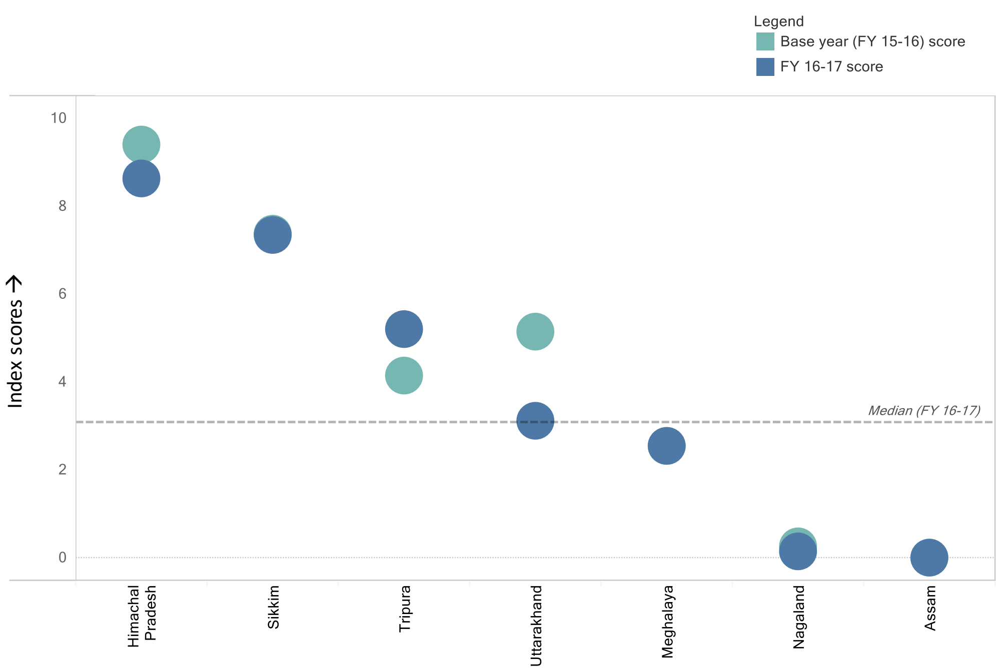


Figure 32: Performance of North-Eastern and Himalayan states on Theme 8 – Urban water supply and sanitation
Index scores (from 0-10) (Base year (FY 15-16), FY 16-17)



While urban water access is high on average, significant gaps remain across the country, and waste water treatment remains stuck at the national average of ~33%. Overall, the median score is 4.77 with states divided equally around the five-point mark. Most states report a high percentage of urban population having access to drinking water, except for the North-Eastern and Eastern regions, with Bihar, Jharkhand, Assam, and Nagaland reporting less than half of the urban population having access. Significant gaps remain across the country though, as even states with the largest urban areas—Maharashtra, Tamil Nadu, and Kerala—are only able to provide drinking water to 53-72% of their massive urban populations. Waste water treatment capacity and actual treatment vary widely, but ~70% of states treat less than half of their waste water and the median state treated ~33% of its water in FY 16-17, indicating ample room for improvement.

It is imperative for the country to boost treatment of urban waste water, both to ensure that downstream areas are not contaminated, and to enable the reuse of water. By reusing water, the country can significantly increase the utility gained out of all available water. The reused water can also be used towards meeting the country's vast agricultural demand. Israel offers the perfect example as the global leader in reusing water—it reuses 94% of all water, with the majority being used to meet 50% of the country's agricultural water demand[57]. Details on the composition and evolution of its world-class reuse system are mentioned in the case study below.

Figure 33: Case study: Developing a treatment and reuse network for India using lessons from Israel

Description

- At present, **India treats only ~30% of its water and reuses a negligible amount**, leading to water pollution due to discharge of untreated waste water, and limited utility gains from water passing through the supply chain only once
- India needs to **establish a network of treatment plants and piping infrastructure** to treat domestic waste water and put in back into the supply system for reuse in domestic consumption and peri-urban agricultural irrigation

Economic viability	Political feasibility	Impact
Low / Medium / High (rated: Low)	Low / Medium / High (rated: High)	
The treatment and reuse network will require significant capital investment as well as continued O&M support, and is expected to be a long-term, resource intensive project	The intervention is likely to have political support given the increasing recognition of adequate treatment requirements and international examples of reuse	This high-impact intervention can ensure that ~100 km^3 of water used for domestic and industrial purposes can be treated and reused for domestic and irrigation purposes

Case study — Israel

Description

- Israel treats 100% of its municipal waste water and **reuses 95%** of it for agriculture and ecological purposes; roughly **50% of the country's irrigation needs are met by reused water**
- This has been enabled by the development of a **national network of infrastructure of treatment plants and reuse pipelines** across 1970-90s, with a focus on using natural reservoirs to return effluent water to aquifers, and differential pricing based on quality to incentivize farmers to use treated waste water for irrigation

Source: FAO, AQUASTAT database; The Tower Magazine, 'How Israel is solving the global water crisis', 2015

57 Source: FAO AQUASTAT database; The Tower Magazine, 'How Israel is solving the global water crisis', 2015

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 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, then, is critical for identifying achievements and practices around state policies, which form the basis for outcomes across many of the indicators described above. 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 and regular validation of integrated data for water in the state. Three of these are binary and have been collected for just one year, to provide a snapshot of the policy and legislation status in a state. This is the main reason why there has been very little movement in state scores across the two years, with data for only one indicator—pricing of urban water—being collected for both years.

Figure 34: Performance of Non-Himalayan states on Theme 9 – Policy and governance
Index scores (from 0-15) (Base year (FY 15-16), FY 16-17)

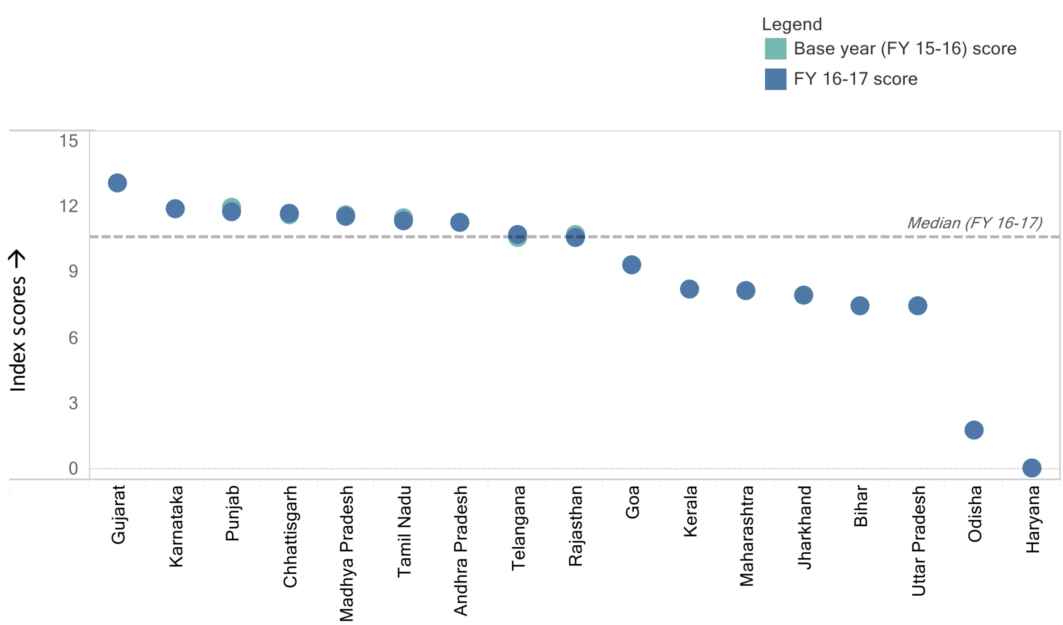
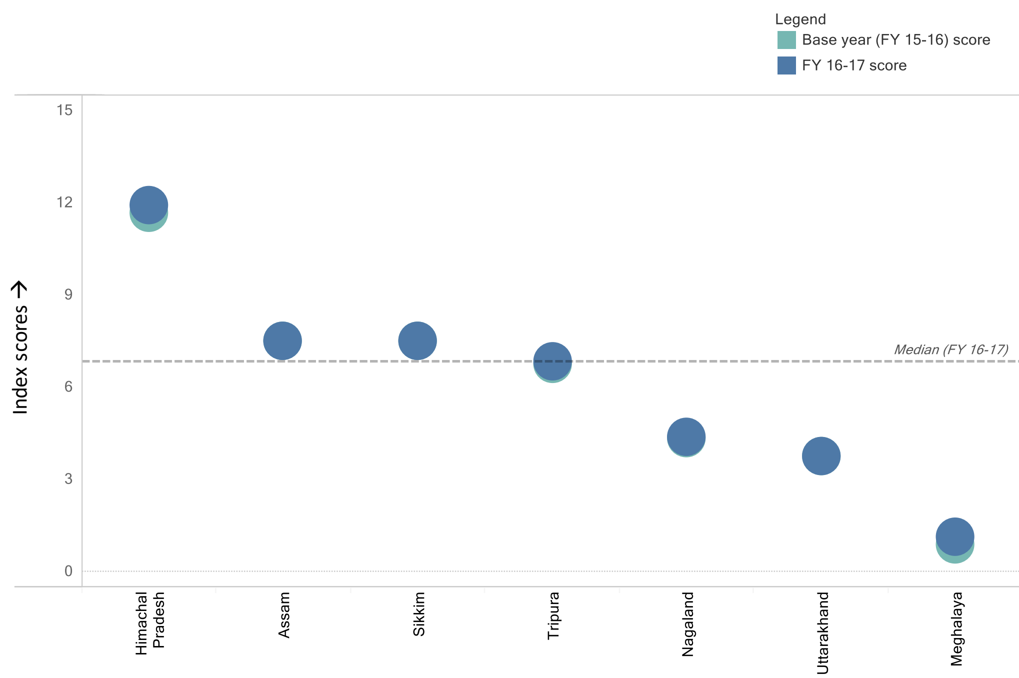


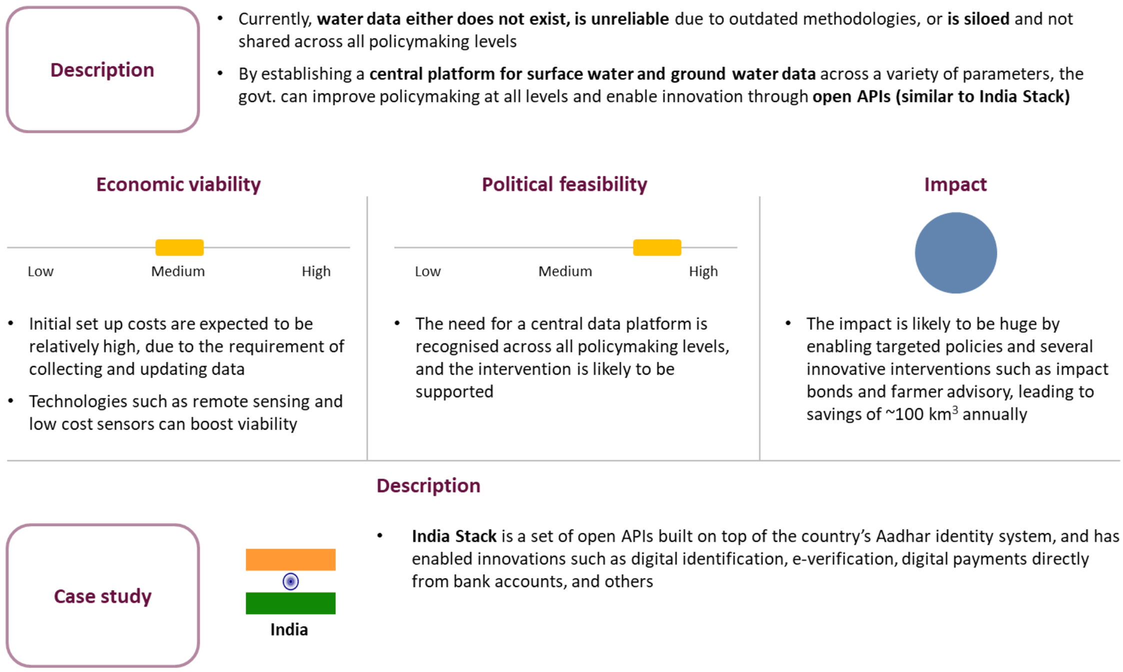
Figure 35: Performance of North-Eastern and Himalayan states on Theme 9 – Policy and governance
Index scores (from 0-15) (Base year (FY 15-16), FY 16-17)



Overall, most states have scored more than 50% on the theme, with some North-Eastern and Himalayan states lagging. 18 states have scored above 7.5 (out of 15) with a cluster of high performers between 10-12 points and median performers located around 7.5 points. The laggard states are Odisha and some of the North-Eastern and Himalayan states, while Haryana has not submitted data for four out of five indicators.

Almost all states have put in place legislations for water conservation, but non-pricing and data management remain key issues. Policy action on water conservation appears to be gaining momentum—70-80% of states have put in place legislation for protecting water bodies and enabling water harvesting in buildings. A key policy reform—pricing of water—remains limited though. There is wide variation in the percentage of households being charged for water, with the average being ~45% in Non-Himalayan states and ~37% in North-Eastern and Himalayan states. Improvement in this indicator is critical to fund maintenance and treatment costs for utilities and to reduce wastage in water-scarce urban areas. More promisingly, 11 states report having an integrated data centre for water resources, which is a crucial enabler for targeted policymaking and broader research and innovation in the theme. As a next step, the centre can build on this progress by creating a 'Central Water Data Platform' with open APIs (modelled on India Stack) to allow private and non-governmental actors to access water data and provide innovative services (see case study below).

Figure 36: Case study: Establishing a central water data platform for India



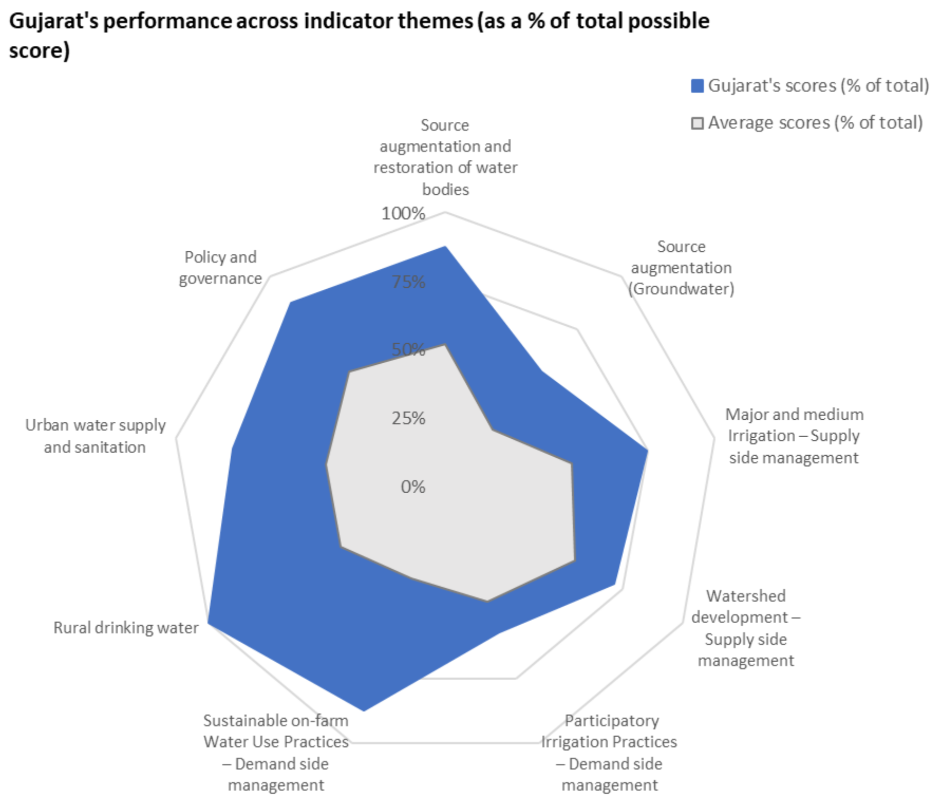
Highest and lowest performing states

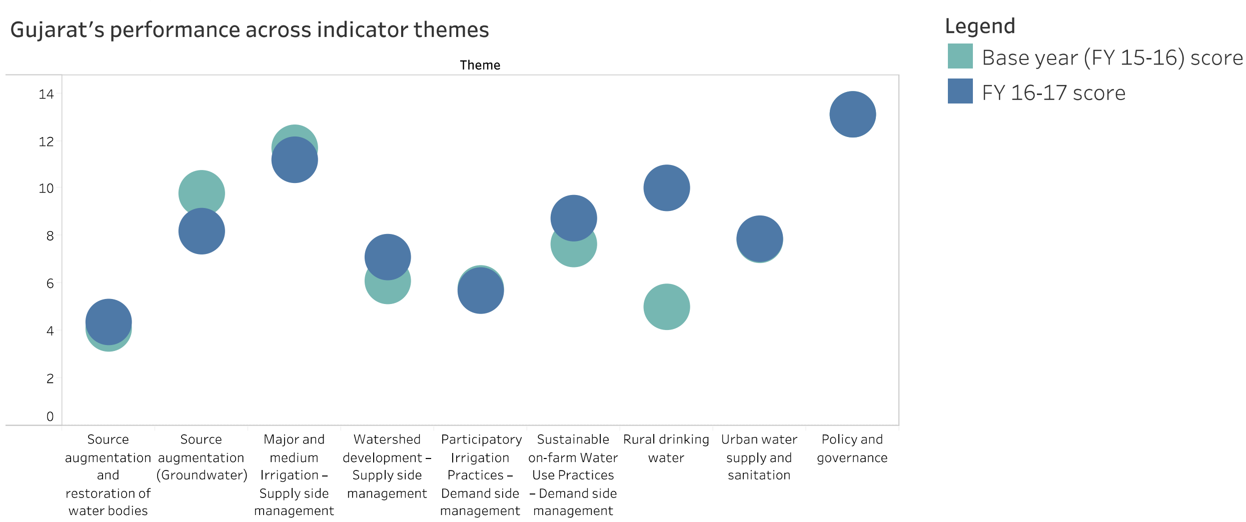
The performance of the highest and lowest performing states across the themes is displayed below, with thematic performance for each state detailed out in the annex.

Gujarat has performed higher than the average across all themes, displaying exceptional performance across on-farm management, rural supply, and policy indicators. Gujarat was the highest ranked state across both FY 15-16 and FY 16-17, boosting its score from ~71 to ~76 across the two years. Gujarat's success has been built upon solid performance across all nine indicator themes, with the state achieving more than 50% of the total possible score across all of these. In several themes, the state has received near perfect scores. For example, Gujarat has achieved 88% of the total possible score in on-farm demand management, which is a significant milestone in water management given that 88% of the state's water is used for irrigation. On rural water supply, the state has achieved a 100% score (See Figure 37), which means that it is able to provide clean water to its ~35 million inhabitants living in rural areas[58].

58 Source: http://www.gujaratindia.com/state-profile/demography.htm

Figure 37: Highest performing state – Gujarat's performance across indicator themes

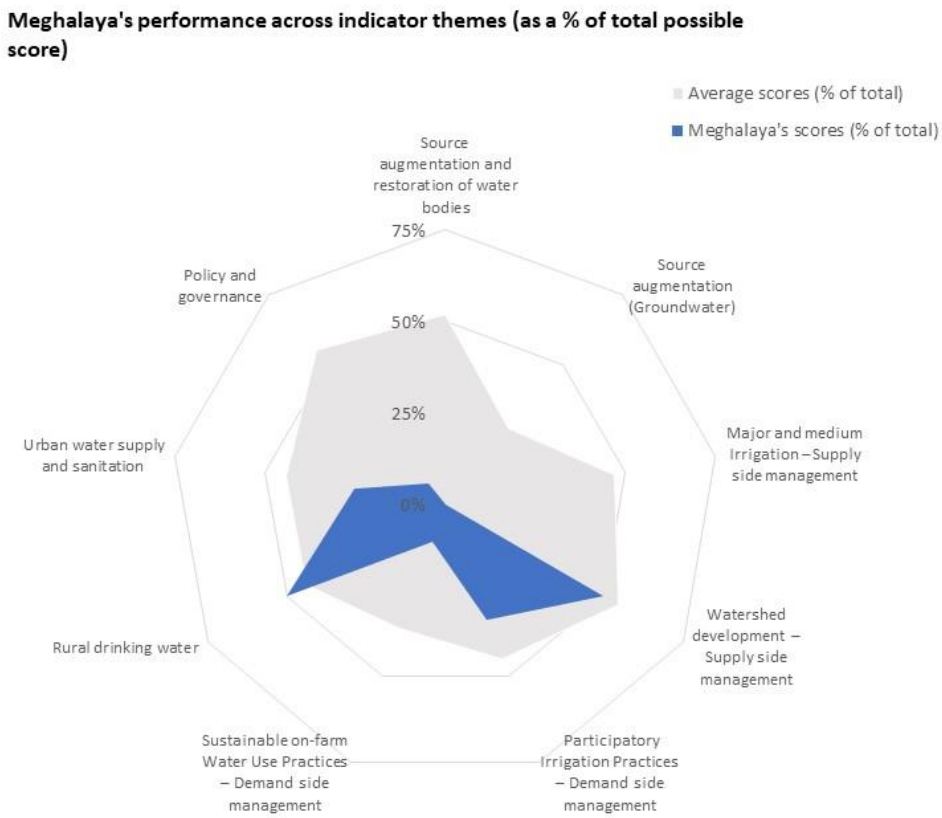




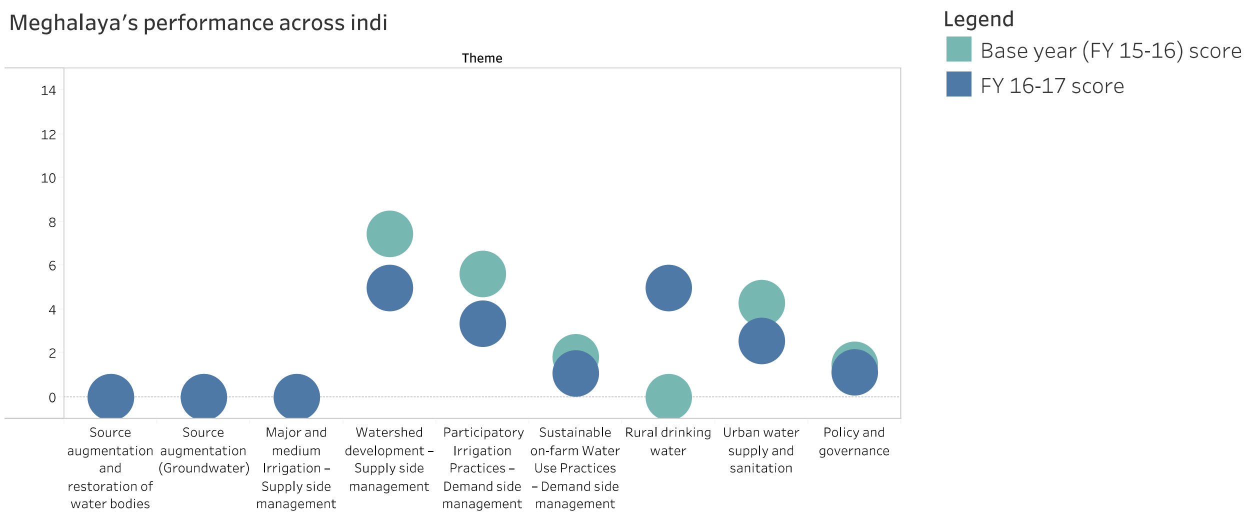
Underlying much of this success has been Gujarat's comprehensive state water policy that has set up a strong institutional structure for water governance and pushed through key reforms (also leading to a high score in the 'Policy and governance' theme). The policy has established several robust institutions, such as a state regulatory authority, a state policy council and implementation committee, river basin organizations, and water research and training institutes. It has also sought to strengthen WUAs as a key lever for improving supply side systems and participatory irrigation management. Other reforms include an early recognition and establishment of an integrated water data centre, and the involvement of the private sector in water projects and conservation drives, such as the month-long campaign during May 2018[59].

Going forward the state needs to sharpen its focus on groundwater rejuvenation, given the inherently water scarce nature of the state, and ensure that WUA participation is actually being implemented well on the ground. The state's focus on data and private sector involvement bode well for the establishment of market innovations such as impact bonds and water markets in the future.

Figure 38: Lowest performing state – Meghalaya's performance across indicator themes



59 Source: Govt. of Gujarat, *'State Water Policy-2015'*; https://www.thequint.com/hotwire-text/month-long-water-conservation-drive-in-gujarat-in-may



Historically water-rich Meghalaya is beginning to improve its water management to cope with recent and future shortages. As a water abundant state receiving one of the highest annual rainfall amounts in the world, the need for water management has never been sharply felt in Meghalaya. Further, given its small size and limited resources, infrastructure has been a challenge, with the state having only 16% of its cultivated land under irrigation and only minor irrigation projects. These factors have contributed to its low performance, with the state occupying the last rank across both FY 15-16 and FY 16-17. In FY 16-17 the state scored below average on eight out of nine themes, due to a combination of a lack of need to augment sources, limited irrigation projects and farm area served, small urban populations, and a lack of policy focus. However, the state did improve its score by about eight points across the two years, from ~17 to ~25, driven by its performance on rural water supply, where it has increased full drinking water coverage of habitations. Recent developments, such as the water shortage in the city of Cherrapunji—the second wettest place in the world in terms on annual rainfall—in 2015, have brought water management onto the agenda of the state government. Apart from the improvement in rural supply, the state is pushing to get 65 new minor irrigation projects approved, which are expected to increase its command area by ~20%. Further, WUAs have been established in several irrigation projects, small reservoirs are being created to store water, and a water act is being formulated. These positive steps indicate that the water management has climbed up in the state's policy agenda and bode well for the state's future performance on the Index[60].

60 Source: https://www.aljazeera.com/indepth/features/2016/01/india-worlds-wettest-place-suffers-water-shortage-160103073018896.html; http://meghalayatimes.info/index.php/30-archive/front-page/march-2012/732-meghalaya-has-only-16-pc-land-covered-under-irrigation

Indicator-wise analysis[61]

What's in this section?

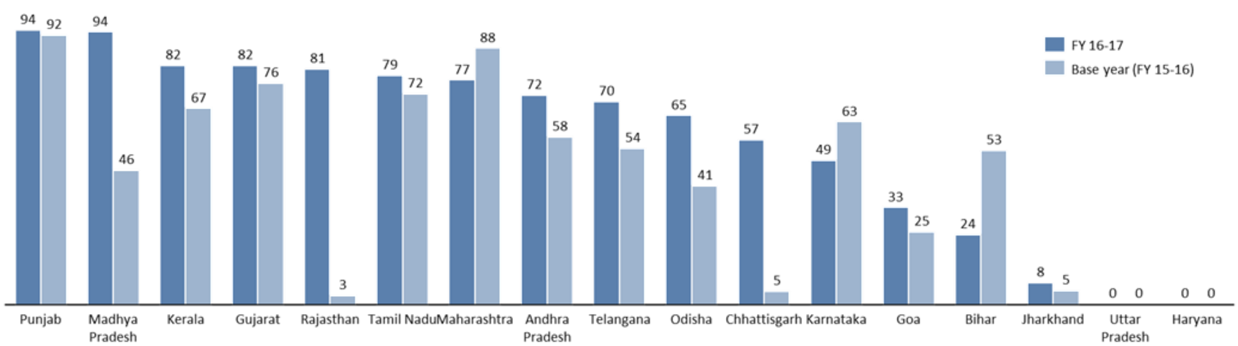
This section provides the most granular analyses, by examining the performance of states across the 28 indicators (with sub-parts) that comprise the Water Index. The drivers and best practices related to the respective best performers for the indicators are also explored, so that these can be leveraged by other states to boost indicator or theme-specific performance. It is important to emphasize that the Water 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.

Theme: Source augmentation and restoration of water bodies

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

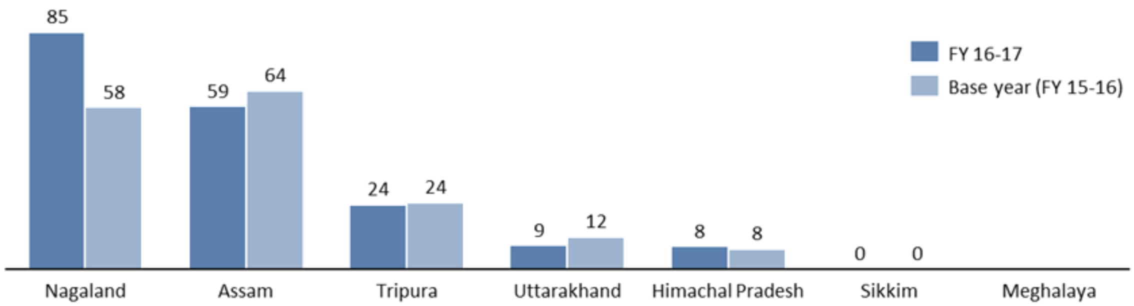
Indicator 1 measures the area irrigated by restored water bodies as a proportion of the total area that can be irrigated by restoring all identified water bodies, including rivers, ponds, tanks, etc. It measures a very tangible benefit of state efforts for restoration of water bodies—the irrigation potential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

Figure 39: 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—Non-Himalayan states
In % (Base year (FY 15-16), FY 16-17)



61 States that have not submitted data, or for which the data is not applicable, have been represented with no data label (not even a 0) on the indicator charts.

Figure 40: 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—North-Eastern and Himalayan states
In % (Base year (FY 15-16), FY 16-17)



Overall, states have displayed excellent performance on this indicator, with the median state restoring ~60% of the possible irrigation potential of identified water bodies. ~70% of Non-Himalayan states have restored more than 50% of the area, while several North-Eastern and Himalayan states are lagging behind. Punjab, Madhya Pradesh, Kerala, Gujarat, and Rajasthan have been the top performers, achieving more than 80%. Rajasthan has also experienced the largest improvement from base year (FY 15-16) to FY 16-17, increasing the percentage of area restored by a substantial amount, from 3% to 81%. The achievements on this theme, though, are dependent on the area covered by water bodies identified for restoration by states, and care needs to be taken that these are reported exhaustively.

State governments can boost restoration and irrigation potential by deeply engaging community organizations and NGOs in the restoration process and providing adequate financing. Madhya Pradesh and Rajasthan have benefited from community galvanization, led by local officers and NGOs, for the restoration of traditional water bodies such as farm ponds and tanks. Since 2006, farmers in the Dewas district of Madhya Pradesh have constructed 8000 ponds, thereby creating an irrigation potential of 40,000 hectares. These have been enabled by loans obtained through banks, such as NABARD, with the help of NGOs and government officers[62].

Theme: Source augmentation (Groundwater)

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 2 measures the percentage of overexploited 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 54% of India's groundwater wells are decreasing in levels and 21 major cities across the country are expected to run out of groundwater by 2020[63]. Eight states—Odisha, Bihar, Goa,

---

62 Source: A Decision Made 10 Years Ago by Farmers in a Small MP Village Is Helping Them Tackle Drought Today, Nivedita Khandekar, June 15, 2016, accessed at : http://www.thebetterindia.com/58237/farm-ponds-dewas-tackle-drought/

63 Source: UN Water, 'Managing water under uncertainty and risk', 2010; World Bank (Hindustan Times, The Hindu)

Assam, Tripura, Nagaland, Meghalaya, and Sikkim—have declared that they have no critical or over-exploited groundwater units, and thus have not been scored for any of the indicators in the theme.

Figure 41: 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—Non-Himalayan states

In % (Base year (FY 15-16), FY 16-17)

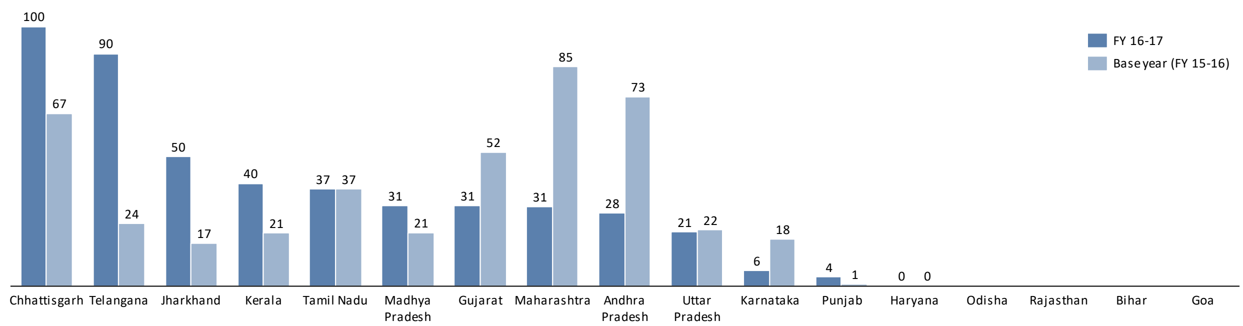
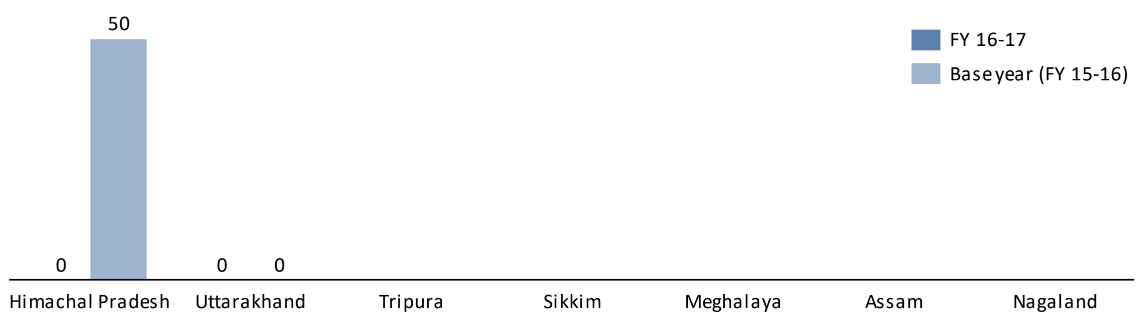


Figure 42: Indicator 2: Percentage of overexploited and critical assessment units that have experienced a rise in water table to total number of assessment units in pre-monsoon current FY in comparison to pre-monsoon previous FY—North-Eastern and Himalayan states

In % (Base year (FY 15-16), FY 16-17)



The performance of states in recharging groundwater has been poor, with only three states achieving a rise in water level for more than 50% of the relevant groundwater units. In FY 16-17 the median state has achieved a rise in only ~31% of over-exploited and critical groundwater units, with almost all states falling below the 40% mark. Most of the North-Eastern and Himalayan states have reported not having any over-exploited or critical units. Further, there has been a lot of variation in data from the base year (FY 2015-16) to FY 16-17, making it difficult to identify high and low performers.

A successful model of a potentially replicable groundwater intervention comes from Andhra Pradesh and its Farmer Managed Groundwater Systems (APFMGS) scheme that targets the key problem related to groundwater—unchecked extraction by farmers. The intervention conducted with the help of the Food and Agriculture Organization (FAO), educated farmers about the best practices surrounding groundwater use through workshops and provided equipment to measure groundwater and rainfall data. From 2005-

07 the intervention was able to save 10 million m^3 of water[64]. In addition to farmer advisory, market based interventions such as an impact bond for groundwater (highlighted earlier in the thematic section) can be used to incentivize community organizations and entrepreneurs to innovate for groundwater recharge.

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 3 measures the percentage of overexploited 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 data collected by the Central Ground Water Board (CGWB) and the state and is used to classify units as over-exploited and critical[65].

Figure 43: Indicator 3: Percentage of areas of major groundwater re-charging identified and mapped for the State as on the end of the given FY—Non-Himalayan states
In % (Base year (FY 15-16), FY 16-17)

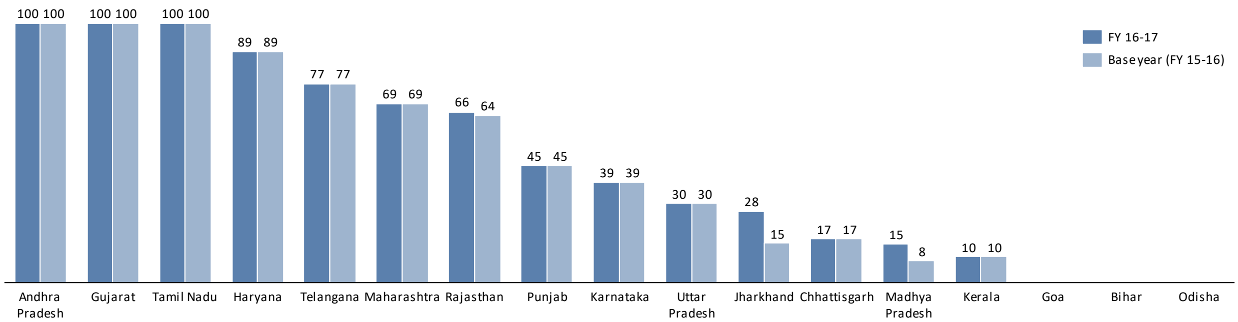
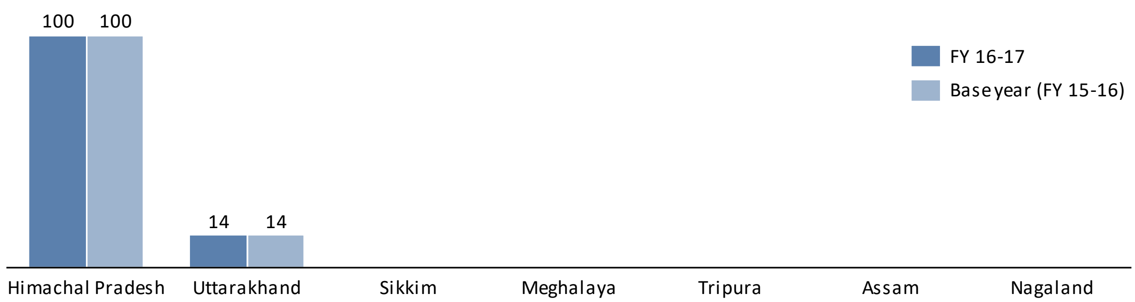


Figure 44: Indicator 3: Percentage of areas of major groundwater re-charging identified and mapped for the State as on the end of the given FY—North-Eastern and Himalayan states
In % (Base year (FY 15-16), FY 16-17)



64 Source: BIRDS. (n.d.). *Andhra Pradesh Farmer Managed Groundwater Systems (APFAMGS) Project: Demand Side Management of Groundwater.* Bharati Integrated Rural Development Society; BIRDS website: http://www.birdsorg.net/apfamgs.html; FAO. (2008). *Andhra Pradesh Farmer Managed Groundwater Systems: Evaluation Report*. Food and Agriculture Organization

65 Eight states—Odisha, Bihar, Goa, Assam, Tripura, Nagaland, Meghalaya, and Sikkim—have declared that they have no critical or over-exploited groundwater units, and thus have not been scored for any of the indicators in the theme.

Several Non-Himalayan states have mapped a large percentage of critical and overexploited groundwater units. Andhra Pradesh, Gujarat, and Tamil Nadu have mapped 100% of their relevant groundwater units, with the median state having mapped ~30% of its units[66]. There has not been any significant change in performance from the base year.

States can build on the groundwater data collected in this exercise to enable value-added services and targeted policymaking. For example, Andhra Pradesh has partnered with a private firm, Vassar Labs, to use groundwater data to build local water profiles, which can then be used for providing farmer advisory services and creating targeted agricultural incentives[67].

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 4 measures the percentage of mapped overexploited 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[68].

Figure 45: 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—Non-Himalayan states
In % (Base year (FY 15-16), FY 16-17)

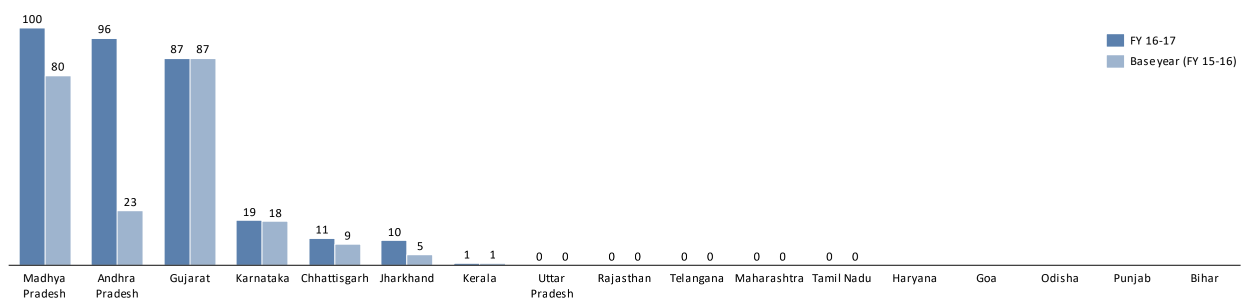


Figure 46: Indicator 4: Percentage of mapped area covered with infrastructure for re-charging groundwater to the total mapped area as on the end of the given FY—North-Eastern and Himalayan states
In % (Base year (FY 15-16), FY 16-17)

---

66 Odisha, Bihar, Goa, Assam, Tripura, Nagaland, Meghalaya, and Sikkim have reported no critical and over-exploited units and so have been assigned a score of 0 for mapping
67 Source: Interview with the founder of Vassar Labs
68 Eight states—Odisha, Bihar, Goa, Assam, Tripura, Nagaland, Meghalaya, and Sikkim—have declared that they have no critical or over-exploited groundwater units, and thus have not been scored for any of the indicators in the theme.

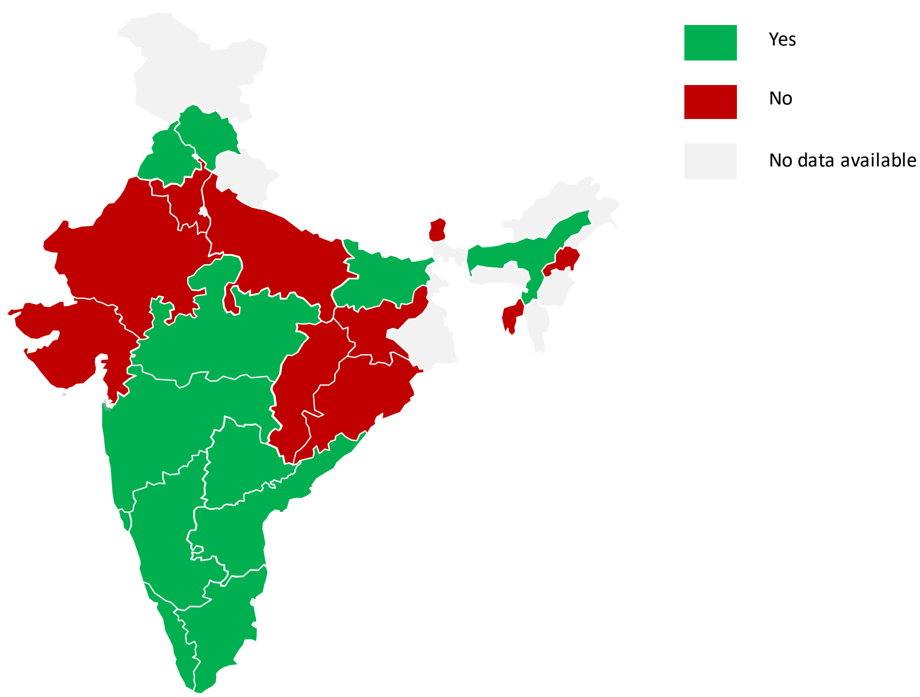
Almost none of the states have built the infrastructure required to recharge groundwater in over-exploited and critical units, thereby highlighting a key constraint in the recharging process. Only Andhra Pradesh and Gujarat have combined mapping all units with creating recharging infrastructure across most of them, while Madhya Pradesh has constructed the required infrastructure across its small mapped area (15% of all relevant units). A majority of the states have constructed no infrastructure at all, possibly explaining the across-the-board poor performance in the rise of groundwater levels (Indicator 2).

Similar to surface body restoration, states need to engage community organizations and provide appropriate financing for the development of this decentralized recharging infrastructure.

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 47: Indicator 5: Has the State notified any Act or a regulatory framework for regulation of Groundwater use/ management?
(FY 16-17)



Currently, ~55% of the reporting states (12 out of 22) have put in place a regulatory framework for managing groundwater. However, worryingly, several of the populous northern states, including UP, Bihar, Rajasthan, etc., have not drafted any such regulation. Given that these states produce ~20-30% of

India's agricultural output, and that groundwater accounts for 63% of all irrigation water[69], unsustainable extraction in these states poses a significant food security risk for the country going forward.

At the national level, the Ministry of Water Resources (MOWR) has drafted a model Groundwater Bill that specifies a legal and regulatory framework for groundwater, with the eventual objective of having all the states adopt the bill with the requisite modifications[70]. Currently, the Bill has been sent out to the states for discussion.

Theme: Major and medium irrigation—Supply side management

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

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.

Figure 48: Indicator 6: Percentage of Irrigation Potential Utilized (IPU) to Irrigation Potential Created (IPC) as on the end of the given FY—Non-Himalayan states
In % (Base year (FY 15-16), FY 16-17)

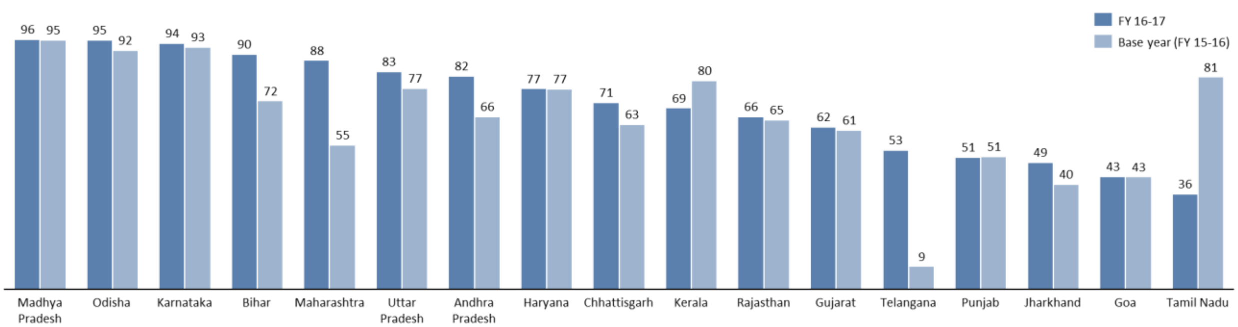
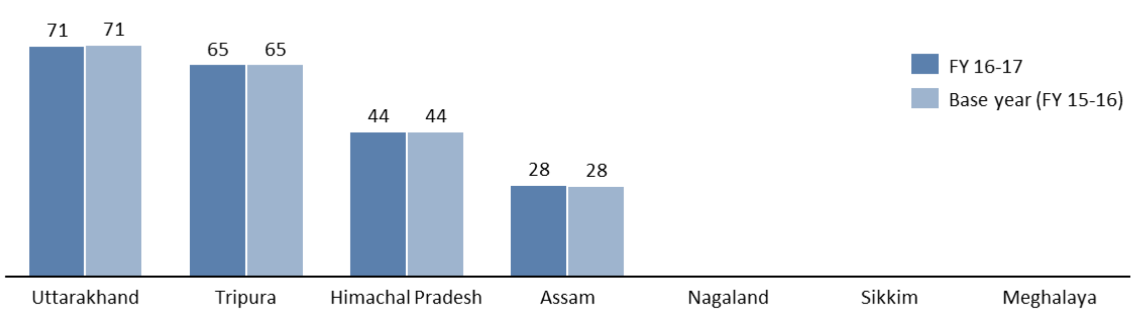


Figure 49: Indicator 6: Percentage of Irrigation Potential Utilized (IPU) to Irrigation Potential Created (IPC) as on the end of the given FY—North-Eastern and Himalayan states
In % (Base year (FY 15-16), FY 16-17)



---

69 Source: Planning Commission Databook 2014; India Energy Statistics 2015; FAO AQUASTAT database
70 Source: MOWR website

A majority of states utilize a high percentage of their irrigation potential, with the median state utilizing ~70% of its irrigation potential in FY 16-17. Madhya Pradesh, Odisha, Karnataka, Bihar, and Maharashtra are the highest performers, having the lowest IPC-IPU gaps. Across North-Eastern and Himalayan states, Uttarakhand and Tripura perform well, while data is not available for most of the other states. From the base year (FY 15-16) to FY 16-17, there has been a modest increase of ~7.5 in the median state's IPU-IPC ratio, with Telangana showing the greatest improvement by increasing its ratio from 4% to 53%.

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 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.

Figure 50: 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—Non-Himalayan states
In % (latest data available from Base year (FY 15-16), FY 16-17)

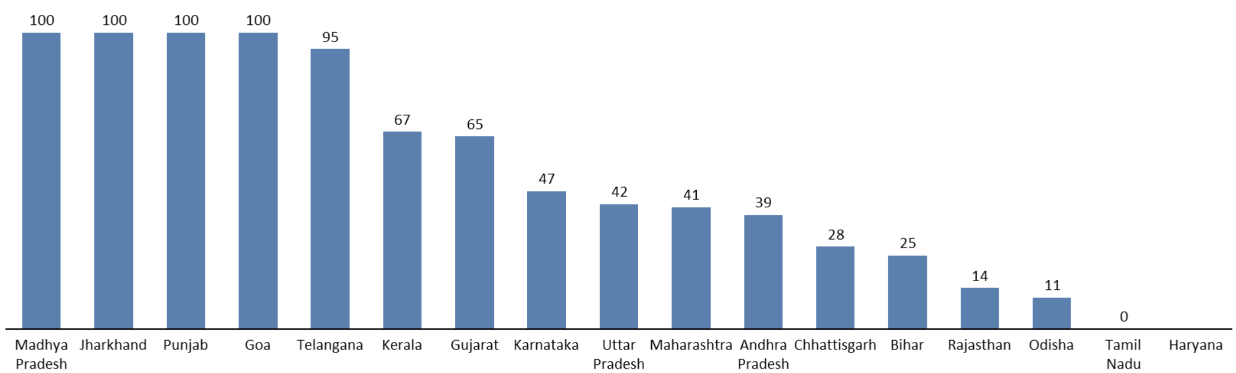


Figure 51: Contextual indicator 7: Total number of major and medium irrigation projects in the state—Non-Himalayan states
(latest data available from Base year (FY 15-16), FY 16-17)

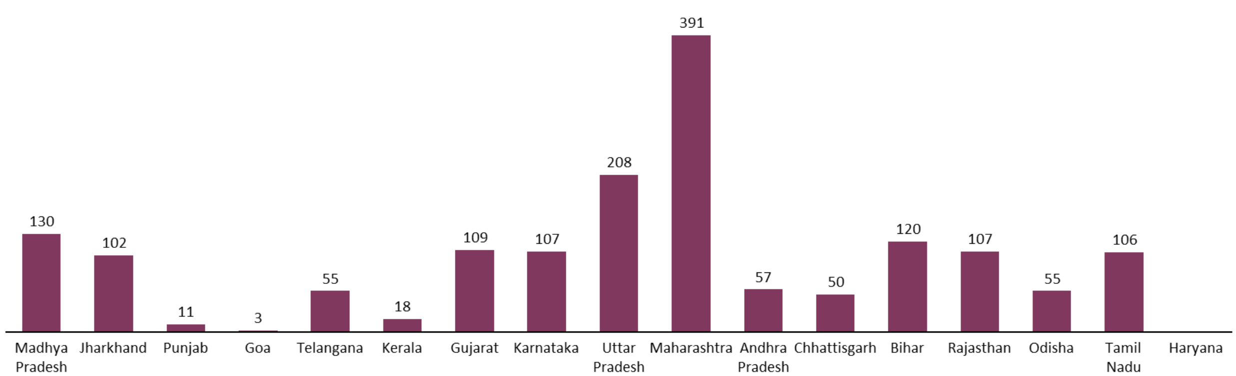


Figure 52: Indicator 7: Number of projects assessed and identified for the IPC-IPU gap in the state out of the total number of major and medium irrigation projects in the State—North-Eastern and Himalayan states
In % (latest data available from Base year (FY 15-16), FY 16-17)

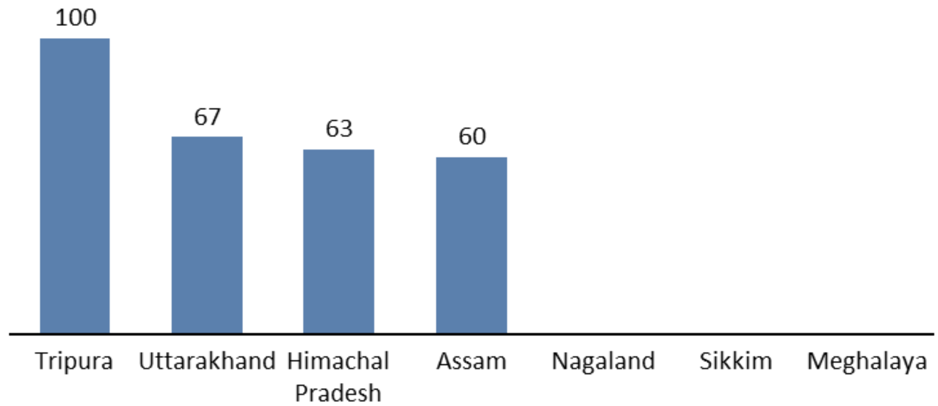
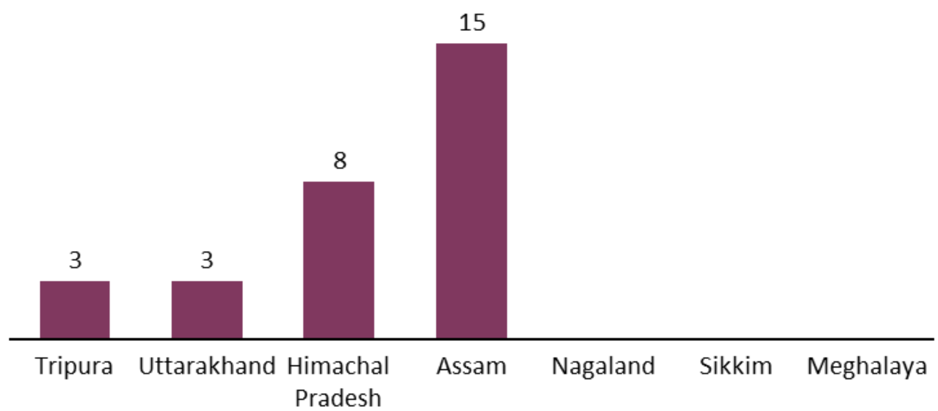


Figure 53: Contextual indicator 7: Total number of major and medium irrigation projects in the state—North-Eastern and Himalayan states
(latest data available from Base year (FY 15-16), FY 16-17)



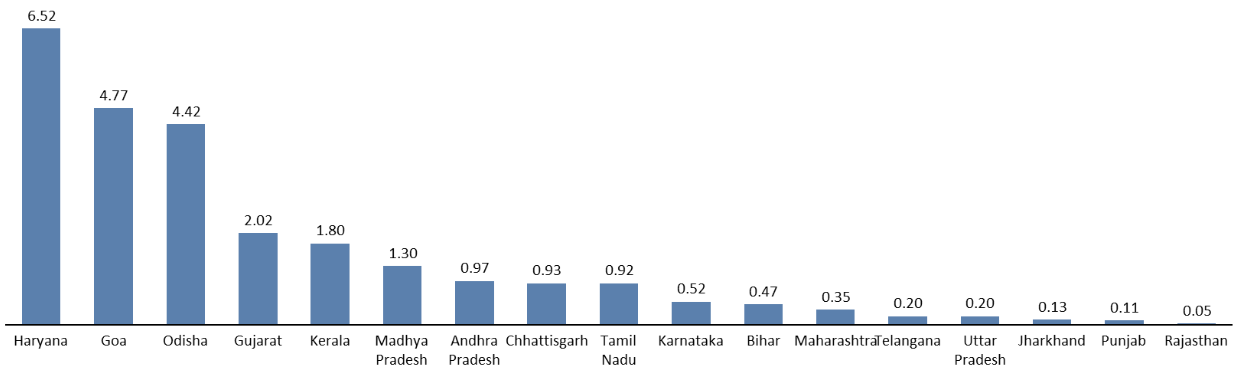
There is a lot of variation in the percentage of MMI assets that large states with more than 100 assets have assessed for the IPC-IPU gap. On one side of the spectrum, Madhya Pradesh and Jharkhand have, to their great credit, been able to assess 100% of their 130 and 102 assets respectively. Maharashtra and Uttar Pradesh, the states with the highest number of MMI assets at 391 and 208, have been able to assess ~40% of all assets in a huge undertaking. On the other hand, lower performing states such as Rajasthan, Bihar, and Tamil Nadu have only managed to assess 0-25% of their ~100 assets each, and need to be pushed and monitored more stringently. North-Eastern and Himalayan states have very few or no MMI assets and have shown medium levels of achievement.

The Working Group on Major and Medium Irrigation and Command Area Development of the erstwhile-Planning Commission identified the IPC-IPU gap and inadequate maintenance as the key challenges in the irrigation sector in the country for the 12th Plan. These were driven by a lack of capacity in state departments and inadequate collection of user fees to ensure maintenance of irrigation assets. The Commission proposed the creation of a National Irrigation Management Fund (NIMF) that would incentivize efficient irrigation management by allocating funds to state irrigation departments in a 1:1 ratio of the irrigation service fee collected from users by each department, with bonus funds awarded for fees collected from Water User Associations (WUAs)[71]. The fund has not been set up until now, and by doing so the central government can boost the performance of states in this theme and ensure effective utilization of the country's irrigation potential.

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

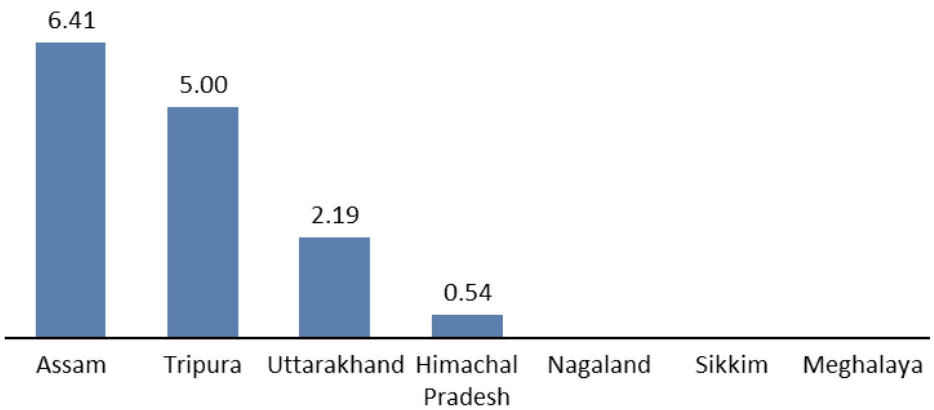
Indicator 8 measures the expenditure on the maintenance of irrigation assets per hectare of command area in a state. According to government discussions on the Index, states with expenditures equal to or greater than INR 1,655 per hectare are awarded the maximum score, while states scoring below the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

Figure 54: Indicator 8: Expenditure incurred on works (excluding establishment expenditure) for maintenance of irrigation assets per hectare of command area during the given FY—Non-Himalayan states
In 1000 INR/ hectare (FY 16-17)



71 Source: Dr. Mihir Shah, EPW, 'Water: Towards a paradigm shift in the Twelfth Plan', 2013

Figure 55: Indicator 8: Expenditure incurred on works (excluding establishment expenditure) for maintenance of irrigation assets per hectare of command area during the given FY—North-Eastern and Himalayan states
In 1000 INR/ hectare (FY 16-17)



Large states with a high no. of MMI projects are spending low amounts on maintenance per hectare of command area. Out of the nine states with more than 100 MMI projects, Gujarat is the only one having a maintenance expenditure higher than the cut-off point. Maharashtra and UP, the states with the highest no. of MMI projects, spend some of the lowest amounts on maintenance per hectare of command area. While the current IPC-IPU gap in these states is low, the lack of maintenance expenditure could have implications for the longevity and upgradation of MMI assets in the states.

Moving beyond the quantum of expenditures, several case studies have shown that the best way to successfully maintain irrigation assets is by delegating the O&M and the collection of user fees to local Water User Associations (WUAs). WUAs are the best placed to perform this function as they have the strongest incentives to maintain assets, the deepest knowledge of local needs and constraints, and multi-stakeholder buy-in for discussions, monitoring, and fee collection. Thus, the states should improve their currently poor performance (see Indicators 13-15) in setting up WUAs and allowing them to retain the majority of user fees for undertaking O&M activities.

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.

Figure 56: 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—Non-Himalayan states

In % (Base year (FY 15-16), FY 16-17)

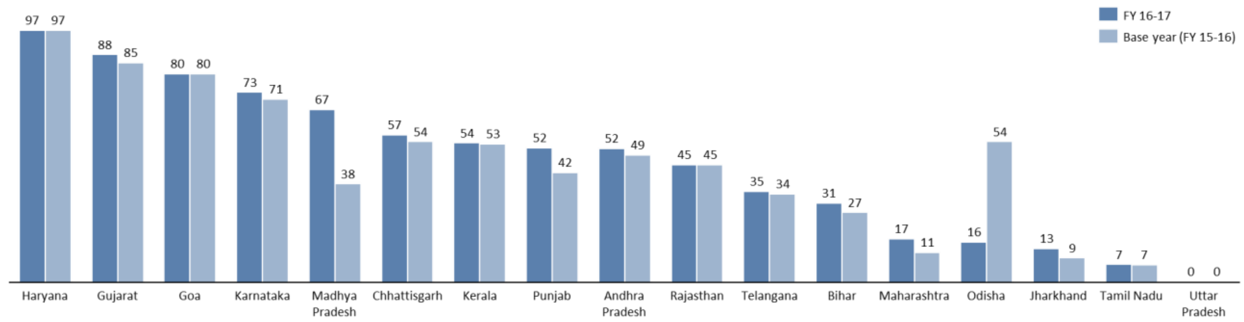
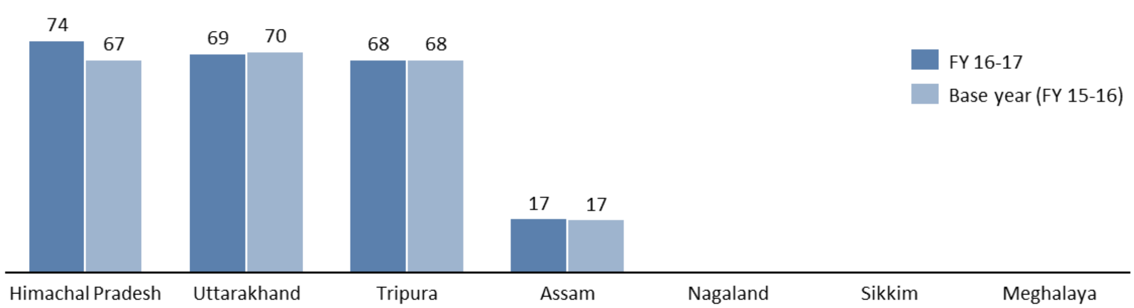


Figure 57: Indicator 9: The length of the canal and distribution network lined as on the end of the given FY vis-à-vis the total length of canal and distribution network found suitable (selected) for lining for improving conveyance efficiency—North-Eastern and Himalayan states

In % (Base year (FY 15-16), FY 16-17)



Most states have lined about half of their identified canal and distribution network lengths, with signs of improvement year-on-year. The median state has lined ~52% of suitable canal length in FY 16-17. Gujarat, Haryana, Karnataka, and Madhya Pradesh are some of the larger states performing well, while other states with large irrigation assets, such as Maharashtra, UP, and Bihar, are still lagging behind. North-Eastern and Himalayan states, for which data is available, have performed as well as the Non-Himalayan states, with Himachal, Uttarakhand, and Tripura being in the top 10 nationally. There has been a modest improvement in achievement from the base year (FY 15-16) with 12 states improving their scores—Madhya Pradesh is the only significant gainer with a 75% increase on base year achievement.

Further improvements in irrigation distribution efficiency using advanced technology are also being explored by states. Pushing ahead with the modernization of distribution networks, the Karnataka government has established a SCADA (Supervisory Control and Data Acquisition) system, including GIS technology, in a canal on the Krishna river to monitor and control water flows in real time, and provide this information to farmers through an online dashboard. Several countries, such as Israel and Singapore, already use sensors and analytics software to improve water distribution efficiency, and Indian states can partner with these countries to enable the technology transfer process.

Theme: Watershed development—Supply side management

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 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[72].

Figure 58: 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—Non-Himalayan states

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

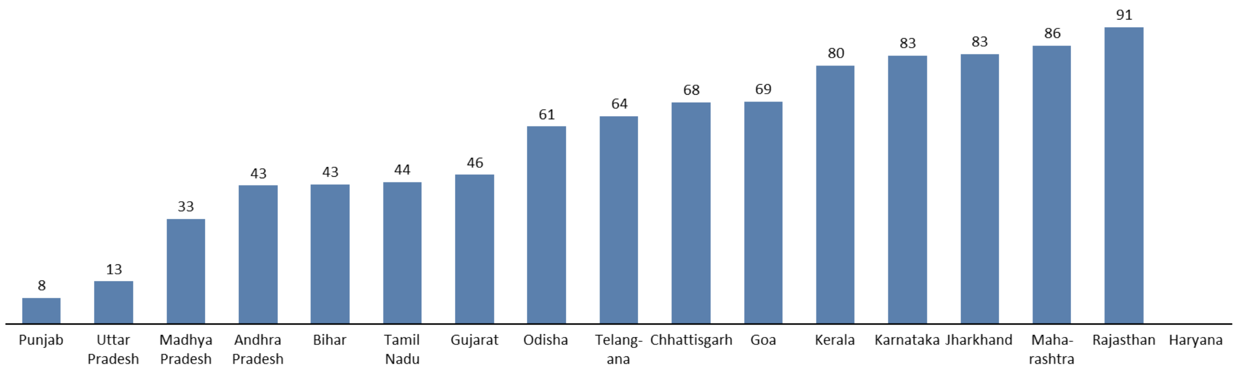
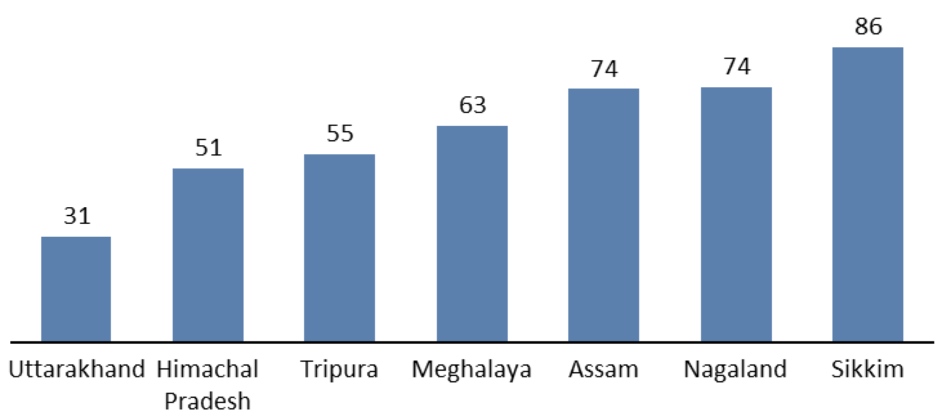


Figure 59: Indicator 10: Area under rain-fed agriculture as a percentage of the net cultivated area as on the end of the current or previous FY —North-Eastern and Himalayan states

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



Most states in India, including those with a large no. of irrigation projects, remain highly dependent on rain-fed agriculture. The median state in the Index has ~60% of its agricultural area as rain-fed. Even states with more than 100 MMI projects, including Maharashtra, Rajasthan, Jharkhand, and Karnataka, have 80-90% of rain-dependent cultivated areas. On the other hand, the large agricultural states of Punjab and UP

72 Scoring methodology has been adjusted accordingly to reflect the inverse nature of the indicator have been modernizing their farms for years and have ~90% of land under irrigation. Across the North-Eastern and Himalayan states, there is wide variation in rainfall dependency, ranging from 86% in Sikkim to 31% in Uttarakhand.

52% of India's agricultural area remains dependent on rainfall; the future expansion of irrigation needs to be focused on last-mile efficiency. Given the fact that even the states with the highest number of irrigation projects remain highly dependent on rainfall, the design of new irrigation systems needs to be focused on optimizing last-mile reach and efficiency. This can involve the inclusion of monitoring technology, early inclusion of relevant stakeholders in irrigation plans, and embedded linkages to on-farm technologies such as micro-irrigation. In fact, it is vital to ensure that water-saving technologies form the bedrock of irrigation expansion plans to ensure that fresh and groundwater resources are not strained further with the modernization of the country's agriculture. The government, thus, needs to position micro-irrigation and farmer advisory at the center of its irrigation expansion schemes and provide appropriate linkages and incentives for adoption.

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 11 specifies the percentage of targeted water harvesting structures constructed or rejuvenated in FY 16-17. 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.

Figure 60: 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—Non-Himalayan states

In % (FY 16-17)

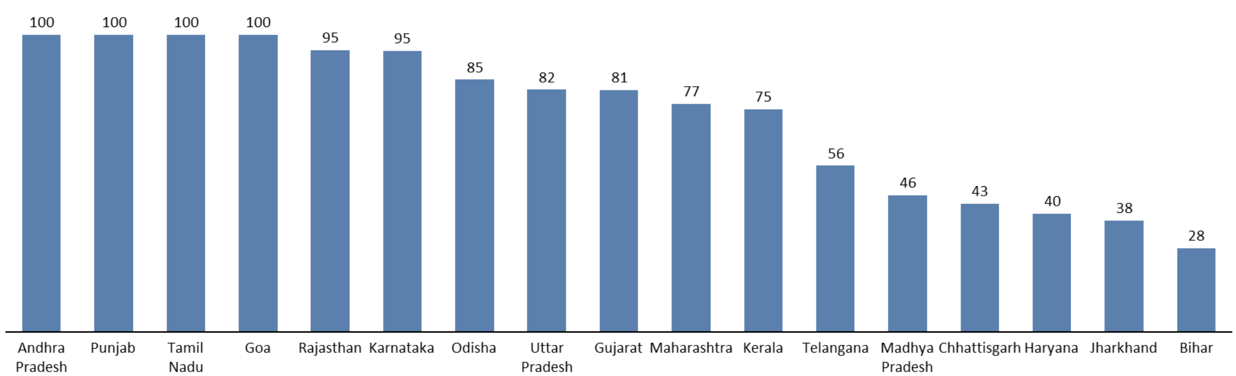
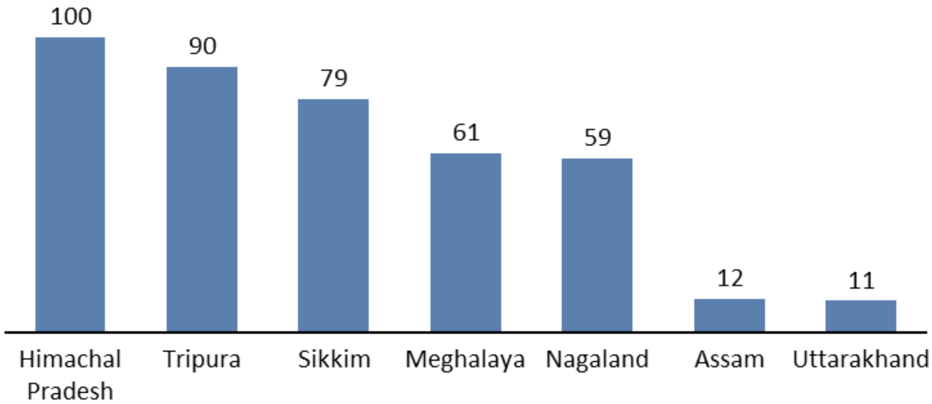


Figure 61: Indicator 11: Number of water harvesting structures constructed or rejuvenated as compared to the target (sanctioned projects under IWMP, RKVY, MGNREGS and other schemes) during the FY—North-Eastern and Himalayan states
In % (FY 16-17)



A majority of states in the country have made significant progress towards their targets for constructing and rejuvenating water harvesting structures for watershed development. Five states—Andhra Pradesh, Punjab, Tamil Nadu, Goa, and Himachal Pradesh—have constructed 100% of their target structures in FY 16-17. Overall performance is also high, with the median state achieving ~78% of its targets. At the category level, Non-Himalayan states have performed better than North-Eastern and Himalayan states, achieving an average success rate of ~73% as compared to ~58% for North-Eastern and Himalayan states.

The largest beneficiaries of these programmes have been small farmers, local communities, and rural workers. The programmes have helped build local water infrastructure, such as ponds, check dams, tanks, etc., leading to an increase in irrigation potential for small farmers and a reduction in water variability for local communities. These watershed programmes are also creating lakhs of jobs, with water and soil conservation projects being responsible for 80% of all MGNREGA work[73]. Several states, such as Kerala, have included local communities throughout the watershed development process, from planning to implementation and monitoring, to ensure sustainability of the structures. Low performing states can boost achievement by similarly involving local communities to achieve buy-in and fast-track the construction process.

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 IWMP that have been geo-tagged, and the contextual indicator provides the total no. of assets created under IWMP in a state. Geo-tagging of water conservation assets has been conducted 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.

73 Source: www.nrega.nic.in

Figure 62: Indicator 12: Percentage of assets created under IWMP geo-tagged as on the end of the given FY—Non-Himalayan states

In % (Base year (FY 15-16), FY 16-17)

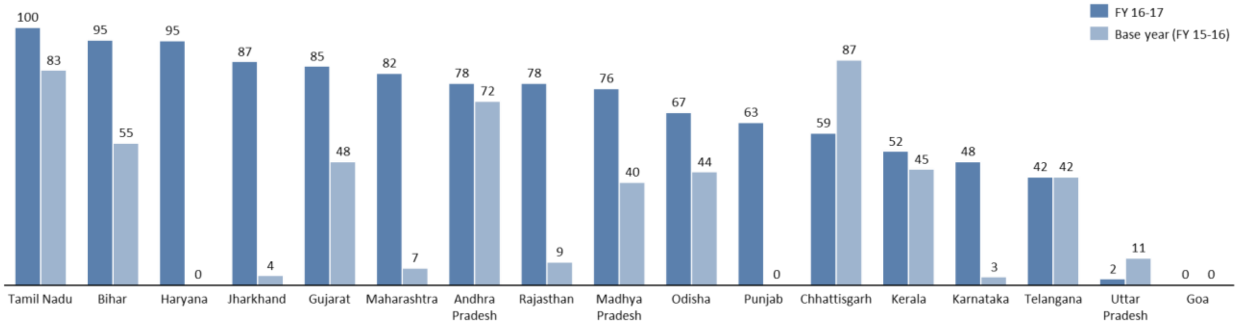


Figure 63: Contextual indicator 12: No. of assets created under IWMP in states—Non-Himalayan states

(latest data available from Base year (FY 15-16), FY 16-17)

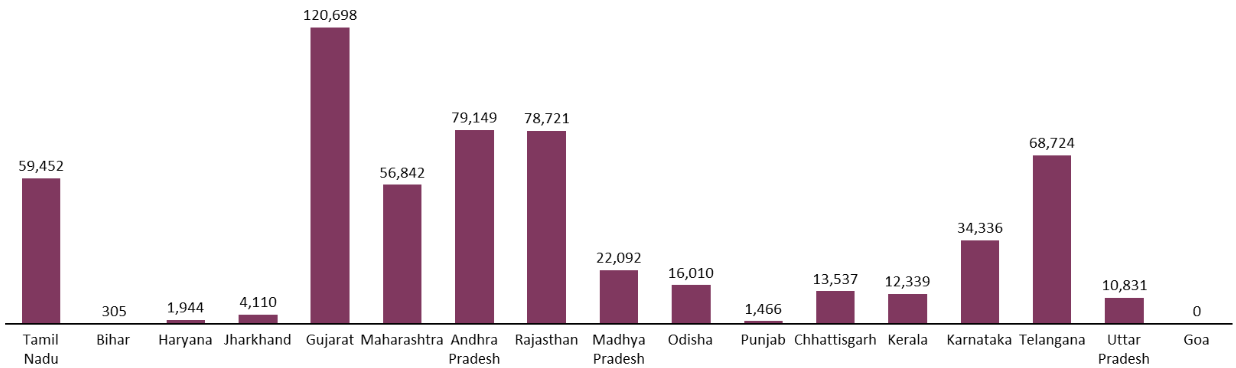


Figure 64: Indicator 12: Percentage of assets created under IWMP geo-tagged as on the end of the given FY—North-Eastern and Himalayan states

In % (Base year (FY 15-16), FY 16-17)

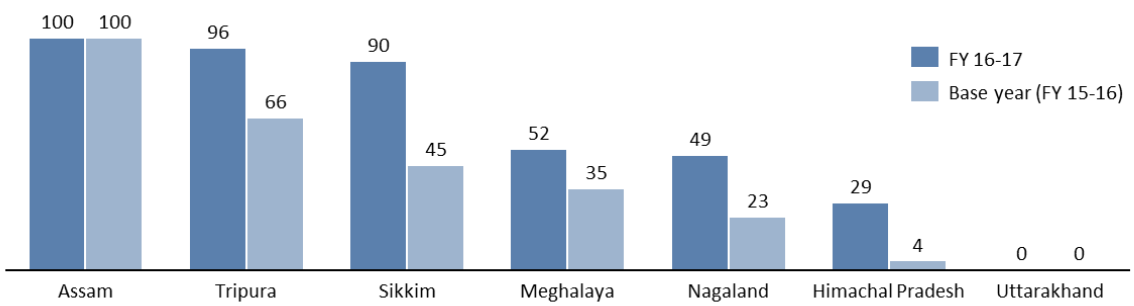
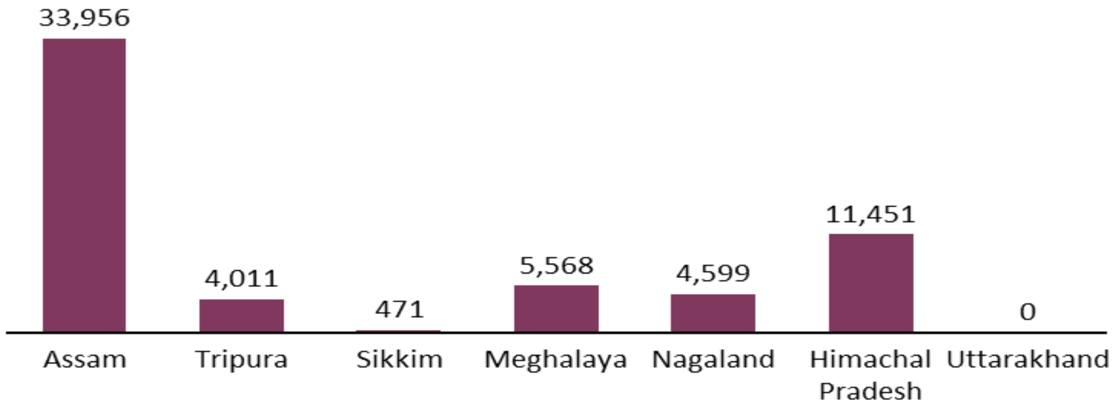


Figure 65: No. of assets created under IWMP in states—North-Eastern and Himalayan states
(latest data available from Base year (FY 15-16), FY 16-17)



Overall performance on geo-tagging water conservation assets is robust—even large states with a massive number of projects have geo-tagged a majority of them—and has improved significantly in the last two years. In FY 16-17, the median state had geo-tagged ~72% of its IWMP assets. Further, even states with more than 50,000 assets, such as Gujarat, Andhra Pradesh, Rajasthan, Tamil Nadu, and Maharashtra, had almost completed a massive undertaking, having geo-tagged more than 75% of their assets. A majority of this progress was made in FY 16-17, with the median state's achievement increasing from ~37% in the base year (FY 15-16) to the aforementioned ~72%. In terms of absolute achievement, Rajasthan improved the most between the years, managing to geo-tag a staggering ~55,000 assets in a single year.

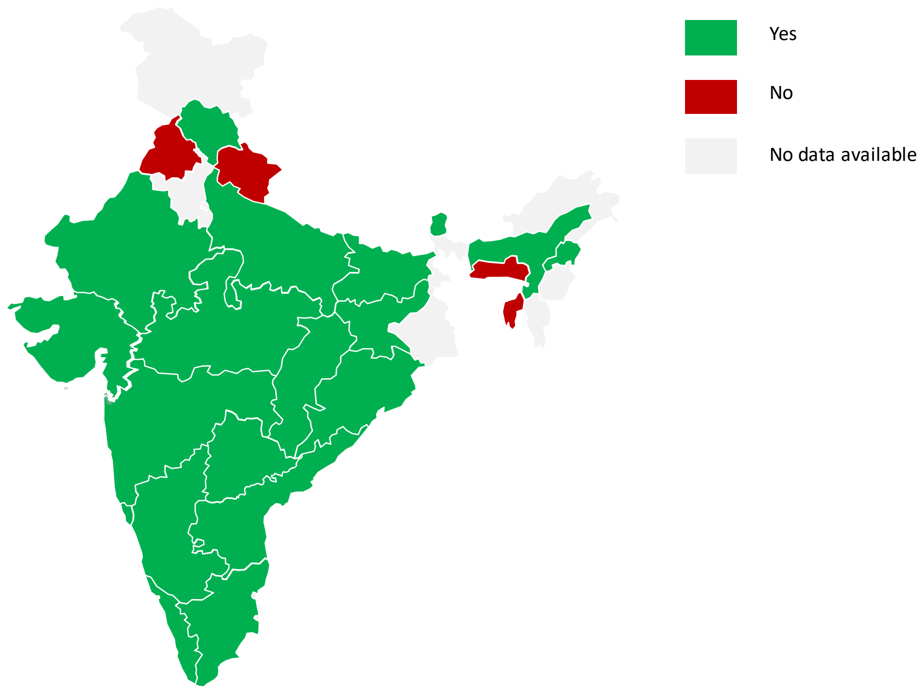
This policy is a positive step towards a data-rich ecosystem for water that can enable policy targeting and innovation. The mandatory geo-tagging of water conservation assets, combined with satellite remote sensing data, not only enables real time progress monitoring, but can also be integrated into state, and potentially national, water data platforms/ centers. The integration would allow precise measurement and identification of successful intervention typologies for recharging groundwater, restoring surface water bodies, etc.

Theme: Participatory irrigation practices—Demand side management

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

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 O&M and user fee collection for irrigation systems due to their local knowledge and direct incentives.

Figure 66: Indicator 13: Has the State notified any law/ legal framework to facilitate Participatory Irrigation Management (PIM) through Water User Associations (WUAs)?
(FY 16-17)



Most states in India have instituted a legal framework for involving WUAs in participatory irrigation management. ~80% of reporting states (19 out of 23) have established a framework for involving WUAs. Punjab, among the Non-Himalayan states, and Meghalaya, Uttarakhand, and Tripura, among the North-Eastern and Himalayan states, are the only ones to not have instituted such a framework, while there is no data available for Haryana.

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 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.

Figure 67: 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—Non-Himalayan states
In % (Base year (FY 15-16), FY 16-17)

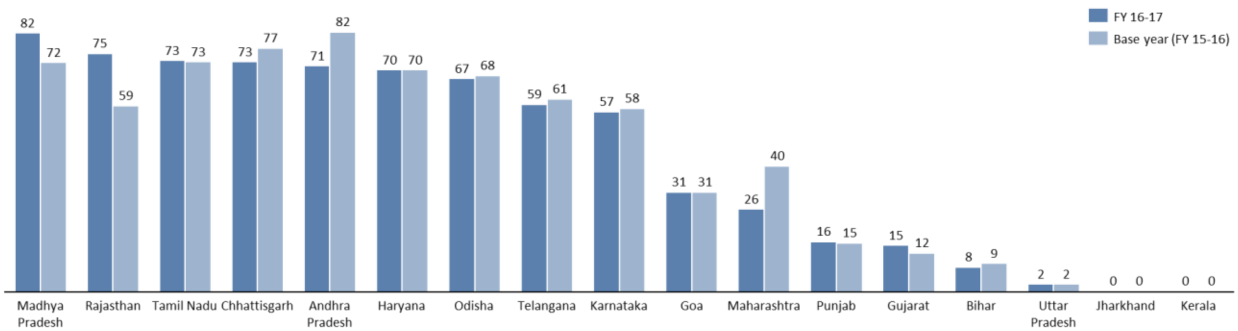


Figure 68: Contextual indicator 14: Irrigated command area in the state as on the end of the given FY—Non-Himalayan states
In lakh hectares (Base year (FY 15-16), FY 16-17)

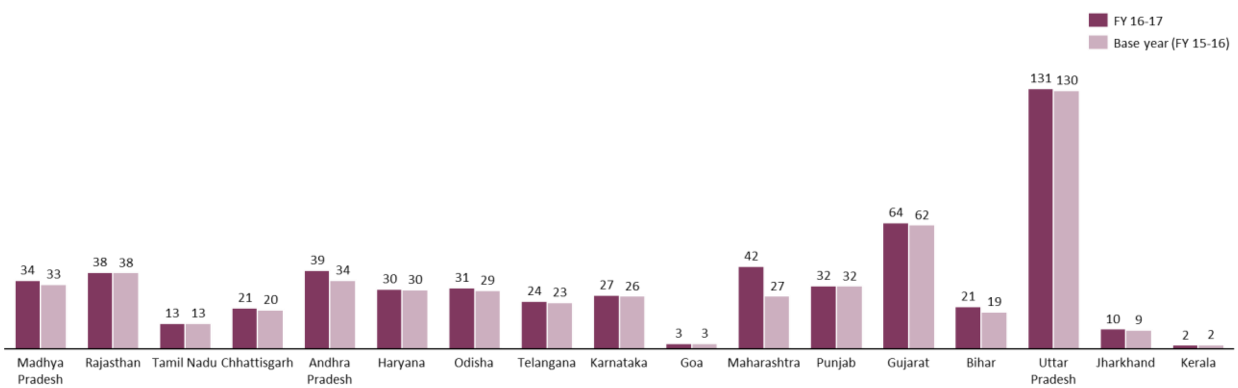


Figure 69: Indicator 14: Percentage of irrigated command areas having WUAs involved in the O&M of irrigation facilities (minor distributaries and CAD&WM) as on the end of the given FY—North-Eastern and Himalayan states
In % (Base year (FY 15-16), FY 16-17)

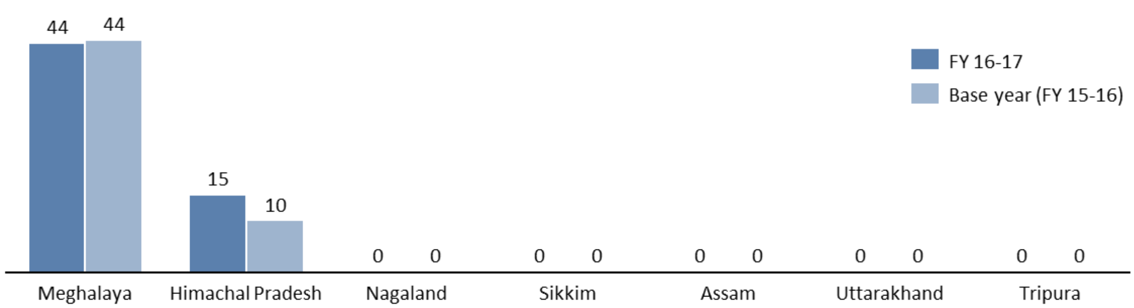
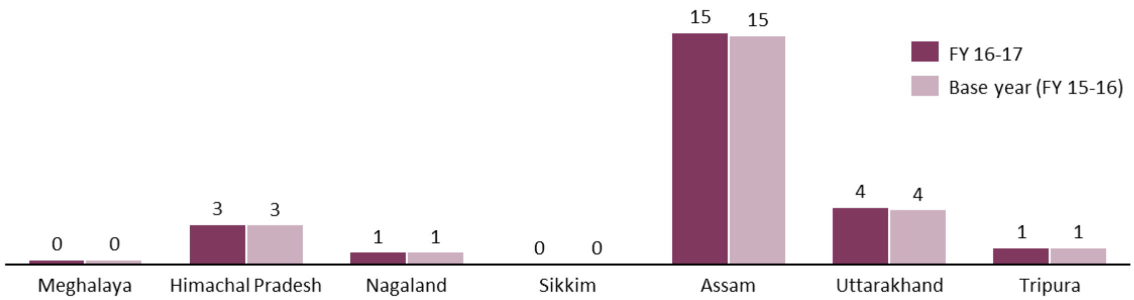


Figure 70: Contextual indicator 14: Irrigated command area in the state as on the end of the given FY—North-Eastern and Himalayan states
In lakh hectares (Base year (FY 15-16), FY 16-17)



There is a lot of variation in the involvement of WUAs in irrigation O&M across states, and states with the largest irrigation areas have worryingly low participation. The median state in FY 16-17 had WUAs involved in the O&M of ~21% of irrigated area, with participation rates for high performers clustered around ~70%, while low performers have sub-20% rates. Gujarat and Uttar Pradesh, the states with largest areas under irrigation, also belong to the low performing category, implying that a significant proportion of the country's irrigation area does not have WUA involvement. North-Eastern and Himalayan states perform even more poorly, with most having no WUA involvement at all.

These figures imply that the envisaged decentralization of O&M activities to WUAs has not materialized. Given the inbuilt incentives for local users to maintain the irrigation systems that support their livelihoods, and their knowledge of local needs and constraints, states need to make a greater push towards WUA involvement at the ground level.

Rajasthan has been a pioneer in involving WUAs to better manage irrigation in the water-scarce state. Rajasthan has achieved high levels of WUA participation due to the early establishment of a regulatory framework to involve farmers in irrigation management (The Rajasthan Farmer's Participation in Management of Irrigation Systems Act, 2000) and the inclusion of WUAs as a major component in the planning and implementation of large water projects, including the water restructuring project with the World Bank in the mid-2000s and the upcoming $100 million rehabilitation of the Indira Gandhi Canal[74].

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.

74 Source: http://pib.nic.in/newsite/PrintRelease.aspx?relid=176564

Figure 71: Indicator 15: Percentage of Irrigation Service Fee (ISF) retained by WUAs as compared to the fee collected by WUAs during the FY—Non-Himalayan states

In % (Base year (FY 15-16), FY 16-17)

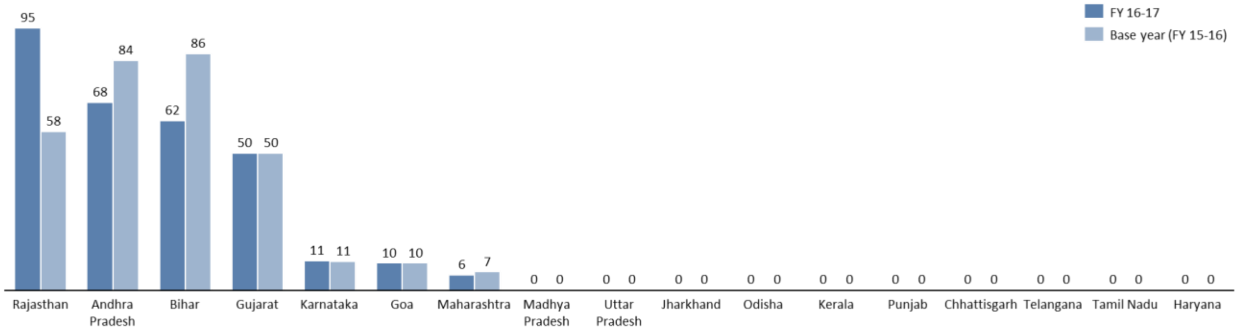


Figure 72: Contextual indicator 15: Total Irrigation Service Fee (ISF) collected during the FY—Non-Himalayan states

In INR lakh (Base year (FY 15-16), FY 16-17)

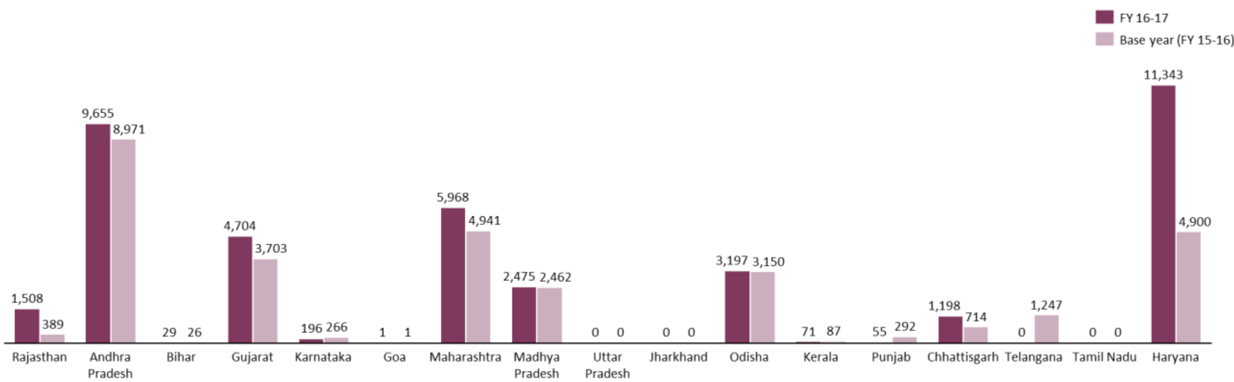


Figure 73: Indicator 15: Percentage of Irrigation Service Fee (ISF) retained by WUAs as compared to the fee collected by WUAs during the FY—North-Eastern and Himalayan states

In % (Base year (FY 15-16), FY 16-17)

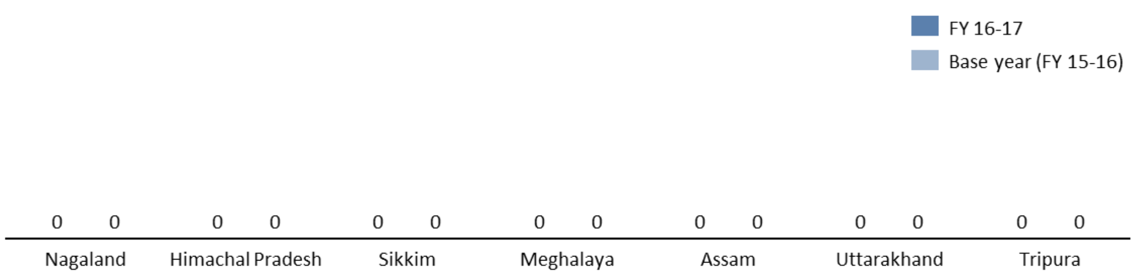
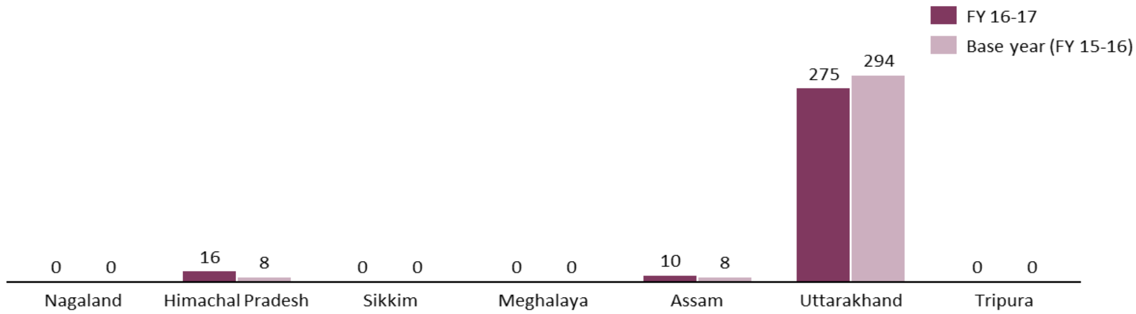


Figure 74: Contextual indicator 15: Total Irrigation Service Fee (ISF) collected during the FY—North-Eastern and Himalayan states
In INR lakh (Base year (FY 15-16), FY 16-17)



Currently, WUAs are not allowed to retain any portion of irrigation fees in most states, thereby limiting the actualization of participatory irrigation management. Only four states—Rajasthan, Andhra Pradesh, Bihar, and Gujarat—allowed WUAs to retain more than 50% of the irrigation fees in FY 16-17. Most of the other states allowed zero retention of fees with WUAs. More broadly, the collection of irrigation service fees across states was poor, with four of the Non-Himalayan states and most of the North-Eastern and Himalayan states collecting no fees at all.

To achieve more efficient and participatory irrigation systems, states need to gradually implement fees for irrigation water and assign greater resources to WUAs. Currently, irrigation fees are non-existent or low, thereby encouraging the use of inefficient practices such as flood irrigation. Further, there are high leakages in distribution systems due to the limited resources available to local users for maintenance. By addressing these two issues, states can significantly boost the distribution efficiencies of irrigation, and encourage efficient use of water on the farm.

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

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 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.

Figure 75: 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—Non-Himalayan states
In % (Base year (FY 15-16), FY 16-17)

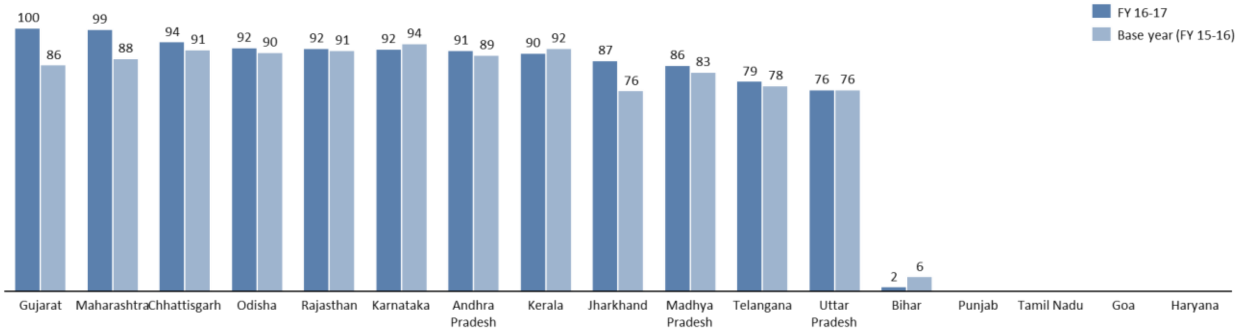
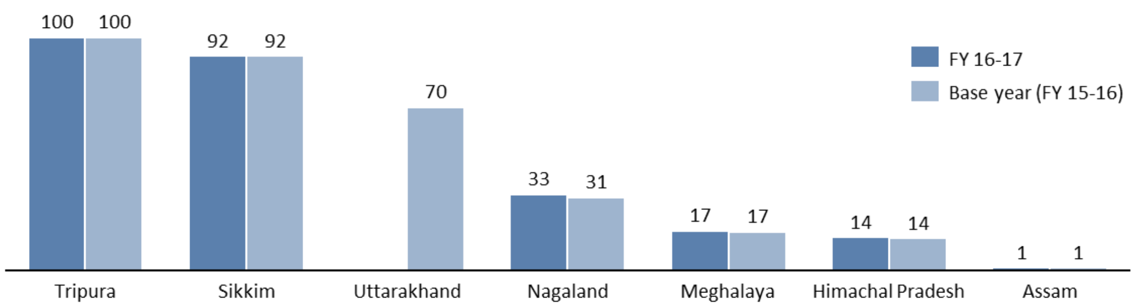


Figure 76: Indicator 16: Area cultivated by adopting standard cropping pattern as per agro-climatic zoning, to total area under cultivation as on the end of the given FY—North-Eastern and Himalayan states
In % (Base year (FY 15-16), FY 16-17)



Overall, states have displayed excellent performance, with ~80% of reporting states having more than 75% of area planted as per agro-climatic zoning. 19 out of 20 Non-Himalayan states have figures above 75%, a hugely encouraging fact, given that these states contain the majority of cultivated area in the country. Tripura and Sikkim are the high performers among the North-Eastern and Himalayan states, but Assam, worryingly given its position as the largest state in this group, has almost no area planted according to agro-climatic zoning. Further, data is not available for Punjab and Haryana, which have some of the highest cultivated areas in the country.

Given the fact that agriculture utilizes 90% of the country's annual water consumption, planting crops in a water-efficient manner is a key lever for overall sustainability, and the exceptional performance of states in this indicator bodes well for the future. Despite excellent overall performance, inconsistencies exist within states, with water-intensive sugarcane being grown in the drought-prone areas of Maharashtra being a well-documented example. These problems can be corrected by building in water considerations into the decision processes for agricultural incentives such as MSPs and fertilizer subsidies.

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 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, they 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. The Indian government is pushing this agenda through DDUGJY (Deen Dayal Upadhyaya Gram Jyoti Yojana), the country's $12 billion rural electrification scheme.

Figure 77: Indicator 17 (a): Has the State segregated agriculture power feeder?
(FY 16-17)

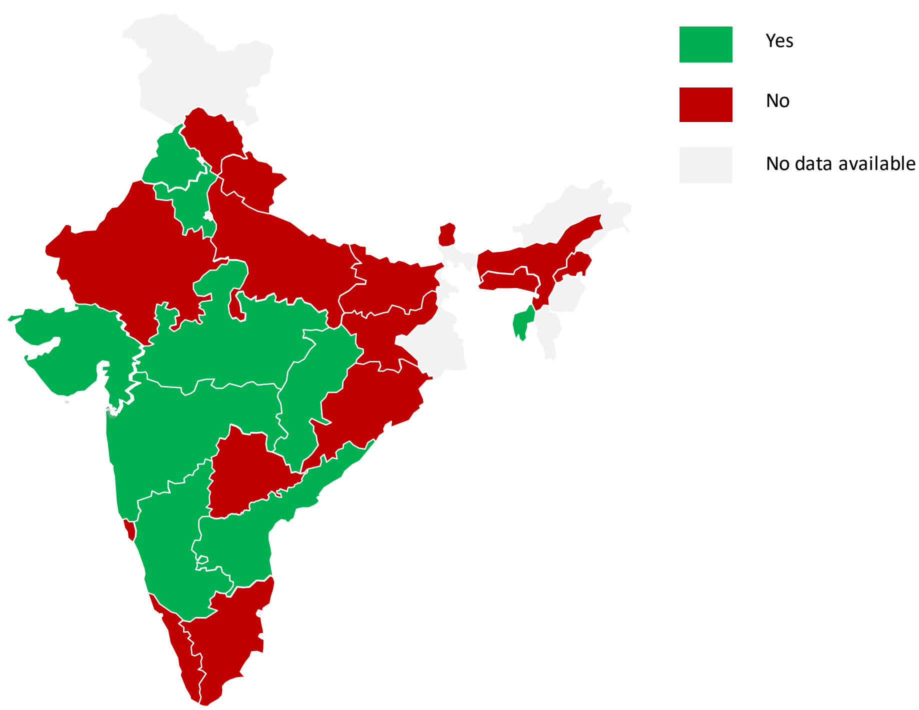


Figure 78: Indicator 17 (b): Area in the state covered with segregated agriculture power feeder as compared to the total area under cultivation with power supply during the given FY—Non-Himalayan states
In % (Base year (FY 15-16), FY 16-17)

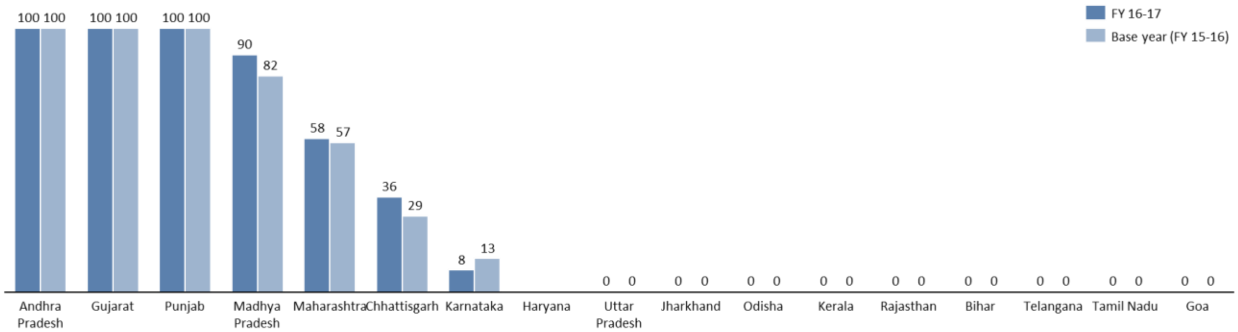
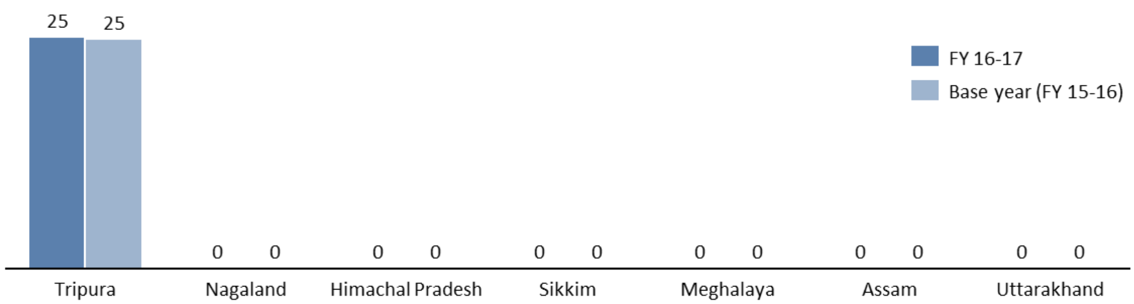


Figure 79: Indicator 17 (b): Area in the state covered with segregated agriculture power feeder as compared to the total area under cultivation with power supply during the given FY—North-Eastern and Himalayan states
In % (Base year (FY 15-16), FY 16-17)



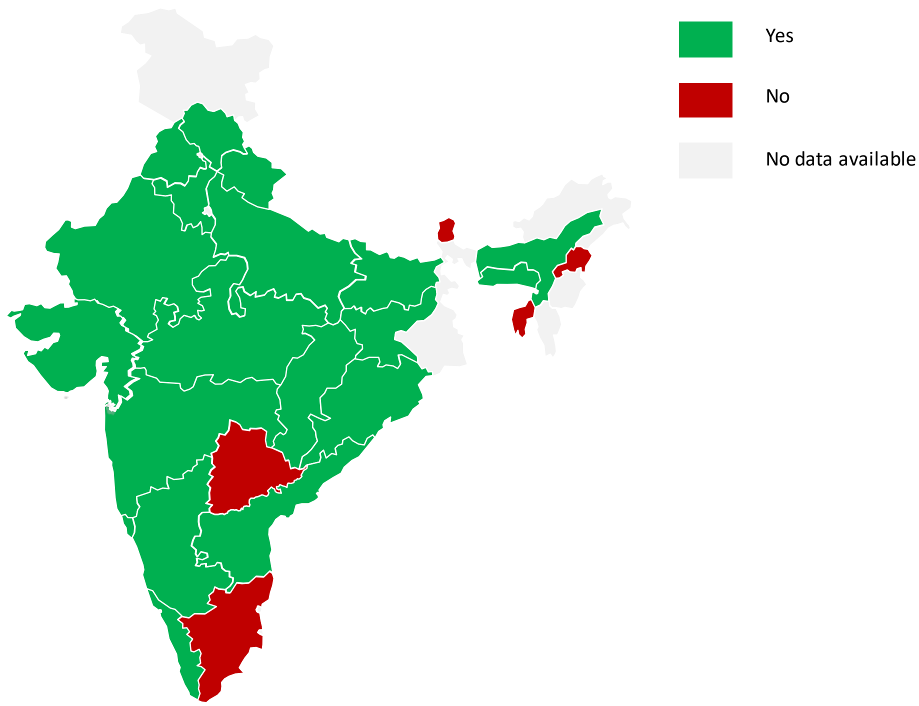
Across India, only nine states have segregated electricity feeders, and several large agricultural states have still not begun the process. Out of the nine states that have segregated agricultural power feeders, four—Andhra Pradesh, Gujarat, Punjab, and Madhya Pradesh—have achieved or are close to achieving 100% segregation. Others, such as Maharashtra, Chhattisgarh, Karnataka, and Tripura still have significant ground to make up, while no data is available for Haryana's achievement in segregation.

Given the dual benefits of feeder segregation for farmers and rural households, and the national push towards reliable electricity supply in rural areas, it is critical for the remaining states to implement this reform in a timely fashion. Meanwhile, states that have already achieved the objective can explore the idea of provision of grid electricity through renewable sources, such as solar generation plants, to mitigate the emissions impact of increased electrification.

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 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 63% of all irrigation water. In fact, the unchecked extraction of groundwater by farmers is driving the country's groundwater crisis, with 54% of wells declining in levels due to extraction rates exceeding recharge rates[75]. 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 to boost irrigation have created an unsustainable situation. Given this worsening crisis, states are slowly moving towards charging farmers for electricity.

Figure 80: Indicator 18 (a): Is electricity to tube wells/ water pumps charged in the State?
(FY 16-17)



75 Source: FAO AQUASTAT database; WRI

Figure 81: Indicator 18 (b): If yes, then whether it is charged as per fixed charges?
(FY 16-17)

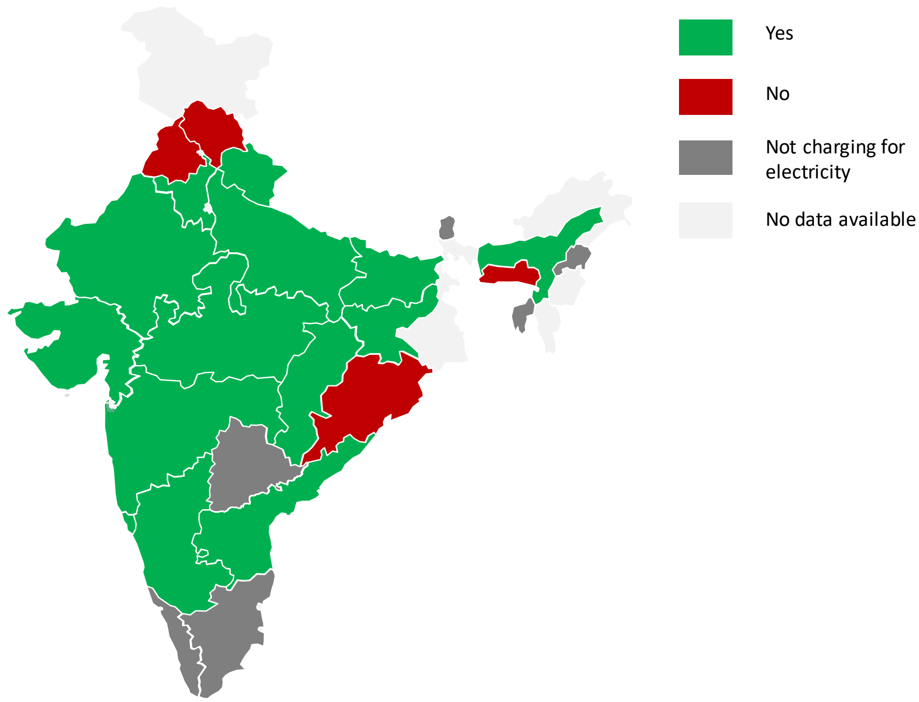
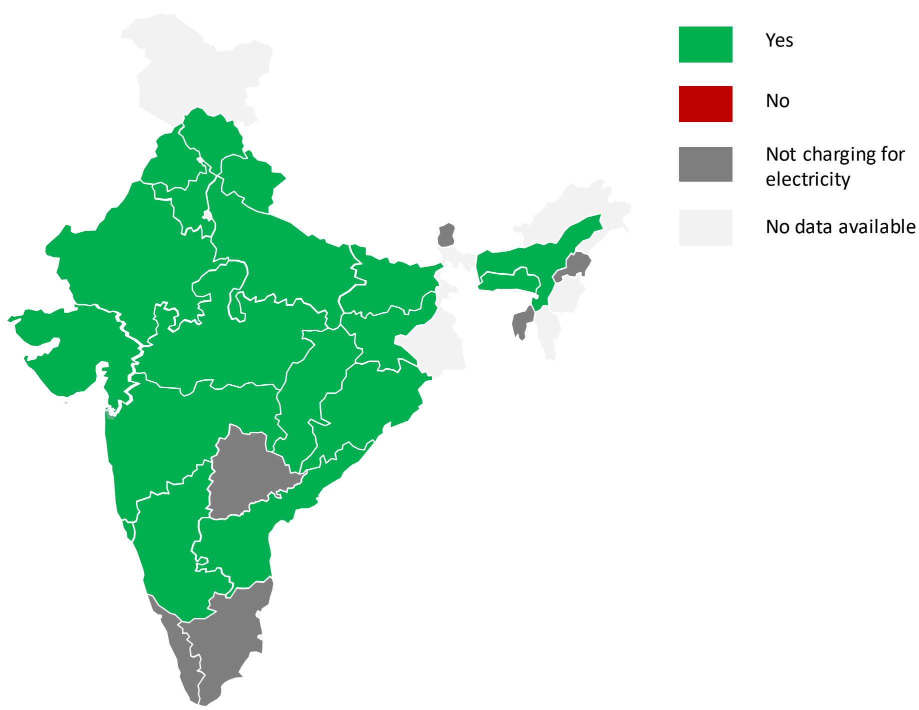


Figure 82: Indicator 18 (c): If yes, then whether it is charged on the basis of metering?—North-Eastern and Himalayan states
(FY 16-17)



Currently, ~80% of Index states report charging for electricity to tube/ borewells, with most specifying a mixture of fixed and metered charges. 19 out of 24 Index states reported charging for electricity to tube/ borewells, with only two Non-Himalayan states—Telangana and Tamil Nadu—and three North-Eastern and Himalayan states—Sikkim, Nagaland, and Tripura—still providing free electricity to farmers. All the states charging for electricity reported having metered connections, while 14 out of 19 reported having fixed charges as well. This likely implies that states have a mixture of users, with some paying fixed charges—possibly in remote areas with a lack of metering, and others paying as per the units used.

Despite the picture painted by these maps, under-and non-pricing of electricity to farmers remains one of the biggest water problems in the country. Independent surveys[76] show that even now, most connections for farmers in the rural areas of large northern states are not metered, and inevitably, in the vast majority of metered connections, the true cost of providing electricity is highly subsidized. These policies lead to over-extraction of groundwater for use in inefficient irrigation practices such as flood irrigation, and thus, exacerbate the zero-sum nature of groundwater extraction for irrigation—large farmers are able to buy more pumps and extract large amounts, reducing the irrigation potential for smaller farmers. A gradual movement towards true-cost pricing of electricity for tube/ borewells to encourage efficient cropping and irrigation practices is, thus, one of the key levers for solving India's groundwater crisis.

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, recently as part of the 'More crop per drop' section of the PMKSY scheme, by providing subsidized equipment to farmers from selected vendors.

76 Conducted by Dalberg and Sambodhi Research across Tamil Nadu, Rajasthan, UP, and Bihar for a previous engagement

Figure 83: Indicator 19: Area covered with micro-irrigation systems as compared to total irrigated area as on the end of the given FY—Non-Himalayan states

In % (Base year (FY 15-16), FY 16-17)

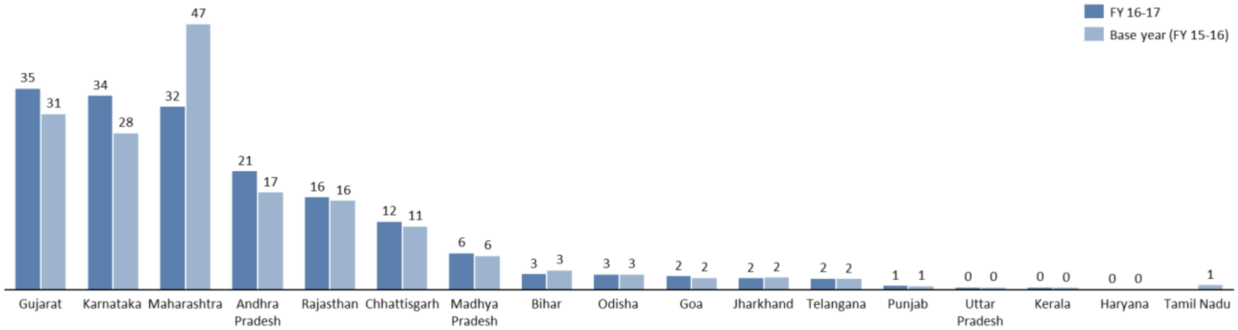


Figure 84: Contextual indicator 19: Total irrigated area in the state as on the end of the given FY—Non-Himalayan states

In lakh hectares (Base year (FY 15-16), FY 16-17)

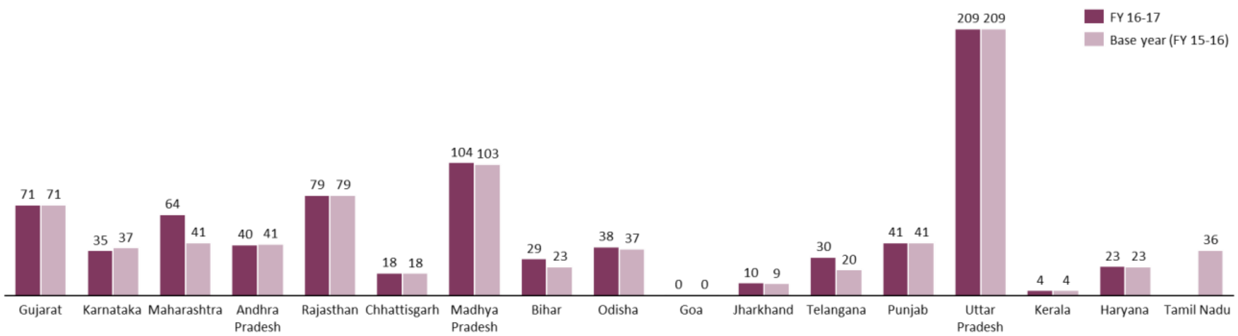


Figure 85: Indicator 19: Area covered with micro-irrigation systems as compared to total irrigated area as on the end of the given FY—North-Eastern and Himalayan states

In % (Base year (FY 15-16), FY 16-17)

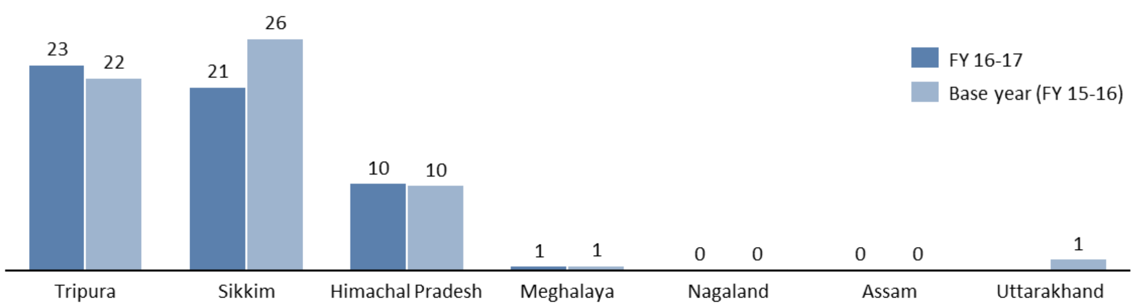
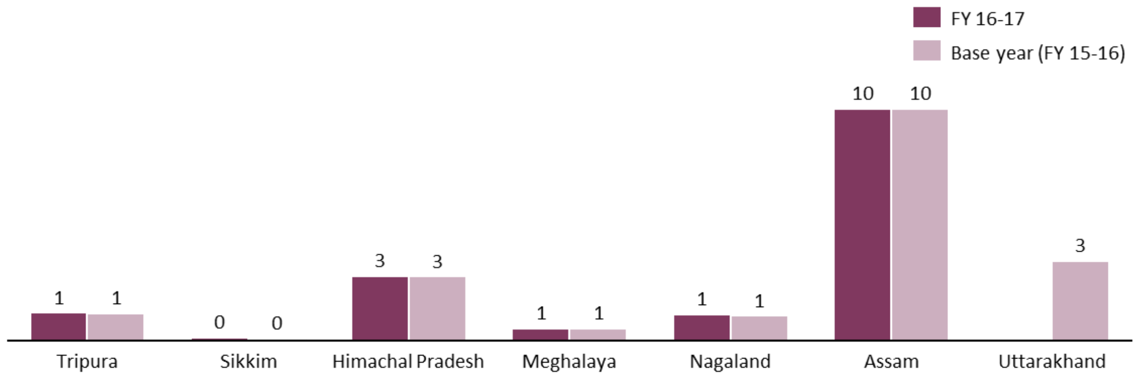


Figure 86: Contextual indicator 19: Total irrigated area in the state as on the end of the given FY—North-Eastern and Himalayan states
In lakh hectares (Base year (FY 15-16), FY 16-17)



State performance on installing micro-irrigation systems is extremely poor across the board, with no state having these systems in more than roughly one-third of the irrigated area. The median state in FY 16-17 had installed micro-irrigation systems on only ~2% of irrigated area, with the average across states being ~10%. Most worryingly, several large agricultural states, such as Punjab, Uttar Pradesh, Haryana, and Tamil Nadu, have negligible micro-irrigation adoption. Even the leading states—Gujarat, Karnataka, Maharashtra, and Andhra Pradesh—have systems in only ~20-35% of irrigated area. Among the North-Eastern and Himalayan states, Tripura and Sikkim are the only ones with more than 10% coverage, while the largest state, Assam, has negligible coverage. These numbers highlight one of the major causes underlying the inefficient use of water by Indian farmers, who currently have one of the lowest water-efficiencies in the world, using 3-5X of water for producing the same amount of crops as compared to farmers in China, the US, and Israel[77].

It is critical to accelerate micro-irrigation adoption to improve water-efficiency in the largest water-using sector of the country. With agriculture using 90% of the country's water[78], widespread micro-irrigation can make a major dent in the projected water deficit for the country. As an example, Israel, one of the most naturally water-scarce nations in the world, has managed to transform itself into the leading global water manager by building on the efficiency gains unlocked by micro-irrigation systems (which it invented). To achieve this transformation, the government needs to accelerate the process of providing Direct Benefit Transfers (DBT) for micro-irrigation subsidies (which it has already announced) to enable innovation and consumer choice in the micro-irrigation market. The government already has a successful programme to draw from, having pushed through DBT subsidies for LPG recently (as described in the case study in *Figure 28).*

77 Source: FAO AQUASTAT database, World Bank data
78 Source: FAO AQUASTAT database

Theme: Rural drinking water

Indicator 20: Proportion of total rural habitations fully covered with drinking water supply as on the end of the given FY

Indicator 20 measures rural drinking water access as the proportion of rural habitations fully covered with drinking water supply[79]. ~70% of India's population (~800 million people) lives in rural areas, making this the largest service delivery challenge in the world in terms of scale.

Figure 87: Indicator 20: Proportion of total rural habitations fully covered with drinking water supply as on the end of the given FY—Non-Himalayan states
In % (Base year (FY 15-16), FY 16-17)

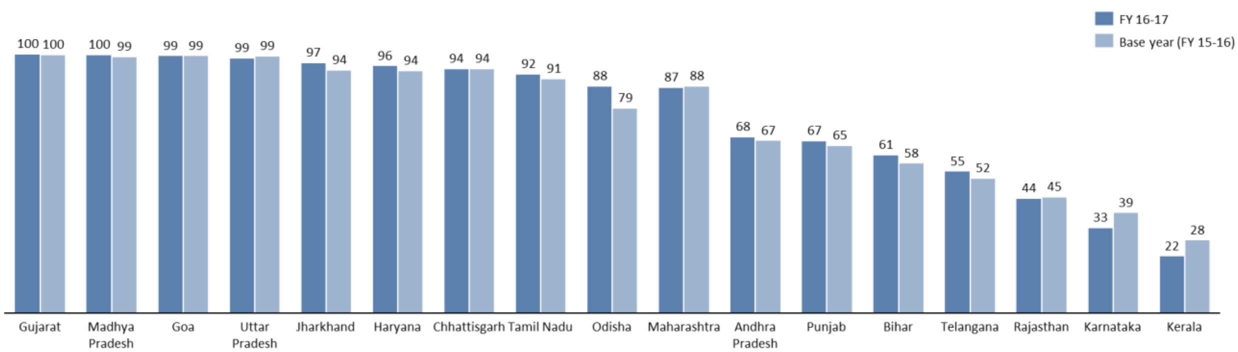
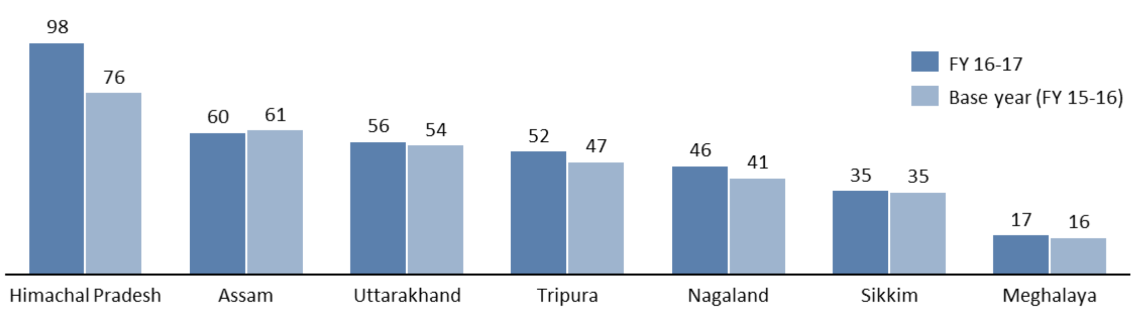


Figure 88: Indicator 20: Proportion of total rural habitations fully covered with drinking water supply as on the end of the given FY—North-Eastern and Himalayan states
In % (Base year (FY 15-16), FY 16-17)



Most states in India have been able to fully cover rural areas with drinking water supply, but some of the well-functioning states, as well as the North-Eastern and Himalayan states, are surprisingly lagging behind. The median state was able to fully cover ~67% of all rural habitations in the provision of drinking water, with nine states having more than 90% coverage. Despite these successes, significant gaps remain. Surprisingly, several states that perform highly on other indicators in the Index, as well as on efficient governance rankings (Eg. Ease of Business rankings)—Andhra Pradesh, Punjab, Karnataka, and Kerala—are lagging behind in this indicator. Further, several North-Eastern and Himalayan states have low coverage rates, with only Himachal fully covering more than 60% of rural habitations. However, these

79 Full coverage means that a rural person will have access to 70 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.

have been gradually increasing, with the North-Eastern and Himalayan state average going up by four percentage points from the base year (FY 15-16) to FY 16-17.

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. Currently, only ~49% of the rural population has access to safely-managed water[80]—which is far behind even our neighbours such as China and Bangladesh—resulting in one of the highest disease burdens due to water-borne diseases in the developing world, with an estimated two lakh annual deaths from inadequate (or unsafe) drinking water[81].

Figure 89: Indicator 21: Percentage reduction in rural habitations affected by Water Quality problems during the FY—Non-Himalayan states
In % (Base year (FY 15-16), FY 16-17)

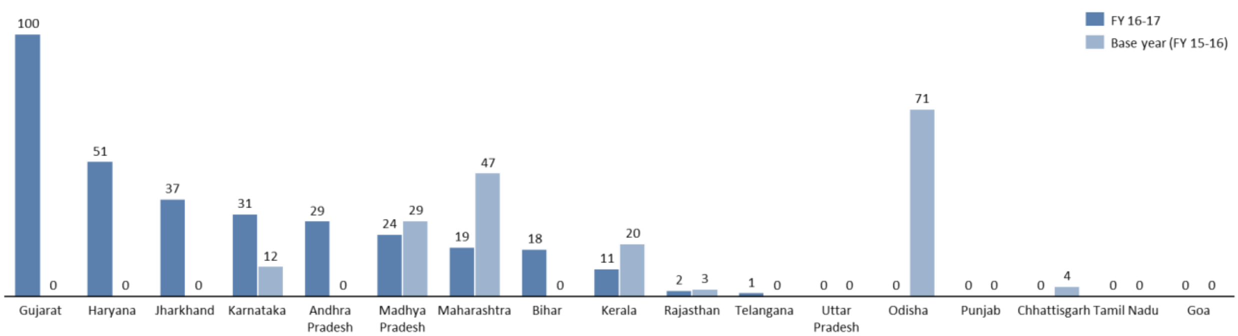
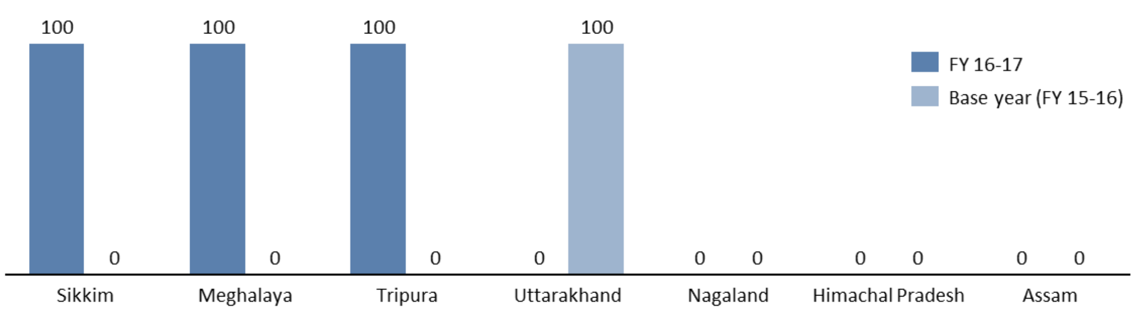


Figure 90: Indicator 21: Percentage reduction in rural habitations affected by Water Quality problems during the FY—North-Eastern and Himalayan states
In % (Base year (FY 15-16), FY 16-17)



Most large states have not been able to achieve improvements in water quality in rural areas, while several North-Eastern and Himalayan states have made significant gains. Except for Gujarat and Odisha, which achieved reductions of 100% (FY 16-17) and 71% (FY 15-16) respectively, Non-Himalayan states have performed poorly in improving quality. Seven states in the category have not improved quality at all,

80 Source: WHO/ UNICEF Joint Monitoring Programme (JMP)—washdata.org
81 Source: WHO, Global Health Observatory data repository

while the others have been able to reduce incidents only by 10-50%. On the other hand, several North-Eastern and Himalayan states have performed well, with four states achieving 100% reductions in quality incidents in at least one of the years.

Several decentralized solutions to improve water quality are being tested across the country, and states can potentially pilot and scale some of these. Many NGOs and entrepreneurs are using decentralized solutions, such as cheap equipment to test household water quality and solar water purifiers, to address quality issues in villages. States can potentially leverage these innovations by establishing a platform for identifying solutions, and by providing piloting and scale-up support for promising technologies.

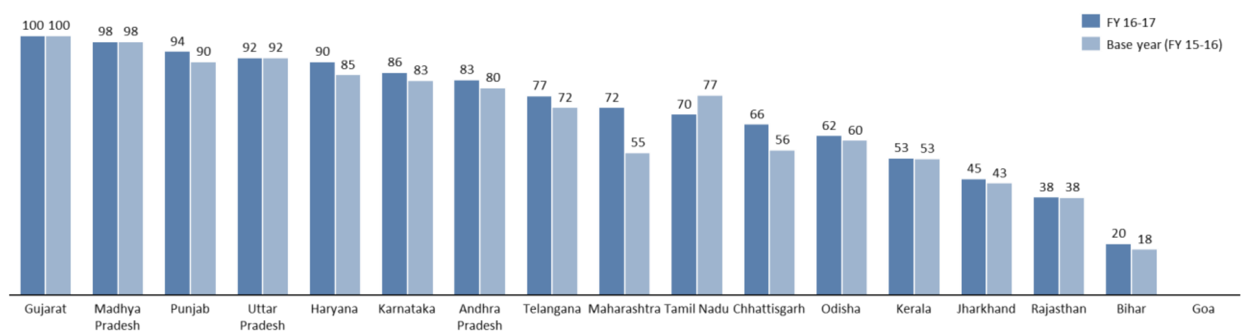
Theme: Urban water supply and sanitation

Indicator 22: Percentage of urban population being provided drinking water supply as on the end of 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'[82], 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. In fact, by 2020, 21 major cities, including Delhi, Bangalore, and Hyderabad, are expected to reach zero groundwater levels, affecting access for 100 million people[83].

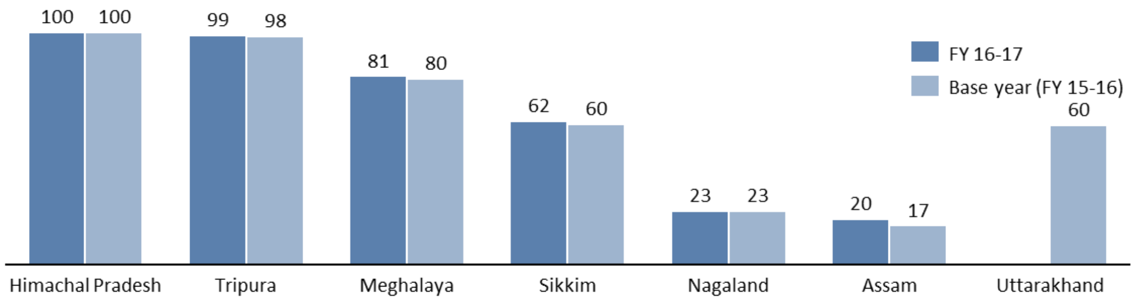
Figure 91: Indicator 22: Percentage of urban population being provided drinking water supply as on the end of the given FY—Non-Himalayan states

In % (Base year (FY 15-16), FY 16-17)



82 Source: WHO/ UNICEF Joint Monitoring Programme (JMP)—washdata.org
83 Source: World Bank (Hindustan Times, The Hindu)

Figure 92: Indicator 22: Percentage of urban population being provided drinking water supply as on the end of the given FY—North-Eastern and Himalayan states
In % (Base year (FY 15-16), FY 16-17)



The data supports the hypothesis of wide variation in urban water access, with several states having large urban areas also lagging behind. The median state provided water to only ~75% of its urban population in FY 16-17, with Bihar coming in at a staggering low of ~20%. Further, states with large urban areas, such as Maharashtra, Tamil Nadu, and Kerala, are also only able to provide drinking water to 53-72% of their massive urban populations. This supply gap is significant given the fact that urban drinking water is the use case that, arguably, receives the most policy and media focus. Also, given that most urban users have significant influence over the political process, this lack of access is likely to be highly concentrated amongst the urban poor. Some North-Eastern and Himalayan states like Assam and Nagaland also provide water to ~20% of their urban populations, with the possible argument of high piping costs negated by the fact that Tripura and Meghalaya have been able to successfully serve more than 80% of their urban population.

It is critical for state governments to work on the dual policy prongs of building out supply networks and limiting private groundwater access to ensure sustainable water use in cities, and prevent the rationing and strife witnessed in the recent water crisis of Cape Town.

Indicator 23: Capacity installed in the state to treat the urban waste water 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 23 measures the ability of states to treat urban waste water by examining the percentage of total urban waste water that can be treated with the currently installed capacity. The contextual indicator specifies the total waste water generated in urban areas of the state, signifying the scale of the service challenge. Treating waste water is important as water contamination is a significant challenge for India, and is estimated to affect three-fourth of the Indian population, contributing 20% of the country's disease burden[84].

84 Source: WaterAid, 'Water: At What Cost? The State of the World's Water 2016

Figure 93: Indicator 23: Capacity installed in the state to treat the urban waste water 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—Non-Himalayan states

In % (FY 15-16)

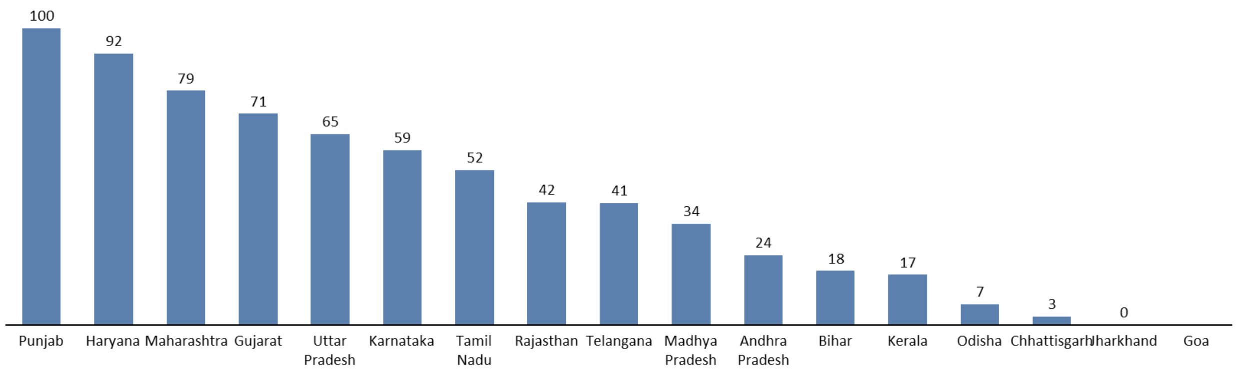


Figure 94: Contextual indicator 23: Total estimated generation of waste water in urban areas as on the end of the given FY—Non-Himalayan states

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

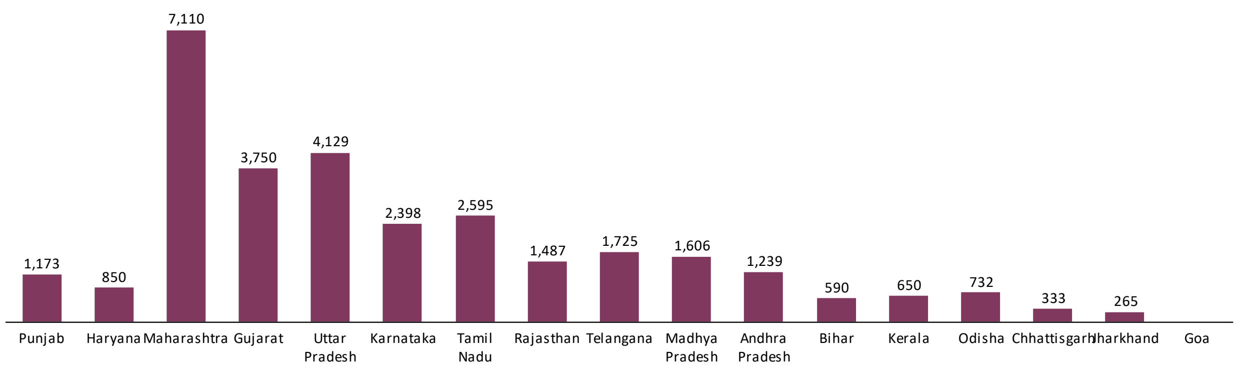


Figure 95: Indicator 23: Capacity installed in the state to treat the urban waste water as a proportion of the total estimated waste water generated in the urban areas of the state as on the end of the given FY—North-Eastern and Himalayan states

In % (FY 15-16)

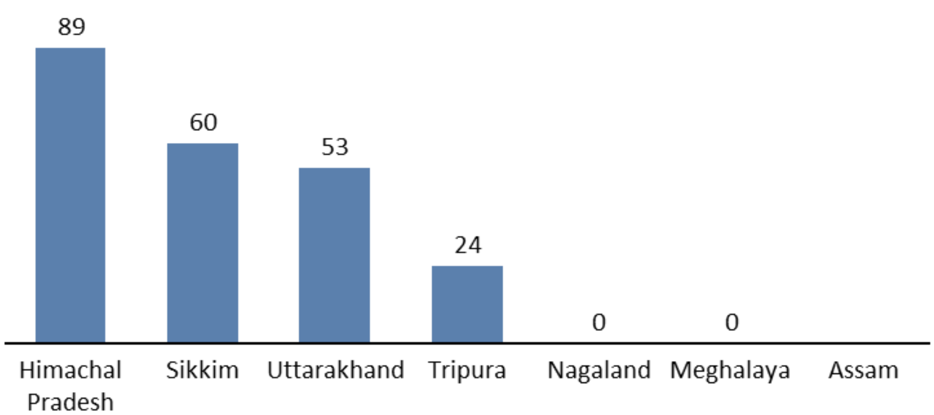
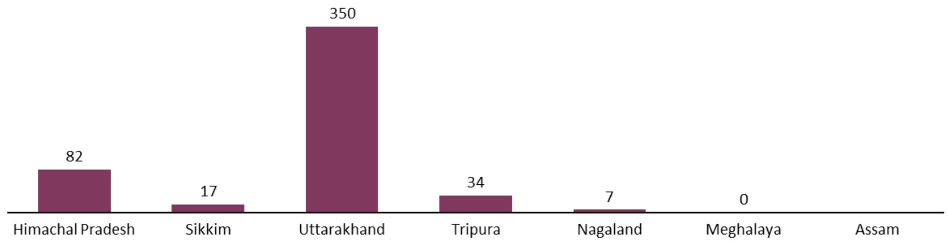


Figure 96: Contextual indicator 23: Total estimated generation of waste water in urban areas as on the end of the given FY—North-Eastern and Himalayan states
In million litres per day (MLD) (FY 15-16)



Most large states have installed capacity to treat more than 50% of their urban waste water, but significant gaps remain. The median state has capacity to treat ~41% of its urban waste water, but the large waste water generators—Punjab, Maharashtra, Gujarat, and UP—can potentially treat 65-100% of their urban waste water. Despite this, many populous states, such as Madhya Pradesh, Bihar, Andhra Pradesh, have only enough installed capacity to treat less than half of their waste water. Further, several North-Eastern and Himalayan states have low or no capacity for treatment.

Indicator 24: Percentage of waste-water treated during the given FY

Indicator 24 narrows down on the actual proportion of urban waste water treated. This data is also available for FY 16-17, 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 16-17.

Figure 97: Indicator 24: Percentage of waste-water treated during the given FY—Non-Himalayan states
In % (Base year (FY 15-16), FY 16-17)

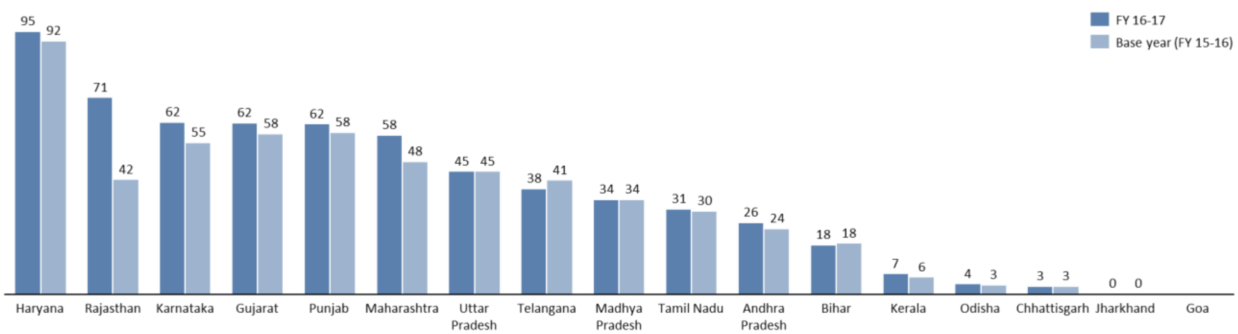
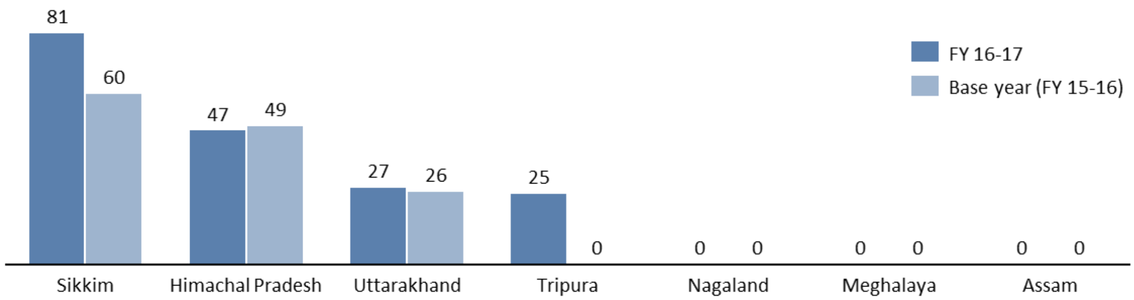


Figure 98: Indicator 24: Percentage of waste-water treated during the given FY—North-Eastern and Himalayan states

In % (Base year (FY 15-16), FY 16-17)



In line with installed capacity, treatment percentages vary from 25-95% for the larger states. Haryana is the leader and treats ~95% of its waste water. Rajasthan, in second position, appears to have significantly increased its treatment capacity in one year, and treats 71% of its urban waste water, up from 42% in the base year (FY 15-16). The median state, however, treated only ~30% of its waste water in FY 16-17, reiterating the treatment gap in several populous states, such as MP, UP, Andhra Pradesh, and Bihar.

Going forward, states need to increase investments in waste water treatment to both meet the growing demand due to rapid urbanization and enable reuse of water. Large urban states need to invest significantly in treatment systems now to meet the projected 65% increase in urban populations by 2050[85]. Further, treatment can enable reuse of water, helping to significantly bridge the supply-demand gap. In other water-scarce countries such as Israel, reuse is one of the cornerstones of water management, with 94% of water being reused for several purposes, including meeting half of the irrigation demand (as highlighted in the case study in *Figure 33*)[86].

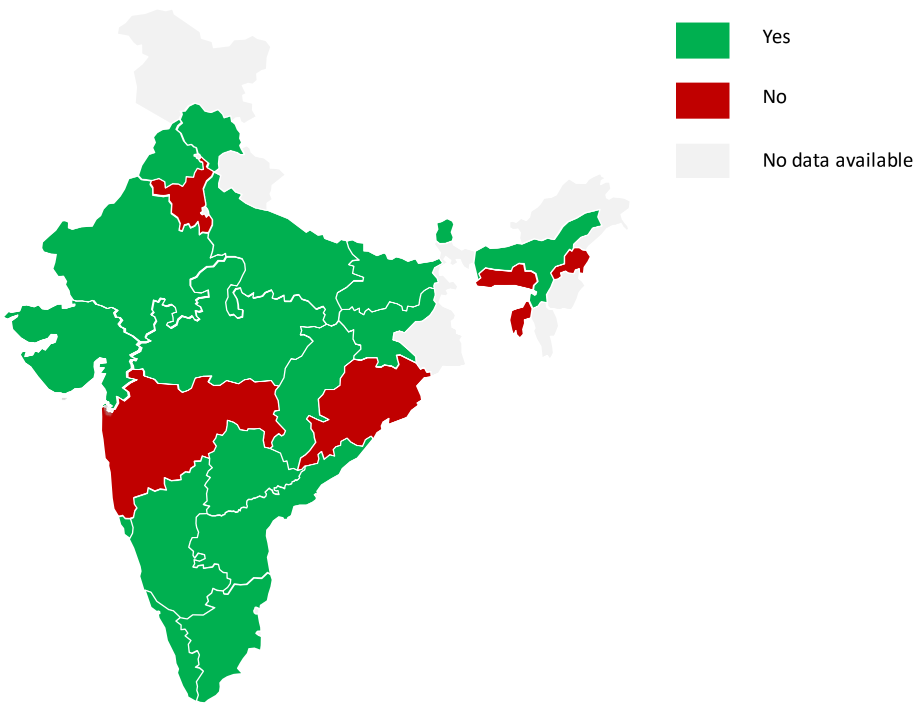
85 Source: UN, 'World Cities Report', 2016

86 Source: FAO AQUASTAT database; The Tower Magazine, 'How Israel is solving the global water crisis', 2015

Theme: Policy and governance

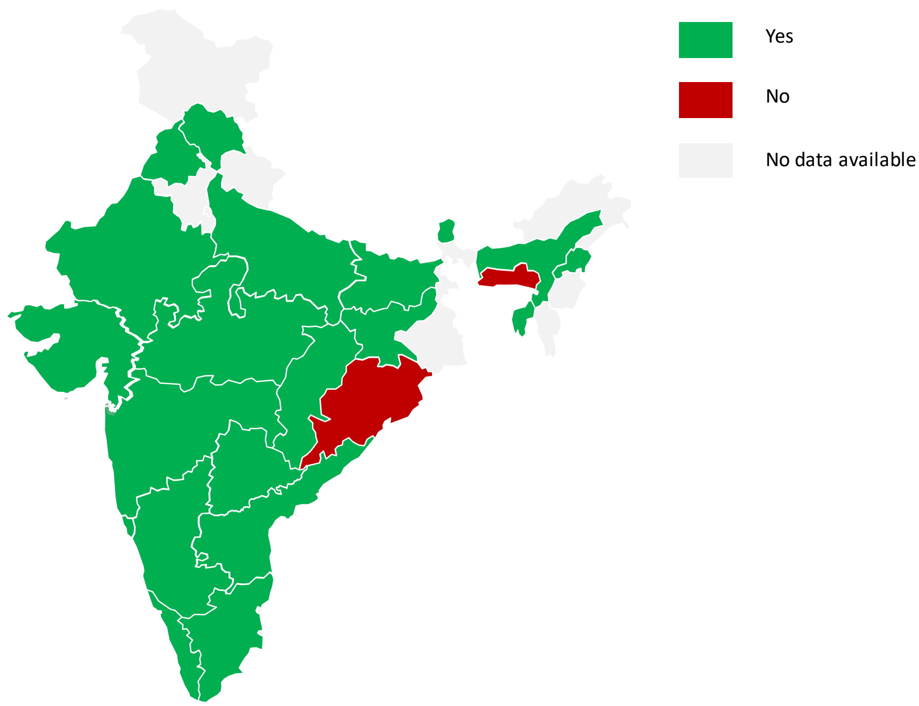
Indicator 25: Whether the State has enacted any legislation for protection of waterbodies and water-supply channels and prevention of encroachment into/on them?

Figure 99: Indicator 25: Whether the State has enacted any legislation for protection of waterbodies and water-supply channels and prevention of encroachment into/on them?
(FY 16-17)



Indicator 26: Whether the State has any framework for rain water harvesting in public and private buildings?

Figure 100: Indicator 26: Whether the State has any framework for rain water harvesting in public and private buildings?
(FY 16-17)



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.

Most states have enacted appropriate legislation for water conversation, indicating increasing institutional ability to deal with water risks. ~75% of reporting states (17 out of 23) have enacted legislation for the restoration and non-encroachment of water bodies and ~90% of reporting states (20 out of 22) have done so for rainwater harvesting in public and private buildings. The establishment of legislation seems to be only loosely correlated to outcomes though, as Maharashtra, Odisha, and Nagaland are doing well on the restoration of water bodies (Indicator 1) despite being three out of the six states to not enact legislation for the same. While this result might be due to a loosely codified state policy and efficient execution, it is important to institutionalise the conservation process by establishing a clear regulatory framework. The widespread enactment of rainwater harvesting legislation also bodes well for the sustainability of urban areas that are fast running out of groundwater supplies.

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 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.

Figure 101: 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—Non-Himalayan states
In % (Base year (FY 15-16), FY 16-17)

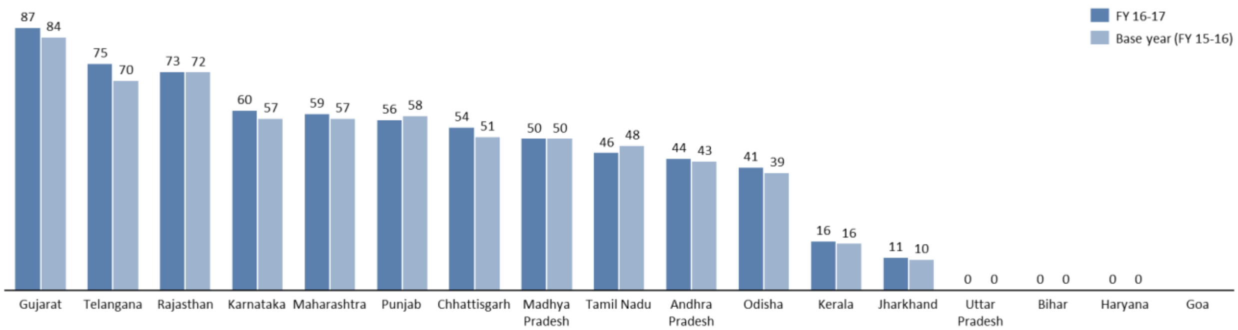
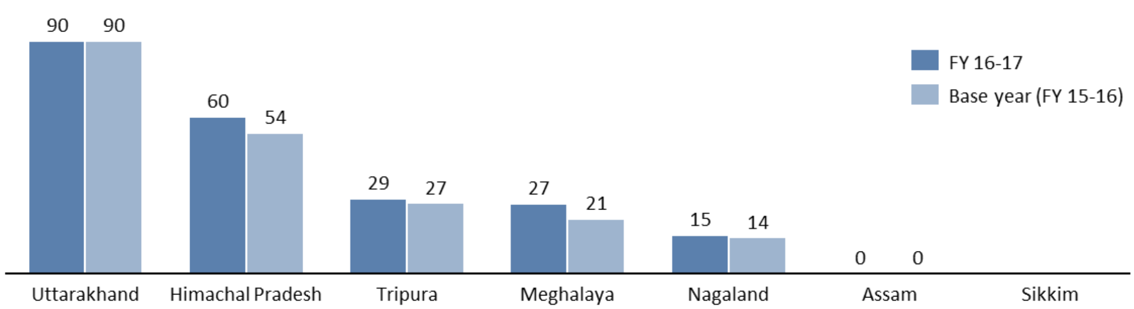


Figure 102: Indicator 27: Percentage of households being provided water supply and charged for water in the urban areas as on the end of the given FY —North-Eastern and Himalayan states
In % (Base year (FY 15-16), FY 16-17)



On average, ~40% of the urban households in the country pay for water, but this value varies widely across states. In eight out of 22 of the reporting Non-Himalayan states, more than 50% of urban households pay for the water supply. However, in several populous states such as UP and Bihar, a negligible proportion of households pay for water. Similar variation takes place across North-Eastern and Himalayan states as well, ranging from 90% in Uttarakhand to 0% in Assam. The trend for the indicator, though, is encouraging, with almost all the states reporting modest increases in the proportion of paying households.

While these numbers are encouraging, they do not indicate the widespread problem of highly subsidized water across urban areas in the country. Even in most of the larger cities, such as Delhi and Mumbai, water is highly subsidized for all users. However, some of these cities are moving towards consumption slab based tariffs, with low consumption users, usually poor people, paying low tariffs and being cross subsidized by the higher tariffs on the high consumption users. Other cities can implement these consumption-based tariffs to ensure equity, while moving water utility systems towards full-cost returns and economic efficiencies as a whole.

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.

Figure 103: Indicator 28 (a): Does the State have a separate integrated Data Centre for water resources?
(FY 16-17)

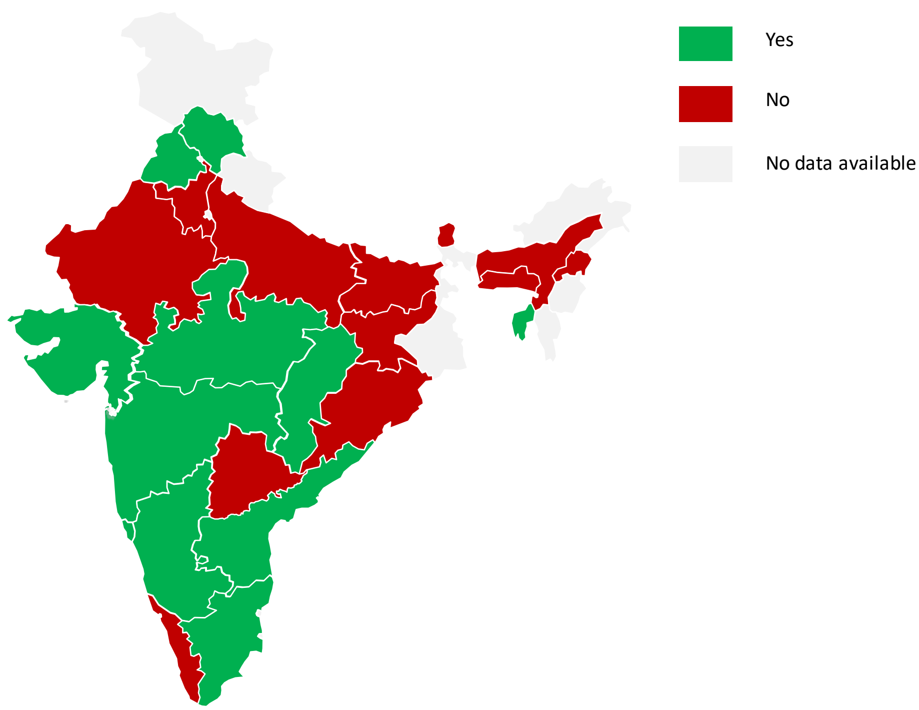
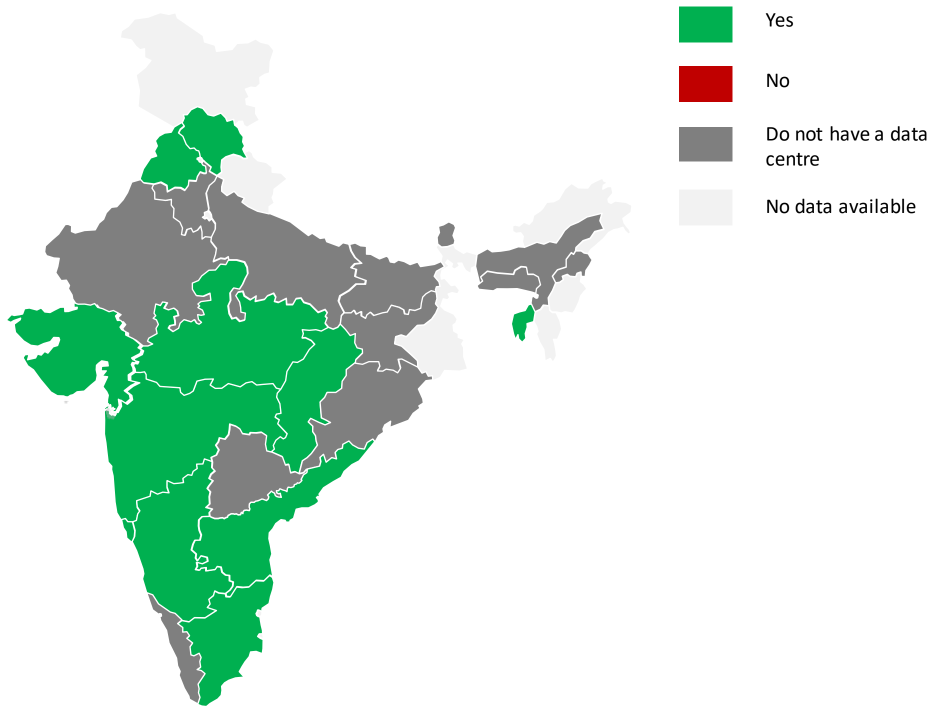


Figure 104: Indicator 28 (b): Whether the data is being updated on the integrated data centre on a regular basis? *(FY 16-17)*



~50% of states have stablished integrated water data centres, and these are updated regularly. In an important and positive development, most of the Non-Himalayan states in the Water Index have established integrated water data centres. These include large irrigation and agricultural players such as Maharashtra, Gujarat, Punjab, Tamil Nadu, and others. The northern populous states of UP, Bihar, Rajasthan, and Haryana are however lagging behind, along with most of the North-Eastern and Himalayan states (except for the exceptionally well performing Tripura, and Himachal Pradesh). In all the states where these centres have been established, they are reported as being updated regularly, though the binary nature of indicator 28 (b) is unable to capture the frequency and extent of these updates.

As described in the thematic section and in the case study in *Figure 36*, these water data systems, especially if consolidated into a 'central water data platform', can enable targeted policymaking by states in areas such as agricultural incentives, groundwater recharge, etc., and can also enable innovative market interventions such as a groundwater impact bond and water markets.

Second, since the data will be available on a public platform, researchers, entrepreneurs, NGOs, and policymakers can use it to create innovative products, provide value-added services, and design targeted policies and interventions. Going forward, the government can support this process by potentially designing a technological platform with open APIs to help unlock innovation in the broader water ecosystem.

Case studies on best practices adopted by states

Case study 1: Community Managed Water Supply Programme: Bringing drinking water to the doorsteps of people in rural Gujarat

Overview

Gujarat's rural water supply programme, led by the state's Water and Sanitation Management Organisation (WASMO), aims to supply the village community with adequate, regular and safe water through household-level tap water connectivity, including households of people from backward communities. The programme strives to build a sustainable model through building capacity of village communities and empowering them to manage water resources themselves. The programme is based on a unique cost-sharing model, where the community partially shares the cost, owns the drinking water supply assets, and holds the operation and maintenance responsibilities.

As a result of this programme, Gujarat has achieved a 100% score in the 'Rural drinking water' theme of the Water Index, implying that it provides clean water to all of its ~35 million rural residents[87].

88

87 Source: http://www.gujaratindia.com/state-profile/demography.htm
88 Source: www.gujaratindia.com

Key actions

1. Initially, villagers are mobilized to discuss the key problems that the local drinking supply system suffers from. These efforts involve participation by NGOs to ensure the inclusion of all views, especially those of women and the poorer members of the village.
2. Based on these discussions, a Village Action Plan (VAP) is drawn up with 10% of the estimated programme cost collected from residents and 90% contributed by WASMO. A representative 'Pani Samiti' for the village is then established to plan and implement the programme.
3. Finally, WASMO and its partner organizations provide hand-holding and capacity building support to the Pani Samitis for a year, to ensure that the programme is technically and financially sound, and thus sustainable.

Impact

The rural water supply project is providing clean water access to villages in all state districts. As of the end of 2013, ~50% of the villages have completed schemes at an investment of 800 crores, and Pani Samitis have been formed in almost all of the ~18,400 villages in the state[89]. This programme has been the driver of Gujarat's 100% achievement in the 'Rural drinking water' category of the Index, helping the state fully cover all rural habitations and achieve a 100% decline in rural water quality incidents in FY 16-17.

Lessons for other states

- **Mobilize community participation:** States should tap into the local knowledge base of problems and challenges surrounding water supply systems, while ensuring true representation through partnerships with NGOs and other relevant organizations.
- **Decentralize O&M and pricing:** Governments need to allow local bodies to implement, maintain, and price local drinking water supply. This ensures a strong incentive structure where the people most affected by the supply are the ones responsible for its maintenance and sustainability.
- **Provide adequate capacity building and technical support:** Community efforts should be supplemented by support in the form of investments, technical know-how, financial management skills, etc.

89 Source: http://www.niti.gov.in/best-practices/community-managed-water-supply-programme-bringing-drinking-water-doorsteps-people

Case study 2: Restoration of alternative irrigation structures: The 'farm pond miracle' of Madhya Pradesh[90]

Overview

Madhya Pradesh's 'Bhagirath Krishak Abhiyan' began in 2006 in the Dewas district through the efforts of a local IAS officer and is focused on the restoration of farm ponds to boost irrigation potential. The programme has resulted in the construction of thousands of farm ponds to boost irrigation potential, through the efforts of local farmers, government officers, and financial institutions such as NABARD.

The impact of this program, detailed below, is reflected in Madhya Pradesh's performance on the 'Source augmentation and restoration of water bodies' theme of the Index, where it has restored 100% of the irrigation potential of identified water bodies and achieved a perfect score.

90 Source: A Decision Made 10 Years Ago by Farmers in a Small MP Village Is Helping Them Tackle Drought Today, Nivedita Khandekar, June 15, 2016, accessed at : http://www.thebetterindia.com/58237/farm-ponds-dewas-tackle-drought/; Miracle Achieved by the Joint Efforts of a Local Community and a government administration: An Economy of Water by a Visionary Crusader Umakant Umrao, Ground Report India, 15 January 2012, 14 April 2012.

Key actions

1. To gain farmer buy-in, large landholders were initially targeted due to their larger risk bearing capacity to construct large farm ponds. The District Collector, along with agriculture department officials and NGOs working in the sector, held discussions with these farmers to convince them of the value of these irrigation potential boosting water structures.
2. The key constraint of financing for large farm ponds was overcome by creating detailed project reports for banks such as NABARD.
3. Finally, the government officers and NGOs provided capacity building support to the farmers for the construction, use, and maintenance of these ponds.

Impact

In the few years since program inception, farmers have constructed about 8,000 water reservoirs of various sizes in Dewas district. These water reservoirs or farm ponds have generated an irrigation potential of 40,000 hectares in the Dewas district and the assured supply of water has meant that farmers can now grow crops both in the Kharif and Rabi season. The efforts also yielded several intangible benefits: a reduction in the use of fertilizers, time savings, and a reduced reliance on electricity for pumping water. An additional benefit has been the increase in migratory birds and other wildlife as the pasture lands around the farm ponds improved in quality.

As mentioned previously, the programme has helped Madhya Pradesh achieve a perfect score on the 'Source augmentation and restoration of water bodies' theme of the Index.

Lessons for other states

- **Provide adequate financing through rural banks:** Community efforts for the creation of water conservation infrastructure need to be supported through the provision of adequate financing; banks such as NABARD and RRBs are well placed to lend for these efforts given their past association with farmers.
- **Support experimentation by local policymakers:** The targeted and phased implementation of the programme by local government officers allowed for the identification and resolution of key constraints at the initial phase, and the successful model could then be replicated at scale through state support.

Case study 3: Data for groundwater management: Andhra Pradesh's online water dashboard[91]

Overview

As part of the Chief Minister's Office's objective of real-time governance through an online dashboard, Andhra Pradesh has established a comprehensive information portal for water resources in the state. The dashboard allows real-time monitoring of rainfall, groundwater, soil moisture, tanks, check dams, and other water indicators.

Real-time monitoring, and the associated reforms, such as farmer advisory for cropping patterns, have helped the state boost its groundwater management, with Andhra Pradesh scoring the highest on the 'Source augmentation (Groundwater)' theme of the Index. As an input into the data portal, the state has also mapped and constructed recharge infrastructure for all critical and over-exploited groundwater units.

Key actions

1. The state has partnered with a private firm, Vassar Labs, to undertake the creation of a water and cropping data system targeted towards water conservation and advisory services to farmers. The system is using satellite data and soil sensor data to create local water profiles and recommend optimal agricultural decisions to farmers.
2. This system has involved geo-tagging and enabling real-time monitoring of several water assets, such as large dams, tanks, groundwater wells, etc., with a high spatial resolution.
3. For groundwater, this means that all units have been mapped and recharge infrastructure created where required, and levels are being monitored in real-time, with interventions such as a ban on extraction being implemented as per need.

---

91 Source: https://core.ap.gov.in/cmdashboard/index.aspx; expert interview with Vassar Labs

Impact

This data and monitoring system has helped Andhra Pradesh achieve an 80% score on the 'Source augmentation (Groundwater)' theme of the Index—the highest in the country. The state has mapped 100% of its critical and over-exploited units and constructed recharge infrastructure across 96% of these, in addition to having created a regulatory framework for managing groundwater.

Lessons for other states

- **Enable data-backed decision making:** States need to create robust water data systems with real-time monitoring capabilities to ensure that the data can be used to target policy interventions and enable innovation in the broader water ecosystem.
- **Leverage private sector expertise:** Private sector expertise, especially in the realms of technology and data, needs to be leveraged by governments to ensure the quick creation and efficient management of data and monitoring systems.

Case study 4: Transformational state water policies: Rajasthan's Mukhya Mantri Jal Swavlambhan Abhiyan (MJSA)

Overview

Rajasthan's Mukhya Mantri Jal Swavlambhan Abhiyan (MJSA) is a multi-stakeholder project, which aims to make the remotest of the villages in the state water-sufficient, by focusing on reviving water bodies, increasing groundwater levels, and providing clean drinking water for all.

This comprehensive scheme has been the driving force between Rajasthan's improvement in the Index score by ~9 points from FY 15-16 to FY 16-17, with 81% of the irrigation potential of identified water bodies being revived under the scheme.

92

Key actions

1. The state has leveraged technology to drive the scheme, such as using drones to identify traditional water bodies for restoration.
2. Another main feature of the scheme has been the participation of the community, both in reviving, maintaining and monitoring water bodies, and also in donating funds to the campaign and undertaking conservation drives.
3. Finally, the scheme has been implemented in a phased manner with clear year-end targets and frequent impact assessments that also measure the broader socio-economic achievements of the scheme.

92 Source: Twitter, MJSA Rajasthan

Impact

The scheme has led to the creation of >4 lakh water harvesting structures and the planting of >1 crore trees across the state's 33 districts. The result has been a ~5 feet average rise in groundwater levels across 21 districts, a reduction in water tanker dependency, an increase in irrigated area, and a greater focus on water conservation in the largely dry state.[93]

The implementation of the scheme has been responsible for Rajasthan's position as the most improved state on the Water Index, gaining ~9 points, by ensuring the restoration of 81% of the irrigation potential of identified water bodies through community involvement and technology use.

Lessons for other states

- **Create overarching policy frameworks:** State governments need to create strong policy and regulatory frameworks for water management and conservation to ensure effective coordination across multiple stakeholders and to provide a platform to engage with and support communities.
- **Combine technology with community efforts:** Community efforts for water conservation can be boosted by providing appropriate technological support to ensure better targeting.
- **Conduct comprehensive impact assessments:** It is critical for governments to assess the impact of their policies by evaluating broader socio-economic outcomes beyond just the infrastructure construction achievements.

93 Source: https://www.hindustantimes.com/jaipur/groundwater-level-goes-up-in-21-districts-of-rajasthan-under-cm-scheme/story-dAzwT3UVHOrrfInup70reJ.html

Case study 5: Rural sanitation: Jharkhand's community-focused toilet building scheme[94,95]

Overview

The Government of Jharkhand has sought to establish a workable implementation strategy for creating and sustaining Nirmal Grams through community involvement. The aim is to enhance sustainable sanitation solutions to 80% of the rural households, and rural piped water supply to 45% of the rural households by the end of the 12th Five Year Plan period.

The state Department of Drinking Water and Sanitation (DDWS) has adapted Nirmal Bharat Abhiyan (NBA) recommendations to the context of the state to develop its own unique strategy for the creation of Open defecation free (ODF) villages. For this, the Panchayats have been empowered to implement NBA and the National Rural Drinking Water Programme, with every revenue village having a Village Water and Sanitation Committee (VWSC) with 12 members (comprising 50% women) that is the implementing agency. The loan for toilet construction is provided to VWSC and not to individual families. Likewise, the subsidy accruing to the community is made available to the VWSC.

This push towards removing open defecation is likely to have contributed to Jharkhand's good performance on the 'Rural drinking water' theme, with the state having the third highest score, and a ~40% fall in the water quality incidents in rural areas (Indicator 21).

Key actions

1. The government has set up VSMCs, with equal participation for women, that are able to mobilize the local communities, provide local expertise, and manage and monitor funds effectively.

---

94 Source: www.niti.gov.in/best-practices/open-defecation-free-villages-creating-and-sustaing-nirmal-grams-through-community
95 Source: Twitter, Swachh Bharat

2. Further, initial financing for toilet construction is released in the form of loans, requiring matching contributions from the community, with subsidies only being provided after achieving ODF status.

Impact

Several villages have achieved ODF status and the government has expanded the scheme across the state, with a plan to build 1.5 lakh toilets under MNREGA and the transfer of INR ~30 crores to VWSCs of Panchayats.

Further, as mentioned, this scheme has likely contributed to the ~40% reduction in water quality incidents in the state by reducing contamination of water.

Lessons for other states

- **Create strong community institutions:** The creation of representative community institutions empowered by financing control is essential to improving sanitation and water quality in rural areas.
- **Leverage synergies between multiple schemes:** The state governments should use the naturally arising synergies between schemes targeting sanitation, water quality, infrastructure construction, etc., to ensure effective utilization of resources.

Case study 6: Effective irrigation management: Rajasthan's integrated irrigation solutions[96]

Overview

The Government of Rajasthan has implemented a comprehensive package of solutions in Sanchore along the Narmada river. As a part of this, micro-irrigation technology has been made mandatory for farmers. Further, there has been a huge push towards actualization of Participatory Irrigation Management (PIM) by the formation of ~2,200 WUAs. Finally, other watershed development tasks, such as tree plantation and bio drainage have also been implemented.

The focus on irrigation solutions has resulted in a strong Participatory Irrigation Management (PIM) system in Rajasthan, with the state having the highest score on this indicator theme.

Key actions

1. The government pushed micro-irrigation adoption by ensuring that the technology was integrated with canal and drainage systems.
2. WUAs have not only been mandated in a majority of the area, but also empowered by allowing them to retain irrigation fees.

96 Source: NITI Aayog, 'Selected Best Practices in Water Management', 2017; www.wikipedia.org (image)

Impact

The Culturable Command Area (CCA) increased from 1.35 Lac hectares to 2.46 hectares with same quantity of water used due to micro-irrigation adoption. Further, the irrigation intervention improved water and farm efficiency in 233 villages. Drinking water facility has also been provided in 1,541 villages and three towns, which was not proposed earlier. The food production has also increased by 277%, based on year 2013-14. Further, this scheme has likely contributed to the ~40% reduction in water quality incidents in the state by reducing contamination of water.

The scheme has also contributed to Rajasthan's exceptional performance on the 'Participatory irrigation practices' theme, with the state achieving the highest score (~9.7 out of 10) in the country. With WUAs involved in the O&M of ~75% of command area, and allowed to retain >90% of irrigation fee, Rajasthan is on the way to achieving true participatory irrigation.

Lessons for other states

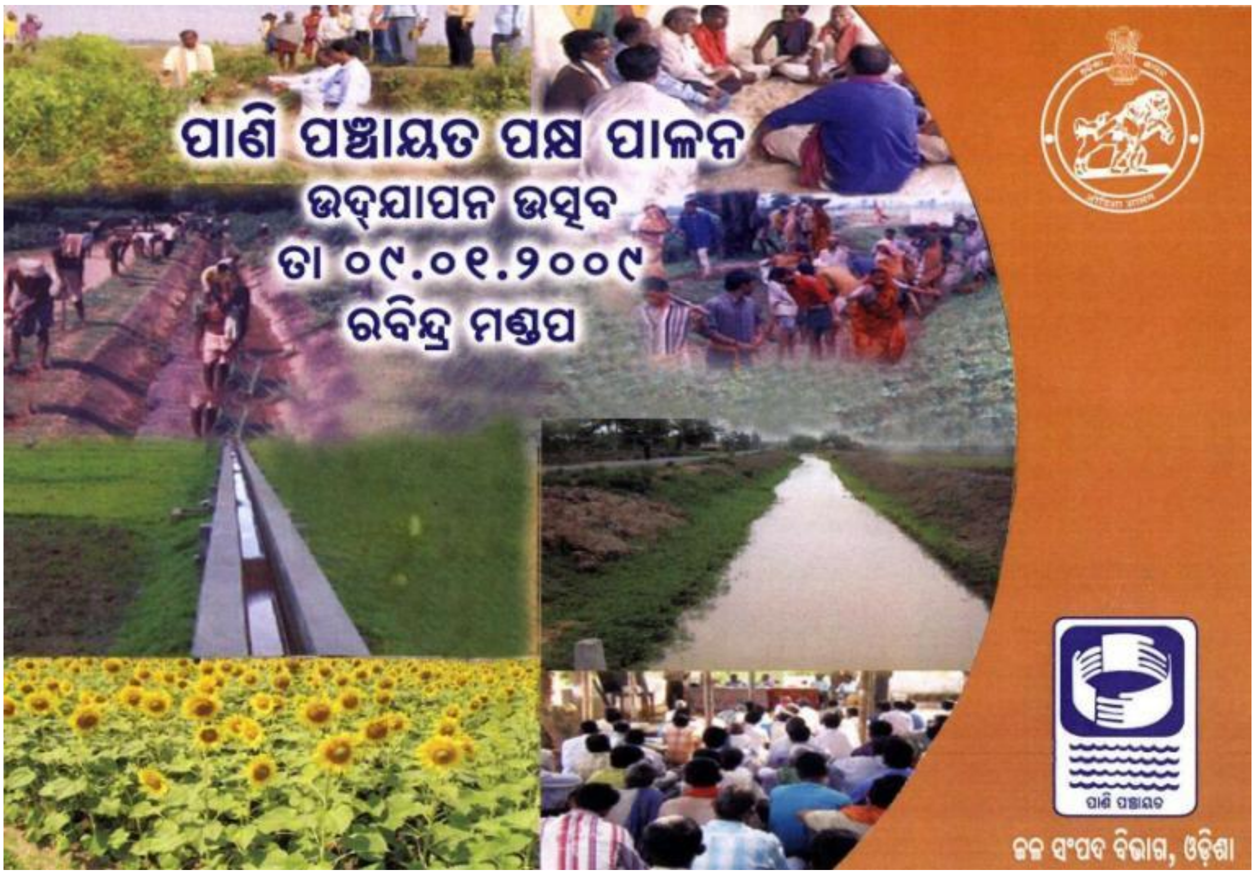
- **Support an integrated approach for irrigation technology adoption:** The uptake of technologies such as micro-irrigation can be increased by ensuring that these are integrated with the existing irrigation systems of canals and drains.
- **Empower WUAs by allowing fee retention:** To ensure true Participatory Irrigation Management (PIM), WUAs must be allowed to retain a majority of the irrigation fee collected. This will enable them to effectively undertake O&M operations independently and ensure efficient irrigation management.

Case study 7: Equitable water management: Odisha's Pani Panchayats[97]

Overview

The Government of Odisha has created a well-defined institutional framework for setting up 'Pani Panchayats', similar to WUAs, to ensure effective management of irrigation systems and equitable distribution of water among farmers.

The establishment of 'Pani Panchayats' has contributed to Odisha's high performance in the 'Participatory irrigation practices' theme, with ~70% of the command area in the state having these panchayats involved in O&M of irrigation systems.



Key actions

1. The government has established a robust regulatory framework for Participatory Irrigation Management (PIM) by passing a legislative act for 'Pani Panchayats'.
2. The efforts of these panchayats are encouraged by regular felicitation ceremonies and the dissemination of best practices through a quarterly publication.

---

97 Source: NITI Aayog, 'Selected Best Practices in Water Management', 2017; www.down orissa.gov.in

Impact

The panchayats have sought to ensure equitable water management by reserving seats for women and all socio-economic classes. They have also sought to enable knowledge exchange through publications and regular award and informational sessions.

This scheme has helped Odisha perform impressively in the 'Participatory irrigation practices' theme (achieving >60% of the possible score). The panchayats are involved in the O&M of irrigation systems in ~70% of the command area, and the next step of fee retention by these could boost equitable water management in the state even further.

Lessons for other states

- **Establish strong regulatory frameworks for interventions:** By having robust institutional structures in place, states can lay a solid foundation for effective water management.
- **Ensure dissemination of knowledge and best practices:** It is critical to ensure the widespread dissemination of best practices in water management through mediums such as publications, ceremonies, etc.

CONCLUSION AND ANNEXURES

5. CONCLUSION

The establishment of the Composite Water Management Index (CWMI) is a landmark achievement in the context of India's water management. The Index can help reinforce the principle of *'competitive and cooperative federalism'* in the country and enable innovation in the water ecosystem. The CWMI is the country's first comprehensive and integrated national dataset for water. The conceptualization, development, and operationalization of this Index has involved close collaboration between several levels of national, state, and local policymakers and government officers. This has enabled the collection and compilation of key information in a data-scarce sector, which is expected to have two major benefits. The first is that the Index can help establish a sense of competitiveness across states to improve their performance in water management, while fostering close collaboration across states and with the centre. Second, since the data will be available on a public platform, researchers, entrepreneurs, NGOs, and policymakers can use it to create innovative products, provide value-added services, and design targeted policies and interventions. Going forward, the government can support this process by potentially designing a technological platform with open APIs to help unlock innovation in the broader water ecosystem.

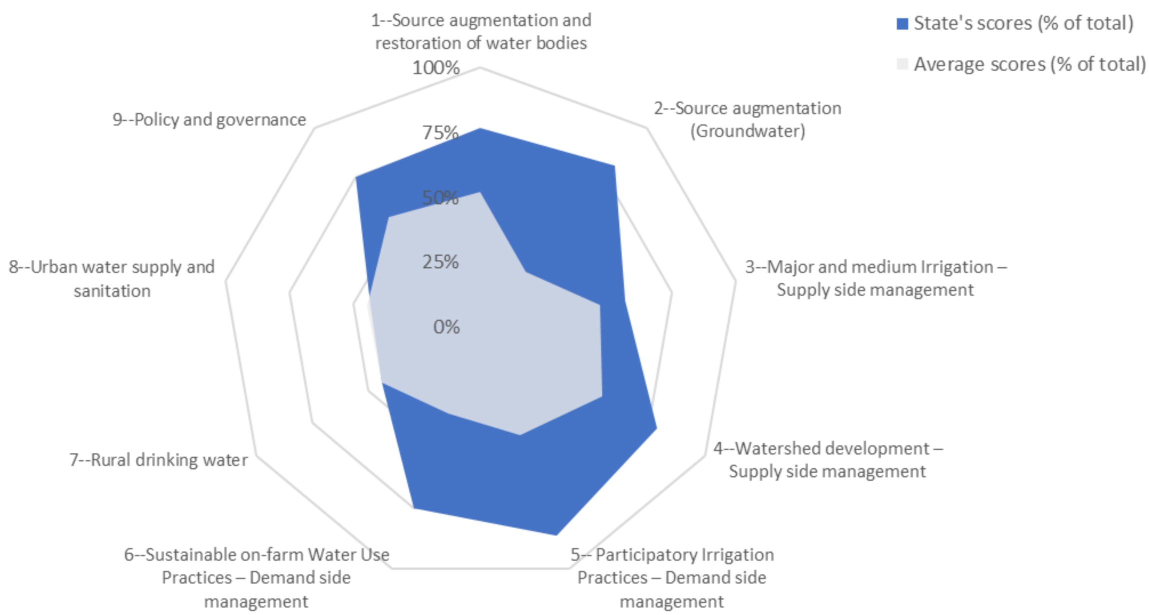
6. ANNEXURES

State profiles

This section contains an overview of CWMI performance for all states, categorized as ‘Non-Himalayan’ and ‘North-Eastern and Himalayan’.

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 105: Legend diagram for thematic performance specifying theme numbers and with sample data displays

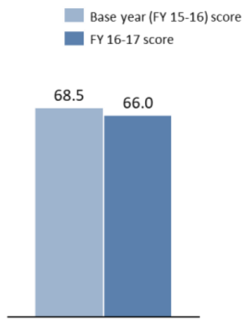


Non-Himalayan states: Andhra Pradesh

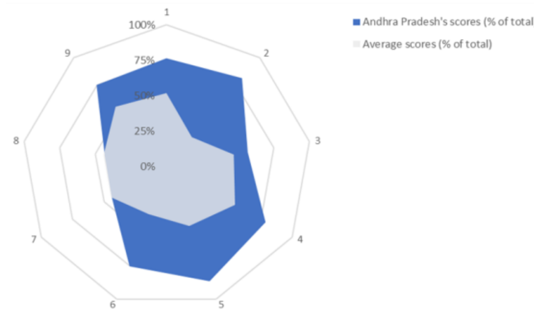
Figure 106: Overview of Andhra Pradesh's CWMI performance

STATE: ANDHRA PRADESH

State index scores
(FY 15-16, FY 16-17)



Performance on indicator themes
(FY 16-17)



KEY INDICATORS

Population: ~4.9 crore

Prop. of national rainfall[1]: ~2.4 %

Prop. of national GW[2]: ~4.9%

Proportion of national ag. output: ~3.7%

Things going well

- *Groundwater restoration:* All over-exploited wells in the state have been mapped and have recharging infra
- *Participatory irrigation:* ~70% of irrigated area is maintained by WUAs, which retain a large portion of the service fees
- *Data:* The state has set up a state of the art, online public platform for water data, including GIS mapping and daily updates

Things to improve

- *Drinking water in rural areas:* More than a third of rural habitats do not have full access to drinking water
- *Waste water treatment:* The state treats only ~26% of its urban waste water due to low installed capacity
- *Urban water pricing:* More than 50% of urban households are charged nothing for water, leading to overuse

Notes: 1. Measured as % of annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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

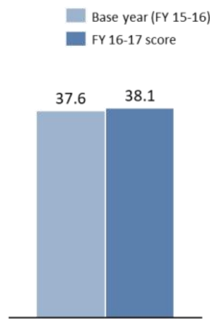
Source: Census of India, 2011; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

Non-Himalayan states: Bihar

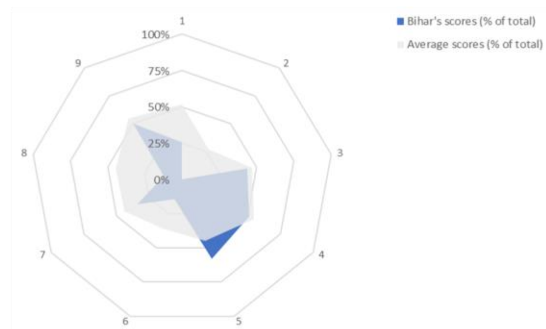
Figure 107: Overview of Bihar's CWMI performance

STATE: BIHAR

State index scores
(FY 15-16, FY 16-17)



Performance on indicator themes
(FY 16-17)



KEY INDICATORS

Population: ~10.3 crore

Prop. of national rainfall[1]: ~3.6 %

Prop. of national GW[2]: ~7.6%

Proportion of national ag. output: ~4.8%

Things going well

- *Irrigation utilization:* 90% of the irrigation potential created by the state's >100 MMI projects is utilized
- *Participatory irrigation:* Wherever WUAs exist, they are empowered by being allowed to retain 62-86% of irrigation service fees

Things to improve

- *On-farm water use:* Only 2% of area is cultivated as per agro-climatic zoning and electricity feeder segregation has not begun
- *Rural drinking water:* Only 60% of habitats are covered and quality has not improved significantly
- *Urban water supply:* Only 20% of the urban population has access—one of the lowest in India

Notes: 1. Measured as % of annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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

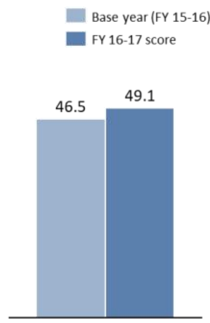
Source: Census of India, 2011; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

Non-Himalayan states: Chhattisgarh

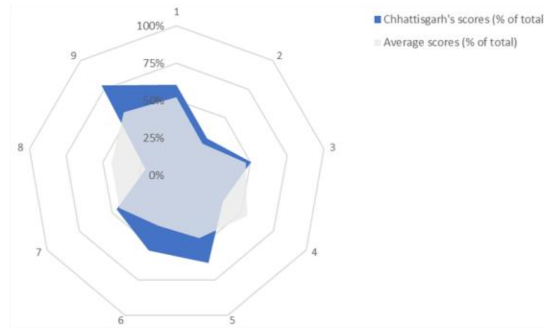
Figure 108: Overview of Chhattisgarh's CWMI performance

STATE: CHATTISGARH

State index scores
(FY 15-16, FY 16-17)



Performance on indicator themes
(FY 16-17)



KEY INDICATORS

Population: ~2.5 crore

Prop. of national rainfall[1]: ~4.1 %

Prop. of national GW[2]: ~3.2%

Proportion of national ag. output: ~1.5%

Things going well

- *Participatory irrigation:* ~73% of irrigated area in the state is maintained by WUAs
- *Policy & data:* The state has enacted legislation for conservation, charges 50% of its urban users, and has set up an integrated data centre

Things to improve

- *Groundwater restoration:* Less than 20% of the over-exploited and critical units have been mapped and have recharging infrastructure
- *Watershed development:* The state has >60% of cultivated area that is rain-fed and has constructed only ~40% of target water harvesting structures
- *Waste water treatment:* The state currently has capacity to treat only 3% of its urban waste water

Notes: 1. Measured as % of annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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

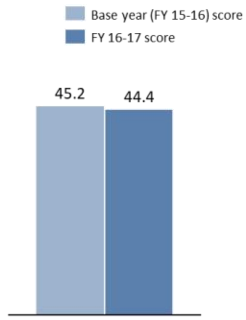
Source: Census of India, 2011; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

Non-Himalayan states: Goa

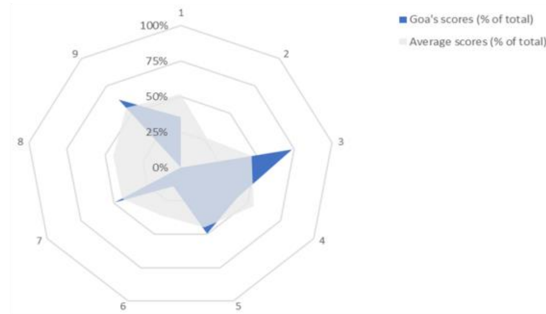
Figure 109: Overview of Goa's CWMI performance

STATE: GOA

State index scores
(FY 15-16, FY 16-17)



Performance on indicator themes
(FY 16-17)



KEY INDICATORS

Population: ~0.1 crore

Prop. of national rainfall[1]: ~9.5 %

Prop. of national GW[2]: ~0.04%

Proportion of national ag. output: <1%

Things going well

- *Rural drinking water:* The state has fully covered all of its rural habitations
- *Policy & data:* The state has enacted legislations for water conservation and harvesting and established a regularly-updated integrated data centre

Things to improve

- *On-farm water use:* The state has not segregated power feeders for agriculture and has a negligible proportion of cultivated land under micro-irrigation
- *Irrigation access:* ~70% of cultivated area is rain-fed with only ~33% of irrigation potential being restored
- *Urban water:* The state must provide data on the critical themes of urban water supply and waste water treatment

Notes: 1. Measured as % of annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

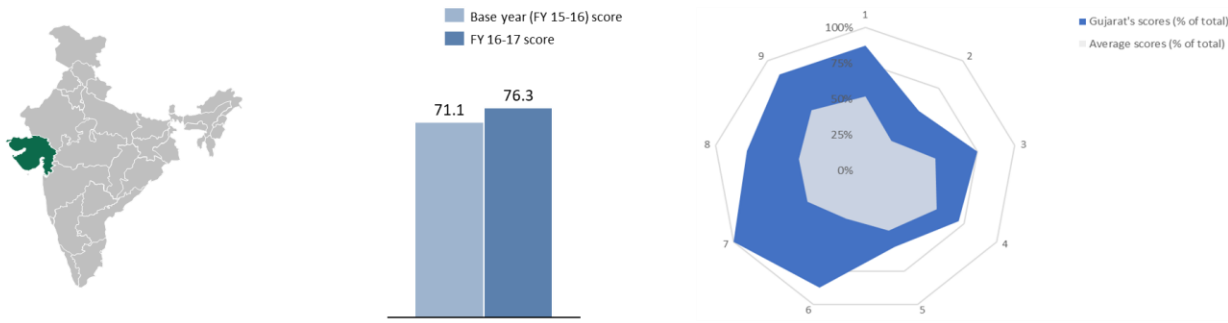
Non-Himalayan states: Gujarat

Figure 110: Overview of Gujarat's CWMI performance

STATE: GUJARAT

State index scores
(FY 15-16, FY 16-17)

Performance on indicator themes
(FY 16-17)



KEY INDICATORS

Population: ~6 crore

Prop. of national rainfall[1]: ~1.9 %

Prop. of national GW[2]: ~5.3%

Proportion of national ag. output: ~4.5%

Things going well

- *On-farm use:* The state has segregated 100% of its power feeders and, at 35%, has the highest proportion of area under micro-irrigation in India
- *Rural drinking water:* Gujarat has covered 100% of its rural habitations and sharply reduced quality issues
- *Urban water:* 100% of the urban population has access, with 87% being charged for water supply

Things to improve

- *Groundwater regulation:* Establishing a regulatory framework for groundwater can help the state boost water levels in more wells than the present achievement of a rise in 33% of wells
- *Participatory irrigation:* WUAs' role in O&M is currently limited to only 15% of command area

Notes: 1. Measured as % of annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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

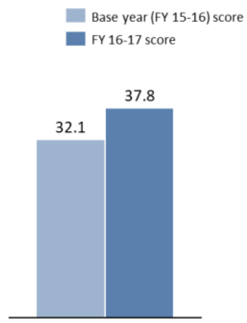
Source: Census of India, 2011; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

Non-Himalayan states: Haryana

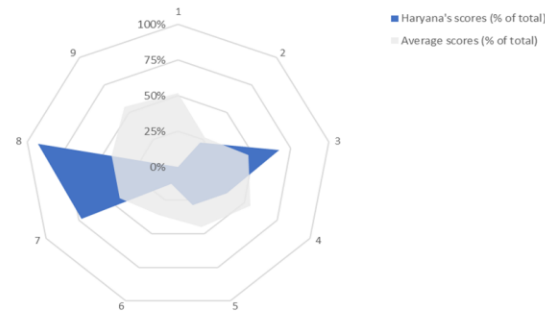
Figure 111: Overview of Haryana's CWMI performance

STATE: HARYANA

State index scores
(FY 15-16, FY 16-17)



Performance on indicator themes
(FY 16-17)



KEY INDICATORS

Population: ~2.5 crore

Prop. of national rainfall[1]: ~1.2 %

Prop. of national GW[2]: ~2.7%

Proportion of national ag. output: ~4.3%

Things going well

- *Irrigation maintenance:* The state has the highest per unit expenditure on irrigation O&M and has lined almost all of its suitable canals
- *Drinking water access:* Haryana provides water to >90% of its rural habitations and urban population
- *Waste water treatment:* Haryana's treatment of 95% of its urban waste water is the highest in the country

Things to improve

- *Groundwater restoration:* None of the identified wells in the state have improved, possible due to a lack of recharge infrastructure
- *Water harvesting:* Haryana has constructed only 40% of its target of water harvesting structures
- *On-farm use:* The state needs to provide information on agricultural indicators, especially given its position as a large output producer

Notes: 1. Measured as % of annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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

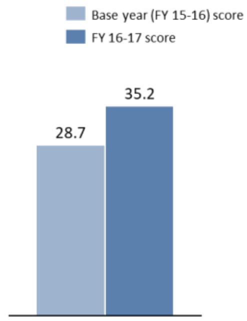
Source: Census of India, 2011; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

Non-Himalayan states: Jharkhand

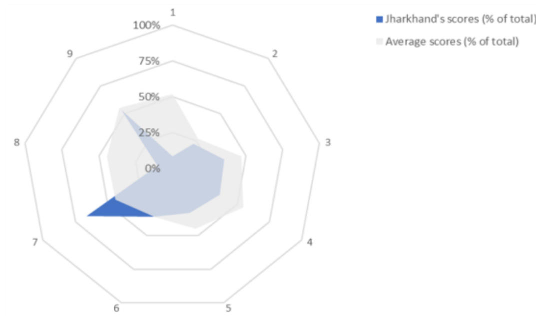
Figure 112: Overview of Jharkhand's CWMI performance

STATE: JHARKHAND

State index scores
(FY 15-16, FY 16-17)



Performance on indicator themes
(FY 16-17)



KEY INDICATORS

Population: ~3.3 crore

Prop. of national rainfall[1]: ~3.9 %

Prop. of national GW[2]: ~1.6%

Proportion of national ag. output: ~1.0%

Things going well

- *Rural drinking water:* Jharkhand has fully covered almost all of its rural habitations and achieved a ~40% decline in water quality incidents

Things to improve

- *Surface water restoration:* The state has restored only ~8% of the irrigation potential of identified bodies
- *On-farm use:* The state has not segregated power feeders and has ~2% of its area under micro-irrigation
- *Waste water treatment:* Jharkhand is the only 'Non-Himalayan state' with zero installed capacity to treat waste water

Notes: 1. Measured as % of annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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

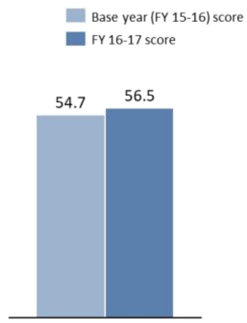
Source: Census of India, 2011; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

Non-Himalayan states: Karnataka

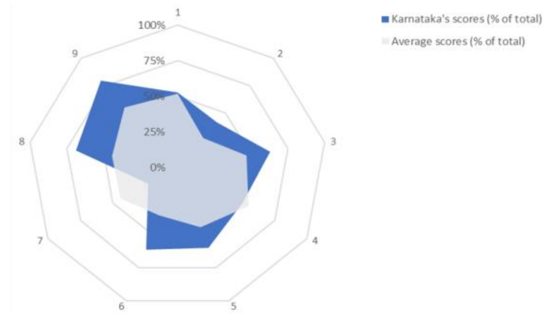
Figure 113: Overview of Karnataka's CWMI performance

STATE: KARNATAKA

State index scores
(FY 15-16, FY 16-17)



Performance on indicator themes
(FY 16-17)



KEY INDICATORS

Population: ~6.1 crore

Prop. of national rainfall[1]: ~2.6 %

Prop. of national GW[2]: ~4.0%

Proportion of national ag. output: ~6.8%

Things going well

- *Irrigation utilization:* Karnataka utilizes ~94% of the potential created by its 107 MMI projects
- *On-farm use:* The state has >90% of its cultivated area as per agro-climatic zoning and the second highest micro-irrigation coverage in the country
- *Urban water:* The state Supplies water to ~86% of the urban population, charges ~60% of them, and treats ~60% of its urban waste water

Things to improve

- *Groundwater rejuvenation:* Only ~6% of over-exploited and critical wells have risen in level, possibly due to <20% being covered by recharge infrastructure
- *Drinking water in rural areas:* More than two-thirds of rural areas do not have full access to drinking water

Notes: 1. Measured as % of annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

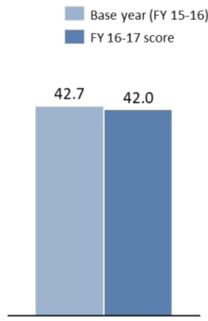
Non-Himalayan states: Kerala

Figure 114: Overview of Kerala's CWMI performance

STATE: KERALA

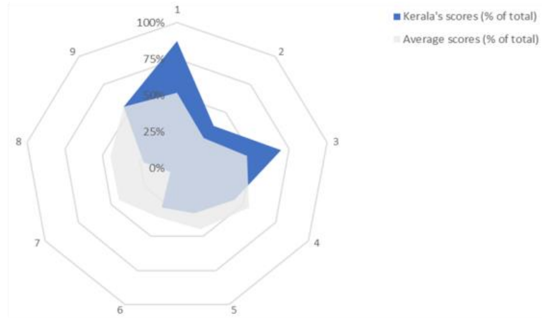
State index scores

(FY 15-16, FY 16-17)



Performance on indicator themes

(FY 16-17)



KEY INDICATORS

Population: ~3.3 crore

Prop. of national rainfall[1]: ~5.8 %

Prop. of national GW[2]: ~1.5%

Proportion of national ag. output: ~0.1%

Things going well

- *Surface water restoration:* The state has restored ~82% of the irrigation potential of identified bodies
- *Irrigation utilization:* Kerala has preformed better than the average on irrigation utilization (IPC-IPU gap), expenditure on maintenance, and canal lining

Things to improve

- *Participatory irrigation:* WUAs are not involved in O&M in any of the cultivated areas
- *On-farm use:* The state has not segregated power feeders and has negligible micro-irrigation coverage
- *Urban water:* Only ~50% of urban population has access, and <10% of waste water is treated

Notes: 1. Measured as % of annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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

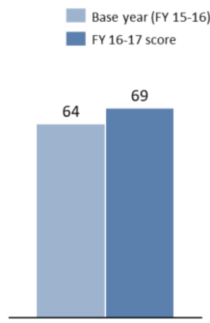
Source: Census of India, 2011; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

Non-Himalayan states: Madhya Pradesh

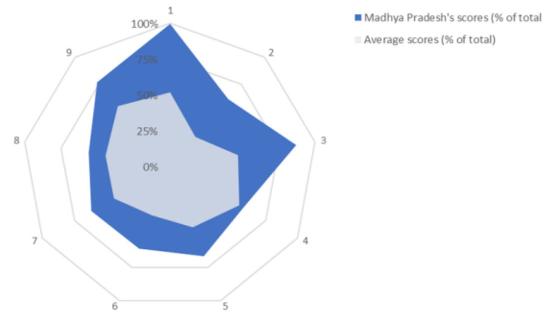
Figure 115: Overview of Madhya Pradesh's CWMI performance

STATE: MADHYA PRADESH

State index scores
(FY 15-16, FY 16-17)



Performance on indicator themes
(FY 16-17)



KEY INDICATORS

Population: ~7.2 crore

Prop. of national rainfall[1]: ~3.7 %

Prop. of national GW[2]: ~9.1%

Proportion of national ag. output: ~8.8%

Things going well

- *Surface water restoration:* The state has restored ~94% of the irrigation potential of identified bodies
- *Irrigation utilization:* Madhya Pradesh utilizes ~96% of its irrigation potential and has assessed utilization gaps across all of its 130 MMI projects
- *Participatory irrigation:* ~82% of irrigated area is maintained by WUAs—the highest in the country

Things to improve

- *Groundwater rejuvenation:* Less than 20% of identified wells have been mapped for recharging
- *Waste water treatment:* The state treats only ~34% of its urban waste water due to low installed capacity

Notes: 1. Measured as % of annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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

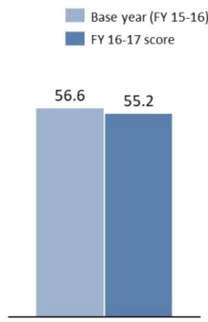
Source: Census of India, 2011; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

Non-Himalayan states: Maharashtra

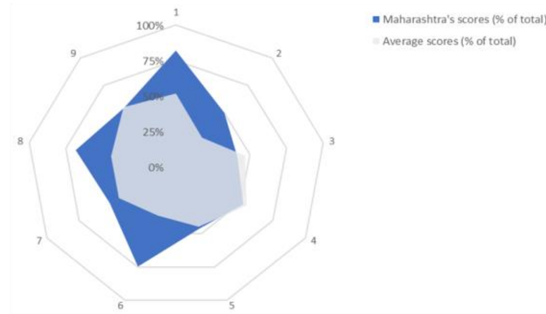
Figure 116: Overview of Maharashtra's CWMI performance

STATE: MAHARASHTRA

State index scores
(FY 15-16, FY 16-17)



Performance on indicator themes
(FY 16-17)



KEY INDICATORS

Population: ~11.2 crore

Prop. of national rainfall[1]: ~4.0 %

Prop. of national GW[2]: ~8.4%

Proportion of national ag. output: ~10.3%

Things going well

- *Surface water restoration:* The state has restored ~80% of the irrigation potential of identified bodies
- *On-farm use:* The state has segregated ~60% of power feeders and has one of the highest micro-irrigation coverage rates in India (at 32-47%)
- *Urban water:* The state charges ~60% of households for water supply and treats ~60% of its waste water

Things to improve

- *Irrigation utilization and O&M:* The state has the highest MMI projects in the country (391) but has assessed only ~40% for utilization gaps and has one of the lowest O&M expenditures
- *Participatory irrigation:* Maharashtra involves WUAs in the O&M of only ~26% of irrigation assets, and they are allowed to retain only 6% of irrigation fees

Notes: 1. Measured as % of annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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

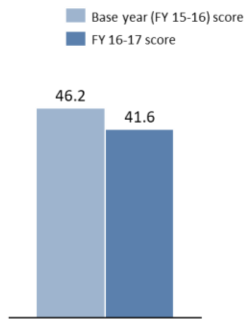
Source: Census of India, 2011; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

Non-Himalayan states: Odisha

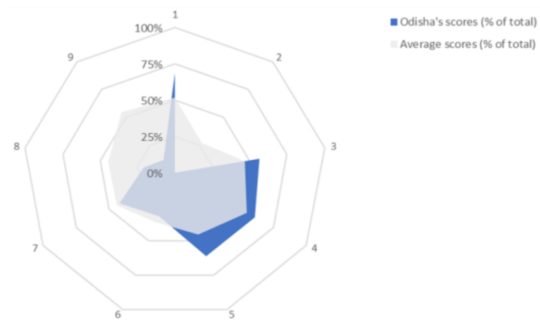
Figure 117: Overview of Odisha's CWMI performance

STATE: ODISHA

State index scores
(FY 15-16, FY 16-17)



Performance on indicator themes
(FY 16-17)



KEY INDICATORS

Population: ~4.2 crore

Prop. of national rainfall[1]: ~3.9 %

Prop. of national GW[2]: ~4.5%

Proportion of national ag. output: ~1.5%

Things going well

- *Irrigation utilization and O&M:* Odisha utilizes >95% of its irrigation potential and has one of the highest O&M expenditures in the country
- *Watershed development:* The state has constructed >80% of its targeted water harvesting structures, two-thirds of which have been geo-tagged

Things to improve

- *Groundwater rejuvenation:* The state has not constructed any recharge infrastructure
- *Waste water treatment:* The state has installed capacity to treat <10% of its urban waste water
- *Policy & data:* Odisha has not enacted any conservation legislation and has not set up an integrated water data centre

Notes: 1. Measured as % of annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

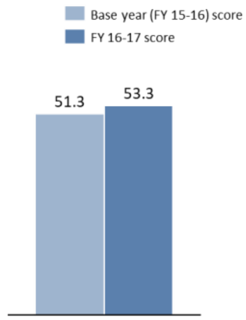
Non-Himalayan states: Punjab

Figure 118: Overview of Punjab's CWMI performance

STATE: PUNJAB

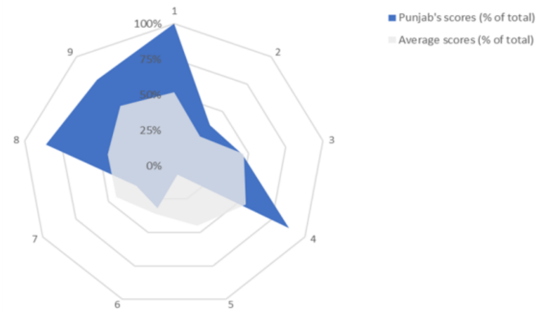
State index scores

(FY 15-16, FY 16-17)



Performance on indicator themes

(FY 16-17)



KEY INDICATORS

Population: ~2.7 crore

Prop. of national rainfall[1]: ~1.4 %

Prop. of national GW[2]: ~6.2%

Proportion of national ag. output: ~6.4%

Things going well

- *Irrigation access:* Only ~8% of the state's cultivated area is rain-fed, and the state has restored ~94% of identified irrigation potential, enabling the production of ~6.4% of the national agricultural output
- *Urban water:* The state provides water to ~94% of its urban population and is the only state to have installed capacity for treating 100% of its waste water

Things to improve

- *Groundwater rejuvenation:* Only 4% of over-exploited and critical wells have improved over the last year
- *Participatory irrigation:* Punjab is one of the few states to not have established a regulatory framework for involving WUAs in O&M for irrigation
- *Rural drinking water:* Access is limited to 67% of rural habitations and quality has not improved

Notes: 1. Measured as % of annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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

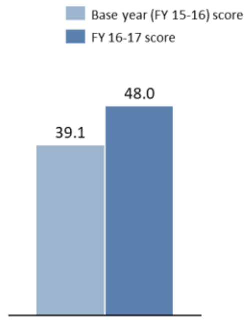
Source: Census of India, 2011; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

Non-Himalayan states: Rajasthan

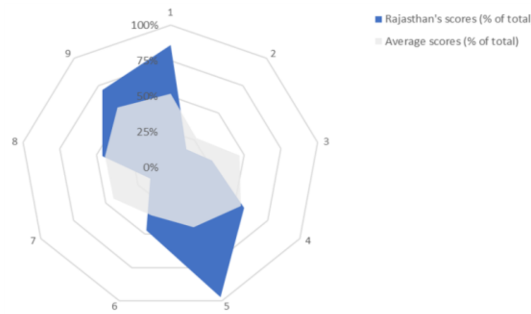
Figure 119: Overview of Rajasthan's CWMI performance

STATE: RAJASTHAN

State index scores
(FY 15-16, FY 16-17)



Performance on indicator themes
(FY 16-17)



KEY INDICATORS

Population: ~6.8 crore

Prop. of national rainfall[1]: ~1.8 %

Prop. of national GW[2]: ~3.0%

Proportion of national ag. output: ~5.6%

Things going well

- *Surface water restoration:* The state has restored ~80% of the irrigation potential of identified bodies, largely through community-managed ponds and tanks
- *Participatory irrigation:* ~75% of irrigated area is maintained by WUAs, which retain ~95% of fees
- *Policy & data:* The state has enacted conservation legislation, charges ~73% of urban households for water, and has set up an integrated data centre

Things to improve

- *Irrigation utilization and O&M:* The state has assessed only 14% of its 107 MMI projects for utilization gaps and has the lowest O&M expenditure in India
- *Rural drinking water:* At 44%, access rates for rural habitations are one of the lowest in the country, and there has been no improvement in water quality

Notes: 1. Measured as % of annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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

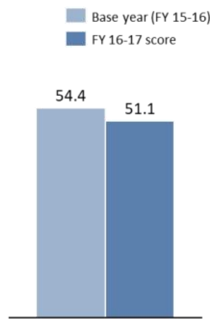
Source: Census of India, 2011; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

Non-Himalayan states: Tamil Nadu

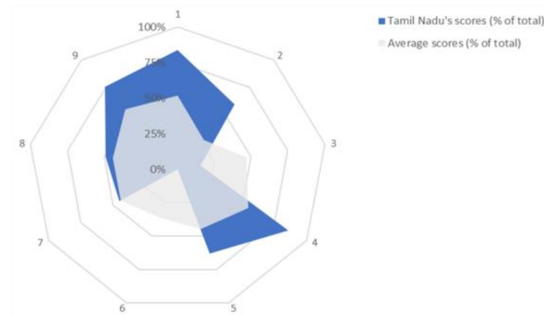
Figure 120: Overview of Tamil Nadu's CWMI performance

STATE: TAMIL NADU

State index scores
(FY 15-16, FY 16-17)



Performance on indicator themes
(FY 16-17)



KEY INDICATORS

Population: ~7.2 crore

Prop. of national rainfall[1]: ~1.7 %

Prop. of national GW[2]: ~5.0%

Proportion of national ag. output: ~5.6%

Things going well

- *Surface water restoration:* The state has restored ~80% of the irrigation potential of identified bodies
- *Watershed development:* The state has constructed 100% of its targeted water harvesting structures, all of which have been geo-tagged
- *Policy & data:* The state has enacted conservation legislation, charges ~50% of urban households for water, and has set up an integrated data centre

Things to improve

- *Irrigation utilization and O&M:* Tamil Nadu utilizes only ~36% of its irrigation potential and has lined <10% of identified canals
- *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, and has negligible micro-irrigation coverage

Notes: 1. Measured as % of annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

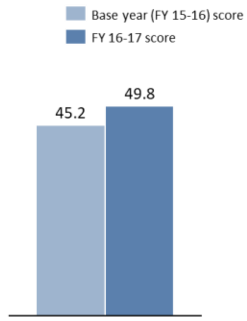
Non-Himalayan states: Telangana

Figure 121: Overview of Telangana's CWMI performance

STATE: TELANGANA

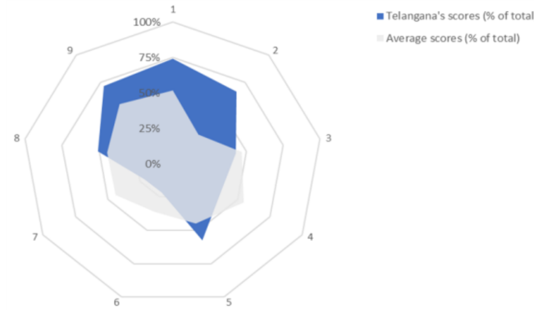
State index scores

(FY 15-16, FY 16-17)



Performance on indicator themes

(FY 16-17)



KEY INDICATORS

Population: ~3.5 crore

Prop. of national rainfall[1]: ~3.2 %

Prop. of national GW[2]: ~3.6%

Proportion of national ag. output: ~1.9%

Things going well

- *Surface and groundwater restoration:* The state has restored ~70% of the irrigation potential of identified bodies and 90% of critical wells have improved
- *Urban water:* ~80% of urban households have access, with 75% of them being charged for the supply

Things to improve

- *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, and has negligible micro-irrigation coverage
- *Rural drinking water:* Only 55% of rural habitations have been fully covered, and there has been no improvement in water quality

Notes: 1. Measured as % of annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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

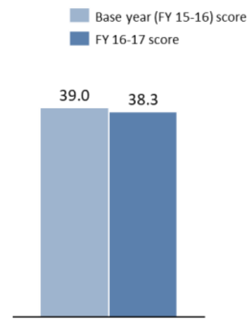
Source: Census of India, 2011; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

Non-Himalayan states: Uttar Pradesh

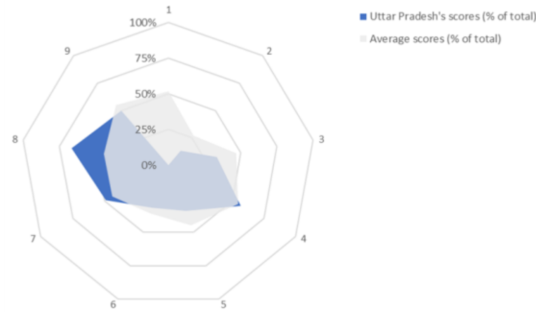
Figure 122: Overview of Uttar Pradesh's CWMI performance

STATE: UTTAR PRADESH

State index scores
(FY 15-16, FY 16-17)



Performance on indicator themes
(FY 16-17)



KEY INDICATORS

Population: ~20.7 crore

Prop. of national rainfall[1]: ~2.5 %

Prop. of national GW[2]: ~19.1%

Proportion of national ag. output: ~23.6%

Things going well

- *Irrigation access:* Only ~13% of the state's cultivated area is rain-fed, enabling the production of a staggering ~24% of the national agricultural output
- *Rural drinking water:* The state has fully covered all of its rural habitations—a massive achievement given its huge population
- *Urban water:* UP provides water to ~92% of its urban population and treats ~50% of its waste water

Things to improve

- *Groundwater rejuvenation:* The state has mapped only ~30% of over-exploited and critical wells, constructed no recharge infrastructure, and established no regulations for management—this is critical given that the state has ~20% 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 annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

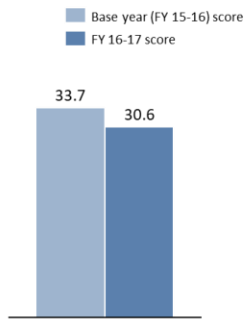
North-Eastern and Himalayan states: Assam

Figure 123: Overview of Assam's CWMI performance

STATE: ASSAM

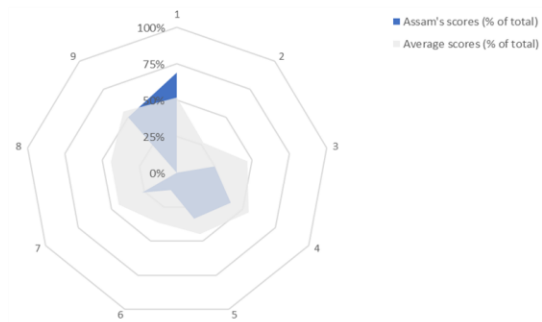
State index scores

(FY 15-16, FY 16-17)



Performance on indicator themes

(FY 16-17)



KEY INDICATORS

Population: ~3.1 crore

Prop. of national rainfall[1]: ~6.7 %

Prop. of national GW[2]: ~7.7%

Proportion of national ag. output: ~1.5%

Things going well

- *Surface water restoration:* The state has restored ~60% of the irrigation potential of identified bodies

Things to improve

- *On-farm use:* The state has no agro-climatic zoning based cultivation, no feeder segregation, and negligible micro-irrigation coverage
- *Rural drinking water:* Only ~60% of rural habitations have been fully covered, and there has been no improvement in water quality
- *Urban water:* Only ~20% of urban population has access and no waste water is treated

Notes: 1. Measured as % of annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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

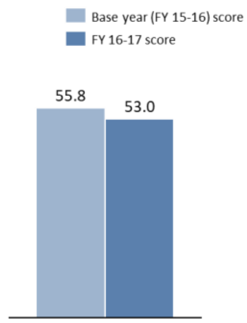
Source: Census of India, 2011; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

North-Eastern and Himalayan states: Himachal Pradesh

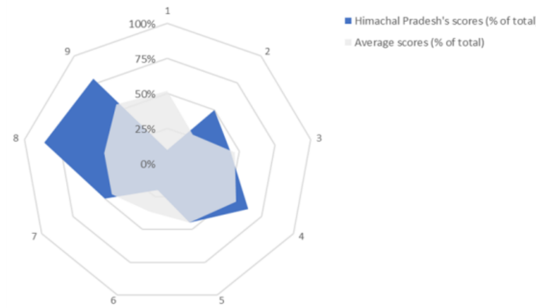
Figure 124: Overview of Himachal Pradesh's CWMI performance

STATE: HIMACHAL PRADESH

State index scores
(FY 15-16, FY 16-17)



Performance on indicator themes
(FY 16-17)



KEY INDICATORS

Population: ~0.7 crore

Prop. of national rainfall[1]: ~2.9 %

Prop. of national GW[2]: ~0.1%

Proportion of national ag. output: ~0.4%

Things going well

- *Rural drinking water:* The state has fully covered ~98% of habitations—one of the highest figures in India
- *Urban water:* HP provides water to 100% of its urban population and has installed capacity to treat ~90% of its waste water
- *Policy & data:* The state has enacted conservation legislation, charges ~60% of urban households for water, and has set up an integrated data centre

Things to improve

- *Surface water restoration:* The state has restored only ~8% of the irrigation potential of identified bodies
- *Participatory irrigation:* WUAs are involved in O&M in only 15% of the command area and retain no fees
- *On-farm use:* The state has negligible agro-climatic zoning based cultivation and micro-irrigation coverage, and has not segregated power feeders

Notes: 1. Measured as % of annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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

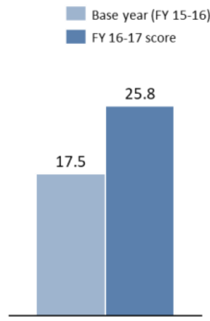
Source: Census of India, 2011; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

North-Eastern and Himalayan states: Meghalaya

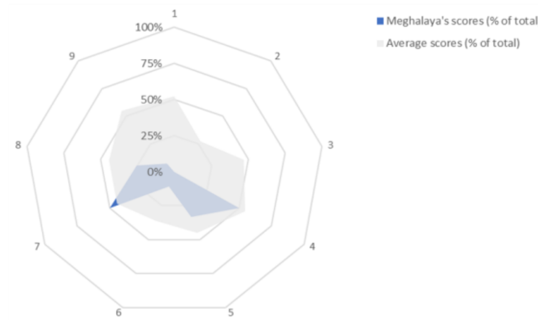
Figure 125: Overview of Meghalaya's CWMI performance

STATE: MEGHALAYA

State index scores
(FY 15-16, FY 16-17)



Performance on indicator themes
(FY 16-17)



KEY INDICATORS

Population: ~0.3 crore

Prop. of national rainfall[1]: ~9.0 %

Prop. of national GW[2]: ~0.8%

Proportion of national ag. output: <1%

Things going well

- *Rural water quality:* While access remains low, the state has achieved a 100% reduction in water quality incidents in rural areas
- *Watershed development:* Meghalaya has constructed ~60% of its targeted water harvesting structures and has geo-tagged half of these

Things to improve

- *Rural drinking water access:* Only ~17% of rural habitations have been fully covered by water supplies
- *Waste water treatment:* The state has not installed any capacity to treat its waste water
- *Policy & data:* The state has neither enacted any conservation legislation nor set up an integrated data centre

Notes: 1. Measured as % of annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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

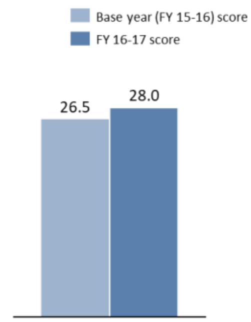
Source: Census of India, 2011; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

North-Eastern and Himalayan states: Nagaland

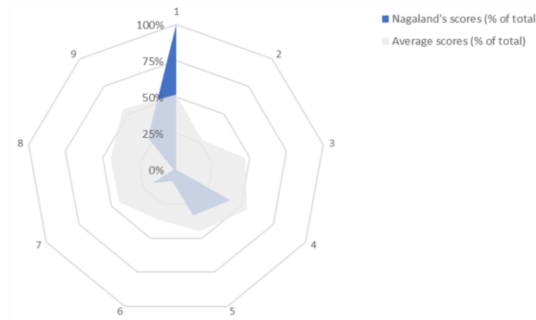
Figure 126: Overview of Nagaland's CWMI performance

STATE: NAGALAND

State index scores
(FY 15-16, FY 16-17)



Performance on indicator themes
(FY 16-17)



KEY INDICATORS

Population: ~0.2 crore

Prop. of national rainfall[1]: ~4.2 %

Prop. of national GW[2]: ~0.5%

Proportion of national ag. output: <1%

Things going well

- *Surface water restoration:* The state has restored ~85% of the irrigation potential of identified bodies—the third highest achievement across all states
- *Watershed development:* Nagaland has constructed ~60% of its targeted water harvesting structures and has geo-tagged half of these

Things to improve

- *Rural drinking water:* Only ~46% of rural habitations have been fully covered, and there has been no improvement in water quality
- *Urban water:* Only 23% of the urban population is covered by drinking water supply
- *Policy & data:* The state has not enacted legislation for the conservation of water bodies and has not set up an integrated data centre

Notes: 1. Measured as % of annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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

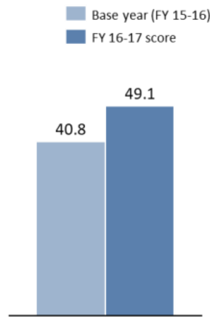
Source: Census of India, 2011; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

North-Eastern and Himalayan states: Sikkim

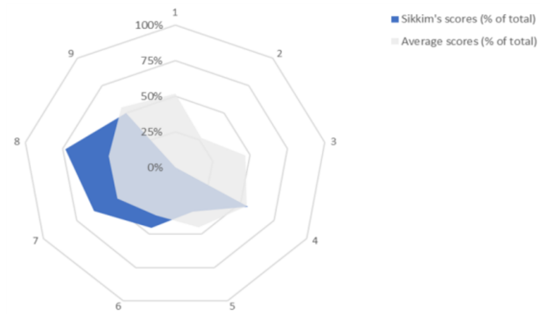
Figure 127: Overview of Sikkim's CWMI performance

STATE: SIKKIM

State index scores
(FY 15-16, FY 16-17)



Performance on indicator themes
(FY 16-17)



KEY INDICATORS

Population: ~0.06 crore

Prop. of national rainfall[1]: ~8.6 %

Prop. of national GW[2]: NA

Proportion of national ag. output: <1%

Things going well

- *Watershed development:* Sikkim has constructed ~80% of its targeted water harvesting structures and has geo-tagged ~90% of these
- *Rural water quality:* While access remains low, there has been a 100% reduction in water quality incidents
- *Waste water treatment:* The state treats ~80% of its urban waste water—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 has not established an integrated water data centre

Notes: 1. Measured as % of annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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

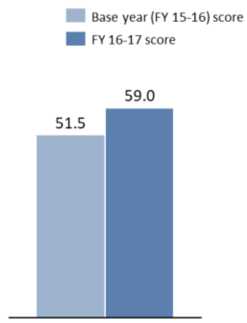
Source: Census of India, 2011; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

North-Eastern and Himalayan states: Tripura

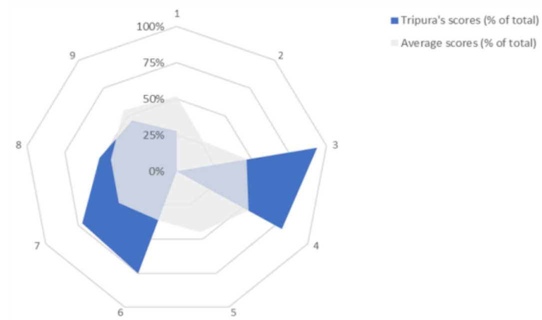
Figure 128: Overview of Tripura's CWMI performance

STATE: TRIPURA

State index scores
(FY 15-16, FY 16-17)



Performance on indicator themes
(FY 16-17)



KEY INDICATORS

Population: ~0.4 crore

Prop. of national rainfall[1]: ~7.4 %

Prop. of national GW[2]: ~0.6%

Proportion of national ag. output: <1%

Things going well

- *Irrigation utilization and O&M:* Tripura utilizes ~65% of its irrigation potential and has the third-highest per unit O&M expenditure nationally
- *Watershed development:* The state has constructed ~90% of its targeted water harvesting structures and has geo-tagged ~96% of these
- *Rural water quality:* While access remains low, there has been a 100% reduction in water quality incidents

Things to improve

- *Surface water restoration:* The state has restored only ~24% of the irrigation potential of identified bodies
- *Participatory irrigation:* The state has not established a framework for involving WUAs in O&M
- *Waste water treatment*: Tripura has installed capacity to treat only one-fourth of its waste water

Notes: 1. Measured as % of annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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

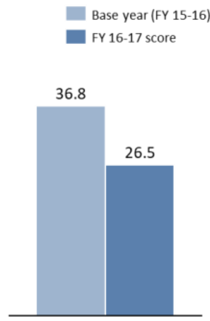
Source: Census of India, 2011; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

North-Eastern and Himalayan states: Uttarakhand

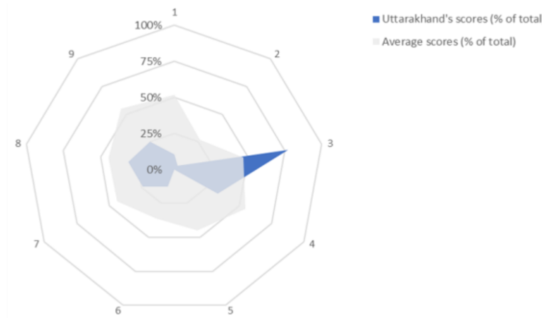
Figure 129: Overview of Uttarakhand's CWMI performance

STATE: UTTARAKHAND

State index scores
(FY 15-16, FY 16-17)



Performance on indicator themes
(FY 16-17)



KEY INDICATORS

Population: ~1 crore

Prop. of national rainfall[1]: ~4.1 %

Prop. of national GW[2]: ~0.5%

Proportion of national ag. output: ~1.0%

Things going well

- *Irrigation utilization and O&M:* Uttarakhand utilizes ~71% of its irrigation potential, has the sixth-highest per unit O&M expenditure nationally, and has lined ~70% of its suitable canals
- *Rural water quality:* While access remains low, there has been a 100% reduction in water quality incidents
- *Urban water pricing:* ~90% of urban households are charged for their water supply

Things to improve

- *Surface and groundwater restoration:* The state has restored irrigation area of <10% of water bodies, and has not mapped or created infrastructure for wells
- *Rural and urban access:* Only about ~60% of rural habitations and urban dwellers are fully covered by water supply systems
- *Data:* The state has not established an integrated water data centre

Notes: 1. Measured as % of annual rainfall for 2016 2. Measured as % of annual replenishable groundwater resources (2013) 3. 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; IMD, 'Rainfall Statistics of India', 2016; CGWB, 'Groundwater Year Book', 2016-17; Statistical Year Book India, 2017

DATA VALIDATION	COMMENTARY, NARRATION, AND ANALYSIS	PORTAL DEVELOPMENT
IPE GLOBAL	Dalberg	Silver Touch TECHNOLOGIES