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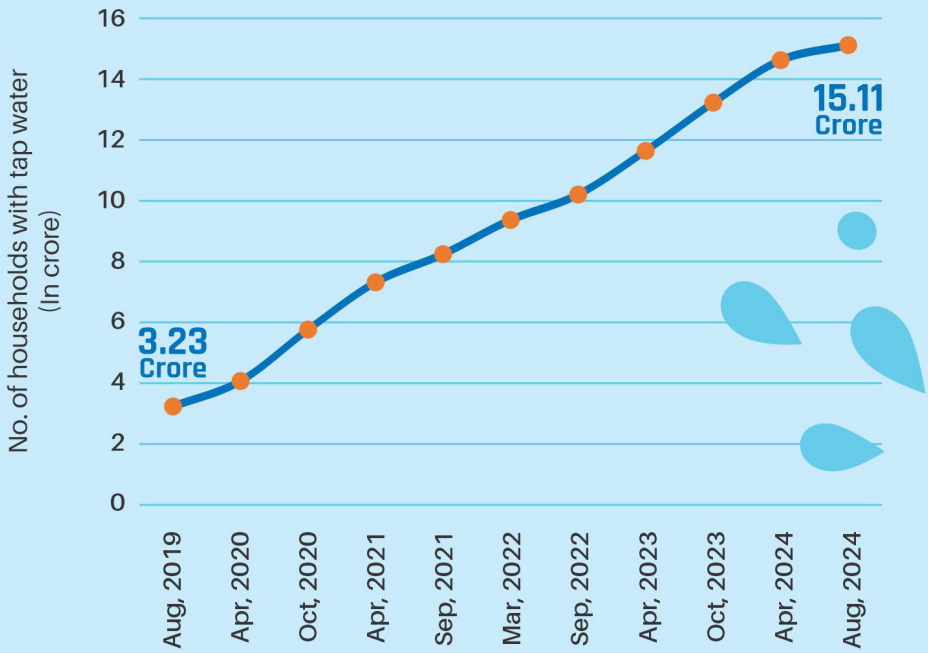
Jal Jeevan Mission - Har Ghar Jal

A Study of Access to Clean Tap Water to Every Rural Home in India



With an Introduction by **Bharat Lal**

September, 2024

Har Ghar Jal
Jal Jeevan Mission

Jal Jeevan Mission - Har Ghar Jal

A Study of Access to Clean Tap Water to Every Rural Home in India

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Voice for a sustainable planet

UNOPS

15 August, 2019, India's 73rd Independence Day

I declare from the Red Fort today that in the days to come, we will take forward the Jal Jeevan Mission. The central and the state governments will jointly work on this Jal Jeevan Mission. We have promised to spend more than ₹3.50 Lakh Crore on this mission in the coming years.

Shri Narendra Modi

Hon'ble Prime Minister of India

15 August, 2024, India's 78th Independence Day

Only 3 crore rural households had access to tap water. Over the past five years, the mission has made substantial progress, extending 'Nal se Jal' to an additional 12 crore households. As a result, approximately 15 crore beneficiaries now enjoy the benefits of tap water under this ambitious programme.

Shri Narendra Modi

Hon'ble Prime Minister of India

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All photographs, figures, graphs, tables and maps are courtesy Ministry of Jal Shakti unless specified.

Front cover image: Data from JJM dashboard (2019-2024) representing the increase in the number of households in rural India with functional tap water connections.

Back cover image: Women from a village in Rajasthan use Field Testing Kits to test the quality of water.

Suggested citation: Sankala Foundation. (September, 2024) Jal Jeevan Mission - Har Ghar Jal: A Study of Access to Clean Tap Water to Every Rural Home in India. Sankala Foundation, New Delhi

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Published by Sankala Foundation

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सत्यमेव जयते

जल शक्ति मंत्री
भारत सरकार
Minister of Jal Shakti
Government of India

11th September 2024

MESSAGE

Jal Jeevan Mission – Har Ghar Jal, announced by the Prime Minister Shri Narendra Modi on 15th August 2019, embodies our government's commitment to improve 'ease of living' to its citizens by ensuring that every rural household has access to piped drinking water supply. The Mission was launched on 25th December 2019 on Good Governance Day, which also happens to be the birthday of Late Shri Atal Bihari Vajpayee, former Prime Minister of India.

Since its inception, this mission has had a transformative impact on about 100 crore people living in rural areas of the country. Now, out of 19.33 crore rural households, about 15.14 crore households have Functional Household Tap Connections (FHTCs), and around 9.28 lakh schools, 9.64 lakh Anganwadi Centres have a stable supply of potable tap water.

Water is a basic human right, and through this mission, the government attempted to address inequalities and ensure that 'no one is left behind'. The success of this mission lies in the collective efforts of the government, communities, and all stakeholders.

This comprehensive study demonstrates India's commitment to the principles of equity, dignity, and empowerment. It showcases the role of piped water in advancing gender equality, health, and economic progress. I congratulate Sankala Foundation for documenting the journey of this critical initiative to provide clean, affordable, and reliable piped water to thousands of rural households.

Jal Jeevan Mission is an example of Prime Minister Shri Narendra Modi's vision to take India to become Viksit Bharat i.e. a developed India by 2047, when we will be celebrating 100 years of independence. This book wonderfully explains how Jal Jeevan Mission can serve as a model for ensuring clean tap water to every home, empowering women and local communities to manage their water supply systems and improve the quality of life and dignity of every citizen especially women and children of the country. I'm sure that book will be useful for not only people involved in water, sanitation, hygiene and public health sector but policy makers and all development professionals.

(C R PAATIL)

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विनी महाजन
VINI MAHAJAN
सचिव
Secretary

स्वच्छ भारत
एक कदम स्वच्छता की ओर

सत्यमेव जयते

भारत सरकार
जल शक्ति मंत्रालय
पेयजल एवं स्वच्छता विभाग
चौथा तल, पं दीनदयाल अंत्योदय भवन
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12th September, 2024

Message

Jal Jeevan Mission represents a significant leap forward in our quest to ensure equitable access to safe drinking water across India. At the start of this Mission in 2019, less than 17% rural households had tap water connections. This stark reality highlighted the immense challenge before us but also underscored the importance of the task at hand. Today, more than 78% of rural households have access to clean tap water in their homes.

This Mission followed the motto 'Building Partnerships, Working Together and Changing Lives'. It aimed to provide potable water of prescribed quality and sufficient quantity with adequate pressure on a regular and long-term basis to each household in rural India.

The scarcity of water has a profound impact on rural communities, especially in times of droughts. Women and children often bear the brunt, spending hours collecting water, which limits their opportunities for education and work. By providing Functional Household Tap Connections (FHTCs), we have not only attempted to address immediate water needs but also empowered rural households with dignity, better health, and the opportunity to thrive.

I commend this effort to document the journey and many success stories of the Jal Jeevan Mission.

[Vini Mahajan]

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ASHOK K. K. MEENA, IAS
विशेष कार्य अधिकारी
Officer on Special Duty

सत्यमेव जयते

भारत सरकार
जल शक्ति मंत्रालय
पेयजल एवं स्वच्छता विभाग
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September 12, 2024

Message

The Jal Jeevan Mission – Har Ghar Jal, launched by the Prime Minister of India, Shri Narendra Modi, is transforming rural India by ensuring safe, reliable, and accessible drinking water in every home. This remarkable initiative is not only improving health and well-being but is also driving socio-economic growth, empowering marginalized communities, and reducing inequalities across the country.

With over 15 crore households now connected to piped water, the mission's impact is felt far and wide. Water, a basic necessity, is also a powerful equalizer. By delivering potable tap water to every household, we are addressing long-standing disparities, fostering equitable development, and enabling sustainable livelihoods. Women, who once bore the brunt of water collection, are now freed from this burden, gaining opportunities for improved health, education, and economic participation.

The Jal Jeevan Mission exemplifies the power of collective action. From leveraging cutting-edge technology, such as data analytics and digital dashboards, to community-led water management and local capacity-building, the mission demonstrates how inclusive planning and modern tools can accelerate change. It is heartening to see communities and stakeholders actively participating in the mission—whether through women taking on leadership roles or villages embracing sustainable water management practices.

This insightful compilation captures the stories of this transformation. From aspirational districts to drought-prone areas, tribal communities, and remote regions, the mission's reach is truly nationwide. The book also sheds light on how water is being made accessible in challenging environments, like the sub-zero areas of Ladakh and the Himalayan regions of Uttarakhand.

As we move forward, the lessons learned and successes achieved through Jal Jeevan Mission will serve as a model for future water security initiatives. I congratulate the team for this comprehensive documentation, which will inspire ongoing efforts to ensure that every household in India has access to safe and sustainable drinking water.

Ashok

(Ashok K. K. Meena)

Special Thanks

On behalf of the United Nations Office for Project Services (UNOPS) India, I sincerely appreciate the entire team of Sankala Foundation for its excellent and timely contribution in completing the book, '**Jal Jeevan Mission-Har Ghar Jal: A Study of Access to Clean Tap Water to Every Rural Home in India**', based on rigorous research across different states of India. This detailed work covers different aspects of Jal Jeevan Mission (JJM), including the rationale behind its launch, the good practices, innovations and how the initiative has emerged as a model for minimising water stress and addressing global challenges of climate change and resilience.

I am indebted to Mr. Bharat Lal, Secretary General, National Human Rights Commission, Government of India and former Additional Secretary, Ministry of Jal Shakti, for the continuous strategic guidance provided to Sankala Foundation. His insights have shaped this book into a vital resource for water and sanitation experts, researchers, and government officials in India and abroad.

I express my sincere gratitude to the Government of Denmark for their continued strategic support to the Government of India's JJM initiative under the Green Strategic Partnerships. The completion of this book is part of this collaboration.

Yours sincerely,

Vinod Mishra
Country Manager
UNOPS, India

Acknowledgements

We thank all officials and field functionaries involved in the implementation of Jal Jeevan Mission for their tremendous efforts to ensure potable tap water in every rural home, all schools, anganwadi centres, ashramshalas, public health and wellness centres and community centres. Their zeal in translating this programme into a reality, and in changing lives of several people, especially women and girls, has been an inspiration for this study.

Our sincere gratitude to Mr Pradeep Singh, Director, DDWS, Ministry of Jal Shakti, for his guidance. We are also grateful to Ms Roopa Mishra, Mr Manoj Kumar Sahoo, and Mr Yugal Joshi, then Directors, Jal Jeevan Mission (JJM), for their insights and guidance in shaping the study and structure of this report. Ms Renjitha M, then Director, JJM and Mr A Muralidharan, Deputy Advisor, National Jal Jeevan Mission (NJJM) helped us in navigating complex policy framework in water governance. We are also grateful to Mr Arun Kembhavi, Deputy Secretary, JJM, for developing our understanding on various initiatives.

We are grateful to Ms Jaspreet Talwar, Principal Secretary, Employment Generation and Training, Government of Punjab, who has worked for a long time in the sector, for her guidance. We are indebted to Dr Syed Abid Rasheed Shah, then Mission Director, JJM Jammu & Kashmir; Er Tomo Basar, Managing Director of the State Jal Jeevan Mission and CE (Eastern Zone) Arunachal Pradesh; Mr Ajeet Sahoo, then Commissioner Secretary, JJM, Ladakh; Mr Vikas Labroo, then Secretary Jal Shakti Vibhag, Government of Himachal Pradesh; and Mr Namit Ramola, Superintendent Engineer, Uttarakhand Jal Sansthan, Dehradun, for sharing their insights and ground level experience in implementing the programme.

We are thankful to Mr R K Sama, former Project Director, Water and Sanitation Management Organisation (WASMO), Gujarat; Mr R Shivaji Kadam, Programme Head, Waterworks Management and Sanitation Programme (Plumbing), Pratham Education Foundation; Mr Arul Kanan, Head, Athenkotasan Muthamizh Kalagan; Mr D S Dhapola, Senior Consultant, NJJM; and Mr Sanjay Singh, Head of NGO Parmarth, for extending all possible help during the course of this study.

We express gratitude also to Ms Rachana Bisht, Social and Behavioural Change Communication Specialist (SBCC); Mr Nanak Santdasani, WASH officer, UNICEF; Mr Divyang Vaghela, Head, Water, Sanitation, & Hygiene, Tata Trusts, and Mr Arif Khan, designer KPMG, for their meaningful contributions. We are grateful to hundreds of other stakeholders, especially rural women, Pani Samiti members, NGOs, Sector Partners and community-based organisations who provided inputs and gave perspectives.

We are grateful to Mr Bharat Lal, Secretary General, NHRC, India and Founder Mission Director, National Jal Jeevan Mission, who was generous with his time and shared insights on the conceptualisation and implementation of the programme. We are also thankful to him for agreeing to write the introduction to this report.

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List of Abbreviations

AAP	Annual Action Plan
ADD	Acute Diarrhoeal Diseases
AI	Artificial Intelligence
ASHA	Accredited Social Health Activist
BCC	Behaviour Change Communication
CBO	Community Based Organisation
CPHEEO	Central Public Health & Environmental Engineering Organisation
CSO	Civil Society Organization
CSR	Corporate Social Responsibility
CWC	Central Water Commission
CWPP	Community Water Purification Plant
DALYs	Disability-adjusted life years
DAP	District Action Plan
DDP	Desert Development Programme
DDUGJY	Deen Dayal Upadhyay Gram Jyoti Yojna
DDWS	Department of Drinking Water and Sanitation
DMDF	District Mineral Development Fund
DPAP	Drought Prone Areas Programme
DWSM	District Water and Sanitation Mission
EBR	Extra Budgetary Resources
EPA	Environmental Protection Agency
ESR	Elevated Storage Reservoir
FHTC	Functional Household Tap Connection
FTK	Field Test Kit
GIS	Geographic Information System
GoI	Government of India
GP	Gram Panchayat
GSR	Ground Service Reservoir
HDI	Human Development Index
HDPE	High-density Polyethylene
HR	Human Resources
HRD	Human Resource Development
IEC	Information, Education and Communication
IMIS	Integrated Management Information System
IMR	Infant Mortality Rate
IPC	Inter Personal Communication
ISA	Implementation Support Agency
IWMP	Integrated Watershed Management Programme
JE-AES	Japanese Encephalitis-Acute Encephalitis Syndrome
JJM	Jal Jeevan Mission
JSA-CTR	Jal Shakti Abhiyan-Catch the Rain
JSK	Jal Shakti Kendra
KPI	Key Performance Indicators
KRC	Key Resource Centre
KVK	Krishi Vigyan Kendra
LPCD	Litres Per Capita Per Day
M&E	Monitoring & Evaluation
MeitY	Ministry of Electronics and Information Technology
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MLALADS	Member of Legislative Assembly Local Area Development Scheme
MMR	Maternal Mortality Rate
MoHFW	Ministry of Health and Family Welfare
MPLADS	Members of Parliament Local Area Development Scheme
MSME	Micro, Small & Medium Enterprise

MVS	Multi Village Scheme
NFHS	National Family Health Survey
NGO	Non-Governmental Organization
NGT	National Green Tribunal
NIC	National Informatics Centre
NJJM	National Jal Jeevan Mission
NRDWP	National Rural Drinking Water Programme
NRWSSSP	The National Rural Water Supply and Sanitation Program
NWP	National Water Policy
O&M	Operation and Maintenance
PFMS	Public Finance Management System
PHED	Public Health Engineering Department
PM-JANMAN	Pradhan Mantri Janjati Adivasi Nyaya Maha Abhiyan
PMKVK	Pradhan Mantri Kaushal Vikas Kendra
PMU	Project Management Unit
PPP	Public Private Partnership
PRA	Participatory Rural Appraisal
PRI	Panchayati Raj Institutions
PSA	Principal Scientific Advisor
PWS	Piped Water Supply
Q&Q	Quality and Quantity
R&D	Research and Development
RGI	Registrar General of India
RJJK	Rashtriya Jal Jeevan Kosh
RWH	Rain Water Harvesting
RWS	Rural Water Supply
SAGY	Sansad Adarsh Gram Yojana
SAP	State Action Plan
SBM(G)	Swachh Bharat Mission-Grameen
SCADA	Supervisory Control and Data Access
SDGs	Sustainable Development Goals
SHG	Self Help Group
SVS	Single Village Scheme
SWSM	State Water and Sanitation Mission
ToT	Training of Trainers
UNESCO	United Nations Educational, Scientific, and Cultural Organization
UNICEF	United Nations Children's Fund
VAP	Village Action Plan
VO	Village Organisation
VWSC	Village Water and Sanitation Committee
WASH	Water, Sanitation & Hygiene
WASMO	Water and Sanitation Management Organisation
WHO	World Health Organization
WQM&S	Water Quality Monitoring & Surveillance

Introduction

By Bharat Lal

India's march towards achieving the goal of a developed country is rooted in the aspirations to secure a higher quality of life, enable 'ease of living' and ensure dignity for all its citizens. Maintaining higher economic growth and achieving fast-paced, yet sustainable development is essential to a nation aspiring to become the third largest economy in the world. However, this aspiration risks remaining unfulfilled if a significant portion of India's rural population is burdened with unproductive daily chores such as collecting water, and lacks access to adequate, clean drinking water. Their potential cannot be fully realised if many of them suffer from water-borne diseases due to lack of clean piped water.

Hence, as a process of empowerment and to make the rural population a stakeholder in India's growth story, the country resolved to increase the capacity and ability of rural India to address challenges like how to ensure safe drinking water and improved sanitation.

Improved Quality of Life, Dignity for All

The Jal Jeevan Mission - Har Ghar Jal was born out of this resolve. Prime Minister Narendra Modi announced the initiative on 15 August 2019, in his Independence Day address from the ramparts of the Red Fort in New Delhi. The programme, launched on 25 December 2019, on Good Governance Day, embarked on an extraordinary journey to ensure that every household and public institution in rural India has adequate, safe, and regular drinking water supply in their taps. With the motto 'Building Partnerships, Working Together and Changing Lives', the Jal Jeevan Mission (JJM) is part of a larger vision of the Government to improve the quality of life, enhance 'ease of living' and ensure dignity for all.

The Mission is committed to provide Functional Household Tap Connections (FHTCs) to every home across rural India. It aims to ensure potable water supply of prescribed quality, in sufficient quantity with adequate pressure on a regular and long-term basis.

The total water demand in India is projected to increase by 32% in 2050, with close to 85% of this increase expected to come from industrial and domestic sectors alone. Water availability is thus critical, as it affects both lives and livelihoods where the lack of it has often resulted in lower productivity, mass migration and poor health outcomes. Ensuring water availability in India rests on the sustainability of the sources of water and the water supply systems.

While the sustainability of the water sources, over or under the ground, affects the quality and quantity of water, poor maintenance and management of the water supply infrastructure as well as depleting water sources affect the sustainability of a system that supplies water to households. The sustainability of sources and systems is the key for functionality of tap water connections. If proper attention is not given to sustainability, it is quite possible that the water supply systems may become defunct and/ or are underutilised, thus precious public investment going to waste.

The JJM addresses these challenges. Water scarcity can disrupt economies, while water security can ensure high economic growth, attract investments, faster socio-economic development, improved quality of life and better health indicators. The transformation of Gujarat from a water-scarce state to a water-secure state with double-digit growth exemplifies this potential.

Equity and Inclusion – No One is Left Behind

The story of access to water in India has not been linear. In 1947, when India became free from colonial rule, the annual per capita freshwater availability was

more than 5,000 cubic meters. Now, this has come down to 1,486 cubic meters. While urban India has better water supply, several villages in India suffer from water scarcity and water quality issues. Although home to 18% of the world's population, India has only 4% of the world's freshwater resource. Rainfall, mostly limited to a few days during monsoon months, is inadequate to meet the basic requirements, especially if ranwater is not stored. In parched lands, clean water takes the value of gold – a wealth difficult to access by many.

Out of the 17 Sustainable Development Goals (SDGs), the success of almost 11 SDGs depends on water availability. In countries like India, where almost half the regions fall under arid/ semi-arid zones, shortage of water not only deprives crores of people of their basic needs, but also hampers socio-economic development. Envisioning India's future as a robust economic force, Prime Minister Narendra Modi since 2014 set the goals for improved sanitation, i.e., open-defecation free India, besides housing, electricity, cooking gas, financial inclusion and assured piped water supply as a prerequisite.

Echoing Prime Minister Modi's call for 'Sabka Saath, Sabka Vikas, Sabka Vishwas and Sabka Prayas', Jal Jeevan Mission adopted the principle of 'equity and inclusion'. The Swachh Bharat Mission (SBM), launched by the Government on 2 October 2014, was pivotal to improving the quality of life, dignity and health of the citizens. With SBM tackling the issue of open defecation, the Jal Jeevan Mission emerged as a corollary, guaranteeing clean drinking water to more than 19 crore (193 million) rural households. With a planned outlay of ₹ 3.60 lakh crores, this ambitious programme aimed to reach millions of households across difficult terrains, inhospitable, and remote areas in five years.

The speed and scale of the programme has been impressive. By end of August 2024, out of 19.33 crore (193.32 million) rural households, 15.11 crore (151.10 million) households have provision of tap water supply. This is more than 78% of the total rural households in India. Adhering to the principle of 'no one is left out', 7 states, 3 UTs, 188 districts and 2.5 lakh villages have ensured that each household is provided with provision of tap water supply.

Children are most vulnerable to water-borne diseases. Safe drinking water, hand washing facility and improved sanitation go a long way in improving the health and wellbeing of children. In the wake of COVID-19 pandemic, in 2020, repeated hand washing became necessary to keep the infection at bay. This was more important in schools, anganwadi (day care) centres and ashramshalas, where a very large number of children are together. Keeping this in view, on 2 October, 2020, birth anniversary of Mahatma Gandhi, a 100-day campaign was launched to bring a sense of urgency to make provision of safe tap water in all schools,anganwadi centres, ashramshalas, PHCs, CHCs, community centres, etc. As a result over 9.27 lakh (88.90%) schools, 9.64 lakh (84.71%) anganwadi centres and close to 4 lakh (about 78%) public institutions have access to safe tap water today.

The JJM initiative embodies more than just access to FHTCs. It unlocks the potential of thousands of rural citizens who are burdened by a daily task of fetching water. In most parts of the country, fetching water for the family is the responsibility of women, who are often accompanied by their daughters. This wastes productive time of women and girls, who can put it to better use. The role of potable piped water supply in homes bring in multiple benefits like advancing gender equality, better health, improved ease of living, dignity to poor and marginalised sections of society, and prosperity.

Besides fulfilling its promise of drinking water security, JJM has given boost to manufacturing, particularly start-ups, and created job opportunities in the rural economy. It has empowered people to take up roles of masons, plumbers, electricians, motor mechanics, water supply developers, pump operators and maintenance staff, vital to ensure the supply of clean drinking water.

Community-managed Programme

After successful implementation of people-centric programmes like Swachh Bharat Mission, Jan Dhan Yojana, Ujjwala, etc., the launch of JJM was a natural step in enhancing the quality of life of Indian citizens and enabling them to dream of a richer and more fulfilling existence.

The mission endeavoured to assist, empower and facilitate states and union territories in planning and developing a participatory rural water supply system for ensuring potable piped drinking water supply on regular and a long-term basis. As a decentralised, demand-driven, community- managed programme, JJM is a pioneering approach in terms of collective decision-making, empowering citizens, especially women, and bringing sense of ownership among rural communities and local self-governments i.e., Panchayati Raj Institutions in rural India.

It is a game changer in rural public health as it promotes 'Gram Swaraj' which means giving power to village people. It gives them control over local resource water management, improves sanitation and hygiene, thus impacting the public health and their wellbeing. Further, it builds partnerships with various international, national, and local organisations, civil society, NGOs, academic institutions and young professionals to contribute collectively to change people's lives. The increased budgetary allocation gave a fillip to meet the aspiration of rural population and offer them enhanced livelihood opportunities. It would not be an exaggeration to call it a silent revolution taking place in the people's lives.

Women-led Development

The aim of Jal Jeevan Mission was to erase the age-old drudgery faced by women and young girls in fetching drinking water and enhancing their potential to lead a more fulfilling and empowered life. The involvement of women in planning, decision-making, implementation, monitoring and in the operations of the mission is truly inspiring. Women have the power to take decisions on water usage in their villages. Village Water and Sanitation Committees (VWSCs) or Pani Samitis, a sub-committee of Gram Panchayat, responsible for water supply and sanitation in villages, are required to have at least 50% women members to ensure gender equality. These committees also have 25% representation from the weaker sections of society, thus solidifying the inclusive approach.

By bringing piped, clean drinking water supply to their homes, JJM has reinforced the importance of safety, security and dignity of women, who otherwise had to travel long distances to fetch water. Today, several women are plumbers, water testers and looking after water supply operation and management in villages. They play a critical role in the delivery of potable tap water in their villages. The Jal Jeevan Mission also helped in developing village level 'responsible and responsive leadership', giving them confidence to manage such a critical service wherein any deficiency in water supply causes huge disruption to the whole village community.

As JJM is a people's programme, about 5.26 lakh VWSCs or Pani Samitis/ water user groups were formed by the end August 2024. Indeed, JJM spurred a grassroots movement, motivating village communities especially women to participate in water, sanitation and hygiene management of their own villages. Over 24.70 lakh women have been trained on various dimensions of water quality, including how to test the water by using Field Testing Kits (FTKs), thus creating a large pool of people who can manage WASH services. In rural areas, water has become everyone's business.

Technology for Change

Technology has been a cornerstone in the successful implementation and scaling up of the Jal Jeevan Mission. Leveraging modern tools and innovative solutions has enabled efficient planning, faster execution, and online monitoring of water supply projects across diverse and challenging terrains in rural India. Advanced data analytics and dashboards have facilitated real-time tracking of progress, ensuring transparency and accountability in the Mission's operations. Smart water management systems have optimized resource utilization and ensured consistent water quality and supply.

The mission is a pioneer in leveraging advanced technologies to tackle water-related challenges faced by rural communities across the country. The problem of geogenic contaminants—such as Arsenic, Fluoride and Iron in drinking water—was addressed by setting up water treatment plants to provide potable drinking water. Another technological advancement employed by JJM is the use of automatic chlorinators that accurately determine the required chlorine concentration

based on the water volume to effectively disinfect against biological contaminants. This not only minimizes human effort but also ensures the optimal chlorine dosage, reducing the risk of chemical hazards associated with water treatment.

To reduce dependency on electricity for water supply systems, under Jal Jeevan Mission solar panels and solar-powered water pumps have been used on a large scale. Through partnerships with various organisations, the mission has driven innovation, resulting in the creation of water purification units. These units have been strategically installed at public places, ensuring widespread access to safe drinking water. The development of GIS-based technologies for locating water resources has further empowered communities to identify and utilise water sources effectively.

Partnerships and KRCs

A concerted effort has been made to forge partnerships with civil society, NGOs, academic institutions for executing the programme on such a large scale. More than 200 NGOs and autonomous organisations have joined hands as sector partners, supporting the programme in different ways. Also, more than 104 educational, academic and training institutions have started work as Key Resource Centres (KRCs) that provides the necessary capacity building and technical support to the programme. By August end 2024, five Professor Chairs in different parts of the country were set up for continuous research and policy support to the programme.

Moreover, to fill the void of a repository institution of knowledge and garner continous support to the water and sanitation sector, Shyama Prasad Mukherji National Institute of Water and Sanitation (SPM-NIWAS) was set up in Kolkata. This institute works on education, research, training, outreach and advice to various stakeholders in the country as well as abroad. There are also plans to set up two 'Centres of Excellence' in two IITs to provide continuous research and support to the sector.

About the Report

'Jal Jeevan Mission – Har Ghar Jal: A Study of Access to Clean Tap Water to Every Rural Home in India' is an effort by the Sankala Foundation to document one of the most ambitious and transformational initiatives of the Government to make provision of potable piped water supply to every household and public institutions in rural India.

This report details the background of Jal Jeevan Mission and examines how it served as a model for ensuring clean tap water to every home, working with speed and on a scale, empowering local communities, involving and strengthening local self-governments and civil society, integrated planning with bottom up approach, improving quality of lives and ease of living, boosting local economy and addressing global challenges of climate change, and building resilience. This happened while the COVID-19 pandemic caused worldwide devastation, loss of lives and livelihoods.

A collaborative effort with the United Nations Office for Project Services (UNOPS), it discusses how different interventions were made to enhance the Functional Household Tap Connections (FHTPs) in rural India using modern techniques and traditional systems of conservation.

'Jal Jeevan Mission – Har Ghar Jal' also attempts to share the complexities and challenges of water supply distribution and conservation. Equally path-breaking in the implementation of JJM is the attention the programme gave to community's role: assured availability of water is their basic right and to enjoy this right, they must also shoulder certain responsibilities, and they will learn to manage water resources, water supply delivery, understand quality issues, grievance redressal, inclusiveness, equity, public health and hygiene, and commit to sustainability.

This collection aims to meet the needs of all those connected to various issues of water resource management and water supply delivery and management: researchers, engineers, innovators, entrepreneurs, tech experts, public policy and government officials and even corporates and businesspersons, and people working at the grassroots level. The detailed documentation in the book can guide those who want to address challenges of drinking water shortages.

The report is divided into eight sections. In the first

section 'Water for Life, Water for Growth', Chapters 1 and 2 trace the historical evolution of water supply systems and delves into the roots of water management in India thereby setting the stage for understanding the transformative goals of Jal Jeevan Mission.

In Section B, 'Jal Jeevan Mission – A Plan for Changing Lives', the four Chapters (3,4,5,6) focus on the vision and mission of JJM, strategic planning of water supply systems, operational challenges, and the integration of data analytics and technology. The three Chapters (7,8,9) of Section C 'Water Management, by the People, for the People' highlight the role of democratic processes in accessing water, community participation through Pani- Samitis, role of Panchayats and community groups and most importantly, how women became leaders of this movement.

These chapters highlight how rural local bodies were empowered, capacities were built and sustainability of the water supply chains were addressed by local village communities. Some of the chapters also detail how planning experts tailored solutions for underdeveloped regions, and considerations for districts affected by specific public health issues.

In Section D 'Tools and Technology for Transformation', Chapters 10 to 13 document how technology helped to address the challenging objectives of scale and speed in the programme. The use of dashboard, data analytics and modern technology enabled JJM to reach its goals faster. As part of Section E 'Not the Last, Not the Least', Chapters 14 to 18 highlight the unique considerations required for water supply in diverse and extreme weather and edapho-climatic conditions.

The mission's efforts to mitigate water scarcity and ensure quality are also discussed in these chapters, including strategies in drought-prone areas, in aspirational districts, in districts affected by water-borne diseases, and in schools and anganwadis. These chapters also address critical issues related to water quality standards in rural India.

Section F 'Success Stories' includes Chapters (19, 20, 21, 22, 23) that record how some states and union territories reached 100% access to safe tap water. These chapters also delve into the water management model of Gujarat, engineering marvels in Arunachal Pradesh and Ladakh, ingenuous techniques applied in Himachal Pradesh providing a glimpse of diverse approaches applied to achieve the JJM goals of providing safe drinking water.

In Section G 'Synergising with Nature: Becoming Sustainable', two Chapters (24, 25) focus on issues like harnessing solar energy for water equity and storing rainwater for future consumption. In Section H 'Coming Together for Water', Chapter 26 describe the role of sector partnerships in fostering collective responsibility and how this massive programme was supported by diverse stakeholders, including private partners. Chapter 27 reflects on India's journey in water management and outlines future directions for achieving sustainable water security. It serves as a culmination of the diverse themes explored throughout the report.

Hopefully, this document will also offer a direction to other countries, especially in the Global South, facing similar problems of water shortage and contamination. It is a blueprint worth considering.

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Section A

Water for Life, Water for Growth

The 1,200 years old Karpur Baoli, Nagpur, Maharashtra

1

Global Scenario

Water, an elemental force that sustains life, has been a catalyst in the evolution and rise of human civilisations. Ancient civilisations like the Egyptian, Mesopotamian and the Indus Valley Civilisation were cradled by rivers like the Nile, Tigris-Euphrates, and the Indus. Managing these rivers appears to have played a pivotal role in shaping agriculture, trade, and cultural development.

In the heart of northeastern Africa, the Nile River emerged as a central character in the development of ancient civilisations. The Nile's annual flooding, predictably consistent, transformed the arid landscape into a fertile food basket. Agriculture thrived, laying the foundation for surplus food production, economic prosperity, and the emergence of a explored social structure. Beyond its pragmatic utility, the Nile held profound cultural significance. It was revered as a deity, woven into the fabric of religious beliefs and practices. The annual inundation, symbolising renewal and fertility, found expression in Egyptian art, mythology, and societal rituals. The Nile was not just a geographical entity; it became a cosmic force shaping the essence of Egyptian civilisation.

Similarly, the Tigris and Euphrates rivers defined the fertile crescent, nurturing the growth of ancient Sumerian, Akkadian, and Babylonian civilisations. The Tigris and Euphrates, with their unpredictable flooding, demanded innovative solutions. The ancient Mesopotamians responded by developing an intricate system of canals, levees, and reservoirs to control the waters. This mastery over water resources fuelled the agricultural surplus, supporting the establishment of urban centres and trade networks. Mesopotamian city-states, with their ziggurats and advanced infrastructure, stand as testaments to the transformative power of water management.

The rivers not only irrigated fields but also facilitated trade and commerce, connecting distant regions and fostering cultural exchange. The Code of Hammurabi, one of the earliest legal codes, reflects the societal complexities that emerged from the intersection of water, agriculture, and governance.

In the Indian subcontinent, the Indus River Valley Civilisation offered an intricate interplay between water and civilisation. Urban centres like Harappa and Mohenjo-Daro were strategically located along the banks, benefiting from the fertile soils deposited by the annual flooding.

The Harappans showcased an advanced understanding of water management to sustain it with well-planned cities featuring an elaborate network of drains, wells, and reservoirs. Agriculture flourished, supporting a dense population engaged in trade and craftsmanship. The Indus became a conduit for cultural exchange, connecting distant regions and fostering the exchange of ideas and commodities.

Historically, water infrastructures emerged as markers of advanced civilisations. The construction of aqueducts, canals, and wells became feats of engineering prowess, reflecting not only technical acumen but also societal organisation. The Romans, with their extensive aqueduct network, elevated water management to an art form. The aqueducts not only supplied water to cities but became symbols of Roman engineering excellence and urban sophistication. Wells, carefully dug and maintained, served as community hubs and markers of settlement. The complex design and engineering behind these structures were not just utilitarian; they were expressions of cultural identity and societal cohesion. Water, in its various forms, permeated the cultural landscape, influencing religious practices, artistic expressions, and societal norms.

In the modern world, the wisdom of ancient civilisations beckons us to re-evaluate our relationship with water. The Nile, Tigris-Euphrates, and Indus Rivers were not just geographical features; they were partners in the journey of human progress. The sustainable

coexistence between societies and water resources, witnessed in these ancient civilisations, remains a guiding principle for our contemporary quest for balance and resilience.

Water shortage forces several communities to migrate

World Water Crisis

Today freshwater scarcity stands as a looming global crisis, posing multifaceted challenges that extend far beyond environmental concerns. According to the United Nations (UN), in 2022, 2.2 billion (220 crores) people still lacked safely managed drinking water, including 703 million (70.3 crores) without a basic water service; 3.5 billion (350 crore) people were bereft of safely managed sanitation, including 1.5 billion (150 crores) without basic sanitation services; and 2 billion (200 crores) needed a basic hand washing facility, including 653 million (65.3 crores) with no hand washing facility at all. Approximately one million (10 lakh) people die each year as a result of not having access to clean drinking water. As the world's population burgeons, urbanises, and climate change disrupts precipitation patterns, the demand for freshwater intensifies, amplifying the stress on available resources.

One of the most critical aspects of the global water challenge is the inequitable distribution of water stress. Regions already grappling with high water stress include the West Asia, Northern Africa, and parts of Asia, with projections indicating that Sub-Saharan Africa is likely to face prolonged water stress due climate change and increasing population.

The economic ramifications of freshwater scarcity are profound. The World Bank (WB) estimates that water scarcity could cost some regions up to 6% of their Gross Domestic Product (GDP) by 2050, affecting industries such as agriculture, energy, and manufacturing. Furthermore, the nexus between water, energy, and food security amplifies the complexity of the challenge. Industries that rely on water-intensive processes experience heightened production costs and disruptions during water scarcity. For instance, the energy sector depends heavily on water for cooling thermal power plants, and disruptions in water availability can lead to energy shortages. In Brazil, a country largely rests on hydroelectric power, a severe drought in 2014-2015 caused electricity shortages and triggered a 50% increase in energy prices, impacting both consumers and businesses.

Cases of transboundary water disputes exemplify the geopolitical dimensions of the water challenge. The Nile River basin, shared by 11 countries, is a hotspot for tensions over water access and allocation. Similarly, the Mekong River basin faces challenges as upstream dams impact downstream water availability in Southeast Asian countries. Israel, Jordan, and Palestine share the Jordan River Basin where competing demands for water resources have contributed to regional tensions in the Middle East region. Central Asian countries, including Kazakhstan, Tajikistan, Turkmenistan, and Uzbekistan, contend with water-sharing issues in the Amu Darya and Syr Darya river basins. Disputes over dam construction and irrigation exemplify how geopolitical considerations intersect with water management.

The challenges of water availability have been intensifing in the last decade due to global climate change. Regions facing prolonged droughts grapple with severe water shortages such as parts of the American West, California. Prolonged dry spells have led to reduced snowpack, diminished groundwater levels, and dwindling reservoir capacities, impacting both urban and agricultural water supplies.

Conversely, the rise in extreme rainfall events has resulted in devastating floods, compounding water-related challenges. For instance, the devastating flooding in Pakistan in 2022 is a poignant illustration. Widespread inundation compromised water quality, disrupted water supply systems, and posed significant health risks to affected populations.

Mitigating global freshwater scarcity necessitates a coordinated, multi-pronged approach. The examples drawn from diverse regions underscore the urgency of embracing sustainable practices, fostering technological innovations, and establishing effective governance frameworks. Collaborative efforts at local, national, and international levels are imperative to navigate the intricate challenges of the global water crisis and secure a sustainable future.

Water for Human Development

Access to clean water is a fundamental determinant of human development, playing a pivotal role in health, education, economic well-being, and overall quality of life. A sufficient quantity of clean drinking water, sanitary facilities, and proper sanitation are essential elements of a healthy lifestyle. Every child deserves the right to grow up in an environment that is safe and clean. Even though COVID-19 brought attention to the need of good hand hygiene in preventing the transmission of illness, yet as per United Nations Children's Fund (UNICEF) there are three billion people globally—including hundreds of millions of school-age children—who do not have access to soap and water for handwashing. The most at risk and impacted are those who live in low-income nations, rural areas, urban slums, and disaster-prone places. Children who have access to basic sanitation services, clean water, and adequate hygiene practices not only have a greater chance of succeeding in life but also continue to prosper.

Contaminated water sources contribute to the spread of waterborne diseases, leading to severe health crises. According to the World Health Organization (WHO), approximately 2 billion (200 crore) people worldwide consume water from contaminated sources, resulting in the transmission of diseases like cholera, dysentery, and typhoid. Access to clean water and sanitation is closely linked to reduced child mortality, improved maternal health, and the overall well-being of communities.

The criticality of clean water on human health can be looked from different health indicators such as Infant Mortality Rate (IMR) and Maternal Mortality Rate (MMR). Japan and Sweden serve as global benchmarks for the positive correlation between advanced water infrastructure, water quality, and low infant mortality rates (IMR). With an IMR of 1.53 and 1.66 deaths per 1,000 live births respectively, Japan and Sweden attribute their success to a robust water supply system and well-developed sanitation systems. Bangladesh and Ethiopia exemplify the impactful relationship between improved water access and reduced maternal mortality rates (MMR) in low-income countries. Bangladesh, with a remarkable reduction, saw its MMR decline from 322 deaths per 100,000 live births in 1990 to 173 deaths in 2017, showcasing the positive impact of enhanced water access on maternal health.

Close to a million (10 lakh) people are estimated to die each year from diarrhoea as a result of unsafe drinking-water, sanitation and hand hygiene. Yet diarrhoea is largely preventable. Each year diarrhoea kills around 4.43 lakh children under 5. A significant proportion of diarrhoeal disease can be prevented through safe drinking-water and adequate sanitation and hygiene.

Education is another key dimension of human development intimately tied to clean water accessibility. Inadequate water and sanitation facilities in schools contribute to absenteeism, particularly among girls who may stay home during menstruation in the absence of proper facilities. The lack of clean water in educational institutions impedes the creation of a conducive learning environment. A report by United Nations Educational, Scientific and Cultural Organization (UNESCO) says that globally, one in three schools lacks basic sanitation, affecting the education and dignity of millions of students.

In many regions, women and girls are traditionally responsible for water-related chores, such as fetching water from distant sources. The availability of clean water in close proximity reduces the time and effort spent on such activities, liberating women and girls to dedicate more time to education.

Moreover, the economic ramifications of inadequate access to clean water are substantial. Waterborne

illnesses not only strain healthcare systems but also reduce productivity and economic output. In many developing countries, individuals, primarily women and children, spend considerable time fetching water from distant sources, limiting their capacity to engage in education or income-generating activities. The United Nations estimates that time spent collecting water could be significantly reduced with improved access, empowering communities, particularly women, to pursue education and participate in economic activities.

Interventions to Promote Sustainable Use of Water

The UN has undertaken a number of initiatives to promote people's access to clean water. These include the International Conference on Water and the Environment (1992) and the Earth Summit (1992). During the United Nations Water Conference in 1977, the first Action Plan was established, recognising that 'everyone has the right to access drinking water in quantities and of a quality equal to their basic needs, regardless of their stage of development and social and economic conditions.' This was followed by the International Drinking Water Supply and Sanitation Decade (1981–1990), which recognise the basic right of all human beings to have access to clean water and sanitation at an affordable price.

Over the last half-century, global efforts to promote sustainable water use have undergone a transformative journey, transitioning from the Millennium Development Goals (MDGs) to the Sustainable Development Goals (SDGs). The introduction of the Millennium Development Goals (MDGs) was a significant step in the UN's long-term strategy to solve the worldwide problem brought on by contaminated water and sanitation, as well as the increasing demand on the world's water resources to meet environmental, economic, and human needs. The MDG 7 aimed to halve the proportion of people without access to safe drinking water and basic sanitation by 2015. By defining rich countries' responsibilities to assist poor countries through aid, debt relief, and improved market access, they also served as a driving force behind international development policy.

Sao Francisco River in Brazil dried up due to drought conditions

Source: Wikimedia Commons

The transition from MDGs to SDGs in 2015 marked a paradigm shift in global development priorities. The SDG 6 aims to 'Ensure availability and sustainable management of water and sanitation for all', reflected a more holistic understanding of water-related challenges. Unlike its predecessor, SDG 6 emphasised not only access but also the sustainable use and management of water resources. The SDG 6, comprising key components, extends the commitment to universal access to safe drinking water and sanitation, broadening the scope to include hygiene and water quality.

Unlike the MDGs, it explicitly addresses sustainable water resource management, recognising its interconnectedness with broader environmental and development goals. Ecosystem protection is emphasised, acknowledging the vital role of water-related ecosystems in maintaining water quality and biodiversity. The SDGs adopt a cross-sectoral integration approach, linking water sustainability with health, education, poverty reduction, and climate action goals. Emphasising global partnerships, initiatives like UN-Water and the International Decade for Action facilitate coordinated efforts, while a robust monitoring framework ensures accountability and evidence-based decision-making.

While the SDGs represent a comprehensive approach, challenges persist. Climate change, population growth, and inadequate infrastructure continue to pose threats to water sustainability. Future efforts

should focus on innovative solutions, technological advancements, and inclusive policies that address the evolving dynamics of water-related challenges. The journey from MDGs to SDGs reflects a maturation of global understanding and commitment to sustainable water use. While progress has been made, the evolving nature of challenges necessitates ongoing collaboration, innovation, and adaptability in the pursuit of a water-secure and sustainable future for all.

Advancements in Clean Drinking Water Access in Global South

In many countries of the Global South, including India, the challenges related to water access are multifaceted. These challenges encompass issues such as inadequate infrastructure, water scarcity, waterborne diseases, and disparities in access, particularly in rural areas. At the same time, in the last two decades, numerous countries in the Global South have embarked on transformative initiatives to enhance access to clean drinking water, recognising its profound impact on public health and socio-economic development.

In Bangladesh, a country plagued by widespread arsenic contamination in its groundwater, the Bangladesh Arsenic Mitigation Water Support Project (BAMWSP) was launched in 1998. This project involved widespread testing of tube wells, identification of safe alternative water sources, the promotion of arsenic removal technologies, and extensive awareness campaigns. While the challenge of arsenic remains a significant public health issue, the programme has drastically reduced exposure and saved lives. In Ethiopia, the One WASH National Programme (OWNP) demonstrates a multi-sectoral approach aimed at universal access to safe water, sanitation, and hygiene services. This ambitious programme emphasises rural areas, utilising technologies like solar-powered water pumps and promoting community-led maintenance models. According to the World Bank, national access to improved water sources rose to 58% by 2021, reflecting progress towards the programme's goals.

In Brazil, the Cisterns Programme has provided a unique solution for water scarcity in the semi-arid Northeast region. This programme promotes the construction of large underground cisterns in homes, enabling families to capture and store rainwater for household use. This simple yet effective solution has addressed water scarcity for millions living in drought-prone areas. Similarly, Vietnam has made significant strides in expanding access to clean water. The National Strategy on Rural Water Supply and Sanitation by 2030, with a vision to 2045 (NRWSSSP) has been instrumental in this progress. The strategy utilises a demand-driven approach, where communities identify their needs and contribute financially to the construction of water supply systems. This empowers communities and fosters a sense of ownership, leading to the long-term sustainability of water infrastructure projects.

These cases underscore the ongoing efforts of countries in the Global South to ensure clean water access for their populations. These initiatives, marked by tangible improvements, contribute to healthier and more sustainable communities, emphasising the importance of sustained progress in the realm of water accessibility. Despite this undeniable progress, hurdles remain. Large-scale infrastructure gaps persist, particularly in hard-to-reach and marginalised communities. Climate change continues to threaten water security, with increasingly erratic rainfall patterns and prolonged droughts undermining water supplies. Moreover, ensuring the long-term functionality and sustainability of water systems, particularly those driven by community participation, requires continued support and capacity building.

2

Water Supply in India: A Historical Perspective

The evolution of water supply systems in India is a journey spanning millennia, reflecting the intricate relationship between human civilisation and water. India's hydrological knowledge dates back to the Vedic Period (c. 1500–500 BCE) and the Indus Valley Civilisation (c. 3000–1500 BCE). Ancient scriptures, such as the Rigveda, Atharvaveda, and Yajurveda, elaborate on the hydrologic cycle and related processes. Varuna, the God of waters, and Indra, the God of thunder and rain, were central figures in these ancient narratives. The Rigveda poetically describes the continuous cycle of water, from the sun's evaporation to cloud formation and rain, showcasing a sophisticated understanding of the natural processes.

Indian history is also replete with recurring floods and droughts which was met with building traditional water storage and harvesting techniques suitable to its geography and culture such as stepwells, tanks, ponds, jack wells and many more. These structures met local needs for many centuries with people taking ownership of its maintenance and remain a great source of knowledge even today to ensure water security, especially considering the vast agrarian economy and livelihoods.

Early Water Systems

The dawn of settled agricultural communities around 10,000 years ago marked a pivotal moment in human history, triggering a transition from nomadic lifestyles to permanent settlements. As communities grew, so did the demand for reliable water sources, leading to the development of primitive water supply systems that laid the foundation for more sophisticated methods in the future.

In ancient civilisations, the ingenuity of early humans in managing water resources is evident in archaeological discoveries. The fertile plains of Mesopotamia, often referred to as the 'cradle of civilisation', boast traces of wells dating back to 3000 BCE. These wells served as essential sources of water for agricultural activities and domestic use. In Egypt, another ancient civilisation, the construction of stone rainfall drains showcased an early understanding of the importance of drainage systems in managing water flow. These rudimentary drainage systems were crucial for mitigating the impact of floods and ensuring the efficient utilisation of water for agriculture.

However, one of the most fascinating glimpses into early water management comes from the Bronze Age metropolis of Mohenjo-Daro, part of the ancient Indus Valley Civilisation located in present-day Pakistan. Archaeologists have uncovered evidence of advanced water infrastructure, including wells, water pipes, and even toilets. This urban centre, dating back to around 2600 BC, featured an intricate network of brick-lined wells that provided a consistent supply of potable water to its inhabitants. The presence of an advanced drainage system indicated an understanding of the importance of sanitation and wastewater management.

The sophisticated engineering of Mohenjo-Daro is particularly noteworthy. The city had a centralised water supply system with carefully designed channels to distribute water efficiently. Each settlement in the Sindhu-Saraswati Basin featured water storage reservoirs, and houses which were seamlessly integrated into primary drainage networks. The Great Bath, an iconic structure in Mohenjo-Daro, not only served ritualistic purposes but also showcased the city's advanced hydraulic engineering, complete with a water supply and drainage system.

The Mauryan Empire (322–185 BCE) witnessed significant contributions to water management. Reservoirs, dams with spillways, and channels, known as Pynes and Ahars, were constructed to harness and

distribute water. The Mauryans established water pricing systems, demonstrated an understanding of water balance, and measured rainfall, showcasing a holistic approach to water governance. Even today, remnants of these ancient water systems endure, underscoring the longevity and efficacy of early water management practices.

During the Mughal era, further advancements in water management techniques, such as wells, canals, and baths, became prevalent. The Mughals recognised the intrinsic connection between water and human well-being. One of the notable achievements during the Mughal era was the creation of extensive gardens, known as baghs or charbaghs which required sophisticated water supply systems to sustain their lush landscapes. The grandeur of Mughal gardens, such as the Shalimar Bagh and the Nishat Bagh in Srinagar, Kashmir, attests to the meticulous planning and engineering employed to ensure a reliable water source for irrigation.

Wells played a crucial role in the Mughal water supply infrastructure. These wells, known as khanats or baolis, were intricate structures designed to access groundwater. Mughal rulers commissioned the construction of stepwells, which were not only functional but also architectural marvels. The Mughals recognised the importance of canals in agricultural development and water distribution. Under their rule, extensive canal networks were established to facilitate the irrigation of agricultural lands. The Yamuna River, in particular, saw the construction of canals that played a vital role in sustaining the agrarian economy of the region.

The colonial rule in India left an indelible mark on various aspects of life, including water supply systems. Colonial rulers, primarily the British, recognised the importance of efficient water supply systems for sustaining their administrative and economic objectives in India. Their approach, however, often differed from indigenous practices, leading to a blend of traditional water management techniques and new technologies. One of the significant contributions of the colonial administration was the development of canal systems. The construction of canals, inspired by ancient Indian practices but executed on a larger scale, aimed to enhance agricultural productivity.

Remains of a well from the ancient city of Mohenjo-Daro, which was also referred to as city of wells

Source: Wikimedia Commons

Canal networks like the Ganges Canal in North India and the Periyar Canal in South India became pivotal for irrigating vast expanses of agricultural land.

However, with the advent of 16th century European colonialism, control and ownership of water began to get codified with increasing state's role along with a push for urbanisation often resulting in a neglect of infrastructure in rural areas. The colonisers attempted to synchronise the hydraulic environment to suit its administrative apparatus, which resulted in irreversible hydro-socio consequences and continue to shape contemporary challenges as well.

In urban areas, the colonial rulers faced the challenge of providing clean water to growing populations. Traditional water bodies and stepwells were complemented by more modern interventions. The establishment of reservoirs, pumping stations, and piped water supply systems marked a departure from historical practices. Cities like Bombay (now Mumbai) and Calcutta (now Kolkata) witnessed the installation of water distribution networks, albeit primarily catering to the needs of the colonial elite.

The colonial period introduced technological innovations in water supply, such as steam-powered pumps and iron pipes. These advancements allowed for the efficient extraction and distribution of water, transforming the scale and scope of water infrastructure. However, these technological interventions were often concentrated in urban centres, leaving rural areas to grapple with traditional methods.

While colonial interventions brought about technological advancements, they also disrupted traditional water management systems. The emphasis on large-scale projects sometimes ignored the intricate, community-driven water governance prevalent in many regions. The shift towards centralised control and the neglect of decentralised systems had lasting implications for the socio-cultural fabric of water management.

Water Supply Schemes in Post-Independence India

After gaining independence in 1947, India has pursued development of water supply systems to meet the needs of a growing population. In the immediate post-independence years, India's water policies cantered on large-scale infrastructure development inspired by the idea of harnessing nature for economic growth.

Key developments of this era include:

(a) **Multi-purpose River Valley Projects:** Ambitious programmes like the Damodar Valley Corporation and the Bhakra Nangal project aimed to generate hydropower, provide irrigation, and control floods. While primarily focused on agriculture, these projects laid the groundwork for augmenting water supplies for wider use.

(b) **Central and State Water Agencies:** The formation of institutions like the Central Water Commission (CWC) and State Irrigation Departments reflected the emphasis on centralised planning and control over water resources.

(c) **Focus on Urban Water Supply:** Recognition of the growing needs of urban India led to the creation of dedicated agencies like the Central Public Health and Environmental Engineering Organisation (CPHEEO) in 1954, tasked with advising on urban water supply and sanitation.

The Third Five-Year Plan (1961–1966) introduced the concept of 'Problem Villages', focusing on regions lacking potable water sources. As India confronted population growth and an increasing need for food security, water policies witnessed a shift toward expanding supply while addressing the specific needs of different sectors. The widespread adoption of tube well technology, coupled with subsidised electricity for agriculture, fuelled a groundwater revolution. This significantly increased water availability but raised concerns about long-term sustainability. Recognising the link between water conservation and recharge, programmes like the Drought Prone Areas Programme (DPAP) and the Integrated Watershed Management Programme (IWMP) promoted soil and water conservation measures at the watershed level.

The focus in the later years shifted to providing drinking water. National Rural Drinking Water Supply Programme launched in 1969 with the technical support from UNICEF, was a landmark initiative by the Indian government to address rural drinking water scarcity. The programme emerged in response to a severe famine in Bihar, highlighting the urgent need for safe and accessible drinking water in rural areas. The programme focused on building borewells, a crucial source of groundwater in many regions. While some piped water connections were installed, these were likely not as widespread as borewells.

A stepwell in Abhaneri, Rajasthan

Source: Wikimedia Commons

The Accelerated Rural Water Supply Programme (ARWSP) was launched by the Government of India in 1972 to address the challenge of inadequate access

to safe drinking water in rural areas. The programme aimed to accelerate providing clean drinking water to rural populations with a focus on villages facing water scarcity or lacking a reliable drinking water source. While the ARWSP significantly expanded rural water supply infrastructure in India, issues like water source sustainability, infrastructure maintenance, and achieving universal coverage persisted. The National Drinking Water Mission (NDWM) of 1986 was launched in the context of several factors that highlighted the need for a more focused approach and use of technology in rural water supply in India. The 1980s coincided with the International Drinking Water Supply and Sanitation Decade (1981-1991), which brought global attention to the issue of safe drinking water access.

At the end of this period during 1996-2002 integrated approach on water, sanitation and health gained momentum due to implementation of the Indo-Dutch Community-Based Drinking Water Supply and Sanitation (CDD WATSAN) programme, spanning from 1996 to 2002. It was a collaborative initiative between India and the Netherlands aimed at addressing waterborne diseases in selected regions of India. The programme focused on implementing community-driven solutions to enhance access to clean drinking water and improve sanitation practices, particularly in areas grappling with waterborne illnesses such as hookworm, tapeworm, and diarrhoea. In this period, many externally aided programmes, supported by Japan and organisations like the World Bank were also implemented.

73rd Constitutional Amendment and Water Supply Management

Decentralisation gained momentum with the 73rd Constitutional Amendment in 1994, granting Panchayati Raj Institutions authority over drinking water provision. Under Entry 17 of the Eleventh Schedule, panchayats gained the authority to plan, implement, and manage water supply within their jurisdictions. The amendment also mandated the creation of State Finance Commissions to allocate resources from the state to panchayats. Panchayats could then use these funds for water supply projects. Additionally, strengthened Gram Sabhas, village assemblies where residents participate, allowed communities a say in how water supply funds are used. This participatory approach, along with increased accountability through regular panchayat elections, has the potential to improve water supply management in rural areas by making it more responsive to local needs.

Following the provisions of the 73rd Constitutional Amendment, during the 9th five Year Plan (1992-97) and 10th Five-year plan (1998- 2003) the community owned/ driven, integrated and conjunctive water sources-based pilot project initiatives were introduced. The Sector Reform Pilot Projects (SRPP) launched in 1999 by the Government of India was a significant step towards decentralising water supply management in the country. The SRPP aimed to shift control of water supply from central-state government agencies to local bodies. This empowered local communities to have a greater say in managing their water resources.

The programme started as a pilot project in a limited number of districts across various states. This allowed for testing the approach and learning from its effectiveness before wider implementation. The SRPP emphasised a shift from a supply-driven model to a demand-driven one. Local communities were expected to contribute to the cost of installation and take responsibility for operation and maintenance of water supply systems. Gujarat, through Water and Sanitation Management Organisation (WASMO) and the Swajal pilot in Uttarakhand and Uttar Pradesh, implemented community led management of services.

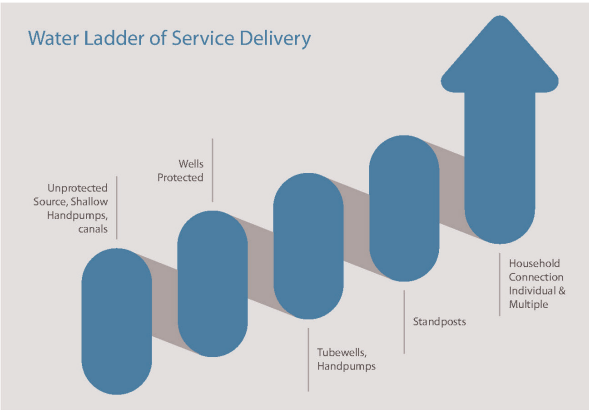
The Ministry of Rural Development introduced the 'Swajaldhara' programme in 2002 to promote community involvement and Panchayati Raj Institutions' active involvement in ensuring the availability of potable water in rural areas. Swajaldhara empowered communities to participate in designing, operating, managing, and maintaining drinking water systems. This allowed for the establishment of long-term programmes based on village needs, ensuring each person received 40 litres of clean water daily. Piped water supply became preferable to hand pumps for ensuring safe drinking water near houses. In 2001, 22.2% of houses dependent on wells, dropped to 13.3% in 2011.

In 2002, the Government of Gujarat established the Water and Sanitation Management Organisation (WASMO) as a Special Purpose Vehicle (SPV) intending to initiate a community-managed reform process in the drinking water sector. To provide communities with adequate, safe, and sustainable drinking water supply and enhanced habitat by means of empowerment and active community management of natural resources, resulting in an improvement in their living conditions.

In 2005, the Bharat Nirman Programme, a five-year initiative aimed at bolstering rural infrastructure, incorporated the enhancement of drinking water provision as one of its key components. The year 2009–10 witnessed a pivotal moment when Swajaldhara underwent an amendment and a subsequent renaming, evolving into the National Rural Drinking Water Programme (NRDWP). This transformation underscored a strategic shift, with the NRDWP prioritising water as a fundamental need and proposing an increase in the minimum clean water allocation from 40 litters per capita per day (lpcd) to 55 lpcd.

Before the inception of the NRDWP, the primary reliance for drinking water sources was on groundwater, predominantly through wells and handpumps. The government actively promoted the usage of hand pumps, particularly the Mark-II and later Mark-III variants, as a significant intervention for supplying clean water at the village level. While underground water sources were generally considered clean in many regions, certain areas faced contamination

Figure 1: Water Ladder of Service Delivery



Source: National Rural Drinking Water Programme

Mark-II handpump

Source: Wikimedia Commons

issues, including heavy metals, salinity, Iron, Nitrate, Fluoride and Arsenic. Over time, the unrestrained extraction of groundwater led to a deterioration in its quality, prompting the government to recognise the necessity of transitioning from groundwater to surface water sources.

The year 2017 marked a notable development as the NRDWP placed a robust emphasis on water supply through piped systems originating from public water management standposts. This strategic shift aimed to enhance the accessibility and quality of drinking water, addressing the challenges posed by groundwater contamination and ensuring a more sustainable and widespread distribution of clean water resources.

The narrative of rural water supply schemes in post-independence India showcases a continuous quest for improvement. From initial reliance on handpumps to exploring diverse water sources and fostering community participation, the approach has undergone significant transformations. This journey reflects a constant struggle to address challenges like accessibility, affordability, and sustainability. While significant strides have been made, ensuring universal access to safe, affordable, and long-lasting drinking water remained an ongoing endeavour.

Navigating India's Water Policy Landscape

The evolution of water policies in India has been a dynamic process, reflecting the changing needs of the nation and the challenges posed by a growing population and increasing water scarcity. Three key

milestones in this evolution are the National Water Policy statements of 1987, 2002, and 2012, each contributing to the shaping of India's approach to water resource management.

Prior to 1987, India lacked a cohesive national water policy. Water management followed a fragmented approach, often leading to unsustainable practices. Recognising the growing water scarcity crisis, the 1987 National Water Policy (NWP) marked a watershed moment.

The policy set three physically verifiable goals: increasing the irrigated area to boost food production, meeting the drinking water needs of the entire population, and addressing sanitation needs. Emphasising the utilisation of groundwater, pollution elimination, and the scientific approach to water resource planning, the policy laid out a comprehensive framework. It declared water a 'prime national resource' and emphasised demand management through water-saving technologies and community participation.

This shift from a supply-driven approach acknowledged the crucial role local communities could play in planning and implementing water supply schemes. However, the 1987 NWP had limitations. It did not adequately address issues like water pollution, the emerging threat of climate change, or specific measures to ensure equitable access for all, particularly vulnerable communities.

By 2002, a review of the NWP was deemed necessary due to new challenges. The revised policy built upon the 1987 foundation while acknowledging the increasing urban population, climate change concerns, and water pollution. This policy focused on creating a vision plan and incorporating global perspectives and concepts in water sector development. The establishment of the Web-enabled Water Resources Information System (India-WRIS) in 2008 was a significant step, facilitating the exchange of data between government agencies and the public.

It also cautiously explored the role of the private sector in areas like water treatment and distribution, while emphasising strong public control. This shift in policy reflected an evolving understanding of water management. Environmental sustainability and the economic realities of water use have become more prominent concerns. The 2002 NWP called for water pricing that reflected the true cost, encouraging responsible water use.

A decade later, the 2012 National Water Policy underscored the growing urgency in tackling water security. India faced its first water crisis, necessitating a more proactive approach. The National Water Policy of 2012 sought to assess the existing state of water management and proposed a framework for a coordinated national approach. Recognising the need for a comprehensive legal framework, the policy recommended the establishment of a National Water Framework Law, drawing inspiration from the EU Water Framework Directive.

The policy explicitly emphasised water security, ensuring not just water availability but also equitable distribution. Rainwater harvesting was promoted as a critical strategy for augmenting water resources, and climate change adaptation became a crucial consideration.

Section B

Jal Jeevan Mission - A Plan for Changing Lives

Clean tap water brings joy to a family in Palanpur village, Banaskantha district, Gujarat

3

Water, Public Health & the 'Ease of Living'

India, the most populous country in the world, has 70% of its population living in rural areas. Every human being aspire for improved quality of life and dignity. Access to basic food and nutrition, and to services like water and sanitation, health and housing and safe environs are essential determinants to the development concept of 'ease of living'. These liveability indicators are linked to several Sustainable Development Goals (SDGs) and are paramount to enhance economic growth and sustainability.

Supplying clean and stable tap water to every household can be a game changer in India as the cornerstone of Indian development is built on the philosophy that everyone should have basic amenities in the long-term, and no one should be left behind.

Access to safe and regular water supply not only improves individual health but removes the drudgery of collecting water, thereby providing an 'ease of living' and an increase in productivity. A study (WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation, 2005b) claims drinking water can provide 320 million productive days each year in the 15 to 59-year age group, an extra 272 million school attendance days a year, and an added 1.5 billion healthy days for children under five years of age, together representing productivity gains of ₹ 990 crores a year. The report states that every year such episodes of water stress cause an economic burden of approximately USD 600 million to India. Inaccessibility to clean water eventually deprives rural folk of opportunities of a more fulfilling life.

Moreover, with finite water resources, rural families continue to struggle for basic facilities like water, and a large part of their day goes in the unproductive task of collecting water, especially for families of small farmers. In context of JJM, the term 'ease of living' envisages better opportunities for rural women to be self-reliant and capitalise on their experience as water managers in their community. It also implies that women in the village are entrusted with the responsibility of safeguarding water quality; be it the water at source or the delivery point. As a result, the women overcome societal obstacles and barriers and fulfil roles as plumbers, pump operators, fitters, etc. in the operation and maintenance of in-village water supply systems.

Towards 100% Coverage

In March 2019, the Department of Drinking Water and Sanitation (DDWS), Government of India, released the data from its Integrated Management Information System (IMIS) that only 3.28 crore out of then 19.33 crore rural households had individual tap water connections, accounting for a 17.7% coverage. This statistic highlighted the persistent challenge of inadequate access to clean and potable water. It emphasised the urgent need for comprehensive interventions to bridge this gap and ensure equitable access to safe drinking water for every rural household.

On 15 August 2019, (India's Independence Day), Prime Minister Narendra Modi announced that a new initiative, Jal Jeevan Mission, will provide Functional Household Tap Connection (FHTC) to every rural household in the country in next five years. This piped water supply to every home would be of quality, adequate quantity, with pressure, shall be regular and for a long term, heralding an era of transformative change among the rural communities.

With a single stroke, JJM endeavoured to reduce the high incidence of water-borne diseases and offer freedom to women and young girls living in rural areas from the drudgery of fetching water. The programme aimed to serve the public both at their homes as well as public institutions, such as schools, anganwadi centres (childcare centres), ashramshalas, Gram

Panchayat and related office buildings, community centres, health and wellness centres, etc.

The adequate quantity was set at a minimum of 55 lpcd (litres per capita per day), based on the calculations made for domestic water requirements and Bureau of Indian Standards (BIS) prescribed the standards for the quality. The other aspects of regularity and pressure were to be set by the villages themselves as suitable to their needs. This flagship initiative (costing estimated ₹3.60 lakh crore) would transform lives: no more loss of school days for young children, more opportunities for women to engage in income generation, and a life of dignity for every household.

The JJM also focussed on maintaining the sustainability of water sources through rainwater harvesting, groundwater recharge, and the management of local water sources. The mission also emphasised the treatment and use of 'greywater' (household wastewater from baths, sinks, washing machines, and other kitchen appliances) for agricultural purposes, thereby reducing the strain on freshwater sources.

Figure 2: Key Indicators for 'Ease of Living'

Source: Ministry of Housing and Urban Affairs

The Story of Hamburg: Role of Water for Public Health

In 1892, Hamburg, a bustling port city in Germany, experienced a devastating cholera outbreak. Hamburg was undergoing rapid urbanisation and industrialisation, with a growing population facing inadequate sanitation infrastructure. The outbreak was traced back to consumption of contaminated water from the Elbe River, the city's primary water source. The lack of proper sewage disposal and the mingling of sewage with drinking water exacerbated the crisis.

Thousands of residents fell ill to the severe dehydration and diarrhoeal symptoms characteristic of cholera, leading to a high mortality rate. The outbreak prompted urgent public health interventions and marked a turning point in recognising the importance of clean water and sanitation in preventing the spread of waterborne diseases. It served as a catalyst for significant advancements in urban sanitation and water management, and subsequent reforms included the development of modern sewage systems, water treatment facilities, and improved hygiene practices.

This historical case underscores the critical role of clean water in safeguarding public health, and emphasises the enduring importance of access to safe water for human development.

An illustration of the cholera outbreak in Hamburg, 1892

Source: Wikimedia Commons

Equal Distribution of Piped Water

Not only India surpassed China as the most populous country in the world in April 2023, concomitantly, there has been an increasing and competing demand for drinking water and expanding economic activities. Despite an improvement in overall access to water with over 99% of rural population having service delivery levels of either 40 lpcd or less, it remained uneven. The distribution of water remained unequal both between and within villages.

With JJM, the renewed focus was on universal access and good governance including mission-mode service delivery. A decade of basic services focused on universal access to housing, toilets, electricity, cooking gas, healthcare, roads, etc. have to a large extent improved the 'ease-of-living' among the rural populace. The cornerstone of Indian development was thus built on the philosophy that everyone should have basic amenities in the long-term, leaving no one behind.

Notably, the revolutionary trinity of Jan Dhan, Aadhar, and Mobile (JAM) that linked the Jan Dhan bank account (the no frill account for all); Aadhar number (the national identification number); and Mobile number of citizens, laid the groundwork for India's digital transformation and making services accessible for all. As a result, verifying became easy and fast, thus plugging any leakages in subsidies and also speeding up the Direct Benefit Transfers (DBTs).

In attendant, the next logical aspiration was to provide piped water supply within the household to further improve 'ease-of-living'. Assured availability of drinking water in the household premises will not only improve the health and socio-economic condition of rural population but will also bring dignity and reduce the drudgery, especially for women and girls. Further, the saved time and improved access to water can boost local economy with increased local employment opportunities.

Universal Sanitation, Universal Water Supply

Health, nutrition, income, and other vital concerns that contribute to a safe life and secure livelihood are invariably and intricately linked to the availability of safe water and sanitation, making it a national priority.

A national conference on JJM and SBM was held in Lucknow, Uttar Pradesh, on 16 February 2024

The movement towards safeguarding public health picked up its momentum in 2014 with the implementation of Swachh Bharat Mission (SBM), the largest behavioural change programme that made India open defecation free by 2019. At the launch of SBM(G) on 2 October 2014, the sanitation coverage was 38.70%. Almost a decade later, it was 100%.

When household tap connections were provided, JJM converged with SBM to achieve holistic sanitation, and the treatment of grey water became a vital component. With limited number of rainy days, more than 42% of land falling in arid and semi- arid regions, to ensure tap water supply to every home, collection and storage of rain water is essential. To achieve this objective, as a first step, focus was on improving sanitation. This would ensure clean rain water is collected and stored for drinking purposes.

However, the need to eliminate all kinds of contamination in the limited sources, especially faecal contamination, had set the stage for the next steps on water supply through the Swachh Bharat Mission by making India open defecation free. Adopting a mission-mode approach, it turned sanitation into a Jan Andolan, a people's movement, thereby making it everyone's business.

Ministry of Health and Family Welfare (MoHFW) regularly provides public health data through its integrated National Family Health Survey (NFHS) making a significant contribution towards evidence-based policymaking since 1992-93. Considering NFHS offers high quality, reliable, comparable and richly disaggregated population-level data on health and family welfare and related determinants, for JJM it was decided to produce data every three years including the effectiveness of the government programmes. The publicly available data fed the research appetite further supporting the evidence-based policymaking. A quick glimpse of the public health data serves as a testament to the ongoing efforts as well as provides direction for future work.

Although, several indicators have showed a marked improvement, some of them remain a cause of concern either because of marginal improvements only or its display of the potential to slip back. In this context, JJM remains a significant initiative for its ability to improve public health indicators (See Table 1).

Contamination of Water

Among communities, microbial contamination of water has been a concern for long. Within India, the cholera outbreaks are tracked by the Integrated Disease Surveillance Programme, which was launched in 2004. Between 2011 and 2020, there were 565 outbreaks that led to 45,759 cases and 263 deaths. While these outbreaks occurred throughout the year, they spiked during the monsoons.

During June-September, the majority cases were reported in five states of Karnataka, Madhya Pradesh, Maharashtra, Punjab, and West Bengal. A review analysing these outbreaks highlighted the main

Table 1: Glimpse of Public Health Indicators

#	Public Health Indicators	NFHS – 3 (2005-06)	NFHS – 4 (2015-16)	NFHS – 5 (2019-21)
1.	Diarrhoea in under-5 children	9%	9.2%	7.3%
2.	IMR – Infant Mortality Rate	57%	40.7%	35.2%
3.	NMR – Number of infant deaths of less than 29 days per thousand live births during a specific year	-	29.5%	24.9%
4.	U5MR – Under-five Mortality Rate	74%	49.7%	41.9%
5.	Stunting - based on a child's height and age, is a measure of growth faltering.	48%	38.4%	35.5%
6.	Wasting – based on a child's weight and height, is a measure of acute undernutrition	19.8%	21%	19.3%

Source: NFHS-3, NFHS-4 and NFHS-5

Life is Easier and Better, after Piped Water Arrives in the Village

Valana village, in Ahmedabad district of Gujarat, had no drinking water connections in 2020. The nearest water source was a km away. During summers, in desperation, villagers even resorted to drinking contaminated water.

During the COVID-19 pandemic, the Rural Water Supply Department of Gujarat started working to bring tap water to the village under JJM. The village's Sarpanch, Vasantben Bharwad, took charge of sharing the advantages of the scheme with everyone. She convinced her villagers to contribute towards the water supply scheme that assured water in every household. Many agreed, and the scheme took off. Once the 2-km distribution pipeline was laid, 560 household tap connections were created. Subsequently, tap water arrived in the village schools and anganwadis.

Today, the villagers have more time to engage in productive activities and also increase their earnings. Vasantben herself spends most part of her day at her tea stall as they had overcome the drudgery of fetching water.

Besides, the incidences of villagers falling sick due to contaminated water, and occurrence of infection and bald patches on women who carry heavy pots on their head have almost disappeared in Valana.

Tap water has reached the village of Valana

drivers to be contaminated drinking water and food, inadequate sanitation and hygiene (including open defecation), and direct contact between households, which underscored the urgent need to provide safe piped water supply directly within households.

As public health measures, the Swachh Bharat Mission and the Jal Jeevan Mission contributed jointly to enhanced health and nutritional and socio-economic status. As the availability of household piped water supply improved, it resulted in increased consumption of clean water which encouraged hygiene practices thus reducing infection rates and water-borne diseases. Besides, approach to safe water offered an opportunity for people to be free from irreversible diseases caused due to geogenic contamination such as Fluorosis, Arsenicosis, etc and food-borne diseases.

American development economist and Nobel laureate Michael Kremer (on 13 July 2022) has claimed in his research paper that nearly 30% infant deaths could be reduced if safe drinking water was made available to communities. He was appreciative of the mission's goal of not only providing water to rural households but also ensuring quality of the water supplied. Thus, JJM played a crucial role in improving health parameters.

A programme of such magnitude required developing in-village piped water supply infrastructure so that every home has a tap connection. Besides, such infrastructure ought to ensure that the water distributed is from a reliable drinking water source and the supply is sustainable. A key component of JJM was making investment in technology so as to remove contaminants from water; for greywater management; to maintain water quality laboratories for testing and surveillance; and evolving a system where villagers contribute to the sustainability of the supply system. In 2022, it had covered close to 50% villages thereby ensuring the safety of 1,36,000 infants (under five) who otherwise would have perished in the absence of safe drinking water.

4

Plan for Piped Water in Every Rural Home

Drinking water supply is a fundamental and essential service. The Jal Jeevan Mission (JJM) geared up to build systems that would last for generations as the mission's leadership envisioned a service-delivery approach rather than an infrastructure-driven approach. The water supply service delivery was defined as 'assured piped water supply in adequate quantity with sufficient pressure and of prescribed quality on regular and long-term basis in homes' – summarised as the Functional Household Tap Connection (FHTC).

The Indian Constitution posits water supply is a state subject and panchayats are responsible for providing water. Thus, JJM planners ensured a decentralised, bottom-up approach. The role of panchayats was further spelt out to set directions for their involvement in providing piped water supply. Panchayats and local village communities were to be trained to own the systems and shoulder the key responsibility of planning, implementation, management, operation and maintenance of the in-village water supply system.

With JJM, water was to be delivered on a mission-mode replacing the 'business-as-usual' mode. A 'sense-of-urgency' was instilled with the unique opportunity of assured funds available until 2024. Changing the working styles of different stakeholders became critical. It required intense 'change management' and leadership capacity development, thus identifying both capacity and capability barriers and solutions to address it in the form of massive investments to develop robust institutions to train, improve skilling, and build capacities at all levels of governance.

There are broadly 20 agro-ecological zones in India that have different amounts of annual rainfall and freshwater availability. About 256 districts out of a total 731 were deemed water-stressed in 2017, highlighting the need for simultaneous water conservation efforts along with provision of piped water supply. While awareness generation and people's movement are capitalised in making water everyone's business, there was a need for innovation and smart water management practices.

The average lifespan of a piped water supply (PWS) system is 30-40 years whereas that of a hand pump is 10-15 years considering the water table it is tapping from. However, in a country with over 6.5 lakh villages, water supply sector has revealed a peculiar mathematics. It was estimated that if 10,000 villages were provided with Piped Water Supply systems in a year, another 10,000 villages would emerge with serious issues of sustainability.

Hence, the idea was to provide a tap connection and ensure sustainability of PWS systems. To meet the aspirational needs of rural population, it was decided to bridge the urban-rural divide and help provide tap water supply in the households at three points – kitchen, toilet and bathroom. This again reflected the philosophy of service delivery.

The mission identified priority areas to provide tap water supply and also laid an outline for different components of water supply system under JJM, such as developing in-village water supply systems; retrofitting and augmenting existing water sources; providing bulk water transfer, treatment plans and distribution network; greywater management; training and capacity building; and meeting unforeseen issues such as natural calamities.

Prior to launching JJM, the most challenging task was to devise a strategy to achieve the target of universal coverage by 2024. As a diverse country, which follows a structure of cooperative federalism, collaboration between the national, state, and local governments is a prerequisite to collectively address the drinking water supply issue. Water being a state subject, the

Envisioning the Jal Jeevan Mission

Vision

Every rural household has drinking water supply in adequate quantity of prescribed quality on regular and long-term basis at affordable service delivery charges leading to improvement in living standards of rural communities

Mission

Jal Jeevan Mission is to assist, empower and facilitate:

- States/ UTs in planning of participatory rural water supply strategy for ensuring potable drinking water security on a long-term basis to every rural household and public institution
- States/ UTs for creation of water supply infrastructure so that every rural household has Functional Tap Connection (FHTC) by 2024
- States/ UTs to plan for their drinking water security
- GPs/ rural communities to plan, implement, manage, own, operate and maintain their own in-village water supply systems
- States/ UTs to develop robust institutions having focus on service delivery and financial sustainability
- Capacity building of the stakeholders and community on significance of water for improvement in quality of life
- In making provision and mobilisation of financial assistance to States/ UTs for implementation of the mission

Prime Minister Shri Narendra Modi released the Operational Guidelines for implementation of Jal Jeevan Mission on 25 December, 2019

views of state representatives and accounting for the resources available to them were crucial to planning.

All states were requested to update the data onto the Integrated Management Information System (IMIS). A broad picture emerged reflecting the drinking water supply status across India. While states like Gujarat, Telangana and Bihar were already implementing state-wide schemes to ensure universal coverage, there were many states that had low coverage.

Further, customised support was required to suit the state-specific challenges such as desert and drought-prone regions like Rajasthan, which needed surface-water interventions, Karnataka required water source and water quality strengthening, etc. Additionally, while some states largely warranted to focus on retrofitting and distribution networks with existing PWS systems, others necessitated to build new infrastructure. A comprehensive strategy was thus sought that could suit all these different scenarios.

Two major steps were taken to arrive at the national budget:

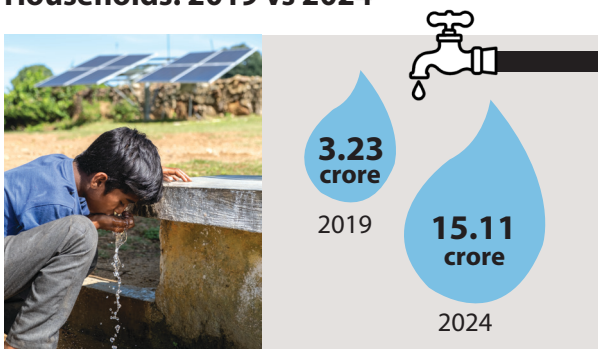
- First, the drinking water IMIS data which was updated over the last two decades and as part of the baseline exercise was analysed to obtain information on different water supply schemes and its associated costs to get estimates of per capita costs. These schemes were funded by different agencies including central and state governments, externally aided projects, etc.
- Second, several visits were undertaken across the country by different national teams to investigate different kinds of water supply schemes, its completion, coverage, functionality, challenges, people's opinions, etc. along with interactions with local and state level engineers and officials. These visits provided richer insights complementing the IMIS data and helped arrive at per-capita costs.

Now, more than 15 crore households have tap water connections. Five years ago, around 3.2 crore households had tap water connections.

Data was also analysed to make estimates for different components of water supply systems as well as identifying drinking water sources that have sufficient quantity and are of good quality (at least 55 litres per capita per day) as per the Bureau of Indian Standards (BIS). Identification of water sources with good Q&Q (Quantity and Quality) was important to understand the scope and estimates for distribution, augmentation, conjunctive use, bulk-water transfer or finding alternatives.

Next, a fund-sharing pattern was identified between Centre and states with 90:10 for Northeast

Figure 3: Tap Water Connection in Rural Households: 2019 vs 2024



and Himalayan states, 50:50 for other states and 100:0 for Union Territories (UTs). Most importantly, to instil ownership of local village communities, contribution was encouraged towards 5% of the capital cost for in-village water supply scheme in the form of cash and/ or kind and/ or labour in hilly and forested areas/ North eastern and Himalayan states and villages having more than 50% SC and/ or ST population; and 10% in remaining villages. Lastly, estimates included up to 5% of the annual allocation to the states for support activities such as human resource, training, communication, monitoring, etc., and 2% of the total allocation for strengthening water quality monitoring and surveillance activities.

Identifying Priority Areas

Under JJM, priority was accorded to water quality-affected habitations, villages falling in drought-prone and desert areas, Japanese Encephalitis/Acute Encephalitis Syndrome (JE/ AES) and Aspirational districts, SC/ST (scheduled caste/ scheduled tribe) majority villages and Saansad Adarsh Gram Yojana (SAGY) villages. This was in recognition of the urgency of ensuring potable tap water supply in certain areas that may be more vulnerable than others. States and UTs were also urged to ensure priority to villages in these areas that have lower development indicators throughout their planning, implementation, and evaluations in order to provide a chance for these areas to catch up to the pace of rest of the nation. It was observed, that even in villages with PWS did not equitable water supply distribution. The poor, SCs/STs did not get water connections in such villages.

Japanese Encephalitis – Acute Encephalitis Syndrome (JE-AES) is a life-threatening illness primarily affecting children and young people, and it is often malnourished children from low-income families who are vulnerable. Its etiology is complex and its vector-borne nature often gets aggravated in poor hygienic conditions. Hence the emphasise on the importance of safe water, sanitation and hygiene services.

With the Ministry of Health and Family Welfare serving as the nodal ministry, up to 60 high priority districts across five states were identified for the purpose of enhancing preventative and control measures with joint efforts of five other union ministries. Jal Jeevan Mission thus became a key programme in reducing the burden of disease in the affected districts of Assam, Bihar, Tamil Nadu, Uttar Pradesh and West Bengal by providing safe tap water supply to poor households.

The NITI Aayog, Government of India, identified Aspirational Districts based on their low human development indices, and significant inter-state and inter-district variations in development form another priority area. The 117 Aspirational Districts were ranked using 49 indicators across five sectors including a 30% weightage for health and nutrition (with 13 indicators) and a 20% weightage agriculture and water resources (with 10 indicators) among others driving inter-state competition promoting speedy implementation of various development programmes. With the principle of 'no one is left out', the Jal Jeevan Mission aimed to ensure piped water supply to these unserved and difficult areas often in remote locations or border areas with terrain challenges. On 15 August 2019, when Jal Jeevan Mission was announced, only 21.30 lakh (7.8%) households in 117 Aspirational Districts had tap water supply in their homes, whereas by end August 2024 that figure significantly rose to cover over 2.12 crore (77%) households (Read more in Chapter 14).

Similarly, Saansad Adarsh Gram Yojana(SAGY) villages launched in 2014 to encourage Members of Parliament (MPs) to develop three model villages in their constituencies including sustainable piped water supply systems formed another priority area as it holds potential to synergise efforts. Villages with majority SC/ ST population too are often under-developed and require more attention.

Women map village resources during participatory appraisal in Gujarat

The other priority area was the water quality-affected regions. Arsenic and Fluoride contamination in groundwater is geogenic in nature and the long-term and sustainable solution lies in replacing ground water schemes with surface water-based piped water schemes. However, ensuring such water supply systems involving bulk water transfer and treatment consumes time. Thus, purely as a stop-gap arrangement, states are advised to install Community Water Purification Plants (CWPP), especially in Arsenic and Fluoride-affected habitations as an interim (short-term) measure to provide 8-10 lpcd meeting drinking and cooking needs of population living in affected villages. Simultaneously, states are to plan for piped water supply to every home in these habitations on priority.

Evidence-based Strategy

States/ UTs were asked to create baseline assessments covering every rural household and update the data on JJM – Integrated Management Information System (IMIS) for proper planning, implementation, and monitoring. While the first snapshot emerged in August 2019 at the time of announcement, considering the massive scale of this exercise, states were requested to review and revalidate the data over the first year, and the exercise culminated by June 2020.

In August 2019, out of the total 19.33 crore rural households, only 3.23 crore (17%) households were having provision of tap water supply. Thus, to ensure clean tap water supply to remaining 83% rural households, water supply infrastructure had to be created to provide Functional Household Tap Connections to about 16 crore households in 5 years. Besides, along with upgrading existing water supply systems to make them JJM compliant, it had to also account for the number of households that would keep increasing, and the systems must cater to them as well.

To achieve this goal, a well thought strategy was developed and adopted. In villages with existing piped water supply system(s), all remaining households and public institutions, viz. schools, anganwadi centres, ashramshalas healthcare/wellness/ community centres, panchayat buildings, etc., were provided with tap water connections by taking up retrofitting/ augmentation of existing water supply schemes, if needed, to make them JJM compliant. Most importantly no family has been left out and all remaining households have been priotised.

In villages where ground/ surface water of good quality is available in sufficient quantity, single village schemes (SVS) were planned and executed. It is the most preferred option as it is easy to operate and maintain by GPs/ VWSCs/ Pani Samitis. In villages with adequate groundwater but with quality issues, water was treated to remove contaminants and/or surface water-based water supply scheme from a dependable source was planned. In water-stressed, drought-prone and desert areas, bulk water transfer, treatment plants and distribution systems were planned and executed with equal emphasis on strengthening of local drinking water sources to achieve long-term water security, and so that O&M expenses on water transfer/pumping is kept to the minimum.

In isolated tribal hamlets/ hilly/ forested areas, stand-alone solar-based and/ or gravity-based water supply systems were given priority as such systems have low O&M expenses and easy to operate and maintain by local community.

Tap water delivered to the mountaineous region of Ladakh

A Task Force consisting of 14 members representing policy makers, experts and practitioners having expertise in drinking water supply and decentralised governance was constituted to analyse various drinking water programmes taken up in the past two decades in various states/ UTs to ascertain whether the substantial investments on these programmes have delivered satisfactory results, reasons for failure/ success, and to incorporate the learning from these programmes to fine-tune the JJM implementation strategy.

Operational Guidelines for Implementation

The Operational Guidelines for the implementation of JJM were prepared through participatory process over four months and was then released by the Prime Minister on Good Governance Day, i.e., 25 December 2019. In the spirit of bottom-up approach, regional conferences were held in each zone of the country covering all states and engaged stakeholders from local to international. Each conference had two components. One on the work and status so far and the other on their inputs, challenges, experiences of the state counterparts followed by discussion.

During this exercise, various reports from Task Force, Comptroller and Auditor General (C&AG), Parliamentary Standing Committee, recommendations of Parliamentary Consultative Committee, etc. too were taken into the account. The Parliamentary Standing Committee has the authority to identify pressing issues and seek expert opinion and present its report. Besides examining such reports on water issues, the parliamentary questions raised by MPs too were studied to understand the concerns of their constituents that provide insights into the kind water challenges arising in different parts of the country.

The Task Force used a three-pronged approach to carry out this mammoth task. First, they held several internal meetings to decide on the best strategy and shared expert views amongst each other. Second, 21 experts and professionals working in the sector provided their insights on the current status, challenges, and issues of rural drinking water sector and suggested remedies to overcome those. Lastly, the team conducted field visits to 29 states and 4 UTs to review the programmes in rural water supply and assess the current status. During these visits members interacted with officers in-charge of rural water supply, village communities, members of self-help groups, and local NGOs to capture the best practices in the sector, document and identify the triggers for success and reasons for failure. The Task Force report provided a well-researched guidance input to ensure a robust policy that addresses the needs of both the present and future populations.

The full-fledged implementation on the ground began with the launch of these robust guidelines, which provided the vision, mission, detailed strategy, planning and implementation roadmap for the states/ UTs to make provision of tap water supply to rural households and public institutions in villages.

5

Institutional Arrangements

Jal Jeevan Mission (JJM), a time-bound and mission-mode programme, needed a robust institutional framework for its successful implementation. Appropriate institutional mechanisms are inevitable for effective planning and implementation, seamless coordination and collaboration among diverse partners and stakeholders. This ensures accountability and transparency, mobilises resources, builds capacities, and ensures long-term sustainability. Ultimately such energised mechanisms contributed to the JJM's aim of providing assured tap water supply to every rural household.

The JJM's goal was not just a provision of FHTCs but also to build a robust institutional system that focuses on 'service delivery' in the long-term.

National Jal Jeevan Mission

As a special focus mission, JJM was set up at the national level within the Department of Drinking Water and Sanitation under the Ministry of Jal Shakti with specific objectives, timelines, milestones and deliverables. It was headed by a mission director with a directorate, empowered to ensure drinking water security to rural communities. The National Jal Jeevan Mission (NJJM) was responsible for overall policy guidance, technical support and financial assistance to states including regular monitoring and corresponding corrective action in a time-bound manner.

As the nodal office at central level, the national mission played a key role. It coordinated with other relevant departments and ministries for convergence of funds and resources, explore and build partnerships with a wide variety of national and international organisations of repute with similar goals. Further, it facilitated cross-learning and scaling up of innovative interventions, help troubleshoot any implementation challenges faced by states, carry out functionality and impact assessments, support communication campaigns, etc. Most importantly, promoting innovation and technology and ensuring expeditious implementation without any compromises.

To support these core activities, a 'Data and Documentation Centre' was set-up with the help of National Informatics Centre (NIC). The NIC is the official technology partner of Government of India under the Ministry of Electronics and Information Technology (MeitY) which was established in 1976 and over the decades, it has emerged as a competent technology partner to both central and state governments to provide Information and Communication Technology (ICT) infrastructure and advice on emerging technologies.

The NIC supported the implementation of JJM through design and maintenance of a wide variety of IT portals maintained by the mission, each customised to cater to the specific needs of the stakeholders. It maintained the IMIS (Integrated Management Information System), the largest repository of rural drinking water supply schemes, and generated timely reports that feed directly into project management and evaluation as well as can help in planning targeted interventions. This often-included monitoring key deliverables of the mission and creating new data capturing formats required to address specific issues that emerge as implementation progresses along with training state partners involved in the implementation.

In addition, the NIC also managed the development, maintenance and training of digital tools including the JJM-dashboard, JJM mobile application, JJM-IMIS and Water Quality MIS with the support of technical agencies. These tools were significant in capturing and tracking progress of the mission as well as setting milestones. By providing timely consolidated information, it helped the decision-support system. Further, these systems have also facilitated data entry for states for which regular training and follow-up was being carried out. This process also promoted transparency and accountability in the system.

Project Management Units

In 2019, it was planned to provide FHTCs to approximately 16 crore rural households. However, states were requested to conduct re-verification exercise to update the baseline data especially keeping in view the new households added in the recent past. The resultant workload was massive requiring highly qualified technical and project management professionals to ensure timely implementation.

Jal Jeevan Mission emphasised early in the programme the key role of women in water management. Many were trained in various states to take on new roles in the management of water resources.

This entailed substantial tasks not only in project management involving physical and financial progress but also in conducting IEC campaigns, documenting, and sharing best practices, performing techno-economic/ socio-economic analyses of water supply systems, exploring innovative technologies, promoting greywater treatment and re-use, etc.

To support NJJM in achieving these goals, Project Management Units (PMUs) co-terminus with the duration of the mission timeline were set up. Two PMUs with highly qualified personnel were established with one providing technical support and other offering management support. They comprise specialists with expertise in public health engineering, techno-economic analysis, community mobilisation, capacity building, knowledge production, documentation and dissemination, training, campaigns, etc. and the mission is assisted by a bunch of inspired professionals who are also committed to contributing to the country's growth.

The technical support team assisted states by conducting frequent field visits and carrying online consultations especially by providing technical guidance, evaluating projects for cost-effective implementation, suggesting corrective measures wherever required, developing design templates and cost estimates for small standalone schemes, aiding in piloting innovative solutions which go beyond the conventional technological interventions to address specific challenges.

The management support team offered assistance in overall project management and monitoring, utilising data analysis tools to identify the bottlenecks in implementation and also provides inputs for financial planning. They also supported NIC in designing the numerous reporting formats for the Jal Jeevan Mission IMIS based on emerging requirements that enable easier monitoring and evaluation. The team also oversaw third-party inspection agencies, functionality assessments, training and capacity building programmes, organising national level conferences/ workshops/symposiums, rolling out communication and awareness programmes and campaigns.

Apart from PMUs, close to 200 sector partners in WASH sector, viz. UNICEF, UNOPS, Tata Water Mission, and WASH Institute also extended their support through placement of highly qualified personnel as consultants for assisting the national mission.

Training, Capacity Building and Research

The effective implementation of JJM required strategic planning and implementation of water supply systems while establishing appropriate institutional mechanisms at all levels. To accomplish this objective, it was deemed imperative especially to reorient and sensitise the engineering officials, district administration, and field-level functionaries about the 'public health angle' of water supply programmes and also ensuring synergy between the efforts made by these strategic players.

To facilitate these efforts, over 104 reputable governmental and non-governmental academic institutions, agencies, firms, organisations, think tanks, training institutions, etc, across the country were enlisted as Key Resource Centres (KRCs) who could play a key role in the mission by reorienting stakeholders, capacity building, documenting and disseminating information, etc.

Furthermore, realising the importance of generating knowledge that can address problems in the drinking water sector, a dedicated institute at national level for conducting research was given additional mandate in consonance with the objectives of the mission. The National Centre for Drinking Water, Sanitation, and Quality (NCDWSQ) was set up as an autonomous

Campaigning about Jal Jeevan Mission in rural Rajasthan

institution under the Department of Drinking Water and Sanitation (DDWS), Ministry of Jal Shakti, and serves as a nationally significant institute for public health engineering.

An eight-member expert committee, chaired by the Principal Scientific Advisor (PSA) to the Government of India comprising three directors of Indian Institute of Technologies (IITs), a former utility head, and public health experts crafted the vision and roadmap. This was done to elevate the institute to an internationally relevant one which now runs training programmes throughout the year catering to a wide array of stakeholders in drinking water sector.

Similarly, a committee was formed to promote collaboration with academic and research institutions, 'Jal Jeevan Mission Professor Chairs' have been conceptualised to conduct high-quality empirical and applied research in the rural drinking water and sanitation sector, addressing sectoral challenges.

State Water and Sanitation Mission

Akin to the national mission, the State Water and Sanitation Mission (SWSM) was set-up under the nodal ministry/ department responsible for rural drinking water supply in that particular state. The chief secretary, the senior most administrative official in the state, was made responsible for overall coordination, convergence and policy direction of SWSM; the Administrative Secretary of the Public Health Engineering Department (PHED)/Rural Water Supply (RWS) department was tasked with overall implementation and monitoring of the mission.

The SWSM, though its first form was set up in late 1990s, has been strengthened and reoriented by giving the prime mandate of providing piped water supply to every rural household under the Jal Jeevan Mission. The mission also stressed the need for delegation of powers to accord technical and administrative sanction to officers at various levels of hierarchy. By empowering the districts/ sub-districts to take key decisions regarding projects that fall under their jurisdiction it aimed to avoid unnecessary delays and accelerate the implementation. This is in line with the bottom-up approach, while the remaining schemes that require large scale interventions being further examined at the state level.

Most of the personnel in the SWSM are taken under deputation from various departments to ensure the time-bound implementation of the Jal Jeevan Mission (JJM). However, to enhance synergy and bring-in subject matter expertise, alongside

Members of Pani Samitis in Assam participate in an online meet with Prime Minister Narendra Modi

government officials, the mission engages such specialists on contractual basis. In addition to public health engineers, the mission comprised of officials and personnel specialising in project management, hydrogeology, water quality, finance, information technology (IT), Information, Education, and Communication (IEC), capacity building, training, and NGO coordination, etc. Most SWSMs are supported by Project Management Units (PMUs) as well.

Structure of SWSM

The SWSM comprises both an apex committee and an executive committee. The functions of apex committee include policy guidance and overseeing overall planning, strategising and implementation of JJM within state, finalising State Action Plans (SAPs) along with Annual Action Plans (AAPs), financial planning including timely release and utilisation of funds, coordinating and convergence.

The functions of executive committee include supporting the creation of district-level mission teams, collate information, monitoring physical and financial performance, promote and support innovation, coordinate with district missions, empanel agencies for speedy implementation, identify NGOs as partner agencies, prepare and roll-out communication and capacity building plans, etc.

Each state also has a State Level Scheme Sanctioning Committee (SLSSC)/ State-level Technical Committee which examines the proposals of water supply schemes that do not fall under the purview of district-level missions, which are often schemes involving large scale infrastructure. This committee comprises both state and national level officials including technical experts from reputed technical institutions.

Gram Panchayat/ Village Water and Sanitation Committee

JJM was meant to be implemented as a decentralised, demand-driven, and community-managed programme with the Gram Panchayat and/ or its sub-committees, such as the Village Water and Sanitation Committee (VWSC)/ Pani Samiti/ User Group assuming pivotal roles in the planning, implementation, management, operation, and maintenance of water supply systems that fall within the village boundary, thereby resulting in Functional Household Tap Connections (FHTCs) for every rural household.

The Public Health Engineering Departments (PHED) or Rural Development and Panchayati Raj (RDPR)/ Rural Water Supply (RWS) Departments responsible for rural drinking water supply in states, are tasked with facilitating Gram Panchayats in fulfilling their

duties. As a corollary, the mission aims to empower Gram Panchayats/ Pani Samitis to truly function as 'local water utilities' dedicated to water supply service delivery in the long-term.

The Gram Sabha decided as to who is responsible for managing water supply in the village be it the panchayat or its sub-committee. In most cases, the states authorities facilitated these decisions. The Gram Sabha decided whether it was to be led by the Sarpanch, Deputy-Sarpanch, GP member, traditional village head, or senior village leader with the support of Panchayat Secretary, Patwari, or Talati serving as the secretary.

While the Pani Samitis may consist of 10 minimum members, including elected panchayat members, 50% women members and the remaining 25% representatives from marginalised sections of the village (SC/ ST) in proportion to their population, different states have come up with different formats suitable to their needs. The state government issues appropriate notifications under the Panchayati Raj Act to provide authority and power to these committees.

To support the development of in-village piped water supply infrastructure and associated source development, village communities are encouraged to contribute 5% of the capital cost in cash, kind, or labour in hilly, forested, Himalayan, Northeastern states, and villages with over 50% SC/ ST population; and 10% in the remaining villages that do not fall under any specific category. As an incentive for successfully completing and maintaining the scheme, communities will be rewarded gradually, receiving 10% of the capital expenditure as revolving fund for their respective in-village water supply scheme for long term operation and maintenance.

6

15th Finance Commission Grants to Rural Local Bodies

When Mahatma Gandhi famously stated that 'every village will be a republic or panchayat having full powers', he envisioned self-governance right to the village level. The 15th Finance Commission's tied grant for water and sanitation in Panchayati Raj Institutions (PRIs)[1] was a step towards this ideal of making rural citizens in charge of their basic needs and facilities.

Ensuring access to safe drinking water, sanitation, and hygiene is crucial for public health. In a landmark move, the 15th Finance Commission (FC, 2020) recommended an allocation of ₹ 2,36,805 crore to Rural Local Bodies (RLBs) for the period 2021-22 to 2025-26. Previously, funding for WASH in rural areas was limited and not guaranteed. The 15th FC mandated a 60% of this grant for Water, Sanitation and Hygiene (WASH). This ensured a consistent and targeted flow of funding to these sectors. To ensure smooth functioning, the commission granted interim awards for the year 2020-21.

The 60% (tied grants of ₹1,42,084 crores,)[2] (see Table 2) is for drinking water, rainwater harvesting, water recycling, sanitation and maintenance of the Open Defecation Free (ODF) status. This 'tied grant' signifies that these funds are earmarked exclusively for these crucial activities, underscoring their paramount importance in the Finance Commission's vision for rural local bodies (RLBs). Earmarked funds and increased financial autonomy empowered Rural Local Bodies, institutes of self-governance to plan and implement WASH programmes based on their specific needs and context. This allowed RLBs to invest in long-term solutions and infrastructure development. RLBs were given power to interchange allocations between water and sanitation as per their needs.

Past initiatives to provide drinking water to rural communities yielded JJM valuable lessons, such as proper investment in both initial infrastructure and ongoing operation and maintenance system yields long term sustainability besides the importance of community ownership and engagement. Community involvement in planning, implementing, managing, and maintaining water supply systems fosters a sense of ownership, a 'utility mindset' focused on service delivery and ensures the long-term sustainability of water sources and systems. Successful Initiatives like the Water and Sanitation Management Organisation (WASMO) in Gujarat and Swajal in Uttar Pradesh and

Table 2: Year-wise Allocation of Tied Grant for Water Supply & Sanitation Services

Year	Tied Grants (In ₹ crore)		
	Water	Sanitation	Total
2021-22	13,470	13,470	26,940
2022-23	13,954	13,954	27,908
2023-24	14,106	14,106	28,212
2024-25	14,940	14,940	29,880
2025-26	14,572	14,572	29,144
Total	71,042	71,042	1,42,084

Source: Surya, S., PRS Legislative Research, & Institute for Policy Research Studies. (2021, February). Report of the 15th Finance Commission for 2021-26 (report). PRS Legislative Research.

[1]Constitutional Provision. Ministry of Panchayati Raj, India. (n.d.). Retrieved from https://panchayat.gov.in/constitutional-provision/
[2]Surya, S., PRS Legislative Research, & Institute for Policy Research Studies. (2021, February). Report of the 15th Finance Commission for 2021-26 (report). PRS Legislative Research. Retrieved from https://prsindia.org/files/policy/policy_committee_reports/Report%20Summary_15th%20FC_2021-26.pdf

Uttarakhand exemplify the success of community ownership models. Access to clean drinking water improves the health and socio-economic conditions for rural populations and alleviates women and girls the drudgery water collection.

However, effectively implementing such a large-scale programme across a vast and diverse rural landscape necessitates significant financial resources. The 15th Finance Commission played a crucial role by allocating adequate financial resources that contributed to building a better system for drinking water security in rural India, while fostering community ownership and ensuring the sustainability of water supply systems.

Finance Commissions

The Indian Constitution mandates the establishment of the Finance Commissions under Article 280. The President of India constitutes a Finance Commission every five years to recommend the distribution of tax revenues between the central government, state governments, and local self-governments- both urban and rural local bodies.

The Finance Commissions generally aim to achieve a balance between equity and development needs. The commission ensures that states with greater needs receive a larger share of resources by considering factors like population size and income disparity, forest and ecology and tax and fiscal effort. This helps bridge the development gap between different regions and promotes balanced economic growth across the country.

The 15th Finance Commission notified in 2019 drinking water supply and sanitation as national priorities. As per the 73rd Amendment to the Indian Constitution, every Gram Panchayat and/or its sub-committee, i.e., Village Water and Sanitation Committee (VWSC)/ Pani Samiti, etc., is expected to function as a 'local public utility' capable of managing, operating, and maintaining in-village water supply and sanitation services on a regular and long-term basis. It is entrusted with the aim to strengthen Panchayati Raj Institutions and contribute to India's overall development trajectory.

To guide the release and utilisation of funds provided by the 15th FC, the Ministry of Finance

During a participatory rural appraisal (PRA) exercise, residents of the Awantipura village, Sehore District, Madhya Pradesh, mapped their resources

issued guidelines. Following these guidelines the 'Operational Guidelines for the implementation of the 15th Finance Commission recommendations on Rural Local Bodies grants during the period 2021-22 to 2025-26'[3], were issued by DDWS department.

Transforming Rural Lives: Clean Water and Sanitation for All

The Constitution of India, under the 73rd Constitutional Amendment Act of 1992, established a robust system of rural local governance – the Panchayati Raj Institutions (PRIs). The 11th Schedule[4] outlines the roles and responsibilities of PRIs, specifically empowering them to play a vital role in water management. Some key responsibilities include:

Water Resource Management: The PRIs are responsible for the planning, implementation, and operation of water supply schemes within their jurisdiction. This encompasses rainwater harvesting, well maintenance, and ensuring equitable distribution of water resources.

Sanitation and Hygiene: The PRIs play a crucial role in promoting sanitation and hygiene practices within villages. This includes construction and maintenance of toilets, solid waste management, and creating awareness about hygiene practices.

Financial Management: They are entrusted with the financial resources allocated for rural development. This includes budgeting for water management projects, ensuring transparency and accountability in fund utilisation.

Community Mobilisation: They act as a bridge between the government and the community. They are responsible for mobilising villagers, raising awareness about water conservation initiatives, and facilitating community participation in water management projects.

Village Water and Sanitation Committees Deliver Clean Water

Pani Samitis, also known as Village Water and Sanitation Committees (VWSC), are playing a critical role in bringing clean tap water to every rural household in the country. These committees are responsible for planning, building, managing, and maintaining village water supply systems.

Prime Minister Narendra Modi highlighted their importance during a video conference with Gram Panchayats (village councils) and VWSCs on 2 October 2021. This virtual meeting marked the launch of the Jal Jeevan Mission App, a tool designed to raise awareness and ensure transparency and accountability. Out of over 650,000 villages in India, Pani Samitis/ VWSCs have already been established in roughly 524,000 villages. Furthermore, more than 51 lakh village action plans have been prepared, outlining the specific steps needed to deliver clean water access in each community.

To ensure the effective utilisation of the 15th Finance Commission grant, several measures were taken. State governments were encouraged to devolve powers to PRIs, particularly Gram Panchayats or their sub-committees, for planning, implementing, operating, and maintaining village water supply systems and sanitation infrastructure. This decentralisation of authority aligned with the core principles of the Panchayati Raj system, empowering local communities to take ownership and responsibility for their development.

The 15th FC has not differentiated between operation and maintenance and capital expenditure. RLB should prioritise allocating funds first to create building infrastructure and then making arrangements for drinking water and sanitation services. Gram Panchayats are also responsible for providing potable water and sanitation services in public institutions such as schools, ashramshalas (tribal residential schools),

[3]Department of Drinking Water & sanitation, Ministry of Jal Shakti, GoI (2021, August). Manual for the utilization of 15th Finance Commission tied grants to Rural Local Bodies/PRIs for water & Sanitation (2021-22 to 2025-26). Manual for the utilization of - 15 Finance Commission tied grants to - Rural Local Bodies/ PRIs for water & sanitation

[4]Eleventh Schedule of the Constitution of India | Ministry of Panchayati Raj | India. (n.d.). Retrieved from https://panchayat.gov.in/document/eleventh-schedule-of-the-constitution-of-india/

Woman Sarpanch Leads from the Front

Sarpanch Sanju Yadav (in yellow saree) with her village community

Sanju Yadav, a 38-year-old resident of Bamer village in Jhansi district, Uttar Pradesh, won the post of Sarpanch (village head), and gained first-hand knowledge of the challenges her community faced: lack of toilets and handwashing facilities, limited access to healthcare, and inadequate water supply.

Women felt a sense of increased representation, finding it easier to voice their concerns to a female leader. Sanju enrolled in a Rapid Action Learning (RAL) training programme organised by UNOPS in Lucknow. She attended the RAL programme, with her son's support, which equipped her with valuable knowledge on village development planning, water quality monitoring, and waste management.

Stagnant water in the village lead to mosquito breeding caused by overflowing toilets and malfunctioning pumps. Lack of water supply rendered many available toilets unusable. Recognising the need for both improved water management and behavioural change, Sanju arranged a workshop to foster collaboration and knowledge exchange among the villagers.

Sanju learned about women in neighbouring state of Madhya Pradesh who worked as plumbers and pump operators, ensuring water availability and performing minor repairs. Further, having local technicians ensured the long-term sustainability of the water supply system.

Sanju is actively involved in strengthening the VWSC and its sub-committees responsible for water quality testing, community engagement, water user charges, and other essential functions. Every step, regardless of scale, contributes to the JJM's goal of providing every rural household with safe, clean drinking water on a regular and long-term basis.

Sanju Yadav's story offers a perspective on the role Panchayati Raj Institutions can play in facilitating community development. By enabling women to participate in local governance, PRIs can create space for them to address community issues and contribute to building a better future for their villages.

health centres, GP buildings, weekly haats, mela (fair) grounds, bus stands, playgrounds/ sports complexes, and more. Moreover, Gram Panchayats should prioritise greywater treatment, reuse, and avoid releasing untreated greywater into water bodies or rivers.

Furthermore, leveraging the 15th Finance Commission grant in tandem with ongoing national initiatives such as the JJM's and Swachh Bharat Mission (SBM) 2.0 has been crucial for achieving optimal results. By aligning the 15th Finance Commission grant with JJM objectives, PRIs can accelerate the pace of providing assured tap water supply to rural households, significantly improving access to clean water [5] .

[5]Year End Review 2022: Department of Drinking Water And Sanitation, Ministry of Jal Shakti. (n.d.). Retrieved from https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1886953#:~:text=Funds%20Allocation%2%200for%20Jal%20Jeevan%20Mission%3A&text=The%2015th%20Finance%20Commission,2025%%202D26%5B2%5D.

The Department of Drinking Water and Sanitation (DDWS) acts as the nodal ministry for determining the eligibility of rural local bodies for the grant and recommending its release to the Ministry of Finance. Furthermore, the DDWS provides technical guidance to RLBs in implementing the grant and utilising the funds efficiently. States are required to identify nodal departments to coordinate with the DDWS and work closely with RLBs/ PRIs. These nodal departments hold the responsibility for implementing the 15th Finance Commission's recommendations, monitoring fund utilisation, reporting, and data updating.

Prime Minister, Shri Narendra Modi, interacted virtually with five Village Water & Sanitation Committees on 2 October 2021

Capacity building at the village level was paramount for the successful implementation and long-term sustainability of these initiatives. The DDWS prepared a comprehensive manual outlining the proper utilisation of the 15th FC funds, which has been translated into local languages to ensure wider accessibility and understanding. Additionally, massive sensitisation and training programmes are being conducted to empower panchayat functionaries on utilising the grant effectively for delivering tap water supply and improved sanitation in villages. This included training local community members such as masons, plumbers, and pump operators to ensure regular service delivery and maintenance.

The 15th Finance Commission's grant by empowering local governance institutions, promoting capacity building, and fostering collaboration between various stakeholders, has revolutionised the way for water supply and sanitation services that are being delivered in rural India.

Section C

Water Management by the People, for the People

Residents of Sundan Village, District Anand in Gujarat, list out water resources in their village to engineers

7

Community-led Water Service Delivery

The Jal Jeevan Mission offered a paradigm shift in the drinking water sector. It aimed to ensure long-term water security by putting the reins of water delivery systems in the hands of local communities. JJM envisioned that each village would own the water supply infrastructure and be responsible for the operations and maintenance of the water system. Aim was to ensure that villages would no longer have to rely on emergency measures such as transporting water by tankers or trains or by installing new borewells each year.

The 73rd Amendment to the Constitution of India recognises the 'Principle of Subsidiarity' which entails the delivery of services by the lowest appropriate level of governance institutions. This amendment empowers Panchayati Raj Institutions (PRIs) with the management of 29 subjects, including 'drinking water'.

The central government-sponsored rural drinking water supply schemes, such as the Accelerated Rural Water Supply Programme (ARWSP) and the National Rural Drinking Water Programme (NRDWP), necessitated the involvement of PRIs from the planning stage until the final takeover of drinking water assets and service delivery. The revised NRDWP notably focussed from handpumps to incrementally increasing piped water supply with household connections.

However, the effective engagement of PRIs in delivering water supply services faced several challenges. The concept of 'take over' or 'handing over' the schemes itself indicated limited participation of communities who were often seen at the 'receiving end' to simply deal with the system provided to them and expected to own, operate, and maintain. This approach, often coupled with inadequate financial mechanisms, presented several Operation and Maintenance (O & M) issues resulting in dysfunctional systems that could not complete their design period.

Before JMM, water supply services were perceived as technical activities that were largely construction-oriented. The State Rural Water Supply Department/ Board/ Corporation ran the services and there was limited involvement of local village communities and PRIs in the planning phase. Inadequate training for local human resources, weak institutional procedures, and a failure to prioritise budgetary planning for assuring drinking water service delivery further limited community engagement. Thus, the water delivery mechanism continued to follow a top-down approach.

With JJM, a more bottom-up approach was adopted to ensure that service delivery is led and organised by village communities/ PRIs, embodying the spirit of Gram Swaraj (wherein decision-making authority is vested with the village community). The village community was empowered to take their own decisions and plan their finances to ensure regular and stable tap water supply.

Empowering Gram Panchayat and the Village Community

The mission identified several key challenges in previous rural water supply programmes regarding participation of PRIs. These included a largely engineering-oriented approach and insufficient availability of human and financial resources at the Gram Panchayat (GP) level.

The mission planned to involve GPs and other village groups in the planning, implementation, operation, and maintenance of the water supply systems. This approach positioned GPs and rural communities as the primary stakeholders, fostering a sense of ownership and responsibility for their water resources and systems.

Village communities were now actively involved in

various aspects of water supply services: including demand generation for household tap connections, deliberating and choosing the appropriate water supply scheme, overseeing its implementation, managing the finances and ensuring long-term operation, and maintenance (O&M) of the scheme.

A dedicated Village Water and Sanitation Committee (VWSC) was set up by the state governments under the Panchayati Raj Act, denoting their significant role in ensuring water supply systems and granting authority for the planning, implementation, management and maintenance of their in-village water supply systems. States usually decide if a GP or a VWSC would lead the in-village work. The state government also decides on the identity of such groups, considering them as Pani Samitis or user groups.

The Pani Samiti is a standing committee of the GP and is responsible for planning, implementation, operation, maintenance and management of village drinking water security.

The panchayats have the power to establish the committees in line with the composition requirements of ensuring about 10-15 members with minimum 50% women members and proportionate representation from Scheduled Castes/ Scheduled Tribes of the village, as well as defining their key responsibilities, setting and collecting water user charges, managing day-to-day operations, etc. While panchayats play a pivotal role, the district and state officials play a crucial role in supporting the panchayats and facilitating the delivery of their responsibilities.

'Jal Sahiya' Sunita Devi, a catalyst of change

Sunita Devi, from the Kotkhas Gram Panchayat, is a driving force behind JJM in Jharkhand. As a member of 'Jal Sahiya', an all-women group supporting water activities, she spearheads the water and sanitation activities including water testing.

Sunita Devi worked on changing the community's mindset by encouraging them to take the responsibility of ensuring potable tap water supply. She led the community to embrace the Village Action Plan (VAP) for JJM implementation through education and mobilisation efforts.

Moreover, Sunita and her team mobilised villagers to take charge of planning and execution of the water delivery system.

Despite initial resistance to water tax, once the mission's goals were communicated – sustainable, affordable access to quality water – the villagers got involved in the initiative.

Today the change in Kotkhas is visible. After getting household tap connections, villagers save time and engage in productive activities. Through initiatives like water tax collection, the community ensures sustainability of water infrastructure.

Sunita Devi, Jal Sahiya of Kotkhash Village delivering monthly water bill

Sunita Devi and the Jal Sahiya group exemplify the power of community leadership in driving the success of JJM. Their dedication and resilience pave the way for a water-secure future, where every individual enjoys the fundamental right to clean water.

Planning for Present and Future

Planning is the first step towards ensuring long-term drinking water security. Under JJM, each village prepares a Village Action Plan (VAP) that is typically valid for the five-year coterminus with the 15th Finance Commission period. This forms the guiding document providing directions for implementation, allocating resources, identifying scope for convergence and collaboration, ways to manage future risks, preparing for future demands, etc.

The Village Action Plan is informed by a baseline survey, mapping of available resources and gaps, and the felt needs of the local community. One of the key components of VAP is identifying and finalising the most suitable water supply system for their village. To assist the village community in making this decision, Public Health Engineers are tasked with presenting at least three techno-economic viable options to choose from, allowing the community to select the most suitable option for them while considering the associated community contribution. This process empowers GPs in designing and executing their water supply systems.

The VAP broadly comprises four main components: augmentation and strengthening of drinking water sources; establishment of drinking water supply systems; treatment and reuse of greywater; and operation and maintenance (O&M). Approved in the Gram Sabha, the VAP serves as the primary document guiding water supply and related initiatives, ensuring every household receives clean tap water in adequate quantity, of prescribed quality with adequate pressure on a regular and long-term basis.

The Implementation Support Agencies (ISAs) help the panchayats, VWSCs by hand-holding them throughout the process including carrying out baseline surveys, conducting resource mapping exercises by mobilising communities, raising awareness about the mission and its goals, helping prepare VAP and its approval process, facilitate meetings between stakeholders, etc.

This proactive strategy emphasises educating and training communities about various issues:

- Significance of clean tap water for health
- Judicious water usage practices
- Prioritisation of domestic water needs
- Importance of greywater treatment and reuse to alleviate freshwater demand
- Timely payment of water user charges
- Prompt grievance redressal mechanisms
- Monitoring and surveillance of water quality accompanied by remedial measures

A handbook titled 'Margdarshika for Gram Panchayat & VWSC to Provide Safe Drinking Water in Rural Households' was developed in both Hindi and English languages with provisions for states to get it translated to local languages to empower panchayats/VWSCs in effectively delivering on their roles and responsibilities. This handbook delineates the roles and responsibilities of panchayats and explains the different components of rural water supply infrastructure, phases of water supply scheme implementation, detailing various water quality issues and ways to treat them, and how to plan for efficient operation and maintenance, etc. It equips any individual at the village level with knowledge and information on water supply systems developing their thought leadership as well.

Building a Cadre of Skilled Professionals in Every Village

The JJM's decentralisation focused on developing 'responsive and responsible leadership' at the grassroots level, nurturing the skills and confidence of panchayat/ VWSC representatives, and establishing a cadre of trained Water, Sanitation, and Hygiene (WASH) professionals in each village. This is in line with the JJM goal of changing the lives of people and empowering village communities to become 'Jal Prabuddha Gaon' (enlightened villages) that are fully capable of self-analysis, deliberation, decision-making, implementation, and evaluation.

To ensure that a pool of skilled personnel is always available at the village level, local youth have been trained in various trades such as masonry, plumbing, electrical work, motor mechanics, and pump operation. This initiative not only provides local employment opportunities but also enables communities to contribute to the development and maintenance of water supply infrastructure within

Shobha Devi: A Pillar of Sustainability

Shobha Devi, a dedicated member of the VWSC from Narghoghi village, Samastipur district, Bihar, emerged as a leader in water management. She, along with other women, meticulously maintains a user charge system.

A nominal monthly fee of ₹30 ensures the availability of funds for necessary maintenance (regular upkeep is essential for the system's long-term functionality). It also ensures minor repairs and prompt repairs prevent leaks, ensuring efficient water usage.

Periodic meetings are held to discuss water usage, address concerns and promote responsible water consumption. The reliable piped water supply has significantly improved the lives of Narghoghi residents. Women are now free from the drudgery of collecting water. Villagers are happy that the water they get is clean and 'sweet-tasting', which has even improved the quality of their cooked rice.

The story of Narghoghi is a testament to the transformative power of women in leadership positions in rural India. When given the opportunity, women can effectively manage resources, promote community participation, and ultimately improve the quality of life for all villagers.

Women attend panchayat meetings in Bihar

their villages. Most importantly, their availability is expected to play a key role in the speedy execution of water supply infrastructure as well as enable them to carry out regular operation and maintenance work including prompt repairs thus ensuring no interruptions to the water supply provision.

The mission has also offered local communities the opportunity to learn and lead water quality surveillance activities through training sessions. In every village, five individuals, preferably women, are being trained on water quality assessment using portable Field Test Kits (FTKs) to test and report the drinking water quality. These individuals conduct regular tests, and sanitary surveys, and upload data onto the JJM portal.

Overall, it is expected that about 20-25 members are trained and upskilled in each village including Panchayats and 10-15 VWSC members, and five skilled persons as masons, plumbers, electricians, pump operators, motor mechanics, etc., and five women on water quality surveillance.

Ensuring Financial Sustainability

One of the reasons for water systems falling into disuse is the lack of financial sustainability. To address this, JJM empowered the panchayats to receive the grants directly enabling them to plan and implement water supply work.

The village communities are encouraged to contribute to the mission either in cash and/ or kind and/ or labour towards capital costs wherein the value of contributions made in the form of kind or labour would be equated to cash. Furthermore, they are also encouraged to recover the costs in the form of monthly water user charges. All contributions are recorded in a register by the Gram Panchayat and are presented at the social audits for improved accountability and transparency.

Additionally, considering the various central and state government initiatives hold the potential to complement each other and lead to holistic outcomes benefiting individuals and communities, JJJM provides an opportunity for convergence. Financial coordination at the village level thus involves pooling resources from various funding sources, including grants from the 15th Finance Commission to Panchayati Raj Institutions (PRIs), Jal Jeevan Mission, Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGA), Swachh Bharat Mission (SBM), District Mineral Development Fund (DMDF), Corporate Social Responsibility (CSR) funds, among others, to ensure effective utilisation of funds.

Gram Panchayats/ VWSCs can utilise these funds for activities like water conservation, aquifer recharge, rainwater harvesting, and greywater treatment, all aimed at achieving water security in villages. By aligning the 15th Finance Commission grants with schemes like JJM and SBM (G), the funds available to the PRIs for water and sanitation initiatives are enhanced, thereby improving resource availability locally.

The Department of Drinking Water and Sanitation (DDWS), under the Ministry of Jal Shakti, is designated as the nodal department responsible for establishing the eligibility criteria for local bodies to receive the grant, as well as for offering technical assistance and guidance to states. Furthermore, state governments conduct extensive training and capacity-building initiatives to empower Gram Panchayat/VWSC officials to effectively utilise this tied grant as intended, which is to ensure tap water supply to every household and public institution, along with improved sanitation in their respective villages.

Lastly, to further support the panchayats/ VWSCs in building their financial resources, the JJM provides an incentive to every village that becomes 'Har Ghar Jal', i.e. a village with 100% tap water supply to households. The incentive ranges around the percent of the contribution made by the community towards the capital costs and thus serves as a 'revolving fund' for them to rely on until water user charges are collected efficiently.

8

Capacity Building for Better & More Reliable Water Delivery

India's vast population of over 144 crore (1.44 billion)[6] and its diversity present numerous challenges in implementing large-scale social programmes. Reaching basic services to millions of people and ensuring long-term functionality of projects across different regions requires an efficient delivery system. Equally critical is the team of experts needed to close the gap between the objectives and planning processes of the programme and its on-ground reality.

Jal Jeevan Mission's ambitious goal of ensuring safe tap water to more than 19 crore rural homes, presented several logistical challenges. Delivering water infrastructure over wide geographical regions (forests, hills, deserts, wetlands, snow-laden districts) with various socio-economic realities required, not just laying pipelines and pumps to integrate the system on ground, but create a well-equipped workforce and an empowered community that can operate and maintain the system independently.

While determining the mission's vision to instil a 'sense of ownership' among the community/ user groups for better implementation and long-term Operation and Maintenance (O&M) of the programme, a crucial question emerged: Were the stakeholders prepared/ qualified/ trained to translate this vision into reality? To bridge the gap between JJM's vision and on-ground implementation, a comprehensive training approach was initiated to build capacities of different teams that would uphold the standards of JJM and shall be committed to precision and reliability in water quality assessment. A spectrum of technological innovations required trained personnel with the capacity to tailor the programme to the community's needs and resources.

An online JJM training portal was established to provide access to materials for all stakeholders. About 104 Key Resource Centres (KRCs)[7] were identified to provide a tailored training programme to each group to ensure everyone possesses the necessary knowledge and skills for their role. Specialised training equipped the stakeholders with the technical expertise to operate and maintain water supply systems efficiently.

Additionally, the Dr Syama Prasad Mookerjee National Institute of Water and Sanitation (SPM-NIWAS), formerly known as the National Centre for Drinking Water Sanitation and Quality (NCDWSQ) started in December 2022, focussed on training government officials on best practices in water management, sanitation and hygiene promotion. Training programmes were also initiated for community-level stakeholders for JJM's success.

Jal Jeevan Mission Training Portal

To simplify training access, a user-friendly online training portal[8] was started. This innovative platform streamlines several aspects of the training process:

- **Identifying Training Needs:** The portal facilitates the easy capture of training requirements for elected representatives and officials involved in JJM. This data is then used to accurately assess the overall training demand and develop targeted training calendars that directly address specific needs.

[6] In 2023, As per United Nations Population Fund (UNFPA)
[7] These institutions would be engaged for capacity building, reorientation of different stakeholders, dissemination of knowledge and information, development of high-quality print and audio-visual content, documentation of best practices, etc. to transform the ecosystem of drinking water supply sector.
[8] JJM Training Portal. (n.d.-e). https://ejalshakti.gov.in/krc

- **Enhanced Programme Visibility:** The KRCs can readily publish its upcoming training programmes on the portal. This transparency allows participants to easily discover programmes based on convenient locations, specific focus areas (thrust areas), faculty expertise, and availability of resource materials before the training begins.
- **Effortless Participation:** Once training calendars are published, states can nominate key stakeholders for relevant programmes. Trainees can then browse available options, register online with a few clicks, and receive timely alerts about programmes of interest. This simplifies the entire participation process.

The JJM Training Portal offered extensive features. Trainers uploaded resources and tracked trainee attendance within the platform. Additionally, the National Jal Jeevan Mission (NJJM) gained real-time insights into training activities, allowing them to identify potential gaps and ensure smooth programme execution.

A Multi-tiered Approach: Equipping Stakeholders for Success

The NJJM, with its emphasis on empowering stakeholders at all levels, exemplifies the principle of 'Building Partnerships and Changing Lives'. The NJJM has issued a document[9] describing the minimal conditions for any institution to apply for that category and become a KRC under JJM. About 104 such institutions, enlisted by the NJNM, have served as the foundation of JJM's training programmes. These specialised institutes, including the Indian Institute of Technology (IIT), National Institutes of Technology (NIT), and reputed State institutes, have the technical expertise and experience to design and deliver capacity-building programmes that are tailored to the specific needs.

Who Got Trained and Why

The training programme comprised of a varied group of stakeholders. They were categorised into three levels. There were:

Capacity building and IEC awareness session held in Weziho village, Kohima, Nagaland, on 5 March 2024

[9] Modi, N. (2020). Jal Jeevan Mission. In Guidelines for Capacity Building by Key Resource Centres. https://jaljeevanmission.gov.in/sites/default/files/manual_document/revised_krc_guidelines.pdf

- **Policymakers and Senior Officials (Level 1):** This category included Chief Engineers/ Engineers -in-chief, department secretaries, and other senior functionaries responsible for formulating policies, allocating resources, and overseeing JJM implementation at the state level. This reorientation programme equipped them with a comprehensive understanding of JJM guidelines, financing mechanisms (including budgetary allocations, central funding, and convergence with other water-related schemes), and best practices in rural water supply management. This knowledge enabled them to make informed decisions, streamline bureaucratic processes, and ensure effective programme implementation.
- **Middle Functionaries (Level 2):** Superintending Engineers, and Executive Engineers District Water and Sanitation Mission (DWSM) officials, Public Health Engineering Department (PHED), and other professionals are part of this category. Their training focused on technical skills critical for the planning, design, construction, and operation of water supply systems. This includes training on water source identification and assessment (groundwater exploration, surface water potential evaluation), selection of appropriate treatment technologies based on water quality parameters, designing efficient distribution networks considering factors like topography and population density, and construction methodologies adhering to quality standards and safety protocols.
- **Community-Level Stakeholders (Level 3):** This crucial group comprised of panchayat and Village Water and Sanitation Committee (VWSCs) members, self-help groups working on water and sanitation issues, and community representatives. Their training equipped them with knowledge of water quality testing using simple field test kits, hygiene promotion practices to prevent waterborne diseases, and basic system maintenance tasks like minor leak repairs and meter readings. This community-level capacity is essential for ensuring ownership, accountability, and long-term sustainability of water infrastructure projects.

What Gets Covered in the Training

The curriculum for JJM training sessions varied based on the target audience. Here's a glimpse of some topics covered:

1. **Policies and Guidelines:** Participants gain a thorough understanding of JJM's objectives, funding mechanisms, and implementation frameworks. This includes detailed explanations

Table 3: JJM Level-wise Stakeholder Training and Number of KRCs Empanelled

Level	Target Group	No. of KRCs Empanelled*
Level – 1(L-1) Senior management level	Senior Policy Makers, Senior SWSM Officials, Administrators, Chief Engineers/ Engineers-in-Chief, etc.	10
Level – 2(L-2) Middle management level	DWSM officials, Superintending Engineers, Executive Engineers, Junior Engineers, Water Utility Managers and Water Testing laboratory personnel from Public Health and Engineering Departments (PHEDs)/Rural Water Supply (RWS) Departments/Public Works Departments (PWDs), etc.	27
Level – 3(L-3) Community level	Elected Panchayati Raj Institution (PRI) Members, Gram Panchayat (GP) Officials, VWSC Members, Members of Implementation Support Agencies (ISAs),etc.	84

*03 KRCs have been empaneled for all levels, 07 KRCs for L-1 & L-2; 09 KRCs for L-2 & L-3 Community level

Every Drop Counts

Rani, a chemist from Rourkela, Odisha, travelled to Delhi for a water quality testing training programme alongside 300 PHE/ RWS department personnel from 15 states. The programme targeted two critical areas: empowering laboratories and optimising water treatment processes. Rani, along with her colleagues, participated in classroom sessions, hands- on lab work, and site visits. Site visits further solidified their learnings, and interactive discussions fostered collaboration among colleagues from diverse regions.

The programme's impact was swift. In 2022-23 and 2023-24, over 550 laboratory staff from 28 states and UTs received intensive residential training and workshops. This surge in trained personnel significantly enhanced the capabilities of PHE/ RWS departments.

With her hard-earned knowledge and skills, she can now analyse water samples with greater confidence. The reliable data she generates allows for targeted water treatment solutions, ensuring the delivery of safe and potable drinking water to rural communities. This, in turn, has a ripple effect on public health, leading to a decrease in waterborne illnesses.

Participants at the training session, conducted at Shriram Institute for Industrial Research, Delhi

of the Functional Household Tap Connection (FHTC) concept, norms for water quality testing, and grievance redressal mechanisms.

2. **Technical Aspects of Water Supply Systems:** Engineers and technicians receive training on water source identification, treatment technologies (including chlorination, filtration, and reverse osmosis), distribution network design, and construction methodologies. They learn about various water treatment options suitable for different water quality conditions and geographical contexts.

To ensure the transparency of these training programmes, an online calendar[10] was created that includes dates for training, the type of training (residential or online), and various topics such as 'Transforming GPs/VWSCs for Functioning as Utility-Planning & Strategy for Improved Service Delivery'. Institutes were also assigned to these trainings

[10] Calendar of Level-1 KRC training programmes. https://jaljeevanmission.gov.in/sites/default/files/training_calendar/Training-Calander-Level-1-02022022.pdf

A Village Learns to Take Action

Gudem Golugula Valasa (GG Valasa), a village in Srikakulam district, Andhra Pradesh, is home to 506 residents, primarily Scheduled Tribes (STs). Their daily lives revolved around collecting water from hand pumps and wells and this challenge became acute during summers.

Jal Jeevan Mission (JJM) marked a turning point for GG Valasa. Led by the energetic Sarpanch, Urlapu Lakshmi, the community actively participated in the programme. A well-attended Gram Sabha meeting introduced the 'Har Ghar Jal' programme. And, a 14-member VWSC was immediately formed, with over 50% of its members being women. A comprehensive village action plan was made, paving the way for tap connections in all 127 households of GG Valasa.

A five-member women's surveillance committee received training to test water quality using Field Test Kits (FTKs). Today, GG Valasa proudly boasts functional tap connections in every home, school, and anganwadi centre. Following JJM's guidelines, a celebratory Gram Sabha meeting confirmed the availability of clean, adequate, and pressurised water. This official declaration certified GG Valasa as a 'Har Ghar Jal' village, a remarkable achievement fuelled by collective effort and a strong sense of community ownership. K. Paradesamma, the anganwadi teacher, witnesses the positive changes first-hand. Women are now actively participating in the workforce, particularly in the cashew plantations, earning ₹3000-5000 per month and contributing to the family's well-being. With readily available safe drinking water, childhood illnesses have decreased, leading to improved school attendance.

and given their email addresses for more effective interaction.

Building Capacity for Effective Water Management

Successful water management requires an empowered community. And JJM aims to empower these rural communities by providing trainings in following areas:

1. **Operation and Maintenance (O&M):** Effective O&M is critical for ensuring the long-term functionality of water systems. Training equips personnel with the skills and knowledge necessary for routine maintenance, minor repairs, and troubleshooting common problems.
2. **Financial Management:** Development of understanding in financial planning, budgeting, and proper utilisation of JJM funds empowers local government bodies to manage water supply projects effectively.
3. **Monitoring and Evaluation:** Robust monitoring and evaluation systems are crucial for tracking progress, identifying challenges, and ensuring the programme's effectiveness. Training equips stakeholders with data collection and analysis skills for effective monitoring of JJM implementation.

The JJM's investment in capacity building yielded positive results. Communities learnt to monitor water quality, address minor issues, and advocated for their water needs. Skilled professionals were better equipped to plan, design, and construct water supply systems that meet specific community needs and adhered to quality standards. Trained personnel could effectively operate and maintain water infrastructure, minimise disruptions and ensure long-term functionality. The mission eventually offered an opportunity to improve water management and modernise and democratise water governance.

9

Women Say Goodbye to Drinking Water Scarcity

For centuries, women in rural India have borne the burden of fetching water for their families from far flung areas. Collecting water not only consumes significant time and energy but also exposes women to physical dangers, such as the risk of snake bites or attacks while navigating remote areas. In hilly or mountainous terrains of Northeast or in deep forested areas of Western Ghats, the rugged topography compounds the difficulty of water collection. Such journeys subject the women to chronic fatigue, strains, and heightens their vulnerability to accidents and injuries.

The psychological toll of living in constant uncertainty over water availability cannot be understated. The persistent stress, anxiety, and mental anguish can have long-term effects on their physical and reproductive health further deteriorating their overall well-being.

In India, over 256 of the 700 districts of India's districts were reported to be water-stressed, and many were 'critical' and 'over-exploited' as per the Central Groundwater Board (CGWB) in 2017[11]. This meant that fetching water in these districts of India had been tougher, as the water table fell deeper making them the most vulnerable to the challenges stated. From limited access to clean water, economic constraints, and restricted participation in decision-making processes, it was felt that such vulnerabilities had to be addressed.

To address such vulnerabilities, JJM not only managed to provide tap water to every home but enabled women to become active participants of water governance – they would monitor the quality of water, check how much supply is being delivered and at what intervals. The mission also sought to empower women to reclaim their time, dignity, and future. In doing so, it not only promised to revolutionise the lives of millions but also to propel India towards a future defined by gender equity and social progress.

Reducing Drudgery

According to the National Report of Functionality Assessment, 2022, 72% of the women surveyed reported a reduction in the time and effort for collecting water (Graph 2).[12] In the study, women from 32,000 households reported that they used to fetch water before getting a functional household tap connection.

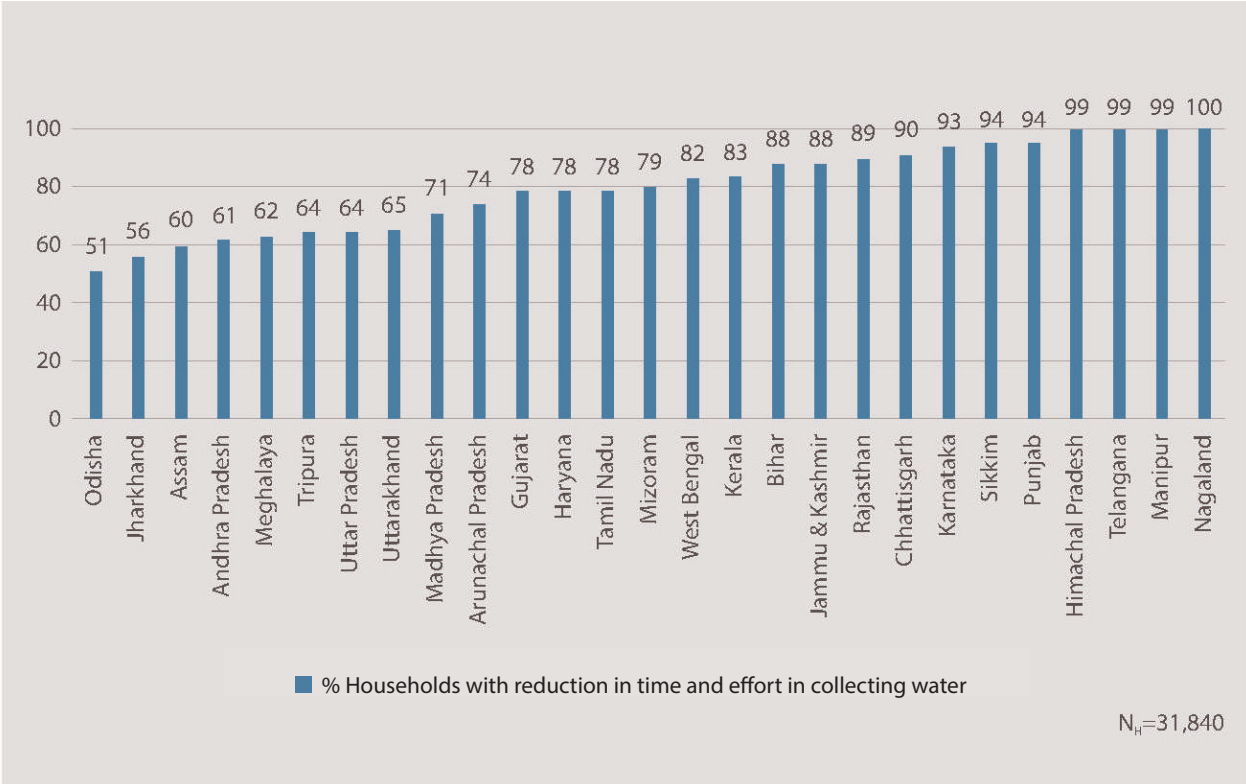
This potentially translates into an improvement in the quality of life for women and children, as it may allow them to redirect their time and energy towards education, income-generating activities, and personal development, thereby contributing to their overall empowerment and well-being.

By engaging in entrepreneurship, agriculture, economic ventures, and leisure activities, women can better contribute to their well-being, family financial stability, and economic independence, thereby fostering empowerment at the grassroots level.

[11] Central Ground Water Board (CGWB) is a multi-disciplinary scientific organisation of the Department of Water Resources, River Development, and Ganga Rejuvenation, Ministry of Jal Shakti Government of India. Central Ground Water Board is the National Apex Agency entrusted with the responsibility of providing scientific inputs for the management, exploration, monitoring, assessment, augmentation, and regulation of groundwater resources of the country. CGWB yearly report 2017-18 can be accessed at Central Ground Water Board, Ministry of Water Resources, RD &GR Government of India. (n.d.). https://www.cgwb.gov.in/old_website/Ann-Reports.html

[12] The Functionality Assessment Report 2022 can be accessed at - Jal Jeevan Mission. (n.d.). https://jaljeevanmission.gov.in/functionality-reports

Graph 1: Reduction in Time Taken and Effort Made in Collecting Water (2022)



Breaking Gender Barriers: Women Become 'Techies'

By offering them pivotal roles in water governance and breaking down gender barriers in traditionally male-dominated sectors, women were put in charge of taking care of their water resources. JJM has implemented extensive training programmes across the country that equip women with the skills and knowledge needed to take on roles such as plumbers and masons, traditionally perceived as male domains.

Partner organisations were instrumental in this endeavour, offering skill development programmes where women plumbers were earning as high as ₹40,000 per month.[13] Partner organisations like Pratham, in collaboration with government bodies and CSR partners, transformed vocational training with programmes like the Waterwork Management and Sanitation Programme (Plumbing) Trade. By providing accessible training and certification, these initiatives encouraged women from disadvantaged backgrounds, offering them vital skills for employment in traditionally male-dominated sectors.

Through comprehensive training sessions being conducted nationwide, women have been empowered to step into these roles with confidence, challenging societal norms and stereotypes. Moreover, JJM has not only provided technical skills but has also entrusted women with critical responsibilities, such as monitoring and maintaining water quality devices. By placing women at the forefront of water governance, JJM has enhanced the effectiveness and sustainability of water projects and has fostered gender equality and empowerment in rural communities.

[13] In an interview with Mr. Shivaji Kadam, Pratham Foundation, stories of empowerment were shared which can be accessed on YouTube at https://www.youtube.com/watch?v=HORbI7ZUHx4

Women across rural India have been trained in skills like plumbing and water testing that were traditionally performed by men



Key Role in Water Governance

The 'bottom-up' approach of JJM empowered women in the realm of water governance and management. Unlike its predecessor, the National Rural Drinking Water Programme (NRDWP), JJM mandated that at least one-third of the members of Village Water and Sanitation Committees (VWSC) should be women. This inclusionary provision not only promoted gender equity but also ensured that women have a meaningful role in decision-making processes related to water supply schemes, a crucial aspect often overlooked in previous initiatives. This push has greatly worked as a catalyst for the success of this mission and women's participation in ensuring sustainable water management across India.

All-Women Pani Samitis: A Key to Gujarat's Success

The concept of Pani Samiti, as exemplified by the transformative experience of Motipura Veda village in Gujarat's Gandhinagar district, is a symbol of community empowerment and women's leadership in water management.

In Motipura Veda, the introduction of a piped water supply system, coupled with the establishment of an all-women Pani Samiti, heralded a paradigm shift in the lives of its residents, particularly women.

The government of Gujarat created a 'Special Purpose Vehicle' called Water and Sanitation Management Organisation (WASMO) in 2002 to empower rural communities. Under this innovative scheme, villagers were actively involved in decision-making processes, including the location and construction of an elevated storage reservoir. Through collaborative efforts, the samitis devised water tariffs, managed operational logistics, and facilitated routine maintenance, thereby ensuring equitable access to clean water for all households.

The success story of Motipura Veda resonated across Gujarat and beyond, inspiring emulation of the Pani Samiti model in numerous villages nationwide. As of August 2020, a staggering 98% of villages in Gujarat have adopted piped water supply systems managed by community-led Pani Samitis, showcasing the scalability and effectiveness of this participatory approach.

The Gujarat model of women's empowerment through Pani Samitis serves as a shining example of decentralised governance, community ownership, and sustainable water resource management. Its widespread adoption underscores the potential for grassroots initiatives to drive transformative change and promote gender equality in water governance practices throughout India.

These Pani Samitis consist entirely of women members. These women undertake responsibilities such as:

A. **Decision-making on user fees:** The Pani Samitis decide on user fees for the sustainability of water schemes, ensuring that financial resources are effectively managed and allocated for the maintenance and upkeep of water infrastructure.

B. **Oversight of Water Scheme Operations:** They also monitor the functioning of water schemes, including water quality, distribution, and maintenance.

C. **Community Engagement and Awareness:** The women engage with local communities to raise awareness about water conservation practices, hygiene, and sanitation, empowering residents to take ownership of water resources.

D. **Advocacy and Representation:** These women serve as advocates for the water-related needs and concerns of their communities, representing their interests in interactions with government officials, agencies, and other stakeholders.

E. **Capacity Building and Training:** Pani Samiti members receive training and capacity-building support to enhance their knowledge and skills in water management, governance, and leadership, enabling them to effectively fulfill their roles and responsibilities.

The Village Water and Sanitation Committees (VWSC)/ Pani Samitis of 10-15 people are being constituted and strengthened. The Village Action Plans are developed through community engagement and Implementation Support Agencies (ISAs) are engaged to support village communities in programme implementation and create awareness among people.

The mandatory 50% representation and participation of women has led them to take proactive steps towards ensuring drinking water security in their villages. This has also fostered the cultivation of accountable and responsive leadership at the grassroots level, aligning with Mahatma Gandhi's vision of 'Gram Swaraj', wherein decision-making authority is vested within the village community, especially women who understand the value of water by being connected with it at various levels.

By end August 2024, significant progress has been made to ensure community participation, especially from women. Out of a total of 6,50,000 villages across the country, VWSC/ Pani Samitis have been constituted in 5,26,000 villages. Additionally, village action plans have been prepared for 5.13 lakh villages, indicating a comprehensive approach towards addressing water challenges at the grassroots level. These action plans serve as blueprints for implementing water supply schemes tailored to the specific needs and conditions of each village, thereby accelerating progress towards the JJM's goal of providing piped water to every rural household in India.[14] Women's participation in such a process within four years of JJM's inception highlights the importance they truly deserve in water governance.

From Household Income to National Economy: Employment and Women

Enhancing opportunities for individual household incomes and thereby boosting the national economy, JJM emerged as a significant catalyst for women's empowerment. A study was undertaken by IIM-Bangalore with technical support from the International Labour Organisation (ILO) in 2023.[15] It reflected a detailed analysis of direct and indirect potential under JJM by estimating generation of 2.82 crore person-year employment including 59.93 lakh person-year of direct employment during the construction phase of JJM and an additional 2.22 crore person-year of indirect employment through manpower engaged. Concurrently, there has been a notable increase in the female labour participation rate in India, rising to 37% in 2022-23 from 23.3% in 2017-18, as reported by the Periodic Labour Force Survey.[16]

In the empowering journey facilitated by JJM, the formation of Pani Samitis at the village level emerges as a noteworthy initiative. The 50% reservation for women recognised and elevated women as primary stakeholders in water governance. Furthermore, the mission's commitment extends to providing

[14] Data sourced from JJM Dashboard

[15] Naik, G., & Singh, A. (2023). Assessment of Employment Generation Potentials of Jal Jeevan Mission. In IIMB-WP N0. 687/2023. https://www.iimb.ac.in/sites/default/files/2023-09/WP%20No.%20687.pdf

[16] Information sourced from- Parthiban, A. (2023, August 10). Jal Jeevan Mission has 2.82 crore employment generation potential: IIM Bangalore study. Careers360. https://news.careers360.com/iim-bangalore-study-jal-jeevan-mission-has-2-82-crore-employment-generation-potential

Members of Pani Samiti at a water quality monitoring meet in Anand district, Gujarat

specialised training for women in utilising water contamination testing kits, known as Field Testing Kits (FTKs), thereby nurturing a cadre of skilled and informed women leaders in water management.

Under this initiative, five women are identified and trained from every village to conduct water sample testing using FTKs. A staggering 24.7 lakh women have undergone this training by end August 2024 with over 59.6 lakh samples tested through FTKs. This concerted effort not only empowers women by involving them in crucial decision-making processes but also equips them with the necessary skills to actively contribute to ensuring the safety and quality of water resources within their communities.

Collaborating with Pradhan Mantri Kaushal Vikas Yojana

JJM also opened avenues in traditionally male-dominated roles like plumbing and masonry. Women nationwide are already breaking barriers, contributing their expertise to water management, and shaping a narrative of gender-inclusive progress. This can be exemplified by initiatives like 'Jal Sahelis' in Bundelkhand, where trained volunteers repair handpumps. In Rajasthan and Gujarat, 'Bhujal Jankars', or para-hydrologists, monitor groundwater under Atal Bhujal Yojana. Linking training, finance, and self-help groups is catalysing women's self-employment and fostering gender-inclusive water security in rural and urban areas.

When 'Jal Andolan' Becomes a 'Jan Andolan'

The participation of women in water governance has transcended conventional boundaries, and is epitomising a paradigm shift in gender dynamics. With JJM, their integral involvement spans crucial roles in water testing, skill enhancement, and governance, exemplifying their multifaceted contributions towards creating a 'Jan Andolan', that is, a people's movement for water. The terminologies may be different across regions but the underlying goal is one. In Odisha, for instance, the Gram Vikas

Droplets of Determination – Assam's Inspiring Water Warrior

An inspiring story of Bhabani Boro emerged as a beacon of resilience, transforming her life and that of her family through her unwavering determination and spirit in Choudhury Para, a village in the heart of Uttar Dakhin Bongaon Gaon Panchayat, Bongaon blocks, Kamrup district, Assam.

Besides having born into an impoverished family, her father Prafulla Boro's death left them in dire straits. Her brother Bhupen Boro shouldered the responsibility for a while until tragedy struck again as he got killed in an accident.

Yet, Bhabani refused to surrender to despair. Her uncle, Paban Rabha, a seasoned Khalashi of PHED, guided her to embark on a journey of self-discovery. She courageously undertook tasks related to the water supply scheme, learning to start the machines, manage the backwash system, and maintain the scheme's hygiene. Paban Rabha's mentorship became the guiding light that illuminated her path toward hope and empowerment.

Bhabhani fills the bucket through her household tap connection

Bhabani's life took an unexpected turn when Jal Jeevan Mission (JJM) cast its transformative spell on their retrofitted scheme in her panchayat to provide tap connections to 153 households. The panchayat president heard Bhabani's story from her uncle, subsequently, the village Panchayat of Uttar Dakhin Bongaon recognised her commitment and resilience by appointing her as a Pump Operator for the scheme in 2022 under JJM's umbrella.

Bhabani dived into her role with unwavering dedication. She underwent training from CML Tata Trust (ISA) and is managing the entire scheme with remarkable proficiency. These training sessions equipped her with the knowledge of pump operation, maintenance, and water quality testing using Field Testing Kits (FTKs), transforming her into an expert in the field.

Bhabani's influence extended beyond the scheme's machinery. With a heart dedicated to her community's welfare, she actively participated in awareness meetings organised by CML Tata Trust. Her voice became an advocate for safe drinking water, echoing the importance of this vital resource. In the face of challenges like pipe leakages or damaged machinery, Bhabani used her interpersonal skills, motivating the community to contribute towards repairs. Her smart management ensured the scheme's sustainability and longevity. The depth of Bhabani's commitment is mirrored in her meticulous record-keeping, documenting cash flows, costs, and savings in a diligent record book. Above all, she continuously participated in the tariff collection drive from the community, whenever any maintenance issues arose. In addition, the opening of bank accounts ensured that the treasurer of the Water User Committee maintained all the tariffs towards operation and maintenance.

Information Courtesy: CML Tata Trust & Public Health and Engineering Department (PHED)

initiative champions the training of 'Jal Bandhus', with a notable emphasis on gender parity, ensuring that women constitute a significant proportion of water stewards. These individuals undergo comprehensive training in hydrogeology, accounting, and advanced software applications, such as Google Earth Pro and Vertical Electric Sounding tests. These transformative endeavours not only stimulate entrepreneurial ventures but also instigate conservation efforts and extend vital support to marginalised communities, particularly the Tribal population, in navigating the intricacies of climate change challenges.

Women in Maharashtra use Field Testing Kits for assessing water quality

In Agrotha village, the narrative of Babita, a 19-year-old resident, emerges as a testament to exemplary leadership and unwavering determination. Her visionary leadership guided the local community through the monumental task of surmounting a formidable 107 km mountain barrier, facilitating the unimpeded flow of rainwater into the village's expansive 40-acre pond. Babita's remarkable initiative garnered widespread acclaim, resonating with the New Delhi State Women Commission and drawing effusive praise from none other than Prime Minister Narendra Modi himself during a broadcast of 'Mann ki Baat'.

Across regions such as Bundelkhand, Uttar Pradesh, and Rajasthan, women galvanised as 'Jal Sahelis' and 'Bhujal Jankars', becoming instrumental forces in diverse facets of water management endeavours. These initiatives not only usher in economic empowerment for women but also fortify water security across both rural and urban landscapes. Through meticulously crafted training programmes, facilitation of financial linkages, and strategic utilisation of self-help groups, a profound potential emerges to nurture women's self-employment in water management, thus heralding an era of sustainable solutions and resounding applause for advancing gender equality within water governance frameworks.

More than 14,000 NGOs/ VOs/ Women SHGs/ CBOs/ Trusts/ Foundations referred to as ISAs are engaged nationwide to facilitate women's participation in all planning, implementation, management, operation, and maintenance of in-village water supply systems and contributions. In addition to their pivotal roles in governance and skill development, women are also emerging as entrepreneurs, spearheading transformative initiatives that redefine the landscape of water management.

The JJM has been able to address the battle for equality, where water, a symbol of inequality has become a symbol of empowerment for the women and children who have long carried the weight of the water governance. A transformative pathway towards gender equality and sustainable development has been created and its impact extends far beyond national borders, serving as a model for empowering women across South Asian countries where similar challenges persist.

Section D

Tools and Technology for Transformation

Men fix the outlet valves of the Overhead Tanks in Bennihalli village, Gadag district, Karnataka

10

Data Analytics to Achieve Speed and Scale

It is a data driven world. Access to extensive data is invaluable for overcoming challenges that defied conventional systems, including water management. Because, data empowers practitioners to trim costs, mitigate risks, and boost operational efficiency.

In 2018, the Environmental Protection Agency (EPA), USA[17] unveiled survey results underscored the need to rejuvenate drinking water infrastructure. Insights from the survey indicated a staggering requirement of almost $500 billion for maintenance over the ensuing two decades.

In a subcontinent-sized country like India, data is critical in addressing a mosaic of challenges and opportunities in the water sector. Large parts of the country reel under pollution from geogenic and anthropogenic sources. The critical step towards ensuring universal access to clean water involves selecting sources untainted by either geogenic or anthropogenic contaminants. Conducting detailed assessments of the condition of water sources, aquifer systems, or river networks, including their levels of depletion and contamination, is imperative for ensuring the sustained viability of these sources.

This task assumes significance in rugged terrains like the Himalayan region and the Western and Eastern Ghats, where reliance on singular water sources such as springs is pronounced. With outdated pipelines and water management practices, numerous systems have become ineffective and the upkeep is costly. The expenses incurred due to undetected leaks or malfunctioning equipment, for instance, can be exorbitant. In confronting these issues, the utilisation of data becomes indispensable.

The Jal Jeevan Mission (JJM) took into cognisance the localised diversity and adopted a flexible approach in its planning and execution processes. The goal to provide tap water connections by end 2024 to all rural households required prompt action across planning, execution, monitoring, and notably, training and capacity building. Here is where the significance of data began to unfold.

Laying Groundwork for Data Collection with Design

The mission's planning process was meticulously targeted and delineated into yearly, biannual, and quarterly phases. The mission undertook a participatory, and bottom-up approach to both planning and implementation. For instance, in villages already equipped with piped water supply systems, the objective was to ensure universal coverage by retrofitting or augmenting infrastructure as necessary, leaving no household overlooked. In villages where ample ground or surface water of acceptable quality was available, the strategy involved devising and implementing Single Village Systems (SVS).

Considering that around 85% of water supply systems were serviced by groundwater sources, its measurement was considered an essential feature of the solution design.[18] Before commencing planning activities, states were tasked with furnishing

[17] EPA's 6th Drinking Water Infrastructure Needs Survey and Assessment | US EPA. (2023, November 17). https://www.epa.gov/dwsrf/epas-6th-drinking-water-infrastructure-needs-survey-and-assessment

[18] Jain, A. K. (2021). Roadmap for the measurement & monitoring of water service delivery in rural areas. Jal Jeevan Mission. https://jaljeevanmission.gov.in/sites/default/files/manual_document/technical-expert-committee-report-on-measuring-and-monitoring_0.pdf

relevant data, which was subsequently stored in the Jal Jeevan Mission database (JJM IMIS), mirroring the structure of the national database known as the Integrated Management Information System (IMIS), operational since 2009.

The data collection design focused on baseline study, topographical, geotechnical and hydrogeological survey.[19] As a first step in the process of the baseline study, comprehensive data about target villages, households, habitation, and population were to be collected. Institutional details such as schools, anganwadi centres, Gram Panchayats (GPs), and Primary Health Centres (PHC) were also prioritised. Understanding the size and makeup of the community was crucial for determining the overall water demand and designing a system with adequate capacity.

Identifying existing water sources was another vital component of the baseline study. This included assessing the availability and accessibility of surface water resources like rivers or ponds, as well as investigating the presence and quality of groundwater sources. It also documented reliance on alternative water sources like rainwater harvesting or water vendors. Understanding the existing water situation helped determine if these sources would be integrated into the project or if alternative options needed to be explored.

Following the baseline study, a topographical survey was conducted to create a detailed map of the villages. It measured the elevation of different points within the village, providing a three-dimensional picture of the landscape. By combining the data from the baseline study and the topographical survey, a comprehensive picture of the villages and their water needs was established. This led to the final stage of data collection: the geotechnical and hydrogeological survey, which focused on the characteristics of the soil and groundwater resources. The combined findings provided a comprehensive understanding of water needs, resources, and challenges.

Leveraging this data for every village, predictive data analytics were employed in the baseline survey to ensure infrastructure compliance with JJM standards. Every decision undertaken throughout the process was meticulously informed by data-driven insights, underscoring the mission's commitment to evidence-based decision-making.

From Habitation to Households Through IMIS

The national IMIS initially focused on assessing habitations, but the JJM IMIS underwent a significant evolution by shifting its focus to collecting data on individual households. This transition involved venturing into the field to compile a comprehensive database of water schemes. The subsequent analysis of this extensive dataset became imperative, and the responsibility was delegated to state teams. The federal structure of governance in India facilitated this collaboration, allowing states to leverage their local knowledge and resources effectively.

Upon examination, it was revealed that the completion time for existing water supply schemes varied significantly, ranging from 3 to 16 years. The overarching objective was to formulate a robust plan that provided a clear direction for implementation and mitigated the risk of uncertainty by forecasting future activities. This entailed identifying priorities, optimising resource allocation, and ensuring efficient utilisation to expedite the process of providing access to clean water to all households.

The data collection exercise with the states played a crucial role in finalising and confirming the baseline figures for both total rural households and those already equipped with tap water supply. Leveraging existing data collected under the Swachh Bharat Mission (SBM) rural housing, Ujjwala Scheme, Ration Card etc., facilitated a streamlined comparison process, simplifying the identification of households yet to be covered under the mission. See Figure 1 for

[19] Planning and design of assured potable water to every rural household. (n.d.). Jal Jeevan Mission. https://jalshakti-ddws.gov.in/en/presentations-water

the difference in household data in JJM and SBM after data received from the SBM IMIS.

Decentralised Data Collection

The process of data entry for the IMIS was a collaborative effort between various administrative levels. Initially, states were provided with a comprehensive three-page data entry form. This form served as the primary tool for capturing essential information crucial for the JJM's objectives.

The data entry process itself was structured into three distinct steps ensuring accuracy and reliability. At the district level, junior engineers entered the data into the system, which served as the foundation for the subsequent verification processes. Ensuing this, the compiled information was then scrutinised by secretaries at the state level. This critical checkpoint involved thorough validation to ensure the accuracy and integrity of the entered data. Any discrepancies or inaccuracies were flagged and rectified before proceeding further.

Following state-level verification, the validated data was transmitted to the national team to finalise the data and facilitate data cleaning to ensure that only accurate and reliable information was incorporated into the system. By integrating Aadhar verification, it adds a layer of authentication to the data here.

Incorporating Data on JJM-IMIS

The JJM-IMIS emerged as a comprehensive platform that combined various important datasets to advance the mission's objectives. It served as a central repository for a multitude of data, encompassing tap connections provided at households, Village Action Plans, District Action Plans, State Action Plans, details of Village Water and Sanitation Committees (VWSCs), scheme completion records, expenditure data, financing and funding details, progress of support activities, and advancements in priority areas, among others.

Furthermore, the integration of geotagging technology within the JJM IMIS facilitated the tracking and documentation of major assets such as Elevated Service Reservoirs (ESRs), storage reservoirs, and drinking water sources. This geospatial data not only enhanced transparency but also enabled effective monitoring and management of critical infrastructure components.

Moreover, to ensure the integrity and authenticity of beneficiary data, the JJM IMIS incorporated a robust authentication process using Aadhar credentials. This additional layer of verification enhanced the accuracy and reliability of the dataset pertaining to households provided with tap water connections, instilling confidence in the mission's outcomes.

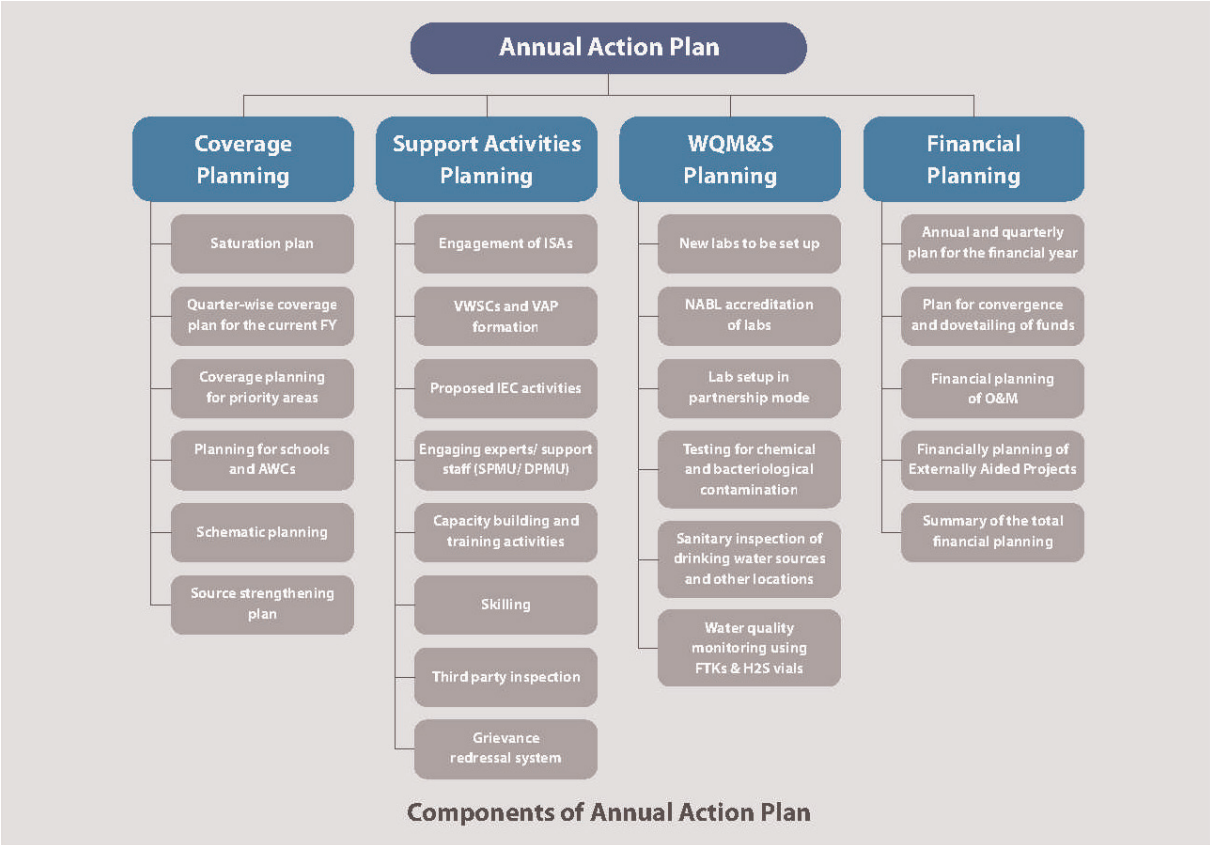
The data analytics-driven village-wise analysis was undertaken to identify 'low-hanging fruits' and enhance coverage rapidly. By targeting these 'low-hanging fruits,' the mission aimed to achieve multiple objectives simultaneously: providing tap water connections to remaining households in villages with existing piped water supply schemes, augmenting and retrofitting existing schemes to meet JJM compliance standards, ensuring connectivity for all households in villages with high existing tap water supply coverage and low coverage for a few households, and analysing the life cycle and design period of schemes to enhance their efficiency. This multifaceted approach maximised the utilisation of existing infrastructure while optimising resources to achieve rapid and sustainable improvements in water access across rural communities.

Data-driven Annual Action Plan of JJM

Through data-driven insights, the Annual Action Plan (see Figure 4) was formulated in collaboration with states, empowering GPs, VWSCs, and Pani Samitis to undertake pivotal responsibilities. This plan facilitated the exploration of convergence by aligning resources at the grassroots level, aiming to identify priority areas guided by the principles of 'equity and inclusiveness' and ensuring that no one was left behind.

Each State/ UT was to also prepare an overall 'saturation plan' to achieve 100% coverage or 'Har Ghar Jal' status. This included creating a saturation plan to guarantee that every rural household received an individual household tap connection. The plan was divided into phases, with each quarter outlining the targeted number of connections to be established.

Figure 4: Annual Plan of Convergence



Support activities played a significant role in ensuring the mission's success. Implementing Support Agencies (ISAs) were identified and assigned specific roles in planning, executing, and monitoring JJM activities at the village level. Additionally, Information, Education, and Communication (IEC) activities were undertaken to raise awareness about the JJM within the community. These campaigns aimed to educate people on water conservation practices, sanitation methods, and the advantages of having tap connections in their homes.

Timely access to data played a crucial role in ensuring the provision of assured drinking water in various challenging contexts, including 27,544 habitations affected by Arsenic and Fluoride contamination, villages situated in drought-prone areas (905 blocks), and desert regions (233 blocks). Additionally, the action plan targeted Aspirational districts (117), districts affected by Japanese Encephalitis (JE) and Acute Encephalitis Syndrome (AES) (60), villages predominantly inhabited by Scheduled Castes (SC) and Scheduled Tribes (ST), and 3,159 villages identified under the Sansad Adarsh Gram Yojana (SAGY).

By leveraging data-driven insights, the Annual Action Plan aimed to strategically allocate resources and interventions, ensuring equitable access to safe drinking water for all communities, particularly those residing in vulnerable and marginalised areas across the country.

Based on the extensive data collected, operational guidelines for the mission were formulated through a participatory process and released by the prime minister on Good Governance Day, 25 December 2019. The comprehensive guidelines served as the cornerstone for the mission's on-the-ground implementation, providing a clear vision, mission, detailed strategy, and a roadmap for planning and executing tap water supply provisions to rural

households and public institutions in villages across states and UT.

Various stakeholders, including state governments, UT administrations, sector experts, NGOs, and civil society representatives were involved in this exercise. This collaborative effort involved regional workshops, national conferences, and soliciting feedback from UN agencies involved in water supply scheme implementation. Additionally, inputs from reports by the Comptroller and Auditor General (C&AG), Parliamentary Standing Committee, and recommendations from Parliamentary Consultative Committees were carefully considered.

A dedicated 'Task Force' comprising policymakers, experts, and practitioners with expertise in drinking water supply and decentralised governance was established. This Task Force conducted a thorough analysis of past drinking water programmes implemented across various states and UTs to assess their efficacy. The aim was to glean insights from previous experiences and incorporate them into refining the implementation strategy of the mission, ensuring optimal utilisation of resources and maximising results.

According to the operational guidelines of the mission, the functionality of a household tap connection is defined as providing drinking water in adequate quantity, at least 55 litres per capita per day (LPCD), and of quality adhering to the Bureau of Indian Standards (BIS) '10500 standard,' with regular and continuous supply in the long term. In the fiscal year 2020-21, the DDWS collaborated with Nielsen (India) Private Limited to conduct a 'Functionality Assessment' of household tap water connections. This assessment covered a total of 87,123 households across 6,992 villages spanning 704 districts in 31 states/UT.

Overcoming the Challenges of COVID-19

Lockdowns and restrictions necessitated a shift to virtual means from March to May in both years, 2020 and 2021, and even during the peak of the second wave of COVID-19 in April-May 2021, the mission's activities continued in this mode.

To ensure the smooth implementation of JJM in alignment with the approved AAP of respective states and UTs, quarterly and mid-year joint review meetings were conducted with all stakeholders. These meetings served as platforms to evaluate quarterly progress, and achievements, and chart the way forward.

Additionally, multi-disciplinary teams from JJM undertook visits to villages across different districts to assess the ground-level implementation status. These visits aimed to accelerate implementation by focusing on prudent investment, adopting the right processes, and achieving targeted outputs. The teams engaged with members of GPs, VWSCs, Pani Samitis, and local communities, as well as officials from Public Health Engineering (PHE), Rural Water Supply (RWS), and Panchayati Raj (PR) departments. Through these interactions, they addressed community participation issues, fine-tuned institutional arrangements, and identified challenges, seeking solutions and documenting good practices along the way.

Data analytics, including Artificial Intelligence (AI) and Machine Learning (ML), played a crucial role in streamlining operations. Standardising data analytics across the country based on sensor data received, information collected from field locations was transmitted to state and central servers for monitoring functionality, quantity, quality, and regularity of water supply. This not only minimised water loss but also facilitated the analysis of demand patterns among user groups, enabling effective demand management and minimising non-revenue water.

The incorporation of data analytics into the framework of the mission marks a significant milestone in the journey towards achieving universal access to safe and sustainable drinking water in rural India. By harnessing the power of data, the mission has been able to navigate complex challenges, optimise resource allocation, and drive evidence-based decision-making at every level of implementation.

11

Drive for Potable Water Supply

A 2023 joint report by the United Nations Children's Fund (UNICEF) and the World Health Organization (WHO) stated that an alarming 2.2 billion people worldwide lack access to safe drinking water services.[20] Close to 144 million individuals globally are compelled to consume untreated surface water. The repercussions of poor water quality are most acutely felt in low- and middle-income countries.

India grapples with the dual issues of water availability and quality, and relies heavily on groundwater, which is stored in aquifers, porous structures within the earth's crust that hold water. However, the proximity of many of these aquifers to metallic rocks often results in contamination with elemental residuals. When present in high quantities, these elements can lead to severe diseases.

States such as West Bengal, Assam, Bihar, Jharkhand, and Uttar Pradesh have reported high contamination levels of geogenic elements. The most commonly found contaminants include Iron, Fluorine, and Arsenic, which can cause fatal diseases like arsenicosis and fluorosis. Similarly, the presence of mercury in the water affects the brain and the nervous system (see figure 5). Presence of iron, above the desired quality, can lead to gastrointestinal diseases, along with metallic poisoning in the blood.

In addition to geogenic contaminants, organic or biological contaminants also pose threat to water quality. Due to age old practice of open defecation and poor sanitation, surface water sources would often be contaminated with biological and organic contaminants like bacteria, fungi, worms etc. The presence of bacteria, worms and fungi in water leads to diseases like diarrhoea, jaundice, cholera and typhoid, which have proved to be fatal in the past.

India's struggle with water quality began as early as 1937, with the first case of fluoride contamination reported in Nalgonda. Since 1954, the country has implemented various rural drinking water supply programmes, starting with the National Water Supply Programme. The Eighth Five Year Plan (1992-97) emphasised the issue of water quality for the first time, including contamination from parasites, fluoride, iron, and salinity. In 1997, the Water Quality Monitoring and Surveillance (WQMS) system was institutionalised, and in 2002, it was included as an activity under the community communication campaign in Swajaldhara guidelines.

In 2009, the Water Quality Monitoring and Surveillance activity was given high importance under the National Rural Drinking Water Programme. The objective was to enable communities to monitor their drinking water sources. In 2013, changes were introduced under the WQMS component of NRDWP to focus on water quality, especially in areas affected by Japanese Encephalitis (JE)/ Acute Encephalitis Syndrome (AES). This included setting up/ upgrading regional, district/ sub-district water quality testing laboratories, supplying Field Test Kits (FTKs), and training grassroots workers.

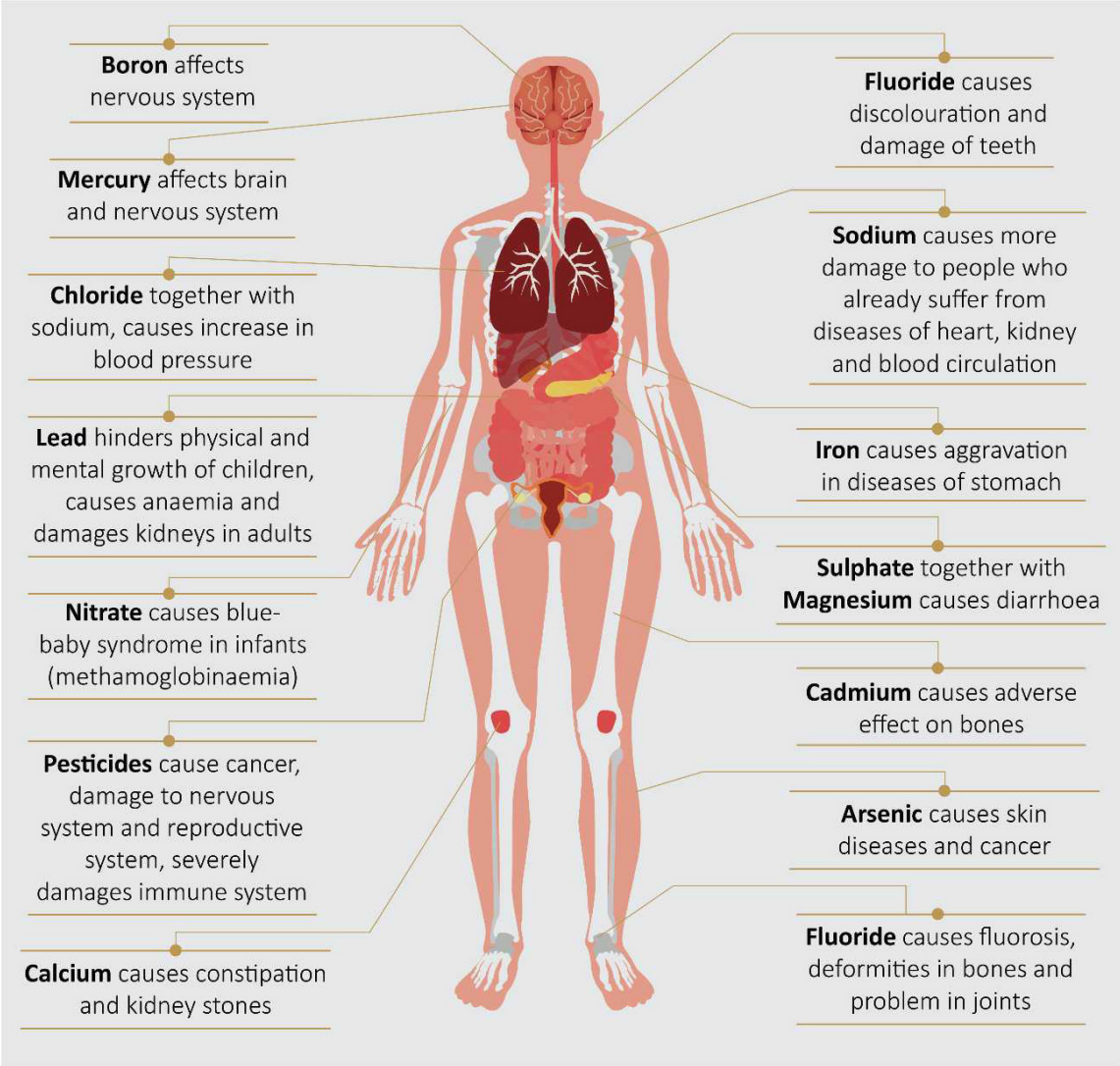
Community Water Treatment Plants

In 2017, the Ministry of Drinking Water and Sanitation initiated the National Water Quality Sub-Mission (NWQSM). The mission's objective was to ensure safe drinking water for 27,544 rural habitations affected by Arsenic and Fluoride. Subsequently, in 2019, the government launched the Jal Jeevan Mission (JJM), the National Water Quality Sub-Mission to ensure potable drinking water in such habitations.

To ensure water quality, JJM has been the proprietor

[20] WHO/UNICEF Joint Monitoring Program for Water Supply, Sanitation and Hygiene (JMP) – Progress on household drinking water, sanitation and hygiene 2000-2022: Special focus on gender. (2023). UN Water. https://www.unwater.org/publications/who/unicef-joint-monitoring-program-update-report-2023

Figure 5: Impact of Water Contamination on the Human Body



of many interventions made at different levels. One of them being the Community Water Purification Plants. The planning and processing of the treatment plants began by determining the areas adversely affected by geogenic-contaminants in the source of their drinking water and formulating an action plan based on authentic data. For habitations adversely affected by the contamination, states were advised to plan and install the CWPPs on priority, as an interim measure to treat and provide 10 litres per person per day. Villages in states like West Bengal, Telangana, and Gujarat, where geogenic contamination was prominent, building of these CWPPs have significantly reduced the problems that arise due to Fluoride contamination. Frequent maintenance activities were conducted to keep the plants running for a longer time. As a result, the number of Arsenic and Fluoride affected habitations with contaminated drinking water decreased from 14,020 and 6,990, respectively, in 2019, to 316 and 265 in early 2024.

Laboratories Open to Public for Testing

In JJM, testing water quality, assessing purification levels and the nature of contaminants in order to treat

them correctly became a priority. The mission allocated up to 2% of the fund to states and Union Territories for water quality monitoring and surveillance activities. This included setting up and upgrading existing water quality laboratories, procurement of equipment, instruments, chemical/ reagents, glassware, consumables, and NABL accreditation of laboratories.

The National Accreditation Board for Testing and Calibration Laboratories (NABL) is an accreditation body which comes under the Quality Council of India and is responsible for conducting quality analysis of a laboratory. The accreditation process of the lab involves submission of an application for accreditation to NABL. The board then reviews the laboratory's quality manual, procedures, and other relevant documents to ensure compliance with international standards. The NABL forwards the Quality Manual to a lead assessor to judge the adequacy of the Quality Manual as to whether it follows ISO 15189 standards. After the COVID-19 pandemic and the nation-wide lockdown, accreditation of water quality laboratories were taken up in a big wave. The laboratories were set up at different levels, ranging from regional level labs and mobile labs to State level labs (See Table 4). As per the latest data, there are 2,159 water testing laboratories across the country, out of which 1,566 have been NABL accredited.

NABL Accredited Water Testing Laboratory

An important step, taken by the government of India, was to advise the states and the union territories to open these water quality laboratories to the public. To encourage people to get their water samples tested and the report be sent on their phones, nominal rates for testing were fixed and publicised. Through this initiative, the public got the liberty and means to ascertain the quality of water they were consuming.

A NABL accredited water testing laboratory in Gujarat

The table below showcases the update on the samples tested, contaminants found, and remedial actions taken for every sample collected in the past three years in the country. The data is derived from Jal Jeevan Mission Dashboard.

Table 4: Number of Samples Found Contaminated and Remedial Actions Taken

Year	Number of samples tested	Number of samples found contaminated	Total contaminated samples with remedial measures taken
2023-2024	**59,18,246**	**5,63,614**	**4,10,473**
2022-2023	**62,81,274**	**7,20,633**	**6,66,341**
2021-2022	**41,72,176**	**6,02,808**	**4,01,262**

Field Testing Kits

Apart from creating robust monitoring structure through a system of labs, JJM also focused on developing a successful citizens driven surveillance mechanism. The surveillance system has enhanced citizens' awareness and has built a culture among masses to enquire and check their drinking water quality.

To actively involve citizens in the surveillance system, focus was laid on enhancing the ease of water testing. In this regard, the intervention of Field-Testing Kits or FTKs was made. The FTK is an assembly of simple portable equipment/accessories which is used to measure the chemical or elemental constituents found in the water sample. The kits provide qualitative estimates with the aid of chemical reagents. The provision to provide field testing kits in every village to reduce the hassle of visiting labs made the process of testing water more widespread. According to the latest data, water samples in around 3,02,321 villages have been done using the FTKs.

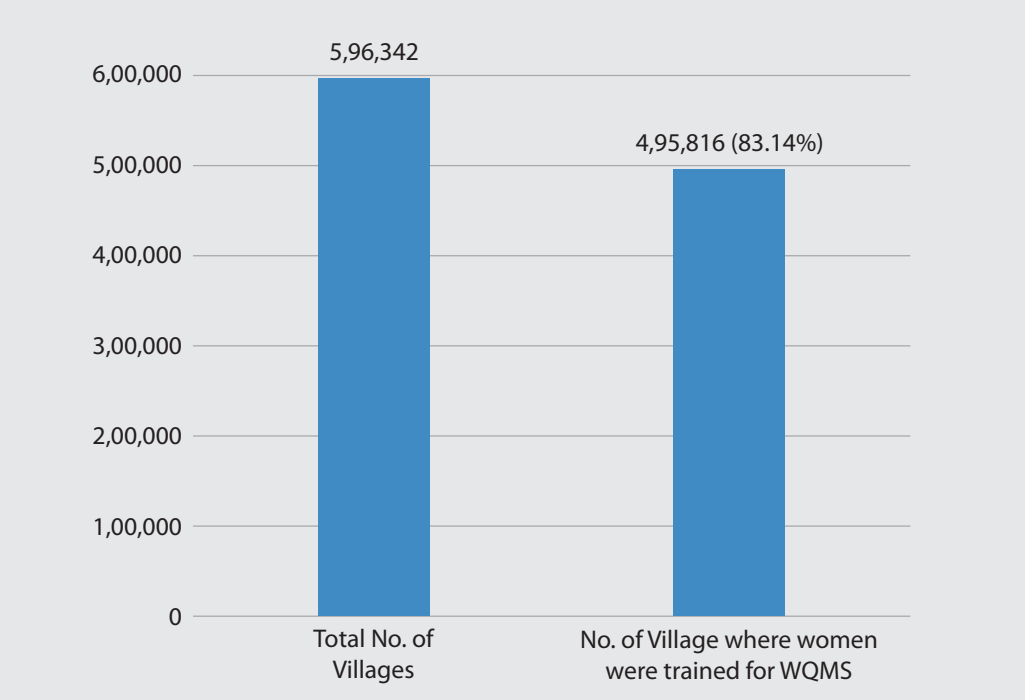
The FTKs were used at grassroots level, i.e., Gram Panchayat/ Village Water and Sanitation Committee for indicative test results. The kit is used in conjunction with tablet/ reagents and colour charts to test different parameters. The kits are portable and battery operated. The parameters that could be tested using the kit included turbidity, pH, total hardness, total alkalinity, chloride, ammonia, phosphate, residual chlorine, iron, nitrate arsenic Fluoride and bacteriological residues.

The prospect of making the surveillance system more decentralised was institutionalised through the creation of Pani Samitis in every village, which had more than 50% women participants. A provision for training five women from every village on how to analyse water quality using the testing kits was made to make it more women-centric and gender equal. The selection of candidates was done amongst local health bodies, Accredited Social

Table 5: State-Wise Distribution of NABL Accredited Water Quality Labs, August 2024

S.N.	State	State level labs		District level labs		Block level labs		Sub-Divisional level labs		Mobile level labs		Regional level labs		Total labs	
		Total	NABL accredited	Total	NABL accredited	Total	NABL accredited/ recognition	Total	NABL accredited/ recognition	Total	NABL accredited/ recognition	Total	NABL accredited	Total	Total NABL accredited/ recognition
1	Andaman & Nicobar Islands	1	1	3	0	0	0	7	0	0	0	0	0	11	1
2	Andhra Pradesh	1	1	26	23	0	0	85	57	0	0	0	0	112	81
3	Arunachal Pradesh	1	0	20	0	0	0	17	0	0	0	0	0	38	0
4	Assam	1	1	34	34	0	0	46	46	2	0	0	0	83	81
5	Bihar	1	1	38	11	0	0	75	0	9	0	0	0	123	12
6	Chhattisgarh	1	1	28	28	0	0	27	18	18	0	0	0	74	47
7	Dadra & Nagar Haveli And Daman & Diu	0	0	2	1	0	0	0	0	0	0	0	0	2	1
8	Goa	1	1	0	0	0	0	13	13	0	0	0	0	14	14
9	Gujarat	1	1	33	33	46	41	0	0	0	0	0	0	80	75
10	Haryana	1	1	21	21	20	20	1	0	1	0	0	0	44	42
11	Himachal Pradesh	1	0	14	10	0	0	56	53	5	0	0	0	76	63
12	Jammu & Kashmir	2	2	20	20	0	0	76	20	0	0	0	0	98	42
13	Jharkhand	1	1	24	24	0	0	6	6	0	0	0	0	31	31
14	Karnataka	6	1	31	28	0	0	48	39	0	0	0	0	85	68
15	Kerala	4	1	14	14	45	42	26	26	0	0	0	0	89	83
16	Ladakh	0	0	2	1	0	0	6	2	0	0	0	0	8	3
17	Lakshadweep	0	0	0	0	7	0	2	0	0	0	0	0	9	0
18	Madhya Pradesh	1	1	51	51	0	0	103	103	0	0	0	0	155	155
19	Maharashtra	0	0	28	28	0	0	144	143	0	0	6	6	178	177
20	Manipur	1	1	12	11	0	0	0	0	0	0	0	0	13	12
21	Meghalaya	1	1	11	4	0	0	18	0	0	0	0	0	30	5
22	Mizoram	1	1	8	0	0	0	18	0	0	0	0	0	27	1
23	Nagaland	1	1	11	11	0	0	0	0	0	0	0	0	12	12
24	Odisha	1	1	30	21	0	0	46	21	0	0	0	0	77	43
25	Puducherry	0	0	2	1	0	0	0	0	0	0	0	0	2	1
26	Punjab	1	1	17	17	0	0	7	7	2	0	6	6	33	31
27	Rajasthan	2	1	26	26	0	0	0	0	20	0	6	6	54	33
28	Sikkim	1	0	1	0	0	0	0	0	0	0	0	0	2	0
29	Tamil Nadu	1	1	37	37	24	24	51	51	0	0	0	0	113	113
30	Telangana	1	1	19	1	0	0	56	0	0	0	0	0	76	2
31	Tripura	1	1	8	8	6	6	6	6	0	0	0	0	21	21
32	Uttar Pradesh	1	1	72	72	57	0	0	0	5	0	3	3	138	76
33	Uttarakhand	1	1	13	13	0	0	13	13	0	0	0	0	27	27
34	West Bengal	2	2	23	23	0	0	192	191	7	0	0	0	224	216
Total		**40**	**28**	**679**	**572**	**205**	**133**	**1145**	**815**	**69**	**0**	**21**	**21**	**2159**	**1569**

Graph 2: Number of Women Trained for Water Quality Monitoring and Surveillance Unit Analysis in Rural India



Health Activist (ASHA) workers and Gram Panchayat members.

One of the key aspects of the training was to explain to the community the potential health impacts if contaminated water was consumed directly. The community was made to understand the importance of frequent water testing as water quality parameters could change at any time due to various factors such as the use of fertilisers, leakage, floods, littering, etc. Moreover, the training also included informing the community about immediate home remedies to check ailments associated with the consumption of contaminated water. This comprehensive training approach ensured that the community was well-equipped to manage and monitor their water quality effectively.

Water Quality Information Management System

In order to pre-empt the issues arising from poor water quality, a database of water testing was created, maintained, and regularly analysed. This database provided vital clues in investigating disease outbreaks, verifying the safety of drinking water, and assisting in taking preventive measures.

The NJJM in partnership with ICMR, developed an online portal on Water Quality Information Management System (WQMIS). The WQMIS facilitated the collection, storage, and analysis of a significant volume of data on water quality nationwide, in a standardised and user-friendly format. Data from FTK testing, water quality sensors from smart water supply systems (where available), and water samples tested at various laboratories were integrated to obtain a comprehensive overview of water source quality. Additionally, in cases where the water quality data for a specific sample indicated contamination, an alert was dispatched to officials in the PHE department, DWSM members, and VWSC members, ensuring timely implementation of remedial actions.

Moreover, 24.70 lakh women have been trained to check the status of their community watere resources

under water quality monitoring and surveillance till now.

Integrating Digital Technology in Water Testing

To use digital technology in water testing, JJM developed Internet of Things (IoT) devices for assessing samples. The system would integrate putting IoT based sensors at the water source point and end point to assess water quality on basic water quality parameters including pH, TDS, chlorine, and nitrate. Along with water quality, the IoT sensors are also used to assess water in terms of its quantity, flow control and time of supply.

The National Jal Jeevan Mission, in partnership with the Ministry of Electronics and Information Technology (MeitY), launched an ICT Grand Challenge to develop an innovative, modular, and cost-effective "Smart Water Supply Measurement and Monitoring System" for village-level deployment. The challenge, which aimed to enhance the service delivery of water supply in rural areas rather than just creating infrastructure, received more than 200 proposals from Indian tech startups, MSMEs, companies, and LLPs.

A jury, appointed by the Ministry of Electronics and Information Technology, was made in charge of evaluating these proposals and selecting the deserving ones to go forward in the contest. The challenge felicitated the top solution with a cash prize of ₹50 lakh, and the runners-up with ₹ 20 lakh each. 'Amrit', an IoT based water management system developed by 'Rydot Infotech Private Limited' won the Grand Challenge in 2020. Amrit solution would help the government to continuously monitor in real-time the predefined amount (55 LPCD) and appropriate quality of water provided to each household as per the guidelines.

Another such innovative challenge was launched by the NJJM in partnership with Invest India, Department of Promotion of Industry & Internal Trade (DPIIT). The challenge aimed to bring innovative, modular, and cost-effective solution to develop portable water quality testing devices that can be used at the household level to test the drinking water quality instantly, easily, and accurately. The testing device detects the relevant water quality parameters based on the geographical areas such as mining prone, heavy industrial based, intensive agricultural fields, and urbanised towns. It should also be able to transmit data to the centralised data repository.

The participants included Indian tech startups, MSMEs (Micro, Small and Medium Enterprises), Indian companies and Indian LLPs (Limited Liability Partnership). Out of the proposals received, 10 were shortlisted and provided with a financial support of ₹ 7,50,000 each. The best four techno-economically viable prototypes were selected for product development and each team received ₹ 25 lakhs to build their solution product.

Surface Water Purification

While water purification systems are required to make impure water fit for drinking, a more sustainable approach is to make sure that water sources remain unpolluted from anthropogenic sources. As the JJM has prioritised surface water as an important source of drinking water, keeping the surface water pure becomes paramount to enhance the quality of households tap water. The Department of Water Resources, River Development and Ganga Rejuvenation is one department that has played a major role in contributing to cleaning of surface water sources, by providing financial and technical assistance for abatement of pollution in identified stretches of rivers in the country through the Central Sector Scheme of Namami Gange Programme for rivers in Ganga Basin, and the Centrally Sponsored Scheme of National River Conservation Plan (NRCP) for other rivers. JJM also aims at cleaning surface water sources, including ponds and lakes, and building water reservoirs.

A major contributor of surface water pollution is the dumped untreated wastewater which comprises of faecal and other harmful contaminants. In this aspect, the role of Swachh Bharat Mission (SBM) in making the surface water clean cannot be over emphasised. The mission launched in 2014 has been one of the most admired and successful schemes of the Government of India. Under SBM, the country has seen significant reduction in open

Steps Taken by Punjab Government to Combat Water Quality Issues

A. **Establishment of Water Quality Testing Laboratory Network:** A network of 31 laboratories was established, equipped with state-of-the-art infrastructure and accredited by NABL. These labs played a crucial role in water quality testing and monitoring.

B. **Occupational, Safety and Health Policy for Laboratories:** To ensure the safety of lab personnel and proper waste management, an Occupational, Safety, and Health Policy was implemented for operationalised labs.

C. **Public Water Testing:** The newly established labs offered water testing services to the public at nominal rates, facilitating access to safe drinking water.

D. **Laboratory Information Management System:** DWSS implemented a customised Laboratory Information Management System across its laboratory network to streamline water quality sampling and testing processes.

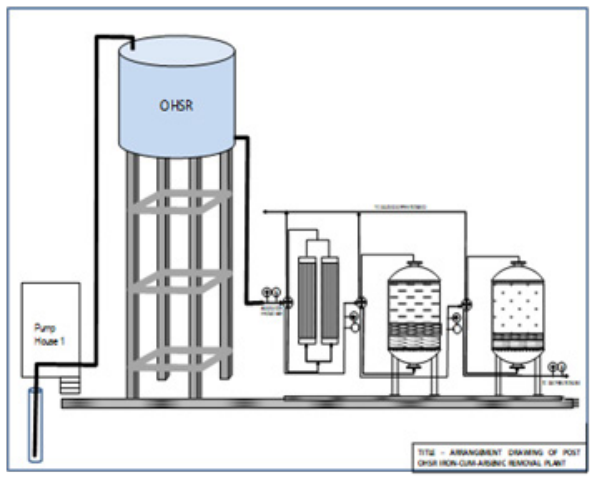
E. **Storage and Dispensing Facilities for Sodium Hypochlorite:** Bulk storage and distribution centres were established to provide sodium hypochlorite for water disinfection in rural areas, ensuring access to safe drinking water for all.

defecation and improvement in sanitation facilities in public places. The SBM has been the initiator of interventions like building wastewater treatment plants with efficient management of the faecal sludge, building household latrines infrastructure in rural households; toilets in schools and anganwadis across the country.

Water supply system in a border village of Punjab

The Jal Jeevan Mission has made remarkable strides in enhancing water quality across India. By addressing geogenic contaminants and establishing water treatment plants, the mission has ensured the delivery of safe drinking water to rural areas. Additionally, the deployment of advanced monitoring systems like WQMIS, along with FTKs and IoT-based sensors, has enabled real-time surveillance of water quality. These efforts have led to significant improvements in public health, with reduced instances of waterborne diseases. Moving forward, continued investment in infrastructure and technology will be essential to sustain these achievements and ensure universal access to clean drinking water.

Figure 6: Diagram of Retrofitted Inline Arsenic-Cum-Iron Removal Plant



Addressing Groundwater Crisis in Punjab

The Green Revolution of the 1960s in Punjab, enabled by technological advancements and high-yield crop varieties, rode on the intensive farming practices and widespread adoption of tube well irrigation, powered by free electricity, had exerted immense stress on the state's groundwater resources. As a result, Punjab had experienced a significant decline in groundwater levels, with approximately 114 out of its 150 development blocks struggling to sustainably replenish the water table. This overexploitation of groundwater had led to a deterioration in water quality, with heavy metals like arsenic, uranium, and fluoride contaminating the groundwater. This contamination had contributed to a range of health issues, including dental and skin problems, kidney ailments, and even cancer in some areas.

Recognising the severity of the situation, the State Water and Sanitation Mission, Punjab (SWSM), had acknowledged the urgent need for action. The mission had developed comprehensive protocols for water quality monitoring, surveillance, and mitigation, laying the groundwork for a holistic water quality management initiative aimed at addressing the critical groundwater quality issues in the state. The primary goal of this initiative had been to ensure the sustainable provision of safe drinking water to all affected villages, thereby safeguarding public health and well-being.

In areas affected by arsenic contamination, the installation of AIRPs in existing water supply systems had served as a long-term solution. Utilising nanomaterial-based adsorption technology, these plants effectively removed arsenic and iron from water.

To ensure the sustainability of water quality mitigation projects, the SWSM had established a 'Water Quality Kosh'. This fund, with an initial corpus of Rs. 10 crore, aimed to address the financial challenges associated with the operation and maintenance of water quality infrastructure. DWSS had implemented a Water Quality Monitoring Protocol, requiring regular testing of groundwater and canal water sources. Annual Water Quality Reports were published on the DWSS website, ensuring transparency and accountability.

The case of Punjab's groundwater crisis highlights the importance of sustainable water management practices. The comprehensive approach adopted by the SWSM and DWSS, encompassing both long-term and short-term strategies, demonstrated the potential for effective water quality management. The success of these initiatives would depend on their effective implementation and the continued commitment to ensuring access to safe drinking water for all.

12

JJM Dashboard: Information on a Single Platform

Technology can transform how we govern our water resources. The introduction of real-time monitoring dashboards helped transform water resource management in the country. The Jal Jeevan Mission (JJM) dashboard was envisioned and operated as a comprehensive digital hub displaying real-time water levels, infrastructure health, consumption patterns, and quality parameters. TATAs, on pro-bono basis, assisted in the development of the JJM Dashboard, which the National Informatics Centre(NIC) now maintains.

The JJM dashboard transforms raw data into actionable intelligence to provide safe drinking water to all rural households, while offering a granular view down to the village level. Using the Internet-of-Things (IoT), the sensors capture real-time data on various water parameters, which is collected, compiled, and analysed within the dashboard, providing a comprehensive picture of the mission's progress and enabling proactive management of water resources.

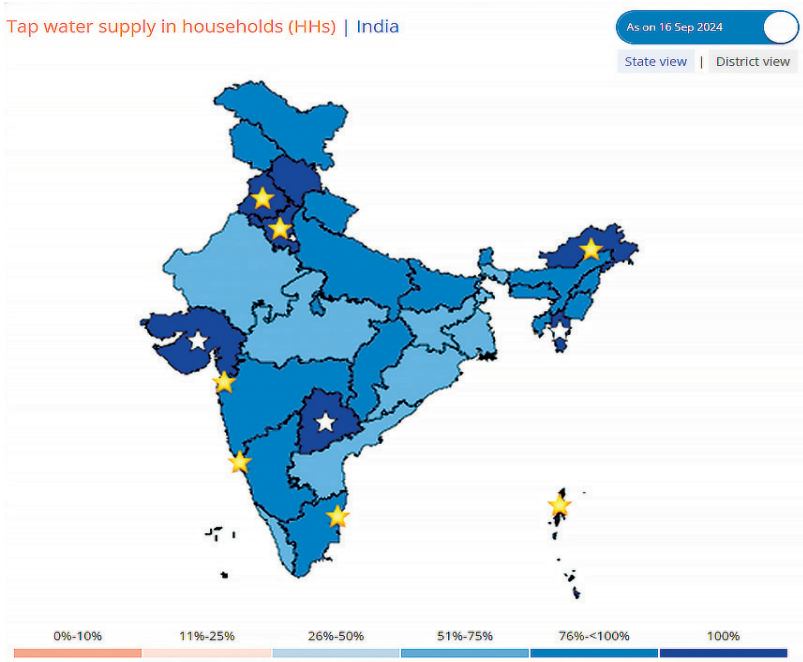
The dashboard receives updates from respective states/ UTs and has been created, developed, and maintained by the National Informatics Centre (NIC). This user-friendly platform offers crucial insights into the mission's progress towards providing tap water connections to all rural households. Users can explore data for specific states and districts, gaining a clear picture of the tap water supply status across the country.

In JJM dashboard displayed the number of households yet to receive connections, alongside celebrating states and UTs that have achieved 'Har Ghar Jal' status, signifying every household has tap water access (see figure 7). This real-time data empowered stakeholders to make informed decisions and track the mission's success in delivering safe drinking water to rural communities. Every tap water connection provided was linked with the Aadhaar number of the head of the household and the water supply infrastructure created was geo-tagged.

Transparent Approach to Water Quality Management

The dashboard embodies several key features, including a citizen-centric corner feature at the top left-hand side of the dashboard, that is critical for public engagement and ensures transparency.

Figure 7: Tap Water Supply in Households as on 16.09.2024



Serving as a comprehensive platform, it presents a user-friendly interface offering real-time updates on water quality, piped water supply, village profiles, and community engagement (see figure 8) to manage water supply within villages effectively. Diving deeper into the village section, reveals detailed information, including the names of beneficiaries, total habitations, total population, among others.

The community engagement section displays the names of the local engineer/plumber in charge, names of women identified for field testing, members of Pani Samiti and other pertinent details. This level of granularity significantly enhances the ability to such specific data, and citizens can track the progress of projects, identify responsible parties, and ensure accountability at every stage of implementation. Further, users can effortlessly book a water quality test in the closest laboratory with just a click of a button.

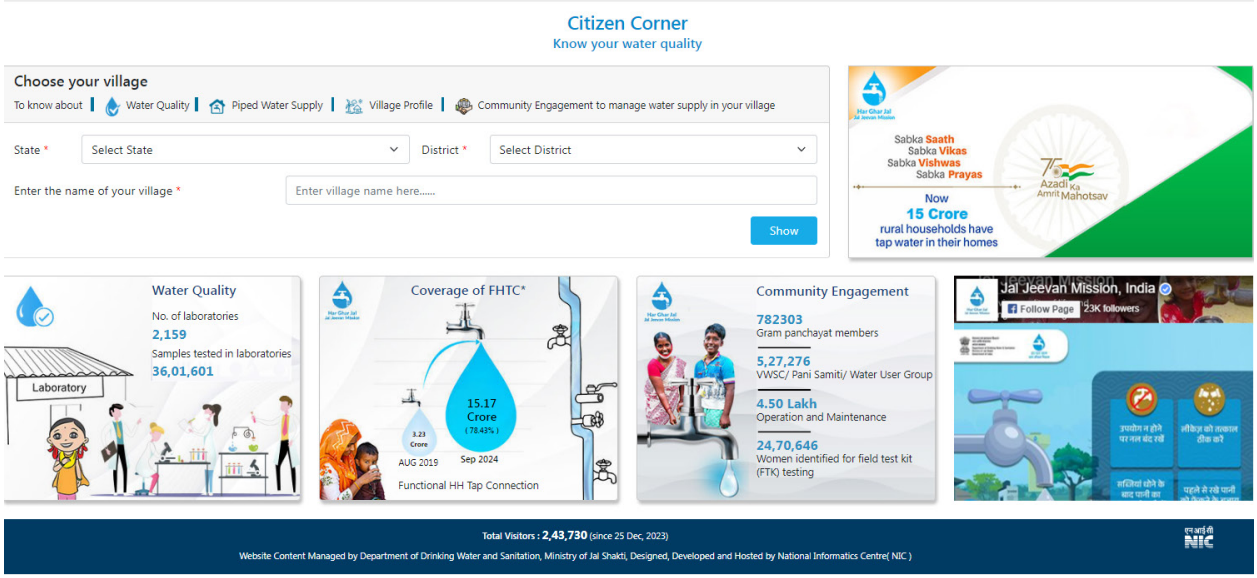
As it enables the users to access information, they can view relevant data of their preferred state, district, or a village. For example, someone in Kerala can easily view the status of a village in Arunachal Pradesh in real time. The dashboard provides detailed information such as the total population of the village, the number of habitations, beneficiaries, status of the village action plan, and tap water supply.

According to the Operational Guidelines of JJM, once tap connections are provided to all rural households in a village, the Rural Water Supply Department of the state designates the village as a 'Har Ghar Jal' village based on the completion report submitted by the project's field engineer. This designation is reflected as 'reported Har Ghar Jal' in the JJM IMIS. Subsequently, during a Gram Sabha meeting, the work completion report is publicly read aloud, and the Gram Sabha formally passes a resolution certifying the village as a 'Har Ghar Jal' village.

The piped water section of the dashboard also showcases various documentation for certified villages, including the Gram Sabha resolution, a brief video capturing the Gram Sabha proceedings and a copy of the certificate provided by the implementing department (PHED).

The dashboard served as a vital tool for the execution layer of government officials (e.g. PHED field engineers) and the utility groups (e.g. Village Water

Figure 8: The Citizen Corner Section of the JJM Dashboard, Displays Options to Check the Status of Water Quality and Quantity



and Sanitation Committee - VWSC/ Pani Samiti/ Water User Group – WUG/ MVWSS management). Other stakeholders include senior government officials (e.g. NJJM, state government, district, senior engineers), scheme operators/employees of utility (e.g. pump operators, linemen), citizens/users, activists, and media professionals.

The PHED has been directly responsible for group water supply schemes catering 50-200 villages and many of the villages may have more than one scheme. With a centralised dashboard, they can track scheme functionality, service delivery metrics like water quantity and quality, and promptly address issues through automated alert systems. Additionally, it facilitates a proactive approach to service delivery management, allowing officials to leverage advanced analytics to guide utilities and communities in pre-emptive measures such as source augmentation, ultimately enhancing scheme success rates and operational efficiency.

For Water User Groups, the dashboard enhanced service delivery by continuously monitoring and promptly highlighting issues such as lower water supply quantities, inconsistencies in supply hours, or low residual chlorine levels through alerts. This ensured timely intervention to maintain service quality. Moreover, it fosters community support and reduces the effort needed for collecting Operation and Maintenance (O&M) charges by boosting user satisfaction through improved scheme longevity, enhanced service delivery, and reduced repair and maintenance expenses.

Similarly, NJJM is responsible for overseeing the water supply schemes in India. They used to rely on data being manually entered by the on-ground workforce. By leveraging real-time data from the dashboard, the officials can now plan future interventions more effectively, ensuring optimal allocation of resources. For example, they can prioritise source augmentation efforts in regions with dwindling groundwater levels or intensify community mobilisation campaigns where water consumption varies significantly. Moreover, the dashboard enables officials to prioritise repair and upgrade work for aging infrastructure based on the extent of non-revenue water (leakage or unauthorised connections).

Additionally, they can strategise government-sponsored initiatives such as advanced greywater management or sewage schemes in areas with high water consumption or substantial overall usage. By facilitating collaboration among these stakeholders, the dashboard promotes transparency.

Figure 9: Illustrative Dashboard for VWSC/ Pani Samiti

Figure 10: District Progress Card of Tinsukia, Assam

Jal Jeevan Surveksha 2023

District Progress Card of March 2024

Tinsukia (Assam)

Category (as on 01 Mar 2024) : High Achiever ★★★★

National Rank in category : 64 /299 State Rank in category : 8/24

Indicator		Maximum Marks	Obtained Marks
Physical Progress	Residual Coverage: FHTC provided afer base date /Remaining FHTC Coverage to achieve 100% Coverage on base date	40	27.0333
	% of HGJ cerfied villages	10	1.192
Water Quality	% of villages where household tap water sample is tested using FTKs or in Labs	10	8.2683
	% of villages where PWS source water sample (taken after WTP) is tested using FTKs or in Labs	10	8.3289
	% of villages having women trained for FTK testing	10	9.963
Institutional Arrangements	% of villages where atleast one JJM scheme handed over to VWSCs/ GPs	10	3.346
	% of villages with skilling done	10	6.893
Total		**100**	**65.0245**

Total number of villages	Total number of households
1,091	2,53,465

FHTCs as on 01 Oct 2022	(A) Remaining households as on 01 Oct 2022	(B) Target FHTC till this month March 2024=[(18/18)*A]
72,065	1,81,400	1,81,400

Parameters	Plan till month of March 2024	Progress till date after 01 Oct 2022	% Progress
Households with tap water connections	1,81,400	1,22,596	67.58
Villages having women trained for FTK testing as per norms	1,091	(73)+1,014	99.63
Har Ghar Jal certified villages	1,091	(1)+129	11.92
Villages where atleast one JJM scheme handed over to VWSCs/ GPs	1,091	(0)+365	33.46

The dashboard exemplified a robust accountability framework through a proactive Water Quality Management Information System (WQMIS). It is a central repository, aggregating and disseminating insights from a vast network of certified laboratories. Through this system, the status of water quality testing for each day, and each month is meticulously documented. For instance, in May 2024, over 2,000 laboratories contributed to the analysis of more than 3,00,000 water samples. This extensive coverage underscores the breadth of data collection efforts, encompassing a diverse array of geographical locations and water sources. By capturing testing outcomes across more than 85,000 villages, the dashboard provided a granular understanding of water quality trends at the grassroots level.

The dashboard also helped to identify chemical and bacterial contaminants, showing the system's sophistication in analysing water quality parameters. It scrutinises chemical factors such as pH, TDS, turbidity, chloride, total alkalinity, total hardness, sulphate, iron, total Arsenic, Fluoride, Nitrate, and residual chlorine among others. Of the bacterial contaminants, it checks the amount of E. coli and total coliform, offering a nuanced perspective on potential health risks associated with water consumption.

The Jal Jeevan Surveksha 2023 initiative aimed to foster a culture of competition among states

and districts, motivating officials to enhance their performance and elevate water service delivery standards in rural areas. Districts are stratified into five categories based on the percentage of households with functional tap connections reported on JJM-IMIS. These categories range from Aspirants (0 to less than 25% coverage), Performers (25 to less than 50%), Achievers (50 to less than 75%), High Achievers (75 to less than 100%) to Front Runners (100% coverage).

States and Union Territories (UTs) receive recognition on a monthly, quarterly, and annual basis for their performance, which is prominently displayed. For instance, the frontrunners for April 2024 include Vadodara, Porbandar, and Kanchipuram, while high achievers during the same period comprise Chittoor, Tirupati, and Annamayya.

The JJS section further features an extensive district progress card, providing insights into the physical progress, water quality, and institutional arrangements within each district. Below, a comprehensive example is presented, detailing the advancements within the district of Tinsukia in Assam. (see figure 10)

Status of Tap Water in Rural Institutions

With safe drinking water readily available, students are less likely to fall ill due to waterborne diseases, leading to reduced absenteeism. Additionally, adequate hydration supports cognitive function, ensuring that students can concentrate better in class and perform optimally in their studies. The dashboard captures data on tap water connections in these institutions. According to data shared by states, the dashboard data (as of Sept. 2024, see gtaph 4) reflects the status of tap water supply in schools at 89.18%.

Similarly, in anganwadis, the provision of tap water supply stands at 86.65%. Additionally, in Gram Panchayats (GPs) and Community Health Centers (CHCs), the tap water supply has reached 76.96%,

Graph 3: Upward Trend in Tap Water Supply Access Across Schools

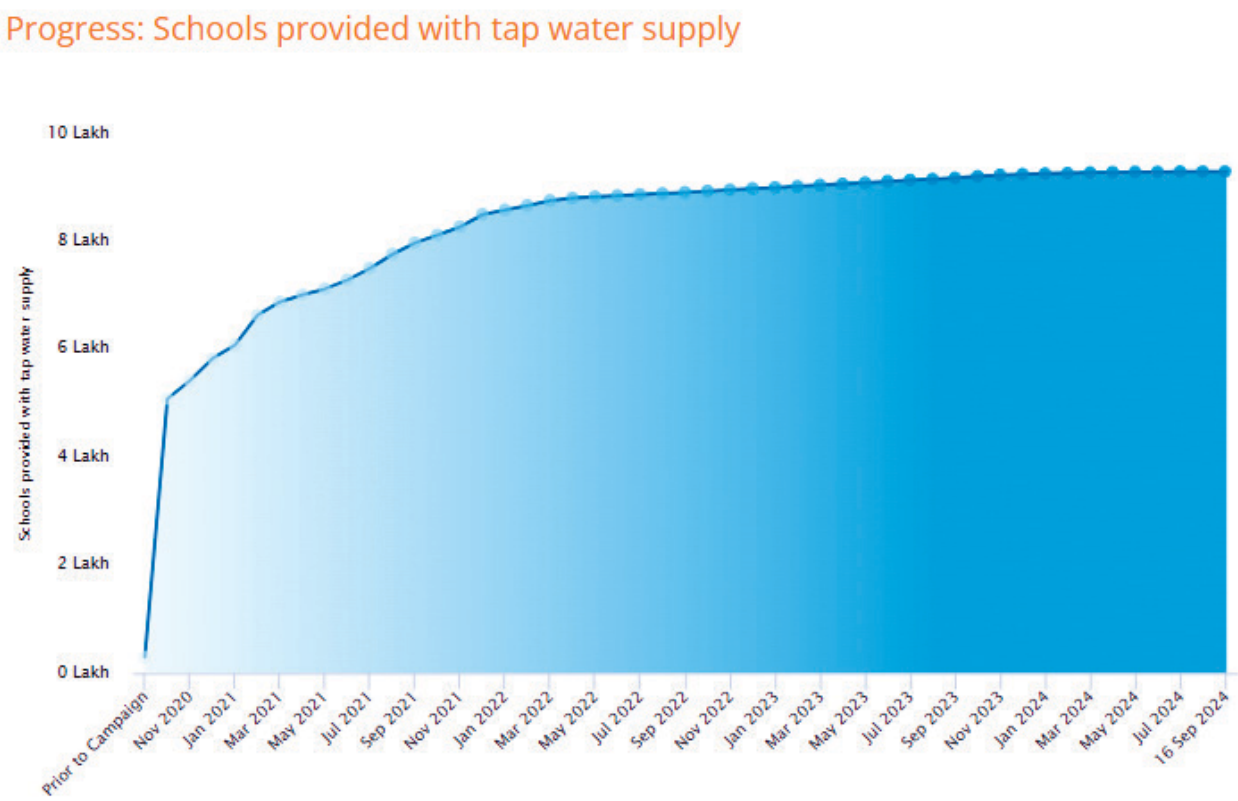


Figure 11: IoT Sensor Pilot Deployment Sites

signifying progress towards ensuring basic amenities in rural healthcare and grassroots governance hubs. By promoting health and educational outcomes, tap water supply has contributed to building human capital, economic growth, and advancing the Sustainable Development Goal 6.

As part of the Jal Jeevan Mission's commitment to universal coverage in rural households, special attention is directed towards prioritised regions. This includes Aspirational Districts, those affected by Japanese Encephalitis (JE) and Acute Encephalitis Syndrome (AES), as well as areas with water quality challenges. The JE/ AES affected districts section facilitates easier comparison between districts through a bar graph. Additionally, users have the option to download the data in excel format, providing further flexibility for analysis and reference.

The dashboard also highlights the progress of districts selected under the 'Mission Utkarsh' initiative, aimed at rapidly improving key performance indicators (KPIs) in designated districts identified by the Ministry of Rural Development. This initiative spans ten districts across Assam, Maharashtra, Nagaland, Jharkhand, Uttar Pradesh, Uttarakhand, Chhattisgarh, Madhya

Pradesh, Odisha, and Rajasthan[21]. Over 190 such priority areas have already achieved 100% coverage, ensuring equitable access to clean water.

Piloting Sensor-based IoT Solutions for Rural Water Supply

The design of rural drinking water supply systems varies significantly across different regions of India, from the western Himalayas to desert areas and Gangetic plains, encompassing extreme climatic conditions ranging from freezing temperatures of -10°C to scorching heat of 48°C. Sensor-based IoT pilots have been deployed in diverse agro-climatic conditions, covering various water sources such as groundwater-based borewells, hilly springs, and surface water from rivers and dams, serving villages with populations ranging from a few hundred to several thousand. These pilots on the dashboard display a pioneering approach to comprehensive remote monitoring and control systems in real-time (see figure 11).

The outcomes of these pilots have been significant. They have facilitated the identification and resolution of distribution issues such as outages, leakages, and low pressure across different sites. Additionally, the IoT systems have effectively alerted both officials and communities about rapidly depleting groundwater levels, prompting proactive measures such as the construction of source strengthening structures to recharge borewells. Moreover, the implementation of sensor-based IoT solutions has promoted efficient and responsible water usage by communities, leading to reduced operational costs through data-driven leak detection, predictive maintenance, and automation.

IoT Device for measuring real-time pH of Water supplied

Prudent Financial Management

Within the JJM framework, financial transparency is rigorously upheld through the integration of the Public Finance Management System (PFMS) into the JJM dashboard. This system facilitates real-time tracking of fund allocations, disbursements and expenditures associated with the mission's implementation. By leveraging PFMS, comprehensive records of both physical progress and financial expenditure are meticulously maintained.

The fund section of the dashboard presents a time-bound overview of fund allocation and expenditure by states, holding them accountable for any disparities between allocated funds and actual spending. For instance, Maharashtra (MH) in the fiscal year 2019-20 was allocated a substantial sum of ₹ 847 crores, but its expenditure was significantly lower at ₹ 300 crores. Similarly, their opening balance for the subsequent fiscal year, 2020-21, stood at ₹285 crores. Despite being allocated a significant amount, the actual expenditure falls far short of the allocated budget, suggesting inefficiencies in fund utilisation. The disparity between the allocated funds and actual expenditure points to potential issues in financial planning, scheme execution, and resource management within the state.

[21] Department of Rural Department, J. (2022). Guidelines for "UTKARSH": a Mission to uplift selected Districts. https://utkarsh.nic.in/Uploade_doc/MP/PMAYG/9425580306-1-23-8-2022%20015937.pdf

13

Modernising Water Supply Systems

The use of technological innovations in JJM brought speed and ensured delivery of safe water at a massive scale across the country. Technology enabled a system where every drop of water could be accounted for, every pipeline monitored, and every household identified for access to safe drinking water.

Under the JJM, in existing piped water supply rusting pipes, hefty handpumps, unsanitary common taps, faulty pumps and deteriorating motors were replaced by a new network of water infrastructure, equipped with smart sensors monitoring water quality and quantity. The inclusion of predictive analytics to forecast water demand and supply, optimise water distribution, and reduce wastage were revolutionary.

In JJM, a total of 123 innovative technologies were introduced, including 76 related to water supply and 47 for sanitation. These innovations played a crucial role in tackling the complex challenges of water scarcity, quality, and sanitation in rural India. These technologies included a broad spectrum of Internet of Things (IoT)-based sensors and smart metering systems to Geographic Information System (GIS) mapping tools. All aimed to improve efficiency and sustainability of water resource management. Additionally, the mission had utilised digital platforms, such as mobile applications and web portals, to enhance service delivery and encourage community participation.

Use of technology catalysed the changes JJM envisaged. It addressed several problems: treatment from geogenic and biological contaminants, maintenance of a long-term drinkable water supply system, and monitoring of service delivery. Operational guidelines of the mission facilitated acceptance of ideas from companies and researchers that generated technological solutions.

Proposals on water and sanitation were received from R&D institutions and several innovators. After scrutiny they were selected for a pilot project. The Technical Committee of the National Mission decided the location for demonstration, in consultation with states and the Union Territories, if necessary. This process was a significant boost for young entrepreneurs and start-ups working in the field of water, enabling them to provide cost-effective solutions.

Further, action research and concurrent evaluation studies were undertaken by the National Mission and State Water and Sanitation Mission. This was done to adopt evidence-based policy and technical interventions to manage rural water supply effectively.

Technology Improves Water Quality Testing and Treatment

One of the most pressing issues of water quality is the presence of water-based biological contaminants in water supply, and the diseases it causes. Chlorination is an established process of eliminating biological contaminants. As part of JJM, automatic chlorinators were introduced to improve water quality. The sensors in automatic chlorinators measure diluted chlorine in the water and add the appropriate amount of chlorine to the water, ensuring it is purified and safe for consumption. This automated process increases efficiency and reliability of water treatment.

Moreover, these sensor-based IoT devices enabled effective monitoring and management of water quality on the ground, which has significantly improved operational efficiency, reduced costs and also addressed individual grievances about water quality. To make the system sustainable, solar automatic chlorinators charged by solar panels, developed by private groups, were also introduced at some sites.

Desalination Membranes for Water Treatment

Whilst there were many technological interventions in the field of water treatment plants, the most notable was the desalination membranes developed to treat water with high Total Dissolved Solids (TDS). In this process, no chemicals are added and the unit does not require an operator on a daily basis. The Bhabha Atomic Research Centre (BARC), Department of Atomic Energy (DAE), developed a desalination membrane machine for treating surface and groundwater that had high salinity rate, microbial contamination, Arsenic, Iron, Fluoride, heavy metals, and nitrate. This unit can remove more than or equal to 99.99% microorganisms, suspended solids, colloids, and high molecular weight organics, thereby producing crystal-clear water complying with BIS 10500. This machine has a shelf life of 10 years, and does not remove ions and minerals present in water.

For JJM, brackish and seawater desalination was also undertaken in rural, remote, and strategic locations of India. The BARC research centre also developed several sites and case-specific desalination and water purification technologies as a spin off to the R&D in nuclear technology. These units can easily address the prevalent groundwater contaminants like fluoride, arsenic, iron, heavy metals, salinity etc. while offering safe drinking water to the public.

A similar device was constructed in Indian Institute of Technology, Jodhpur, which used membrane-assisted technology to filter water with high salinity. This model was deployed in many villages of Rajasthan.

A water purification unit installed at Platform-14/15, Mumbai Central; deployed by DAE, Bhabha Atomic Research Centre

Source: Bhabha Atomic Research Centre, PIB

IoT Devices and Their Development

The IoT technology enabled real-time monitoring, data-driven decision-making, and improved efficiency in water supply systems. The IoT sensors and devices were deployed to monitor water levels, quality, and usage in real-time, enabling efficient water resource management, early detection of issues, and timely decision-making. The IoT devices also helped in optimising energy usage in water supply systems by incorporating smart grid technologies. The ICT Grand Challenge, launched by the National Jal Jeevan Mission and the Ministry of Electronics and Information Technology (MeitY) created a platform for technology developers to propose their projects for providing water through FHTCs under the mission. (Refer chapter 11)

The IoT pilots were deployed at various locations in 123 villages of 14 States. This real-time data was available in the public domain on the JJM dashboard. Later, states were issued guidelines to upscale IoT-based systems. In Gujarat, 10,000 villages, in Goa the entire state, in Haryana 1,044 sites in two districts and 897 villages in Punjab opted for IoT devices. Both in Maharashtra and Bihar, the IoT based systems proved to be very effective. This initiative resulted in improving the delivery in other states like Andhra Pradesh, Rajasthan, Odisha and Uttarakhand.

Technology Development in Water Monitoring

The mission emphasised the importance of regular monitoring to ensure the sustainability of water supply systems and the quality of water provided. Regular monitoring helps in identifying issues in the water supply, such as contamination or supply disruption at an early stage, enabling timely corrective actions. It also aided in the efficient management of water resources, ensuring that water is not wasted and is evenly distributed among all households. Further, monitoring helped in assessing the progress of the mission, providing valuable data that can be used to improve strategies and make informed decisions.

IIT Jodhpur's Ultrafiltration for Water

The Indian Institute of Technology (IIT) Jodhpur has pioneered an innovative water purification unit as part of JJM. This unit employs membrane-assisted absorption-based Ultrafiltration (UF) technology to ensure the water is adequately purified. The technology has been implemented in several schools across rural areas of Rajasthan, including districts like Jodhpur, Sirohi, Pali, and Jhunjhunu.

The IIT Jodhpur model led to the installation of water purification systems in 25 village schools, government primary schools and anganwadis of Jodhpur District under the Scientific Social Responsibility (SSR) segment of Corporate Social Responsibility (CSR).

This model involves the participation of all stakeholders, including teachers, staff members, and students. Through education and capacity building in installation, Operation and Maintenance (O&M), local participation is ensured. This approach promotes skill development at the primary level and introduces school students to practical aspects of education. Furthermore, it fosters a novel approach to a decentralised community-managed system, thereby ensuring the sustainability of the project.

Source: Indian Institute of Technology Jodhpur-Jal Jeevan Mission Centre for Sustainable Drinking Water

The role of technology in monitoring begins as soon as the decision to set a connection for water supply is taken. While it is easy to quantify surface water, it is difficult to quantify groundwater sources. This disparity often goes unaccounted for, and hence leads to poor management practices and impacts water security. This can be challenging for small and marginal farmers, livestock keepers, the landless, and women who fetch water.

Advanced sensors and real-time monitoring systems can detect a wide range of pollutants and changes in the water's physical parameters, such as temperature, pH factor, turbidity, and dissolved oxygen levels. This data is crucial for assessing water quality and identifying any potential threats to human health or the environment. Furthermore, these technologies can provide continuous, real-time data, enabling immediate response to any sudden changes in water quality. This is particularly important in situations where pollutants can have immediate harmful effects.

Technology empowered administrators with tools to manage water resources effectively, ensuring safe and clean water for all. An example of such tool developed was the Sarvajal Enterprise Management System or SEMS.

Potable Water Supply and Smart Metres

Potable water is essential for sustaining life and maintaining public health. It is crucial for hydration, cooking, hygiene, and other domestic needs. Potable

A sensor based IoT device used for assessing and detecting nitrate in water

Source: Department of Science and Technology, India

Application of CLART in Water Management

In the state of Karnataka, the Rural Development and Panchayat Raj Department (RD&PR) launched the Antarajala Chetana programme in 2020 (renamed as the Jala Sanjeevini Programme in 2022) to improve groundwater status, increase green cover, and enhance agricultural production. An MoU was signed by the Government of Karnataka, Foundation for Ecological Security (FES), Arghyam, and Socion Advisors LLP to enable field functionaries to utilises data and technology for planning and implementation. Clear guidelines for Gomala sub-plans were made accessible through an open platform, and in-person and virtual capacity-building sessions and guided mentoring was facilitated.

The Composite Landscape Assessment and Restoration Tool (CLART) is a GIS-based support tool that has been instrumental in aiding the planning and designing of soil and water conservation interventions. By overlaying information layers such as rock type, slope, and land use/land cover, CLART calculates the recharge potential of a given area and color-codes the region on the map. Different colours indicate different recharge potentials, enabling stakeholders to plan suitable interventions. This tool demystifies data and supports decision-making through a suggestive approach, fostering community-led scientific planning.

Source: Navigating Water Security: Leveraging Technology for collective and Sustainable Futures, Foundation for Ecological Security (FES)

water supports economic development by enabling food production, industrial activities, and contributing to poverty reduction. Recognising its importance, the United Nations declared access to safe drinking water a fundamental human right, emphasising that everyone has the right to sufficient, continuous, safe, acceptable, physically accessible, and affordable water for personal and domestic use.

The Grand Challenge, in collaboration with the Atal Innovation Mission and the All India Institute of Information Technology (AIIIT), led to the selection of several sensor-based potable water quality testing devices. These advanced devices, equipped with Bluetooth and SIM-based technology, were designed to replace traditional reagent-based water testing kits, offering a simpler and more efficient solution for on-the-go testing. It was emphasised that every Public Health Engineer should carry one of these devices, as they were considered as essential to their work as a stethoscope is to a doctor, providing instant and accurate water quality assessments. By ensuring ease of use and rapid results, these devices were expected to play a crucial role in maintaining public health standards and safeguarding access to safe drinking water in all regions.

Building on the significance of accessible drinking water, smart metres have served as a pivotal element in realising the goals of the mission. These metres provided instantaneous insights into water consumption patterns, which was crucial for informed decision-making at all levels. Smart water flow metres marked a notable progress in the technology of water measurement and management. Their integrated design had facilitated real-time monitoring and management of water usage, granting stakeholders timely insights without the dependence on external power sources or extra IoT components.

The deployment of smart water flow metres within the JJM represented a significant leap in water governance, allowing for comprehensive monitoring and management of the scheme's performance across the nation. Installed at strategic points including Overhead Tanks (OHTs), distribution lines, and District Metering Areas (DMAs), these smart metres have become indispensable in enhancing service delivery and governance.

They had provided a clear picture of consumption patterns and supply trends, enabling rural communities to proactively manage their water needs and guarantee fair distribution. These metres had been crucial in the daily monitoring of water supply, recording the volume and timing of the supply, which assisted stakeholders in adhering to service benchmarks and pinpointing opportunities for supply optimisation and waste reduction. In regions

SEMS, a Perfect Online Tool

The Sarvajal Enterprise Management System (SEMS), an in-house developed online enterprise resource planning (ERP) tool by the Piramal Foundation, offered an integrated solution for comprehensive data and administrative control over water purification and dispensing units. It also facilitates groundwater level monitoring. This tool adopts a proactive, community-focused approach to rural water management, empowering local committees, utilising technology for monitoring and decision-making, and prioritising water quality.

Piramal Foundation was able to make considerable progress in providing safe drinking water and improving the quality of life in rural communities. Further, SEMS could continuously monitor over 1,100 installed safe water infrastructures, and aid the team in ensuring uninterrupted 24x7 safe water availability across approximately 20 states.

Village water committees, responsible for managing purification units and overseeing water distribution, could control usage, adjust to seasonal variations, and make informed decisions about water management. This data-driven strategy optimised water usage and ensured the sustainable use of available water resources.

In collaboration with its technical partner Urdhvam, Piramal Sarvajal strengthened 59 borewells across 28 villages in Madhya Pradesh, Rajasthan, and Maharashtra. Water conservation structures and soak pits have been constructed to promote water retention and infiltration into the ground. Sensors deployed at each of these water conservation structures have been connected to the SEMS platform, enabling data collection, analysis, and monitoring of water outflow.

Source: Sarvajal Enterprise Management System (SEMS by Rahul Sinha, State IT Programmer, DWSD Jharkhand; Biplab Shankar Dey, SPM, Piramal Foundation

Composite Landscape Assessment and Restoration Tool (CLART)

Source: Foundation for Ecological Security

dependent on groundwater, the metres at abstraction wells have been key in assessing the sustainability of water sources, aiding in the informed decision-making for sustainable extraction rates that would prolong the lifespan of water sources and strengthen water security.

The Vijaya Vahini Foundation's initiative installed such metres in the villages of Mycherlapalem and Seemunapalle in Andhra Pradesh, equipping around 300 households in each village with individual tap connections. The initiative also enabled precise water supply estimation.

Section E

Not the Last, Not the Least

Women fetch water from a nearby hand pump in a village near Kunda, Udaipur, Rajasthan

14

Piped Water Reaches Homes in Aspirational Districts

The development narrative in India has undergone a significant shift over the years, moving from a focus on the BIMARU states (Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh) to more localised and district-level programme initiatives for development. The BIMARU states were characterised by high poverty rates, low literacy levels, inadequate infrastructure, and other developmental challenges. However, in the last decade, the shift towards a more nuanced and decentralised development strategy led to the concept of 'Aspirational Districts'.

The idea behind Aspirational Districts emerged when the NITI Aayog identified 112 districts across 26 of 28 states that exhibited significant gaps in development indicators despite being part of relatively better-performing states. Notwithstanding considerable economic growth, India ranked 134 out of 188 countries on the Human Development Index (HDI) in 2016. It signifies an unequal economic growth and significant inter-state and inter-district variations in the living standards of people in India.

The government honed in on districts with slower progress in achieving crucial social outcomes such as – better health, education, and inclusive development through the adoption of the 'Transformation of Aspirational Districts' programme. Initially labelled as 'Backward districts', these regions were rebranded as 'Aspirational' by Prime Minister Narendra Modi. These Aspirational Districts were named so because they represented areas with immense potential and aspirations for improvement. This shift in terminology signalled a change in the development narrative towards optimism and empowerment, and to accelerate progress and promote inclusive growth.

The Jal Jeevan Mission swiftly prioritised areas among the aspirational districts where access to safe drinking water remained a pressing concern. From remote regions inhabited by tribal communities to remote settlements grappling with water quality issues, JJM strategically planned to prioritised provide water to areas that had been facing myriad challenges for decades.

Water – The Prerequisite of all Aspirations

For the success of a nation as a whole, and particularly for the effectiveness of initiatives like ADP, water security stands not merely as a priority, but a prerequisite for social development. In addition to being a basic necessity for life, safe drinking water functions as the lifeblood of communities, essential for driving agricultural productivity, maintaining public health, fostering overall well-being, and stimulating economic vitality.

Within the context of the ADP, addressing the fundamental needs upon which the growth and prosperity of marginalised communities depend was imperative. Providing 'safe drinking water' would not have just alleviated their daily struggles but also given them opportunities to live a life with dignity.

In 2019, JJM took a significant step by prioritising these Aspirational districts with the explicit goal of ensuring that every household gains access to a functional household tap water connection (FHTC), thus embodying the principle of leaving no one behind. In the mission, ST majority villages and villages in Aspirational districts were prioritised.

Furthermore, a 10% weightage was assigned for the population residing in SC/ ST dominated areas, while allocating the funds, to prioritise the coverage in these areas. The Government of India also approved Pradhan Mantri Janjati Adivasi Nyaya Maha Abhiyan (PM-JANMAN) for the development of Particularly

What is the 'Aspirational Districts Programme'?

Launched in 2018, the Aspirational Districts Programme (ADP) aims to swiftly and effectively revitalise 112 of the most under-developed districts in the nation. Three core aspects frame the structure of the ADP:

Convergence: Convergence of Central and State government Schemes in Aspirational districts.

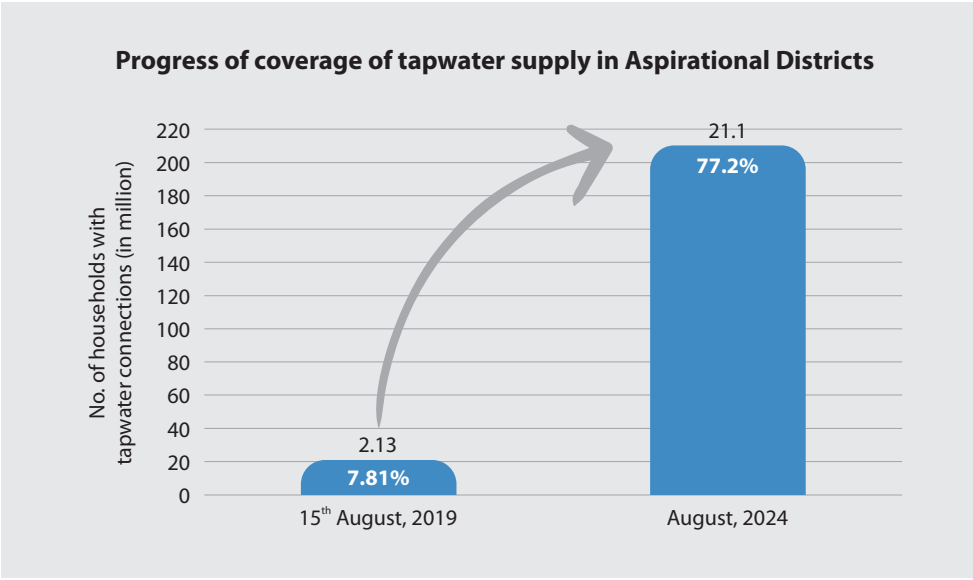
Collaboration: Collaboration of State and District Officers

Competition: Fostering healthy competition among districts.

Convergence entails the integration of central and state schemes, while collaboration involves coordination among central and state-level 'Prabhari' Officers and District Collectors. Central Prabhari Officers are officers nominated in the rank of Additional Secretary/Joint Secretary and state-level Prabhari Officers are nominated by the state to drive the progress of the ADP. Additionally, the programme fosters competition among districts. The programme is driven primarily by the states and instituted for the state government. This initiative focuses on the strengths of each district and identifies the attainable outcomes for immediate improvement while measuring progress and ranking the selected districts according to achievements. The progressive ranking will be aimed at fostering healthy competition among districts in 4 key domains i.e. health, education, agriculture and water resources, financial inclusion and skill development, and basic infrastructure.

Evidence-based decision-making has been an important consideration for the programme strategy. It comprised 49 key performance indicators and 81 data points which can be tracked in real-time on a dashboard (called Champions of Change). Districts are encouraged to first match the standards set by the leading district within their state, and then aim to excel on a national level by engaging in friendly competition and collaborative learning, embodying the principles of competitive and cooperative federalism.

Graph 4: Increase in Tap Water Supply Access in Aspirational Districts from 2019-2024



Vulnerable Tribal Groups (PVTG) aiming at the targeted development of 75 PVTGs.

Many studies have highlighted the unequal distribution of water resources, particularly impacting marginalised communities and geographically remote villages. For example, ActionAid India, an NGO, in its 2017 study on Aspirational Districts, highlighted as to how limited access to nearby water sources not only wasted precious time and also perpetuated socio-economic disparities among marginalised communities.

Beyond availability, water quality posed a significant health risk in Aspirational Districts. The NITI Aayog's 2018 report found that over 70% of rural water sources in these regions were contaminated with faecal bacteria, with E-coli being the most prominent, leading to waterborne diseases like diarrhoea and typhoid fever. Outbreaks of waterborne diseases caused by water contamination in rural and tribal regions have been a prime concern. The impact and intensity of waterborne diseases also contributed to the underdevelopment of these regions, affecting health, education, and economic opportunities, particularly for women and girls.

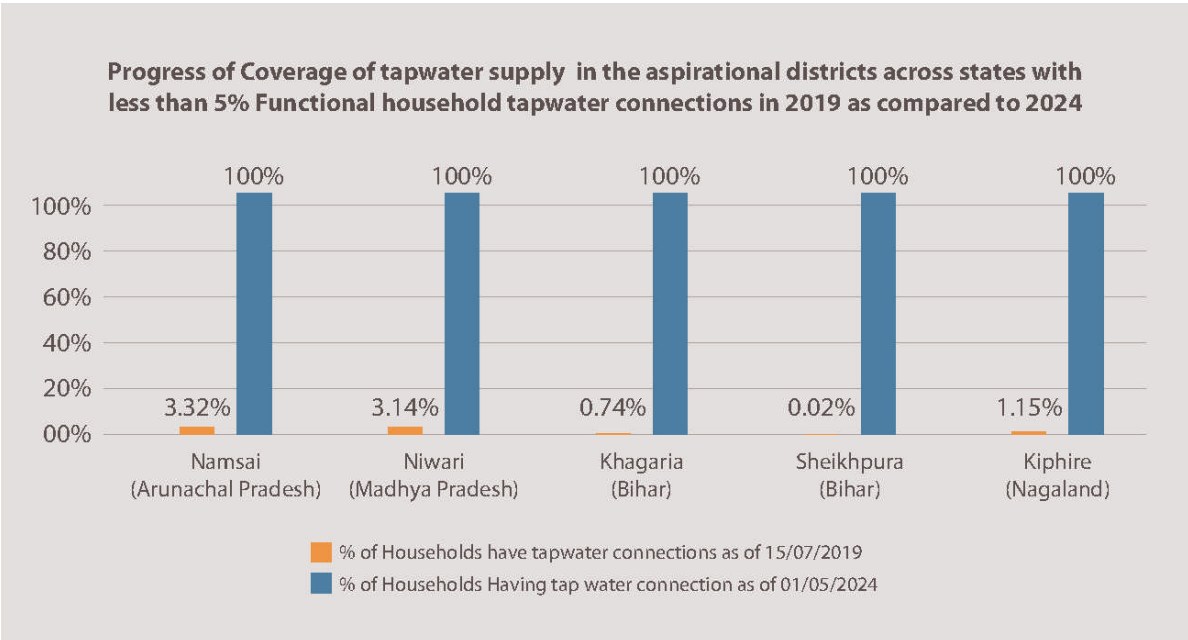
In 2019, the Aspirational Districts from different states reported only 7% households with safe tap water connections. By August 2024, over 77% households were covered by JJM (for progress up till May 2024, refer graph 5).

As reflected in Graph 6, Namsai, an Aspirational district in Arunachal Pradesh with a population of around 81,000 with 85% living in rural areas had only 549 out of 16,549 households with tap water connections. Similarly, Niwari (Madhya Pradesh), Khagaria and Sheikhpura (Bihar) and Kiphire (Nagaland) were Aspirational Districts having less than 5% of their households with tap water connections, that now have 100% coverage.

Bihar's Progress in Providing Tap Water

While most of the state's other than Bihar had Aspirational districts with 10% or more households covered with tap water supply, Bihar had many of Aspirational districts with less than 10% of households had tap water connections. Today, most of the Aspirational districts in Bihar have achieved 100% coverage, and a closer examination of what worked

Graph 5: Progress in Aspirational Districts Across States with <5% Tap Water Connections



and how in Bihar is worth a glance.

Bihar, the third-largest state of India with a population of 13.1 crores, has 13 districts namely Nawada, Araria, Aurangabad, Banka, Begusarai, Gaya, Jamui, Katihar, Khagaria, Muzaffarpur, Purnia, Sheikhpura, and Sitamarhi as Aspirational districts. A predominantly agrarian economy, Bihar's demographic landscape is predominantly rural, with 89% of its inhabitants residing in rural areas. The state experiences an average annual rainfall ranging from 1,250 to 1,350 millimetres, with a significant portion, 87%, concentrated within the three monsoon months.

Geographically, Bihar's water table varies considerably, ranging from as low as 5 meters in the northeastern region to 20 meters in the southern districts.[22] Situated in the transitional climate zone between humid West Bengal and sub-humid Uttar Pradesh, Bihar grapples with recurring floods, a critical issue affecting its populace. These floods have inundated vast areas in the past years, rendering approximately 9.4 lakh hectares waterlogged and adversely impacting up to a quarter of the state's population in some years.

Water Quality Issues

Bihar faces water stress, particularly during the summer in its southern regions, despite its abundant water resources in the northern parts of the state. Moreover, seasonal rains induce floods in northern Bihar leading to unsafe drinking water due to faecal contamination causing the rise in waterborne diseases such as diarrhoea, dysentery, typhoid fever, intestinal helminthiasis, jaundice, and cholera. Compounding these issues is the emergence of chemical contamination in groundwater, further jeopardising the provision of safe drinking water.

As per the Public Health Engineering Department (PHED), Government of Bihar Report, Arsenic contamination affects water sources in 13 districts along the Ganges, with 1,750 habitations partially affected. Arsenic contamination is predominantly observed within the younger alluvial belt along the Ganges River. These areas are not only prone to flooding but also exhibit geochemical characteristics conducive to the mobilisation of Arsenic in groundwater. Conversely, Pleistocene aquifers remain unaffected by Arsenic contamination.

Additionally, excess Fluoride (>1.5 ppm) impacts 6,373 habitations in 22 districts, while excess iron contamination is prevalent in 9 districts of Bihar. Under JJM, till now habitation intervention of Iron has been done as a short-term measure in Saharsa district.

The prevalence of Arsenic and Fluoride contamination in groundwater, coupled with inadequate sanitation facilities, poses a significant challenge to water supply in both rural and urban areas of Bihar. Rural regions, in particular, face heightened risks due to their heavy reliance on hand pumps drawing water from aquifers located less than 70 meters below ground level.

What Worked and How

In Bihar's Aspirational districts, the success can be attributed to a combination of factors, including the ward-wise approach, regular review meetings, and the presence of pre-existing schemes.

- The ward-wise approach played a pivotal role in Bihar's success story. By focusing efforts at the ward level, the state could thoroughly assess the water-related challenges faced by each specific area. This micro-level planning allowed for targeted interventions tailored to the unique needs and circumstances of each ward. Firstly, the JJM focused on low-hanging fruits like retrofitting and augmentation of existing water supply to households. The habitations with SC/ST populations were identified and prioritised by the central government while announcing JJM had made sure to govern it with a 'no one is left out' philosophy.
- Community consultations and participatory decision-making ensured that local voices were heard, fostering a sense of ownership and cooperation among residents. As a result, efficient resource allocation and precise project implementation made possible leading to tangible improvements in water access and quality. This empowerment has created a

[22] Census of India, 2011

Women trained in Field Testing Kits checking water quality in Bihar

profound sense of leadership and ownership among individuals.

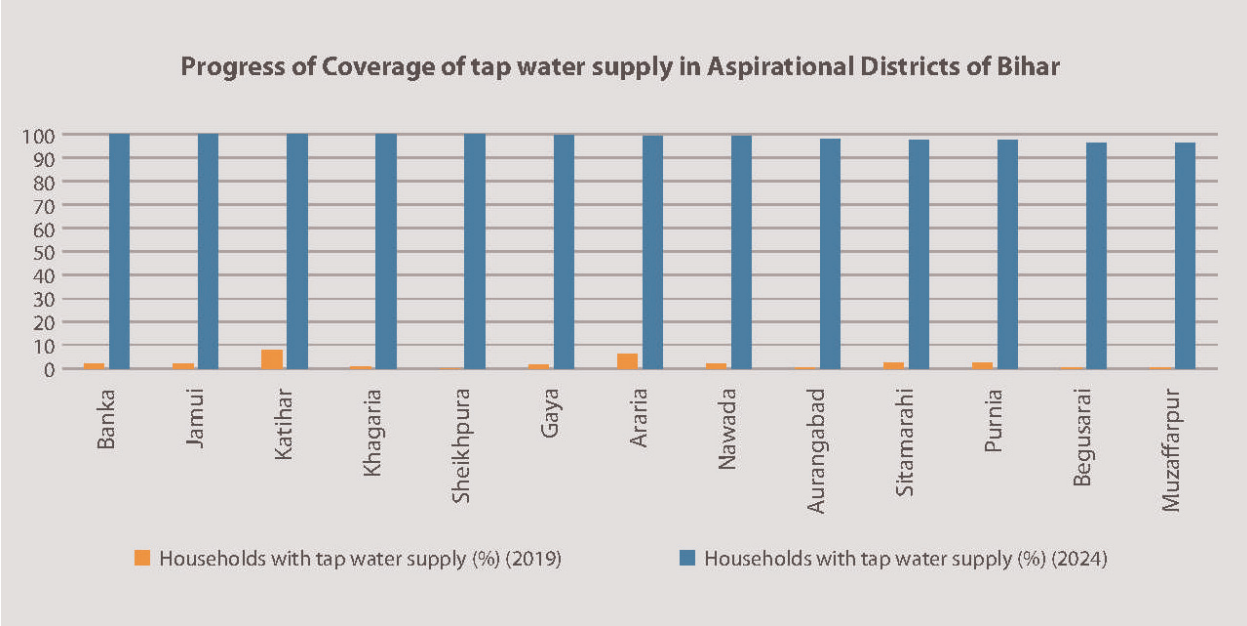
- Regular review meetings further bolstered Bihar's efforts involving all stakeholders provided a platform for transparent dialogue and strategic planning. By regularly assessing progress, identifying bottlenecks, and devising solutions, Bihar could course-correct and expedite project implementation, especially in Aspirational districts. The collaborative nature of these meetings ensured that decisions were well-informed and consensus-driven, leading to effective resource utilisation and project management.
- Additionally, the presence of pre-existing schemes complemented Bihar's JJM initiatives. For instance, the Har Ghar Nal Ka Jal Yojana (HGNJY) tap water supply scheme that began in 2016 had the infrastructure and institutional mechanisms already in place helped expedite the implementation process.

The decentralisation of approval levels significantly accelerated the process. By devolving approval authority to lower administrative levels, the bureaucratic hurdles have been minimised. This granular approach made it considerably easier for small-scale village water supply schemes to be swiftly approved and implemented, ensuring timely access to safe drinking water for rural communities.

Moreover, frequent field visits by the National Jal Jeevan Mission (NJJM) team played a crucial role in expediting the implementation process. These visits facilitated closer monitoring of progress and underscored the urgency and priority accorded to covering districts in need of water infrastructure improvements. Thus, the NJJM team ensured that the mission's objectives were realised effectively and efficiently, thereby positively impacting the lives of countless individuals in Bihar.

Hence, by dovetailing the existing schemes the government has undertaken various measures. In Arsenic-affected areas, the construction of sanitary dug wells and the implementation of multi-village piped water supply schemes are underway. Similarly, in Fluoride-affected regions, domestic Fluoride removal filters are being distributed, alongside the construction of community water supply schemes equipped with solar-powered motors and pumps and adsorption-based treatment units. Contaminated water sources were being marked red to raise awareness among the populace, supplemented by extensive Information, Education, and Communication (IEC) activities at

Graph 6: Percentage of Functional Household Tap Water Connections (FHTC) in all the Aspirational Districts of Bihar from August 2019 to April 2024



the district, block, and panchayat levels. Grassroots workers were trained to utilise Field Test Kits (FTKs) for water quality testing.

The state government of Bihar, in collaboration with various implementing agencies, embarked on an ambitious plan to develop water supply infrastructure. This included the construction of water treatment plants, laying of pipelines, installation of storage tanks, and setting up tap connections in every household. Recognising the importance of community involvement, the state government encouraged the participation of the local community in the planning and execution of water supply projects. Gram Panchayats and local water committees were actively engaged in identifying water sources, designing schemes, and monitoring implementation. Through these efforts, many districts' names have been a recurrent feature in the delta rankings over the last three years.

The concerted efforts of the Bihar government, along with the active participation of communities, are indeed yielding remarkable results as seen in Graph 7.

By focusing on Aspirational districts, JJM aimed to create models of inclusive and sustainable development that can be replicated and scaled up across the country. Through targeted investments in infrastructure, human capital development, and livelihood promotion, the aspiration is to transform these districts into vibrant hubs of opportunity, prosperity, and social progress.

Overall, a holistic and participatory approach, guided by the principles of equity, sustainability, and inclusivity, has been key to advancing the objectives of the JJM and ensuring universal access to safe drinking water in Bihar and beyond.

15

Taps Replace Tankers in Drought-prone & Desert Areas

Drought, a persistent environmental challenge in India, due to its unique geographical conditions and positions. Prolonged dry spells and rising temperatures deplete water sources, affecting agriculture, livelihoods, and overall well-being. Climate change is exacerbating the frequency and severity of droughts. According to the Indian Meteorological Department (IMD), over 50 million people across 300 districts were impacted by drought in 2019 alone. With nearly two-thirds of India's farmlands relying on rainfall, addressing drought is a national imperative.

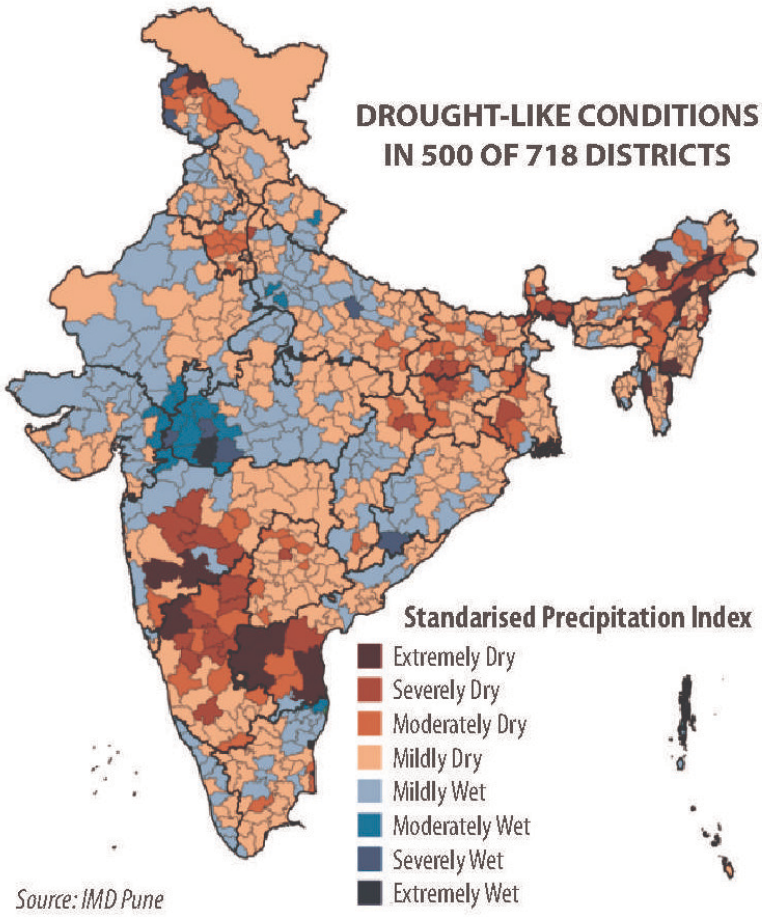
Ensuring safe and potable water supply is a monumental challenge as a UNICEF report[23] records that two-thirds of India's 718 districts face extreme water depletion, and 29% of households are lacking access to drinking water facilities (2011 Census). The World Health Organization (WHO) states, 'drought is a prolonged dry period in the natural climate cycle that can occur anywhere in the world. (See figure 12).

Droughts affect agriculture, water availability and food supply and can also disrupt education, deteriorate health, increase multidimensional poverty and can marginalise the women. Availability of clean drinking water in drought prone areas is scarce and that puts the strain on the women and the children, resulting in long treks to fetch water from distant wells and lakes. According to an UNICEF report[24] nearly 54% of rural women spend 35 minutes daily to get drinking water.

Water supply reaches drought-prone regions of Marathwada (Maharashtra)

[23] Clean drinking water. UNICEF. https://www.unicef.org/india/what-we-do/clean-drinking-water
[24] Clean drinking water. UNICEF. https://www.unicef.org/india/what-we-do/clean-drinking-water

Figure 12: Pictorial Representation of the Urgency of the Situation of Drought-Prone Districts in India



Regions that are chronically affected with drought such as Marathwada, Saurashtra, Mirzapur Plateau etc. witness harsher human drudgery for sourcing drinking water.

It is not just droughts but the lack of clean drinking water too can create insurmountable conditions for communities and leave them vulnerable against diseases such as cholera and dysentery. Previously, drought-prone regions relied heavily on water tankers to meet basic needs. Recognising clean drinking water as a basic human right and the urgency of the situation, the Government of India through JJM aims to provide Functional Household Tap Connection (FHTC) to every rural household by 2024.

Effective implementation in a vast and diverse country requires a strategic approach. Water management being a state subject, various state-level schemes already existed. However, JJM presented a unique challenge: how could the central government effectively guide and support a nationwide programme while respecting state autonomy? This chapter explores the central government's strategies to navigate these complexities and ensure JJM's success, particularly in drought-prone regions. We will delve into the specific challenges faced by these areas and how JJM was adapted to address them.

Building Resilience in Drought-Prone Regions

In regions characterised by erratic precipitation and recurrent droughts, a novel strategy is being implemented. Droughts, previously accepted as an inevitable force of nature, are now being countered with the resourceful application of human ingenuitpy. The objective of this initiative is to break the self-perpetuating cycle of diminishing water resources and ever-growing demand. The traditional well, once a symbol of hope, now runs dry faster with each passing year. Decades of over-extraction have left groundwater tables sinking lower, threatening the very lifeline of these communities. But amidst the dust and despair, a new strategy is emerging – a focus on building drought-resilient infrastructure. Let's take a look on how drought-prone regions are building resilience:

Prioritising Source Sustainability: The JJM spearheads this initiative, recognising that sustainable drinking water sources are paramount. Convergence with water conservation efforts and groundwater recharge activities aims to improve water quality, quantity, and long-term availability.

Smart Villages Secure Water: A Tech-Powered Water Revolution

Water scarcity, a pressing issue across India, manifests in two critical challenges: quantity and quality. Due to groundwater contamination from factors like rising salinity, nitrate, and iron content. Access to safe drinking water becomes a distant dream, jeopardising public health and development. To tackle this issue Piramal Foundation collaborated with Standard Chartered Bank and launched a programme in 75 villages across four states (Maharashtra, Uttar Pradesh, Madhya Pradesh, and Rajasthan) to ensure Source Sustainability and Promoting Water Demand Management.

The project embraced a holistic approach, ensuring safe drinking water access and quality while fostering a sense of community ownership. Village-level institutions were established, empowering residents to plan and oversee water conservation efforts. The initiative's impact was undeniable, reaching over 5 lakh beneficiaries

The Daily Struggle: Women in rural Rajasthan trek long distances for water

across 75 villages in four states, with a significant presence in Aspirational Districts with low Human Development Index (HDI) scores. Building upon this success, the programme has broadened its scope to encompass water security and source sustainability in 148 locations.

Adaptability and Innovation: Overcoming Obstacles

The initial plan envisioned large, four-lakh-litre tanks. However, determining land area for water conservation tanks proved difficult due to variations in terrain and village sizes, and the team opted for smaller, manageable structures – one-lakh-litre and two-lakh-litre tanks alongside soak pits – maximising land utilisation. Recognising

Workers build a water storage structure

that irrigation consumed 60% of groundwater, the project, in collaboration with Krishi Vigyan Kendra knowledge centres, launched an educational programme for farmers. This initiative equipped them with Agri-water-efficient methods, leading to a significant reduction in water consumption.

The project's current focus lies in constructing water storage structures, revitalising existing water bodies, and raising community awareness about water conservation practices. These efforts have yielded impressive results. Over 850 water-saving solutions, including soak pits and storage tanks, have been implemented across 75 villages. These solutions conserve an estimated 2.94 crore litres of water annually, while rooftop rainwater harvesting utilises an impressive 3.74 lakh square feet of space.

Additionally, the project has integrated IoT-based tracking sensors with remote monitoring technology to monitor groundwater levels and provide solutions for increased water security.

A Ripple Effect: Transforming Water Management in Bundelkhand

Bundelkhand carries a rich history and captivating landscapes. However, for generations, its story has been intertwined with a relentless struggle – water scarcity. Erratic rainfall and decades of overexploited groundwater resources have pushed the region towards aridity. A transformative project, however, is rewriting this narrative in Chattarpur and Damoh districts. This collaborative effort, spearheaded by EY India Foundation, Just A Drop (UK), IndusInd Bank, Bajaj Finance, Climate Impact Partners (UK), and Pernod Ricard India Foundation, is fostering a more sustainable approach to water management in 162 villages nestled within the vulnerable buffer zone of Panna Tiger Reserve.

The uneven water table, shaped by both geographical realities and human actions, is addressed through a scientific approach. Geophysical surveys and pump tests pinpoint viable groundwater reserves, ensuring long-term sustainability. Local VWSCs are trained for needs assessments, project planning, and ongoing maintenance, fostering a sense of ownership and accountability for this precious resource.

Furthermore, the project acknowledges the intricate link between water and sanitation. An integrated approach promotes good hygiene practices, minimising sanitation-related risks and safeguarding public health. Source-strengthening measures, such as rainwater harvesting structures, recharge pits, and afforestation initiatives, are implemented to ensure the long-term viability of water sources.

The project's impact extends far beyond the number of gallons delivered. It's etched in the empowered lives of women who are liberated from hours spent fetching water, allowing them to pursue education or income-generating activities. It demonstrates that with innovative solutions and a community-centric approach, even the most arid landscapes can be coaxed back to life.

Community Engagement and Behaviour Change: The Ministry of Jal Shakti, tackles India's water scarcity by promoting water harvesting at the community level. Recognising the crucial role women play, particularly in maintaining water supply systems (over 50% of water users in India are women), it fosters a culture of water conservation by empowering citizens.

The Jal Shakti Abhiyan[25], a nationwide campaign, promotes rainwater harvesting at the community level. Over 47 million structures have been built across India, capturing the precious rainwater that once flowed away unused. Community engagement campaigns can effectively promote behaviour change. Educational programmes and workshops raise awareness about the importance of water conservation and rainwater harvesting. This empowers citizens to adopt water-saving practices in their daily lives, leading to a collective impact on water security.

Harnessing Technology: Geographical Information Systems (GIS) and Hydro Geo-Morphological (HGM) maps help identify suitable locations for sustainable groundwater sources. Smart water systems, leveraging the Internet of Things (IoT), big data, and AI, are being piloted to minimise water scarcity challenges and optimise resource utilisation. Real-time monitoring of rural water supply systems[26] under JJM exemplifies this approach.

The path to water security in drought-prone regions is paved with a combination of infrastructure development, education, and a fundamental shift in mindset. The story of drought resilience is not just about infrastructure; it's about human ingenuity rising to meet the challenge of a changing environment. In addition, it is about communities taking ownership of their water resources and building a future where even the driest lands can flourish. This ongoing battle for water requires continued collaboration, adaptation, and a collective commitment to sustainable water management practices.

[25] Jal Shakti Abhiyan. https://jsactr.mowr.gov.in/
[26] JJM Dashboard. https://ejalshakti.gov.in/jjmreport/JJMIndia.aspx

16

Potable Tap Water in Tribal Homes

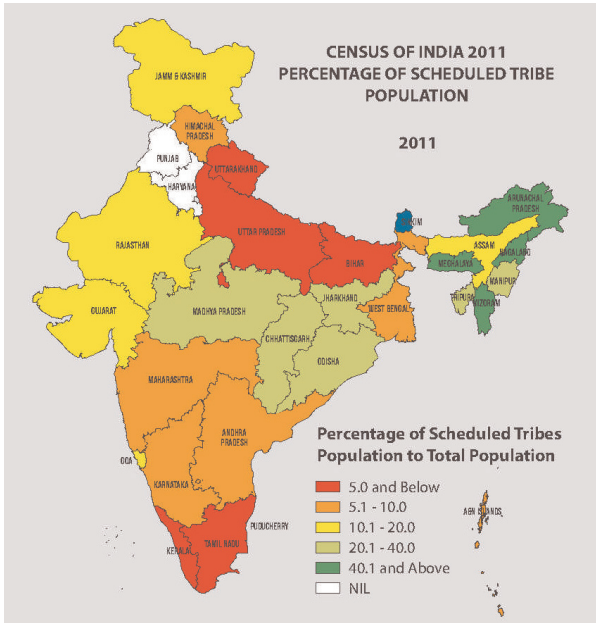
India has the second largest population of tribal communities that live in and around the deep and diverse forests and landscapes spread across various states. These regions, often classified as 'tribal belts' or 'Scheduled Areas' constitute roughly 10% of India's geographical landmass and are home to over 8.6% of the population.[27]

The tribal population is generally coterminous with forested areas. In India, these areas are located in Central and South India (Maharashtra, Chhattisgarh, Madhya Pradesh, Andhra Pradesh, Karnataka), Northeastern India (Manipur, Nagaland, Meghalaya, Assam, Arunachal Pradesh), West (Rajasthan and Gujarat) East India (Jharkhand, West Bengal, Odisha) and far North (Jammu and Kashmir, Himachal Pradesh).

In many tribal communities, water is revered as a sacred entity, a gift from the divine that sustains life and fosters nature's bounty. Communities residing along major rivers like the Narmada, Kaveri and Ganga view them as personified goddesses, offering prayers and performing rituals to ensure their continued flow. The Bhils of Madhya Pradesh worship the Narmada River as 'Narmada Mai' (Mother Narmada) believing that her blessings bring prosperity and fertility. Similarly, the Garo community of Meghalaya considers the Simsang River sacred, offering sacrifices and conducting annual boat festivals to appease the river spirits. Water for them is not just a resource but a symbol of life, renewal, and purification.

The Constitution of India recognises the unique identity and challenges faced by these communities,

Figure 13: Percentage of Scheduled Tribe Population According to Census of India 2011



Source: Tribal Co-operative Marketing Development Federation of India Limited, Ministry of Tribal Affairs, Government of India

dedicating specific provisions to their social, educational, and economic advancement. Over 700 tribal communities have been notified under Article 342[28] of the constitution of India. Articles 244 (1) and 275 (1) empowers states to enact special legislation for the administration of tribal areas, while the Fifth Schedule lays out specific areas that qualify as Scheduled Areas due to a predominantly tribal population.

[27] Ministry of Tribal Affairs, Government of India

[28] Article 342: As per National Commission for Scheduled tribes (https://ncst.nic.in/): The framers of the constitution took note of the fact that certain communities in the country were suffering from extreme social, educational and economic backwardness on account of the primitive agricultural practices, lack of infrastructure facilities and geographical isolation. The Constitution of India in Article 366 (25) prescribe that the Scheduled Tribes means such tribes or tribal communities as are deemed under Article 342 of the Constitution to be Scheduled Tribes.

The Springs Initiative

The Springs Initiative, supported by the Ministry of Tribal Affairs, Government of India, and the United Nations Development Programme (UNDP) India, was taken up by Gram Vikas in partnership with village communities in Odisha. For technical support, the Advanced Centre for Water Resources Management and Development (ACWADAM)[29] was engaged in selected blocks of Gajapati, Kandhamal and Kalahandi districts of Odisha. The initiative aimed to develop community-led efforts for spring-shed management, spring rejuvenation, and establishment of drinking water systems by harnessing the potential of perennial springs sustainably.

Within the broader category of tribal communities, a sub-section faces even more critical challenges – the Particularly Vulnerable Tribal Groups (PVTGs). These groups, numbering around 75 across India, are characterised by their small populations, remoteness, and distinct cultural heritage. Often classified as 'primitive tribal groups' in the past, the term PVTG acknowledges their vulnerability and emphasises the need for targeted development efforts.

Challenges of Water Supply in Tribal Areas

Amidst seemingly endless forests, many tribal communities in India grapple with persistent water issues, including availability and the safety of drinking water. While these regions boast rivers, streams, and verdant landscapes, the very features that define a forest – remoteness, rugged terrain, and dispersed settlements – present formidable challenges in delivering clean drinking water. Since tribal habitations are located in hilly mountainous terrain, forested areas, or areas having a limited supply of water, it is often considered the most valuable assets.

The connection between water and place, often categorised as 'relational values', is strong in many tribal cultures. Take the Reang community in Tripura, classified as PVTG, who considers water as a sacred entity and spiritual value. This reverence is evident in the water rituals and ceremonies that these communities continue to practice. When guests visit a tribal home often faced with its scarcity of water, they are often greeted with water in clean, washed glass with a lot of regard.

Access to clean water is a critical concern especially for the PVTGs, who often rely on sources like streams, springs, and shallow wells. These sources are not only unreliable but also susceptible to contamination, leading to a high prevalence of waterborne diseases.

The JJM planned to reach each household with a piped safe tap water connection. Laying pipelines through dense vegetation and uneven terrain is a costly and arduous task in tribal and forested regions. The logistical hurdles of constructing a water treatment plant in a village nestled within a hilly, densely forested region like the Aravalli Hills, where the Bhils reside are aplenty. The heavy machinery needed for construction might not even reach the village, and the dense canopy can make traditional surveying techniques impractical. The scattered nature of tribal settlements further complicates matters. Building individual water infrastructure for smaller communities can be financially prohibitive for the government. In the regions with water contamination building a centralised water treatment plant and pipeline network for such a dispersed population may also be unfeasible, requiring exploration of alternative solutions like rainwater harvesting systems and small-scale water purification units for individual households.

Testing groundwater quality in remote locations can be a logistical nightmare, leaving communities unsure of the safety of their water source. Traditional methods of water quality testing may not be readily available in these regions, necessitating investment

[29] ACWADAM is a non-profit organisation working on technical concepts of ground water management.

in mobile testing units or training local communities in basic water quality assessment techniques. The seasonal nature of water sources in forested regions adds another layer of complexity. Rivers and streams in tribal belts like the Western Ghats, home to the Kadava tribe, may overflow during monsoons, rendering them unsuitable for consumption due to high sediment loads.

Deforestation and unsustainable land use practices can exacerbate water scarcity in forested areas. Loss of tree cover leads to increased soil erosion and reduced water infiltration, impacting groundwater recharge. Additionally, deforestation can disrupt natural water cycles, altering rainfall patterns and stream flows. Furthermore, mining activities in some forested regions can contaminate groundwater with harmful chemicals, further jeopardising the availability of safe drinking water.

The JJM prioritised SC and ST dominated areas, allocating 20% and 10% of funds exclusively for the intervention priorities in these regions for water supply schemes.One of the first steps in ensuring coverage of each household by FHTCs was the electrification drive through schemes like Deen Dayal Upadhyay Gram Jyoti Yojna (DDUGJY)[30] and Saubhgya Yojna[31]. The electrification drive led to the reach of electricity to 99.6% of households in 2021 from 88% in 2015.[32] The regular electricity supply was essential for the uninterrupted operation of motor-based water supply systems in remote unreached regions.

In tribal and forested areas, the major water supply systems are as follows:

A. Gravity-based (from Springs) Water Supply System: A majority of the population in hilly regions depends on spring water system. This gravity-based water supply system uses the earth's gravitational force, water flows from a higher altitude to the ground. This is one of the most preferred and economical modes of water supply delivery. This system requires low maintenance, even when the water line gets damaged. It is also more climate-friendly and reduces the vulnerability of the community.

Water quality testing in progress by women leaders in Kashipur block, Rayagada district, Odisha

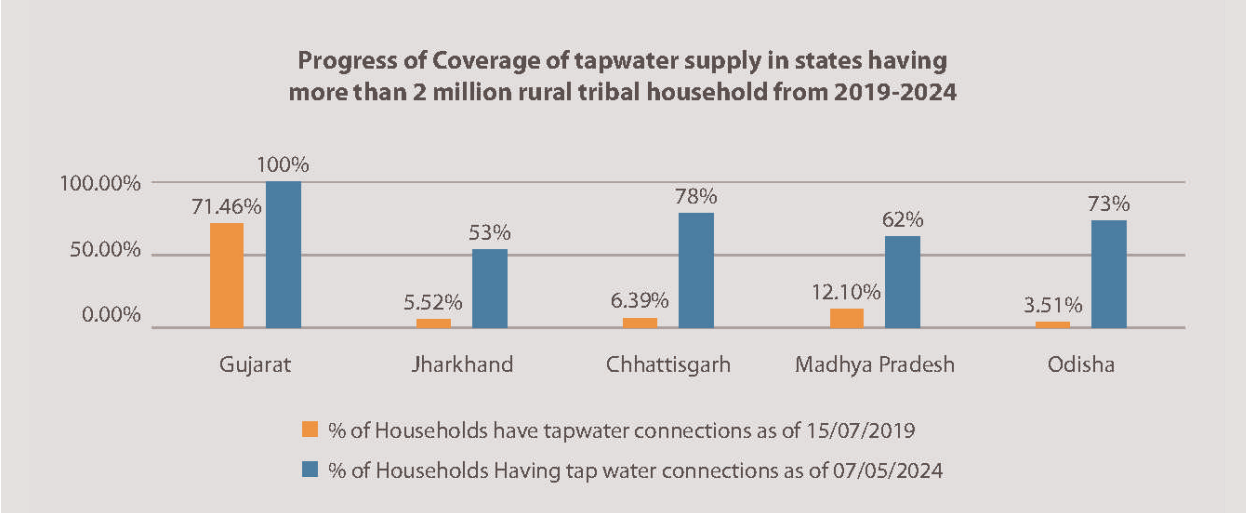
B. Spring-shed management: In hilly forested areas, especially at higher altitudes where houses are scattered, it is expensive to pump water to each household. Spring-based sources, rainwater reservoirs and stand-alone bore-well systems appear to be more suitable for the JMM objectives. Spring-based systems require careful identification and delineation of spring sheds. Aquifers that contribute to springs, and recharge them also need to be located for this purpose.

Using Renewable Energy

A critical challenge in rural drinking water mechanisms is the availability of energy resources and their costs. Among many communities, since the source is groundwater, it is extracted using water pumps running on diesel or electricity. However, these systems have high to moderate initial capital investment and high energy tariffs leading to higher maintenance costs.

[30] DDUGJY: Deen Dayal Upadhay Gramin Jyoti Yojna is a Government of India scheme designed to provide continuous electricity supply to rural India. A budget allocation of ₹ 756 billion has been done under this scheme.
[31] Subhagya Yojna: Sahaj Bijli Har Ghar Yojna was launched in 2017 focussing on last mile connectivity and electricity connection to all electrified households. Government has allocated ₹ 140 billion under this scheme.
[32] World Bank Open Data. (n.d.). World Bank Open Data. https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?end=2021&locations=IN&start=1993&view=chart

Graph 7: The Progress of Coverage of Tap Water Supply in States with Tribal Communities



Source: PIB, Government of India (Status of Jal Jeevan Mission in Tribal Areas)

A model of gravity-based water Supply System

Spring Water Atlas

Spring Water Atlas is an online repository of information on springs, spring sheds, and spring scrapes to strengthen spring management for addressing water scarcity issues for tribal communities in India. The GIS (Geographic Information System) enabled online inventory of springs will help in mapping springs, and analysing their health status, water quality, discharge capacity, and other physical, chemical, and biological properties. The portal strengthened various aspects of spring management to address water scarcity.

In tribal and hilly regions, where villages/hamlets are spread across large geographical areas, a substantial investment is required for setting grid systems for water requirements. Increasing energy charges make such systems financially unviable as the operations and maintenance burden goes to consumers.

Under JJM, technological innovations – such as setting up a water supply system powered by solar energy,

Distant, But Not Left Out

Pratipada village Nandre, Gram Panchayat in Dhule district of Maharashtra, is a ST majority village spread on a hillock with no pucca (metal) road for accessibility. During monsoon season, the habitation is usually cut off from the mainland. It is a farming community of approximately 25 houses. The dwellings are mostly mud-plastered huts, while some are under construction as part of the Pradhan Mantri Gramin Awas Yojana.

Jal Jeevan Mission has provided tap water to all the families in the village. It has ensured last-mile connectivity by delivering pure tap water via tap connections in this distant settlement. Members of Pratipada community (seen in the pictures) are grateful for having access to pure water.

Functional Household Tap Connection in remote Pratipada village

with minimal O&M costs, were promoted in isolated villages. A dedicated mini water supply system with solar panels and battery back-up, storage tanks of adequate capacity with sensors like motor on-off sensors, dry-run sensor, and water level sensor and steel stages was set up. Such models were set up in Maharashtra, Odisha, Chhattisgarh, and Jharkhand. Based on field experiences, it is evident that solar-based systems have proven to be operationally, financially, and environmentally sustainable.

The progress made in the forest areas, dominated by tribal communities, demonstrates JJM's commitment towards a more inclusive approach to water delivery (See Graph 8). The innovative measures used in these areas represents the mission's goal of ensuring last-mile connectivity for delivering pure water.

17

Safe Tap Water in Districts Affected by JE-AES

Infectious disease is a perennial public health problem in India, despite significant economic and epidemiological transitions and advances in recent times. One such severe health challenge is the Acute Encephalitis Syndrome (AES), including Japanese Encephalitis (JE), a common vector-borne disease that breaks out in rural and suburban areas where rice and pig farming coexist.

In India, JE-AES results in a high number of deaths, especially among children. Most JE infections are asymptomatic, but if clinical illness develops, it causes significant morbidity and mortality. The spread of this disease is exacerbated by compromised water and sanitation conditions, providing ideal breeding grounds for disease- carrying mosquitoes like 'Culex vishnui' and 'Ritaeniorhynchus'. The impact is profound, with thousands of reported deaths and cases over the past decade, as per the National Vector Borne Disease Control Programme.

Recognising the gravity of the situation, the Jal Jeevan Mission has prioritised intervention in the most challenging regions, aiming to ensure universal access to safe drinking water. By addressing water availability concerns, JJM seeks to mitigate the spread of JE-AES, offering hope for healthier communities across India.

Footprints of JE/AES in India - A Serious Health Hazard

Acute Encephalitis Syndrome (AES) presents a grave health concern, especially affecting malnourished children from economically disadvantaged backgrounds in India. Its emergence coincides with the spread of the Japanese encephalitis virus (JEV), first documented in 1955 in Vellore, Tamil Nadu. Subsequent outbreaks, notably in the Bankura district of West Bengal in 1973, have been reported across various states including Uttar Pradesh, Assam, Andhra Pradesh, Karnataka, Bihar, and Haryana. The Case Fatality Rate (CFR) of AES/ JE in India stands at 17%, showing significant variation among different states, with reported annual cases ranging from 1,714 to 6,727 and associated deaths from 367 to 1,684.

Acute Encephalitis Syndrome (AES) can result from infection with the Japanese encephalitis virus (JEV) or other infectious and non-infectious causes. The JEV is the primary contributor to AES cases in India, ranging from 5% to 35%. However, AES can also stem from various pathogens such as Herpes simplex virus, Nipah virus, Zika virus, Influenza A virus, West Nile virus, Chandipura virus, mumps, measles, dengue, scrub typhus, and S. pneumoniae.

Transmitted by the Culicine mosquito, JEV is the main culprit behind AES outbreaks. Many cases in India have been linked to contaminated drinking water, with pigs and wild birds acting as reservoirs of infection. Humans and horses, on the other hand, serve as dead-end hosts. Interestingly, the virus remains asymptomatic in its natural hosts but continues to spread through mosquitoes. After an incubation period of 5 to 14 days, AES primarily affects the Central Nervous System, often resulting in severe complications, seizures, and even death.

Though confirmation of a specific etiology is not always necessary for clinical management, AES typically presents with symptoms such as high fever and altered consciousness, predominantly in children under 15 years of age.

To combat the spread of these infections linked to unsafe drinking water, government initiatives have been implemented under the Jal Jeevan Mission to target JE-AES hot spots. The National Centre for Vector Borne Diseases Control, under the Directorate General of Health Services, Ministry of Health and Family Welfare, Government of India, has been tasked with monitoring the incidence of JE/ AES cases. This

monitoring covers 171 districts across 19 states in India to detect and respond to any outbreaks promptly.

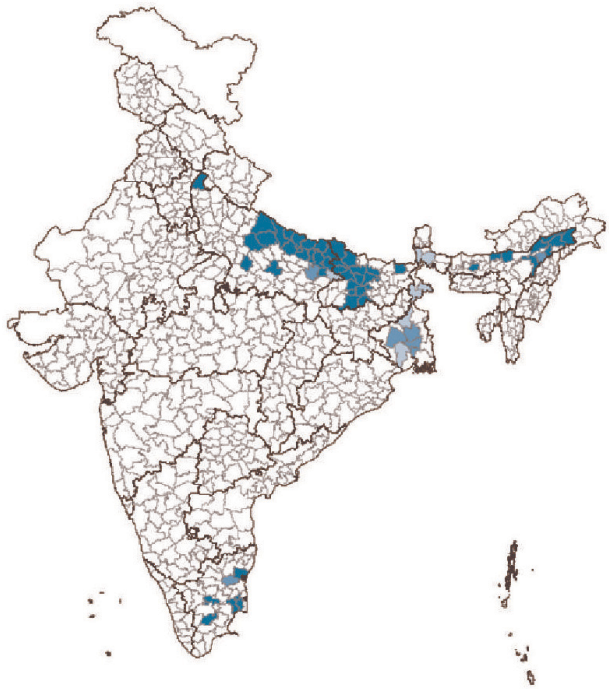
Preventive Measures Under JJM

The Government of India is implementing the National Vector Borne Diseases Control Programme in the country for the prevention and control of JE/ AES under the overreaching umbrella of the National Health Mission. The states/ UTs implement the programme whereas the technical as well as financial guidance is provided by the central government. The national programme for prevention and control of JE/ AES has adopted a multi-pronged strategy in sixty high-priority districts in five states namely Assam, Bihar, Tamil Nadu, Uttar Pradesh, and West Bengal. Later one more district from Tamil Nadu was added due to the partition of the district in the state, thus making the total districts 61. It included the participation of the Ministries of Health and Family Welfare, Drinking Water and Sanitation, Housing Urban Poverty Alleviation, Social Justice and Empowerment, Women and Child Development, and Human Resources Development.

The programme focuses on activities including drinking water and sanitation, public health interventions, expansion of JE vaccination, improved case management, medical and social rehabilitation, and improved nutrition. One of the components that were focussed during this period was the promotion of environmental sanitation practices with time-bound missions like the Swachh Bharat Mission. India has progressed rapidly in ending open defecation across the country. The number of people defecating in the open has reduced significantly by an estimated 450 million people[33]. Additionally, safe hygiene practices such as hand washing, and safe disposal of wastes were promoted under the mission.

However, incidences of waterborne diseases remain a common occurrence in the country, and according to UNICEF estimates, water contamination led to more than 1 lakh diarrhoeal deaths in India among children under 5 years of age group. Water contamination is the most serious challenge plaguing the reach of portable water reach to everyone.

Figure 14: JE-AES Affected Districts in India



Jal Chaupal being held in Jhajha, Bihar

Source: Ministry of Health and Family Welfare-Government of India.

[33] UNICEF. https://www.unicef.org/india/what-we-do/water-sanitation-hygiene

Under JJM, the quality of potable water is maintained under BIS (Bureau of Indian Standards)[34] addressing both geogenic[35] and bacteriological contamination.[36] Under JJM, activities have been carried out in JE-AES affected 61 districts as one of the priority areas for providing safe drinking water as per existing policy by taking up piped water supply (surface/ground-water) schemes to provide Functional Household Tap Connection (FHTC) at service level of 55 LPCD[37]. In all completed/ ongoing schemes, states have taken measures to provide FHTCs at a service level of 55 LPCD to every rural household by retrofitting and making it JJM compliant.

The identified 61 JE/AES affected districts were given high priority in the implementation of the scheme. During the preparation of the annual action plan, a separate reporting mechanism was followed for these districts and monitored separately by the National Jal Jeevan Mission. Under the mission, 0.5% of annual allocation has been earmarked for continuing the activities envisaged under JE-AES components.

Jal Jeevan Mission has significantly strengthened the preventive measures to reduce the spread of JE-AES by providing clean tap water supply to economically poor households in the affected districts of Assam, Bihar, Tamil Nadu, Uttar Pradesh, and West Bengal. Hence, Jal Jeevan Mission is playing a key role in reducing the burden of incidences of disease in these districts.

Jal Jeevan Mission has provided tap water supply to more than 2.28 crore households[38] in 61 JE-AES affected priority districts. Since the inception of JJM, the connection in households has increased from 8.01 lakh to 2.28 crore increasing coverage percentages by about 75% just four years.[39] Thus, Jal Jeevan Mission has significantly strengthened the preventive measures to reduce the spread of JE-AES by providing clean tap water supply to economically poor households in the affected districts of Assam, Bihar, Tamil Nadu, Uttar Pradesh and West Bengal.

Women Lead the Drive Against JE-AES

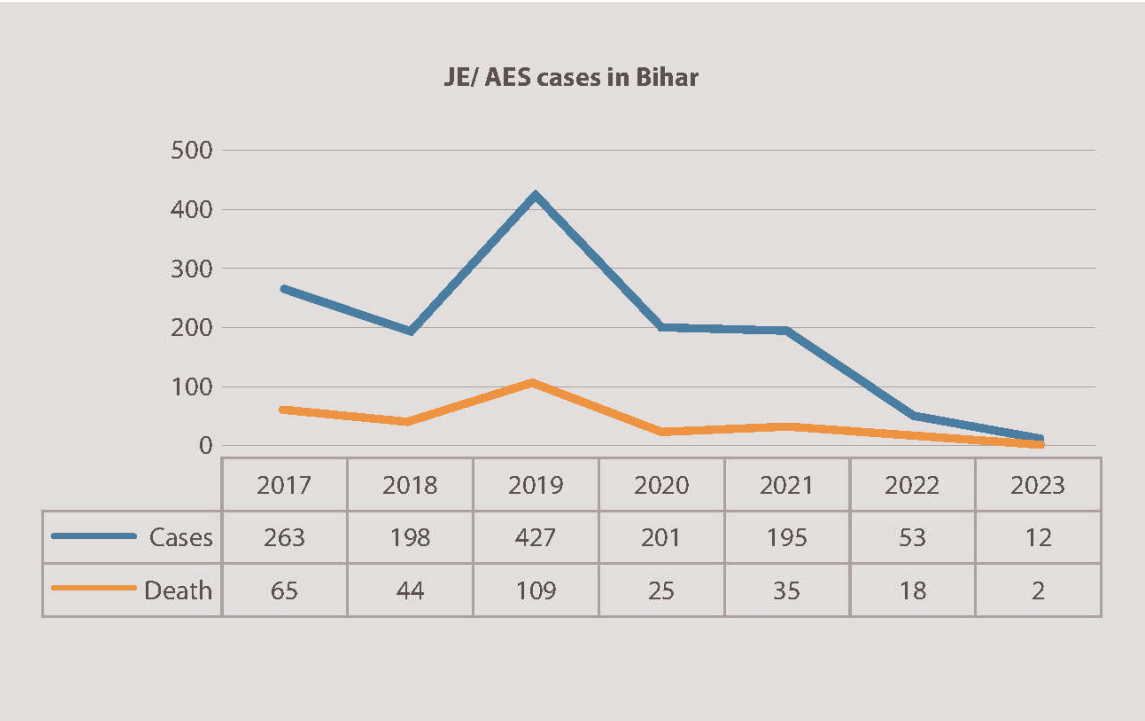
In Bihar, several women are working at the grassroots level on various schemes and programmes. For ensuring of availability of safe water, frequent water testing has been done by trained women volunteers through Field Testing Kits (FTK's) and accredited network of laboratories. They have also undertaken sanitary surveys.

A capacity building exercise of Pani Samitis, Village Water and Sanitation Committee was undertaken in Bihar with use of Information Education and Communication (IEC)/ Behaviour Change Communication (BCC) tools. This exercise generated awareness and creation of robust system for frequent and timely water testing in JE-AES affected locations. The women in many villages function as pump operators and Village Water and Sanitation Committee members.

A pump operator in Bihar

[34] BIS: Bureau of Indian Standards
[35] Geogenic contamination: Contamination which occurs due to geological sources such as Iron, Manganese, Arsenic etc.
[36] Bacteriological contamination: This occurs due to presence of bacteria such as E. coli in water.
[37] Litres per capita per day
[38] JJM Dashboard. (n.d.). https://ejalshakti.gov.in/jjmreport/JJMDistrictView.aspx
[39] E-Jal Shakti dashboard on AE-JES as assessed on 09th May 2024

Graph 8: JE/AES Cases and Death Numbers in Bihar from 2017-23



	2017	2018	2019	2020	2021	2022	2023
Cases	263	198	427	201	195	53	12
Death	65	44	109	25	35	18	2

The prioritisation of the 61 affected districts of JE-AES on JJM led to speedy progress in these districts. Specific funds, a 0.5% budget under JJM, is allocated for JE/AES-affected priority districts based on drinking water sources and the extent of water contamination. About ₹ 462.81 crore has been allocated to these five states as JE-AES components for 2021-22.

JJM has taken a leap in ensuring fewer occurrences of JE-AES in prioritised regions by ensuring the supply of potable water by reaching out to prioritised districts in mission mode. The assurance of clean drinking water at home will prevent contaminated water and vector control such as mosquitoes. The fund allocation on the ground at prioritised locations will also help in ensuring 100% coverage in nearby years.

JJM Tackles JE-AES in Bihar

Bihar is situated in eastern India and faces a multitude of health problems and challenges. Bihar is the third largest state in India with a population of around 10.41 crore accounting for 8.6% of the country's population but only has 2.89% of land area. According to National Health Authority (NHA) 2017-18, the per capita government health expenditure is ₹ 556, which is considerably lower than the national average of ₹1753. The Health Index Report of 2019 by NITI Ayog and the Ministry of Health and Family Welfare places Bihar at rank 20 out of 21 among large states on various health indicators.

Bihar has been one of the worst affected states in JE/AES in the country with significant number of reported child deaths. There have been 2561 cases reported of JE/ AES in Bihar in 2012-14 with 775 deaths. The hospitals in districts such as Aurangabad, Muzaffarpur, and Samastipur were inundated with infected children.

The case of progress of one of the most severely JE-AES-affected regions of Bihar has been significant. For instance, 17 districts in the state were prioritised on JE-AES, which had coverage of 0.1%-6% of households having FHTC since the onset of JJM. However, robust planning and focussed implementation saw an average of 97.50% of the household being covered by FHTC by September 2024 . The advent of JJM in 2019

and the cases of JE/AES in the subsequent years can be seen in Graph 9.

As the central government prioritised Bihar, it also aligned with the state government priority of reaching each household with functional tap connection. As a result, 15 districts from the state were included in the JE/AES prioritised districts. The nodal department for implementation of JJM in the state i.e., PHED along with support agencies prepared an annual action plan for the JE/AES districts. These districts had an average of 2.2% of households with tap water connection when JJM was launched, however, it reached 97.51%[40] as of September 2024 .

This shows central and state government priorities in reaching JE/AES affected districts first. The district Jehanabad top-ranked all India AE-JES district in providing FHTC to the community. Sustained efforts of JJM in prioritising JE-AES-affected districts in the provision of safe water along with efforts by the state government have resulted in reducing the cases of JE-AES in recent years. In JE/AES districts, the increase in coverage of FHTC has been 75% as compared to 60% in entire country. Additionally, the fall in number of cases and death due to AE/JES shows the effectiveness of JJM reach in these districts. This has saved numerous lives of children especially in the hotspots of the disease in the UP, Bihar and West Bengal.

[40] As per JJM dashboard.

18

Tap Water in Schools, Anganwadi Centres & Ashramshalas: Investing in the Future

Provision of clean and safe drinking water in schools, anganwadi centres and ashramshalas (residential tribal hostels), guarantees long-term child health. Poor sanitation, water scarcity, use of contaminated water and improper hygiene practices post a serious challenge to this objective. For close to a decade, organisations like the WHO and UNICEF have linked inadequate sanitation, water supply, and hygiene practices (WASH) in such institutions to the high incidence of diarrhoeal diseases and even deaths. According to a WHO report,[41] globally, diarrhoea claimed lives of around 3.7 lakh children in 2019. Clean water acts as a shield against these diseases, safeguarding their health and survival.

But quality and assured quantity of water in most schools, anganwadi centres and ashramshalas, was not assured for many years. Water and sanitation facilities were often non-functional in the absence of a well-maintained water supply system. As per the findings of the Rapid Survey on Children (2013-14)[42], approximately 22% of schools in India lacked proper toilet facilities for girls, while a staggering 58% of preschools had no toilets. Close to 56% of preschools lacked access to water on their premises. In rural areas water quality emerged as a significant concern, with numerous schools lacking sufficient water treatment infrastructure to test for contaminants such as iron, arsenic, or fluoride.

Children spend extensive hours within the educational and care institutions. The physical cleanliness and environment of these establishments significantly influence children's health, learning capabilities, and overall well-being.

Children washing hands at an anganwadi in Keonjhar district, Odisha

100-day Campaign in Schools and Anganwadi Centres

With the spread of COVID-19, the government recognised the critical importance of fostering robust WASH behaviour and practices in institutions like schools, anganwadi centres and ashramshalas. Many of these establishments also served as COVID-19 care centres, underscoring the imperative to prioritise sanitation and enhance infrastructure and facilities. During the pandemic, the government permitted water works and sanitation activities to continue.

[41] Diarrhoea. (2021, March 10). https://www.who.int/health-topics/diarrhoea#tab=tab_1

[42] Water, sanitation and hygiene. (n.d.). UNICEF India. https://www.unicef.org/india/what-we-do/water-sanitation-hygiene#:~:text=In%20India's%20schools%2C%20reports%20show,no%20water%20on%20the%20premises.&text=Chemical%20contamination%20of%-20water%2C%20mainly,present%20in%201.96%20million%20dwellings

While schools and colleges were closed; there was a pressing need to improve the existing water system infrastructure. On 2 October, 2020, a 100-day Campaign was launched to provide piped water supply in anganwadi centres, ashramshalas and schools. This campaign aimed to offer:

i. Tap water for drinking and cooking purposes (for midday meals)
ii. Hand washing facilities
iii. Running piped water in urinals and toilets
iv. Rainwater harvesting for demonstration purposes
v. Treatment and re-use of grey water.

The campaign was launched to underscore the critical public health aspect of children as they are the most susceptible to water-borne diseases. In September 2020, while unveiling the 'Margdarshika' for Gram Panchayats and Pani Samitis to implement JJM, Prime Minister Narendra Modi named this campaign. Under the campaign, Gram Sabhas were to convene and discuss the resolution for providing safe water in all schools, anganwadi centres, and ashramshalas within 100 days.

As per the operational guidelines of JJM, schools, anganwadi centers, and ashramshalas were to receive tap water along with the entire village. However, it was decided that children could not wait for such a long time to recieve tap water in their schools and other centers. Hence, states/ UTs were granted the flexibility to offer stand-alone piped water supply solutions instead of waiting for the completion of village water supply infrastructure for schools. At the time of the launch, there were 14 lakhs anganwadi centres and 15 lakhs schools spread across the country.[43]

The 100-day Campaign was devised to ensure comprehensive water security across all anganwadi centres, ashramshalas, and schools, catering to essential needs such as drinking, cooking mid-day meals, handwashing, and toilet use. Furthermore, the campaign aimed to implement piped water supply systems in various public buildings including Gram Panchayat (GP) buildings, health centres, wellness centres, community centres, and community toilets, with a long-term plan for their regular maintenance and upkeep. During the campaign period, Gram Sabhas convened to discuss the resolution for providing safe water in all schools, anganwadi centres, and ashramshalas within 100 days. Subsequently, rapid action was initiated by the water supply department/agency in the village to provide piped water connections to these institutions.

A pivotal aspect of the campaign was to provide children with integrated life skills education, emphasising critical hygiene behaviours such as ensuring overall water security and safety, safe handling and storage of drinking water, proper handwashing techniques with soap, and maintaining personal and community hygiene standards.

Moreover, the campaign sought to prioritise the provision of safe water to anganwadi centres, ashramshalas, and schools by engaging water supply providers. It also aimed to enhance awareness regarding water quality and implement surveillance measures to ensure the potability of water within these premises. To address potential challenges arising from the provision of Piped Water Supply (PWS), mechanisms for greywater treatment and reuse were established. Additionally, arrangements for rainwater harvesting were made to promote source sustainability, among other objectives.

For institutions where piped water supply (PWS) existed but was defunct, efforts were directed towards retrofitting and/or augmenting the existing infrastructure to provide safe drinking water through tap connections on a regular and sustainable basis. In sparsely populated areas such as hilly, forested, desert, or tribal regions lacking PWS, the implementation involved deploying solar-powered stand-alone water supply systems to cover the entire hamlet or habitation, inclusive of anganwadi centres, ashramshalas, and schools.

[43] 100 Days Campaign to Provide Piped Water Supply in Anganwadi Centres, Ashramshalas and Schools. (n.d.). Jal Jeevan Mission (JJM Doc. 8). Ministry of Jal Shakti, Government of India. https://jaljeevanmission.gov.in/sites/default/files/publication_and_reports/100_Days_Campaign_10_Oct_2020_0.pdf

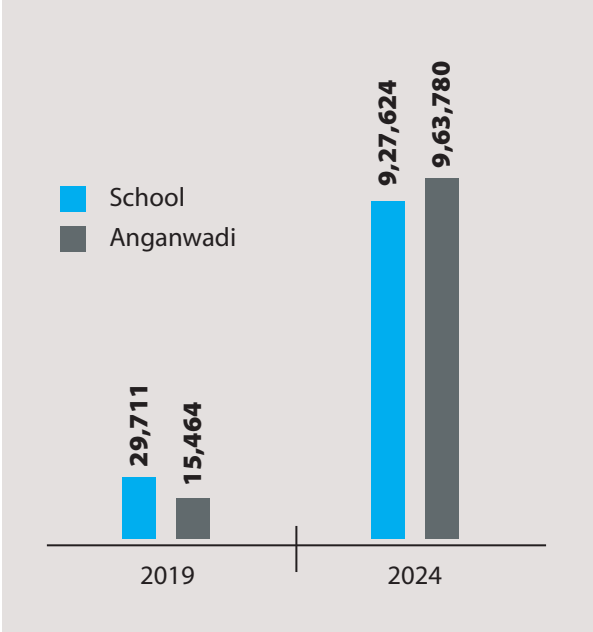
School children in Vizianagaram district, Andhra Pradesh, conducting water quality testing using Field Test Kit

This endeavour also entailed focused efforts in the form of a time-bound campaign, involving Public Health Engineering/Rural Water Supply departments/agencies, sector partners, NGOs, Self-Help Groups, etc. to foster a true Jan Andolan (people's movement) for the well-being of children. Additionally, the allocation of Rs. 1.42 lakh crore for water and sanitation over five years by the 15th Finance Commission enabled Gram Panchayats to function effectively as public utilities to provide tap water. With the campaign extended beyond its initial 100-day duration, schools received potable water in adequate quantity and on a regular, long-term basis, adhering to the BIS:10500 standard.

Improved water facilities contributed to a dignified and comfortable learning environment, fostering a sense of dignity and self-esteem among children. It also played a significant role in promoting gender equality by ensuring that girls have equal access to education without facing barriers related to non-availability of water. Furthermore, the provision of adequate water supply and sanitation facilities in schools encouraged regular attendance and reduced dropout rates, as clean water shielded children from preventable illnesses caused by contaminated water conditions.

Prior to the campaign, over 29,000 schools and over 15,000 anganwadi centres had tap water connections.

Graph 9: Tap Water Supply in School/ Anganwadi Centers 2019 vs 2024



As of September 2024, more than nine lakh schools and anganwadis have safe and clean tap water connections (See Graph 10).[44]

Prof. Kremer in his study[45] concluded that if households had access to safe drinking water, infant mortality might be reduced by approximately 30%. During his investigation, he determined that providing safe water can prevent one out of every four child deaths. As a result, the 100-day campaign played a crucial role in improving health outcomes, especially for newborns and infants.

Children Get Field Testing Kits

School children were also capacitated to conduct water quality testing using Field Testing Kits (FTKs). It empowered children with valuable knowledge and skills related to water quality and environmental health. They learned about the importance of clean and safe drinking water and gained practical experience

[44] JJM Dashboard. (n.d.-b). https://ejalshakti.gov.in/jjmreport/School/JJMSchool_India.aspx
[45] Nobel laureate, Professor Michael Kremer meets Officers of Jal Jeevan Mission, DDWS. (n.d.). https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1841315

Tying Rakhi to a Water Tap: Celebrations in Boddavalasa

Boddavalasa, a hamlet, situated within the Sankili Gram Panchayat of Aspirational District Vizianagaram, Andhra Pradesh, which is five km away from the sub-district headquarters of Regidi Amadalavalasa. It has earned the distinction of being a 'Har Ghar village', where all 129 households, along with one school and one anganwadi centre, have access to potable water through tap connections.

Before the inception of the Jal Jeevan Mission, life in Boddavalasa revolved around the arduous task of fetching water from the distant Nagavali river. This ordeal, particularly challenging for the children, posed serious health risks and hindered their access to education. Waterborne diseases, fever, diarrhoea, and skin allergies were rampant, forcing many children to miss school regularly. The anganwadi worker's efforts were primarily consumed in fetching water, leaving little time for essential childcare activities.

Under the 100-day campaign, Andhra Pradesh swiftly covered all schools and anganwadi centers, bringing joy and relief to the residents of Boddavalasa. With the arrival of running tap water on their premises, the once daunting task of fetching water became a thing of the past. The happiness and excitement among the students at the anganwadi center knew no bounds. In a heartwarming gesture, the anganwadi students celebrated Raksha Bandhan in 2022 by tying Rakhi to the water tap, symbolising their commitment to protect, cherish, and utilise water judiciously.

Water brings joy to a school girl

As the residents of Boddavalasa continue to cherish the gift of clean and safe water, their story serves as an inspiration for countless other communities striving for a better future.

In India, on Raksha Bandhan (a festival when sisters tie a decorative sacred thread or band called Rakhi) several young children across villages tied a Rakhi to a water tap and took an oath to protect it. In the picture is a young girl from a village in Andhra Pradesh drinking water from a tap with lots of Rakhis.

in assessing water quality. This hands-on learning experience enhanced their understanding of scientific concepts and encouraged environmental stewardship. This contributed to citizen science efforts by expanding the network of individuals involved in monitoring water quality. The data collected by school children also complemented official monitoring efforts and provided valuable insights into local water quality issues.

Recognising the urgency of addressing children's water needs, the government has demonstrated remarkable speed, scale and sensitivity in providing tap water connections to schools and anganwadis. Close to 85% institutions were equipped with tap water connections, thus making significant progress in ensuring access to clean and safe drinking water for children.[46] (See figure 15).

[46] JJM Dashboard. (n.d.-b). https://ejalshakti.gov.in/jjmreport/School/JJMSchool_India.aspx

School students from Ravan Bhata, Chhattisgarh, spread awareness on water conservation

Figure 15: Tap Water Supply in Schools/ AWCs/GPs/CHCs

India | Tap water supply in schools/ AWCs/ GPs/ CHCs etc.

Tap water supply in schools	Tap water supply in anganwadis (AWCs)	Tap water supply in GPs/ CHCs etc.
+278	+172	
9,27,624	9,63,780	3,92,767
(88.86%)	(84.68%)	(77.18%)

Details of facilities in schools

Tap water supply in toilets/ urinals	Tap water supply for hand washing	Provision of rainwater harvesting	Provision of grey water reuse
+20	+14	+0	+0
7,38,877	8,53,250	1,00,905	1,30,054

The government leveraged technology and innovation to scale up the provision of tap water connections. Digital platforms and data-driven strategies were employed to identify priority areas such as ashramshalas, assess water demand, and optimise resource allocation for maximum impact in these institutions. Moreover, partnerships with stakeholders such as community organisations, non-governmental organisations (NGOs), and private sector entities have been instrumental in expanding the reach of tap water connections in schools.

More than seven lakh schools and close to six lakh anganwadi centres have been equipped with tap water supply in toilets and urinals, ensuring access to clean water for sanitation purposes. Additionally, more than eight lakh schools and anganwadi centres were provided with tap water supply specifically for handwashing, emphasising the importance of hygiene practices in promoting children's health. More than a lakh schools and 69,000 anganwadi centres were equipped with rainwater harvesting systems, allowing for the collection and utilisation of rainwater for various purposes.

Several schools and anganwadi centres also had greywater reuse systems installed. These systems enabled the treatment and recycling of wastewater for non-potable purposes such as flushing toilets. By implementing greywater reuse, schools contributed to water conservation efforts while reducing their environmental impact.

Section F

Success Stories

Image of Multi Village infrstructure under Thunag village, Himachal Pradesh

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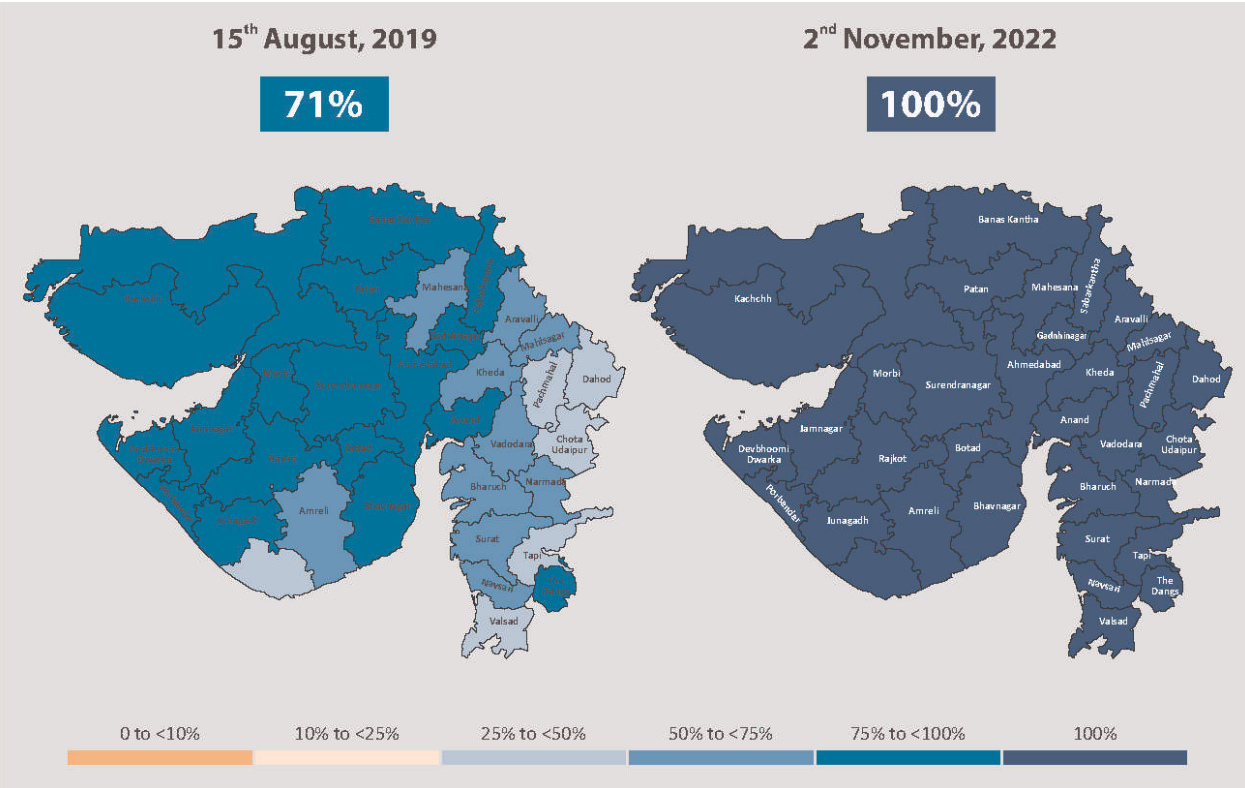
How a Water Scarce State Became Water Secure

Gujarat's sun-drenched landscape has experienced decades of water scarcity. Its communities have historically faced long spells of water shortage and have struggled to navigate through difficult periods. The Jal Jeevan Mission (JJM) operated in this state not only as a government project but as a collective vision of the people of Gujarat to overcome challenges and create a future that was free of water stress.

By October 2022, every rural household in Gujarat had gained access to tap water, marking a monumental achievement, encompassing over 91 lakh households. This considerable progress extended beyond mere infrastructure development; it reflected the diligent implementation and maintenance of the Jal Jeevan Mission (JJM) system across the state. Moreover, the provision of tap water to educational institutions, Gram Panchayats, and anganwadi centres underscores the comprehensive scope of this transformative initiative spearheaded by the Gujarat government.

Crucial role was played by three organisations, namely the Gujarat Water Supply and Sewerage Board (GWSSB), Gujarat Water Infrastructure Limited (GWIL) and Water and Sanitation Management Organisation

Figure 16: **Households with FHTCs in 2019 and 2022 in Gujarat**



Source: Press Information Bureau

Formation of VWSC at Gram Sabha of Anand District, Gujarat

(WASMO) which were the constituents of the Water Supply Department, Government of Gujarat. The Gujarat Water Supply and Sewerage Board (GWSSB) was the body which ensured sustainable water supply and sanitation services in the state of Gujarat. On the other hand, GWIL is the company that established a bulk water pipe grid, which transported bulk water from the river Narmada to the areas where water availability was dwindling. The organisation which worked towards drinking water security and habitat improvement by empowering communities to manage their local water sources and village drinking water supply system and services, was called WASMO.

After the Government of India had assigned funds to the state, they were spent on wages, energy charges, chemical reagents, breakdown charges and preventive maintenance based on comprehensive planning. From the outset, JJM aimed to make the scheme a collective initiative, where even the villagers get a sense of ownership. This ownership was created through Pani Samitis.

Creation of Village Water and Sanitation Committee

To mobilise communities and offer help, NGOs teamed up with WASMO. Significant efforts were made to fortify water sources, control water supply, and manage grey water using a campaign-style methodology. Each village started creating its own Village Action Plans (VAPs) with the help of non-governmental organisations to guarantee a reliable supply of drinking water.

Every village had at least five people trained to evaluate the quality of the water, most of whom were women. In accordance with the Panchayati Raj Act, the government enacted a special resolution to create a Village Water & Sanitation Committee (VWSC), or Pani Samiti. This committee was a sub-group of the Gram Panchayat, consisting of 10-15 members, with women making up 50% of the committee and 25% representation from the more vulnerable sections of society, in proportion to their population.

The control of drinking water sources, drinking water supply, greywater management, and village operation and upkeep were all centred around the VWSC/ Pani Samiti. As a result, 'responsible and responsive leadership' was developed at the village level, and the local community now has the knowledge, self-assurance, and resources to assume full responsibility for the provision of water. To ensure that the local water sources are sustained throughout the year, enormous efforts have been made to gather rainwater and artificially recharge aquifers.

Pani Samitis or the Village Water and Sanitation Committee decided to collect water delivery charges, also known as the tariff system, to recover taxes from households in the villages, to meet the operation and maintenance expenditure. According to the Annual Action Plan, 2020-2021, communities would pay an average of ₹ 40, depending on their household size. This step gives a sense of ownership amongst the citizens and to maximise accountability.

Transporting Water from River Narmada to Households

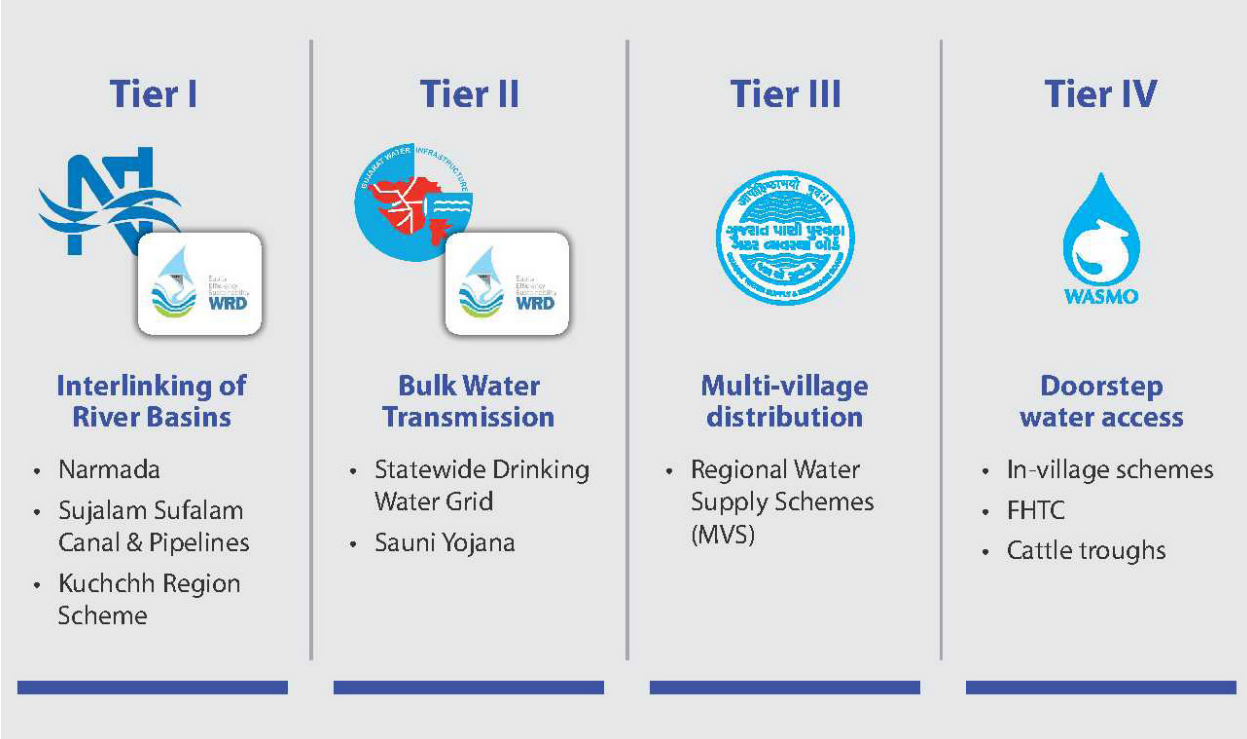
The process of transporting water from areas of surplus to the state's households were facilitated by a meticulously planned four-tiered institutional structure. Each tier was responsible for a specific level of water transfer.

Tier-I involved the large-scale redirection of water from the Narmada River, abundant in water, to regions experiencing scarcity. The increasing water demand, especially in the drought-affected areas of North Gujarat, Saurashtra, and Kachchh, was addressed by diverting water from the Narmada through a vast canal network. An innovative approach was adopted to transfer flood water from the Narmada to these water-deficient regions. This involved the construction of the Sujalam Sufalam canal, a 332 km unlined recharge canal running parallel to the main Narmada canal on the northern side. This initiative significantly aided in groundwater replenishment, effectively reversing the trend of groundwater depletion.

Tier-II came into action next, which involved the transmission of this bulk water through state-level infrastructure like the State Drinking Water Supply Grid and specific initiatives like the Sauni Yojana was implemented to ensure water security in the drought-prone Saurashtra region. Upon completion, surplus

Sujalam Sufalam Canal carrying Narmada's floodwater

Figure 17: The Four-Tiered Institutional Arrangement for Water Transportation in Gujarat



Source: Records of Maintenance Monitoring, Gujarat

water from the Narmada was transferred and stored in approximately 115 reservoirs of Saurashtra.

In line with the Sujalam Sufalam Yojana, over 41,000 water storage structures were constructed, 16,588 ponds were deepened, and 8100 check dams were de-silted, creating an additional water storage capacity of 420 crore cubic feet.

When the water reached regional water distribution centres, Tier-III was activated. This tier focused on distributing treated potable water to clusters of villages, towns, and cities. To ensure drinking water security, a comprehensive state-wide water supply grid was planned. This project involved the construction of a 2,900 km long pipeline for bulk water transfer, 270 water treatment plants, 350 major pumping stations, 1,073 elevated storage reservoirs, and 1,883 groundwater storage structures. These infrastructural developments have played a crucial role in ensuring a reliable supply of potable water across the state.

Finally, Tier-IV of the management hierarchy was responsible for delivering water to each household through a village-level distribution system. This ensured that water from a surplus region reached the taps of households in areas where water was scarce, through Functional Household Tap Connections (FHTCs). More than 14,000 villages benefitted from the scheme (See Figure 17).

The establishment of a comprehensive drinking water network across the state, the encouragement of a decentralised, demand-oriented, community-led drinking water supply programme via WASMO, and extensive water conservation initiatives have rendered the transportation of drinking water via road tankers and railway rakes obsolete in the state.

Multi-village Scheme Infrastructure

The elaborate setting of the infrastructure in Gujarat made it possible for the remotest villages to receive water. However, the maintenance and management

of the infrastructure played a crucial role in facilitating water supply as well. Like the distribution of the scheme, the maintenance and monitoring were also divided in two sectors, MVS or Multi-Village Schemes and In-village schemes.

Multi-Village schemes in JJM works on the principle of transfer of bulk water from the water surplus region to the water deficient regions through open channels or pipelines or both. The scheme involved transferring of the said bulk water to the Gram Panchayats. The maintenance and monitoring of the MVS involves meticulous record keeping of all. The reports and records of the equipment, bills, inventory, workforce, tools, and timelines that were used during the operations phase of the multi-village schemes.

All the reports and records made and collected in this phase followed a certain mechanism and tools, which may be similar or may vary depending on the type of report or record to be registered. On the other hand, these records were the responsibilities, and were overseen by only a few people. Depending on the requirement, these records were maintained mostly by a DEE[47], and AE[48] or an O&M expert/ partner for tasks like creating daily checklists for equipment, maintenance, repairs, calibration along with leak repair register and handover documentation. The process of maintenance and management happened at a decentralised level, and locals from the village were trained to function as a vital component in it. Whilst the infrastructure maintenance of the scheme was crucial, assessment of water quality was equally important, and both the processes were done with the help of IoT devices.

Digital Water Assessing System

The Internet of Things (IoT) technology is a crucial intervention which can be applied in every possible sector and domain. JJM found its profound application in assessing the water quality, quantity, and regularity in the state of Gujarat. The state had introduced interventions like sensor-based flowmeters and quality analysers, and they were used for monitoring

Women use IoT devices for real time information on water quality

water level, discharge, water quality, automatic motor operation, and data logger for capturing the data. Introduction of bulk flow meter and water meter in every village monitored and measured the inflow of the water coming in bulk, followed by its distribution in each household.

Supervisory Control and Data Access Systems (SCADA) were the elaborate systems which were used in large treatment plants for both operation of the plant as well as for monitoring and distribution systems. The SCADA monitored the plants on parameters like pressure, water quality, flow rate and others. The data that was collected through these IoT devices were captured and transmitted to the public portals and mobiles so that people could make informed decisions and become useful to researchers and analysts.

Real-time service level monitoring was revolutionised by the state's adoption of remote data monitoring for both the quantity and quality of water distribution. This system incorporated comprehensive dashboards and visualisations, offering an enterprise-wide perspective on key performance indicators (KPIs) and utilised tools such as spatial mapping and differential flow analysis to enhance governance.

Furthermore, the system's capability to detect line losses promptly through differential flow mapping ensured timely leak detection and resolution. Leveraging the accuracy of flow metres and quality analysers, which have ±0.5% and ±5% precision

[47] DEE- Deputy Executive Engineer
[48] AE-Assistant Engineer

respectively, alongside sophisticated analytical software, decision-makers could visualise spatial data, identify patterns and trends, and forecast future scenarios. Any anomalies in process values or KPIs would trigger alarms and alerts, facilitating swift corrective action.

By employing spatial mapping to monitor live data, the system ensured adequate water coverage in remote or tail-end regions. Quality surveillance, including parameters such as pH, turbidity, and chlorine, could be conducted remotely. Moreover, the system optimised human resource utilisation by pinpointing areas requiring focused attention, enabling management to allocate resources efficiently to address recurring issues or high-incidence areas.

Prevention, Planning and Quality

The state had initiated proactive approaches to conduct inspection, repairs, and servicing activities, which include surveys, replacements, and oiling of the parts. The periodicity of the preventive maintenance activities varies from daily to yearly, depending on the components and the necessity of maintenance of them, which are categorised from daily checklist to annual checklists. Through these approaches, Gujarat maintains the quality and increases the lifespan of the assets involved in the scheme.

To ensure that the stakeholders and various bodies of schemes are working in cohort, and the understanding of distribution of work, along with taking accountability of the work, is something that is usually missed in the execution of a scheme as big as Jal Jeevan Mission. However, the Gujarat government avoided this by conducting periodic planning and review meetings. The regular interaction of employees within the scheme and with officers and operating staff ensured that the state authorities, contracting agencies and operators were working in coherence with clear agendas and assigned responsibilities. For example, a daily planning meeting (DPM) was conducted by a maintenance engineer, whereas a Quarterly Review Meeting (QRM) was conducted by the executive engineer. The key discussion topics of these meetings included target service levels, review performance and preparedness for breakdown or major incidents.

Ensuring quality of delivered water encompassed an important aspect of JJM. Gujarat government, through planning deduced protocols that were used to evaluate water quality at multiple levels. There were several levels of supervision involved in the water quality testing technique. The Field Test Kits (FTK) were used by local organisations like VWSC, Pani Samiti, and User Groups to do sanitary inspections and evaluate all sources of drinking water that fell within their purview, including private sources.

Subdivision/ block laboratories oversee conducting thorough yearly testing, which included at least thirteen fundamental water quality measures. Chemical parameters were evaluated once a year, while bacteriological parameters were evaluated twice a year. Every month, 250 water sources or samples were assessed by district laboratories. These samples were selected at random from various geographic locations, and if a test result was positive, lower-level laboratories referred the sample. To ensure a uniform and random distribution across the state, the laboratory was required to evaluate a minimum of 5% of all samples obtained from district-level laboratories, including those that have previously tested positive. Across all tiers of governance, this multi-tiered approach guarantees comprehensive and methodical monitoring of water quality.

A maintenance worker of Kuha village, Gujarat conducts regular checks of equipments.

Unlike the MVS, maintenance and monitoring in in-village schemes was more focussed and pin-pointed. The components that were regularly monitored and maintained included the water source, pump houses and pumping machinery, rising mains, the pipeline grid that connects households with the reservoir or the storage, the standposts and the chlorination plant, if the water source was detected with biological contamination. A manual for troubleshooting issues, along with the actions that should be taken to address the said issues, was prepared. The potential problems that could be/ are generated comprises motor issues, pumping machinery, panels, and quality related issues. The initiatives to maintain and assess, was given to the local communities and Pani Samitis.

Post-Utilisation Wastewater Management System

The Government of India had taken multiple initiatives toward the circular economy of water in the spirit of people-driven programmes. The National Project on Aquifer Management (NAQUIM), one of the world's biggest programmes of its kind, envisaged the formulation of aquifer management plans to facilitate the sustainable management of groundwater. Gujarat is one of the pioneering states which successfully got mapped for the conservation programme. Jal Jeevan Mission, in collaboration with other schemes like Swachh Bharat Mission, prioritised decentralised wastewater management techniques, including the extensive use of soak pits[49], in addition to centralised sewage treatment plants and sewage networks.

Soak pits, sometimes referred to as soakaways or soakage pits, are easy-to-build structures that are used to gather and absorb wastewater from places like kitchen sinks, restrooms, and laundry rooms.

A soak pit in the village of Gujarat

Source: Grey-Water Management Manual (Swachh Bharat Mission)

These pits were usually made of a covered excavation that was layered with sand, gravel, and coarse and fine aggregates. These materials served as natural filters, allowing wastewater to seep into the surrounding soil. The discharged water was purified because of natural biological processes that assisted in the breakdown and treatment of pollutants as the wastewater seeped into the soil.

Along with soak-pits, wetlands and septic tanks were created as a measure for managing wastewater at a decentralised level. These required the usage of natural bodies and vegetation to treat grey water. At a more centralised level, in towns and cities, intricate planning of drainage and then directing the water to major water-treatment plants showcased the efforts the government of Gujarat took to ensure waste-water management. Besides, JJM facilitated an initiative to convert organic waste into fertilisers and manure, which could be used in agriculture and production of biogas.

[49] Emerging Water Governance in India—Learnings from Gujarat to Achieve Water Security. (2022). In IIPA Digest. https://www.iipa.org.in/cms/public/uploads/142571668416627.pdf

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Supplying Piped Water in Sub-Zero Temperature

Ladakh is a land of towering peaks, serene lakes, and centuries-old monasteries in the Himalayas, which spreads over 2,400 sq. km and boasts some of the highest mountain ranges in the world. The average elevation in this area surges around 3,500m and is one of the highest inhabited areas on earth, and it is also known as the 'land of high passes'. The Himalayas are home to some of the largest glaciers present on earth.

The area has a cold, desert-like environment, with extremely cold winters and reasonably warm summers creating a marked difference in the temperatures between days and nights. This is coupled with high precipitation rates from the month of July to September, resulting in flash floods and landslides in the region. Extremely low temperatures result in the flourishing of new flora and fauna adaptable to sub-zero temperatures and any fluctuation in the temperature leads to disturbance in biodiversity.

Ladakh (a union territory since 31 October 2019), is home to 52,596 households, with 75% of the people residing in rural areas[50]. Ladakh has two districts namely Leh and Kargil.

Insulated water supply pipelines

The terrain here is highly challenging due to harsh climatic and topographic conditions. In area Ladakh is bigger than two major states, Haryana and Punjab, but has the second lowest population (after the union territory of Lakshadweep). Population density in Ladakh is three person/ sq. km[51]. The dispersed nature of the villages, combined with the 80 mm of precipitation on average annually and the extremely cold weather make having tap water at home a luxury.

Challenges of Water Supply in Ladakh

In district Leh, where the average temperature is roughly -6.2°C and drops to about -31°C (between January and December), it is extremely difficult for the locals to carry out daily tasks like collecting water. The water pipeline freezes during the winter disrupting water supply. Sometimes the frozen pipelines burst, if care has not been taken during their installation.

It was a common sight in Ladakh, long queues to fetch drinking water, where mostly women have to walk miles to collect water for their families.

The hilly terrain also poses challenges in transporting construction materials as these have to be transported from ground level to higher altitude areas. This increases the overall cost of the water supply programmes. One of the major hindrances for the rollout of water supply schemes is the limited period available for implementation. The harsh climatic conditions, frequent spells of rain along with incidences of landslides, and flash floods render the

[50] As per Census 2011
[51] District at a Glance. District Leh, Union Territory of Ladakh. India. (n.d.). https://leh.nic.in/about-district/ataglance/

workflow slow and skewed as transporting materials becomes a challenge in these months. Transportation of construction materials in the hilly terrain in sub-zero temperatures is also a challenge.

Traditionally the people in Ladakh source water from streams fed by glaciers in the region. These streams, also called 'Tokpo' in local language, are found in every settlement. However, in recent years, locals have started sourcing water directly from river beds.

In the early phase of JJM, several local people expressed apprehension about getting drinking water from a tap located in their homes. Initially, the communities were hesitant to support the Public Health Engineering Department (PHED) officials and other implementing agencies involved in the area. There was a rumour that their land would become barren after laying off the pipes and affect the already short agricultural season. Another apprehension was the possible damage to their homes in case of pipe bursts during extreme temperatures and frosting.

Ensuring Reach of Functional Tap Connection with Innovative Solutions

The implementation of JJM in the challenging region of Ladakh was tough. The PHED team and state officials needed to be persuaded. The experience of the National Jal Jeevan Mission (NJJM) team, especially the technical experts, enabled the local teams to devise appropriate technology for sub-zero temperatures. The PHED officials and engineers held discussions with local communities and used their knowledge and expertise to identify suitable technology for implementation and foster a sense of community ownership.

A gravity-based mechanism is the most commonly used water supply system in the area. Using the earth's inherent gravitational pull, this technique can supply water for up to 15 hours a day. A storage tank is kept at a higher elevation than the homes where water has to be supplied. A lift water supply system was also used where water is supplied to the upper habitations from lower levels using a motor. However, this method could provide water supply for only four-eight hours.

Under JJM, innovative measures to tackle sub-zero freezing temperatures were proposed like the use of insulated pipes to prevent freezing. Additionally, efforts were made to build tap connections inside homes to prevent freezing. This initiative aimed to ensure uninterrupted water supply and safeguard infrastructure against harsh winter conditions.

Some of the far-flung villages with no roads were delivered pipes through helicopters and air sorties by the district administration. In other regions, horses and mules were used for transportation of materials.

The contracts of transportation were split into two components, viz., material, and labour/ work. The construction materials were procured on the GeM (Government e-marketplace)[52] portal and provided at the site by the department and the labour component was tendered separately for easy action. Also, a clause for insurance was added for the protection of construction material against theft and damage.

The technical consultants, PRI members, and the local community devised a set of solutions after a series of experiments. Some of these are listed below:

A. Source of Water Supply: Since at sub-zero temperatures, traditional water sources, i.e. surface water freeze, a borewell-based water supply system was preferred for the Ladakh region. In case of non-availability of water at a certain depth or rise of rocky strata from the bottom, an infiltration gallery was used where percolated pipes collect water from pores from sub-soil.

B. Transportation of Water in Sub-zero temperatures: In other regions, pipelines were laid at 0.9 m depth. However, for sub-zero temperatures, pipelines were laid at the frost line depth.[53] (This differs from place to place as soil moisture is present at different depths at different locations.)

[52] GeM (Government e Marketplace is fully Government owned and National public procurement portal.
[53] Front line Depth: Depth at which the groundwater in the soil is expected to freeze.

Jal Jeevan Maah

On 2 October 2022 (Mahatma Gandhi's birthday), a 30-day campaign called 'Jal Jeevan Maah' (Jal Jeevan Month) was celebrated by the Public Health Engineering Department (PHED), Ladakh, at Spituk Farkha Panchayat in Leh district. Through Jal Jeevan Maah, the administration aimed to spread awareness about JJM and its impact. The necessity of regular water quality testing to provide safe water and technical interventions tailored to sub-zero temperatures was discussed. Additionally, the process of the village action plan (VAP) and community-led social audits and their significance was also discussed.

During this occasion, the Implementation Support Agency performed a skit to create awareness of various aspects of JJM such as planning, implementation, O&M, and water management. The participants were also shown awareness videos about the effects of JJM, grievance redressal procedures, and solar-powered supply systems.

C. The laying of a pipeline below the soil surface is a costly exercise, but the use of geotechnical data and soil strata data can be used to lessen the depth of the pipeline. Innovative materials are employed, such as thermal insulation pipes, which are three to four times thicker than regular pipes with a bigger diameter. Pre-insulated material pipes can also be used which are now available but costly.

D. High-density polyethylene (HDPE) pipes instead of Galvanised Iron (GI) pipes were utilised, as they have greater durability and chemical resistance properties. The GI pipes are prone to rusting. An underground tank or partially underground tank was used for the storage of water. It was covered with soil. Wooden coverage of the RCC[54] tank was done using local insulating material.

A Gush of Joy for Women of Umla

Tsewang Dolma lives in Umla village in Leh. Umla village is located at a height of 13,900 ft. The village comprises 24 households living in harsh climatic conditions. It was difficult to provide water to this region through the year. The PHED team undertook a survey to find out the kind of technologies that could be used in the region. Teams travelled by foot to build a water supply system in these regions as any other mode of transportation was unfeasible.

Tsewang was delighted with the progress made under JJM. She no longer had to walk miles in the snow to get water from the river. The road is more slippery due to snow. Walking in snow with a bucket of water made one vulnerable to a fall.

She spent her entire youth and later years transporting water from far-off areas. Her face lit up when she first saw water gush out of the tap in her home. Tsewang says due to JJM, her children can now engage in studying or learning new skills.

Tsewang with her tap connection in Umla village

[54] RCC: Reinforced Cement Concrete

Harnessing Sun's Energy

Ladakh has many isolated and remote regions without access to electricity. In such areas, the use of solar energy serves as a blessing for inhabitants. Since Ladakh is situated at a high altitude, it receives high-intensity sunlight for nearly 300 days a year. Even at sub-zero temperatures, solar energy can be used to run mechanical equipment like pumps, heaters, and lighting of structures. This ensures 100% renewable energy use in the region. Batteries of solar panels can also be used to provide necessary power even during the lesser sunny days. Replicative models of solar-based water supply systems are also used in Ladakh.

E. Insulation of storage tanks to prevent freezing: A greenhouse shed was also used to keep water warm. Sometimes thermal liner[55] was used to keep the tank warm. Keeping the water flow in the pipe continuous.

F. Prevented freezing: The practice of keeping one extra tap open at night was followed to prevent water from freezing.

Conventional techniques like the 'ice stupa' a snow toy that melts when the sun rises, and the 'vertical net snowfall', that gathers water droplets using a net are also employed to gather water.

Using these innovative, technical, and traditional measures, the JJM team successfully implemented the scheme to reach the maximum number of households. One of the prerequisites to the implementation of the scheme involved a proper study of the site condition to ensure the selection of appropriate technology. The water availability and water quality are important factors to be taken to consideration while doing so.

The onset of JJM in Ladakh began with a pilot scheme of 24X7 water supply that was undertaken in the peri-urban areas of Ganglesh and helped boost the confidence of engineers immensely. The initiative showed good results even during peak winters. The positive outcome paved the way for the success of many other schemes in the state.

The officials of National Jal Jeevan Mission (NJJM) conducted regular meetings, consultations, and workshops with community leaders, including members of Panchayati Raj Institutions, Sarpanch, Councillors, Block Chairman, and representatives of the people, such as Members of Parliament (MPs) and Members of Legislative Assembly (MLAs). Ladakh's existing Village Water and Sanitation Committees were revived for implementation, planning, and monitoring of the programme. The committee also took charge of conducting capacity-building sessions, awareness campaigns, and user fee collection for O&M. The state's adoption of a bottom-up approach has benefitted the scheme's implementation greatly.

At the early phase of JJM, in 2019, only 1,414 households (3.47%) had functional household tap connections. However, with continuous efforts and zeal of the Jal Jeevan Mission team, stakeholders, and the community, Ladakh reached 94% of households with tap connections in August 2024.[56] There are 250 villages in Ladakh and every village has constituted a VWSC. Also, Village Action Plans[57] have been prepared for 240 villages. Close to 98% of schools and 97% of anganwadi centres (AWC) have received clean water through JJM.

[55] Thermal liner: Current is passed to keep pipes warm
[56] As assessed on E-Jal Shakti portal on 26th August 2024, JJM Dashboard. (n.d.). https://ejalshakti.gov.in/jjmreport/JJMStatetView.
[57] As per JJM dashboard assessed on 26th August 2024, JJM Dashboard. (n.d.). https://ejalshakti.gov.in/jjmreport/JJMStatetView.

21

New Dawn in Jammu & Kashmir: Tap Water in Remote Areas

Jammu and Kashmir is a region synonymous with breathtaking natural beauty, where snow-capped peaks pierce the azure sky and emerald valleys cradle gurgling rivers. The mighty Indus river and its tributaries like the Jhelum, Chenab, and Shyok carve their path through the region. These rivers, fed by the seasonal snowmelt from the towering Himalayas and the Karakoram ranges, are a potential source of life-giving water to over 20 administrative districts.

In recent decades, several phases of militancy and violence have scarred the state's psyche. Constant violence has prevented growth and development and deprived local people of even basic amenities. Constant disruptions due to insurgency have further compounded the problems for citizens who yearn for a better infrastructure for basic facilities like water and sanitation. In the rugged mountains, harnessing drinking water was a monumental task.

The Kashmir Valley experiences a sub-Mediterranean climate with distinct seasons. Winters bring bone-chilling temperatures that plummet well below freezing, limiting the window for infrastructure development and maintenance in areas like Kupwara, Kishtwar, Doda, and Tanghdar. Jammu and Kashmir's fight for clean drinking water is further complicated by the harsh reality of its winters. Every year, the region endures a gruelling four-to-six-month winter season. This extended period of snowy weather became a wrench in efforts to maintain and improve existing water quality and infrastructure.

Spatial Variation in the Availability of Water

The rainfall patterns in J&K are generally erratic. While some areas yearn for a drop, like the Kandi belt of Kathua district,[58] others are deluged by sudden downpours. These intense bursts of rain, often concentrated in short periods, overwhelmed the natural drainage capacity of the mountainous terrain. Natural water bodies like rivers, lakes, streams experience irregular discharge, leaving communities unsure of how much water they could rely on from one season to the next. Adding to the problem was the limited availability of groundwater.

Water sources in J&K have been susceptible to bacterial contamination, particularly in areas with grazing animals (pastures) and high tourist activity. These sources are often the starting point for the water supply system, making them critical points for maintaining water quality. Springs that act as a major source of water were also vulnerable to pollution caused by runoff from the surrounding hillsides. The runoff carried contaminants such as soil, animal waste, and pesticides, posing a risk to human health.

Apart from water collection, ensuring clean drinking water requires proper disinfection procedures like chlorination. Unfortunately, many water storage facilities in J&K were located in remote areas. This made it difficult to consistently deliver the necessary chlorine supplies and maintain proper chlorination levels, especially during challenging weather conditions like heavy rain and snowfall.

The geographical challenges were further compounded by a unique set of challenges due to limited resources. Prior to 2019, the region suffered from a scarcity of local infrastructure companies with specialised knowledge and experience required for building and maintaining water infrastructure projects. Furthermore, attracting contractors from outside the region proved challenging due to the

[58] Brochure of Kathua District. (2013). https://www.cgwb.gov.in/old_website/District_Profile/JandK/kathua.pdf

harsh environmental conditions, including extreme weather patterns and the remoteness of project sites. Their participation in tenders was seemingly low.

The scarcity of skilled personnel extended beyond construction firms. There was a dearth of qualified labour for the construction, operation and maintenance of water treatment facilities. Transportation of readily available resources like sand or gravel relied heavily on manual labour, as mechanised transportation options were often unavailable or impractical due to the sparse road network.

Apart from physical infrastructure, local governing bodies such as Gram Panchayats (village councils) and Pani Samitis (water user associations) had opportunities for improvement in addressing the water crisis. While they possessed the willingness, they often faced challenges due to limited awareness and resources, exacerbated by terrorist activities that impeded the participatory process. This called for the need for opportunities to enhance informed decision-making and further empower local communities to manage their water resources sustainably.

A phase of renewed focus on transparency and accountability within the governance structure was ushered in 2019 with the abrogation of Article 370. This enabled better governance opportunities and access of ordinary citizens to essential rights like clean drinking water. This change coincided with the launch of the ambitious Jal Jeevan Mission (JJM) in Jammu and Kashmir.

Adaptation to Design Challenges

The mission adopted some ingenious solutions to adapt to the hilly terrains, like the use of gravity-based system. Generally, the water reservoirs are constructed at higher levels and the villages are located at lower levels. The mission used natural gravity flow for supplying drinking water to avoid breakdown during heavy snowfall/rains as well as low power usage. Before construction of the gravity-based structure, the area was mapped to identify water sources and the best route was identified to lay the pipework.

Water was collected at springs high above the villages,

Workers brave the snow to dig a trench for new pipes

which were then protected and fenced to ensure good water quality by preventing contamination by people and livestock. The water was then collected in a collection tank and carried through a pipeline to a ground service reservoir (GSR) tank, from where it was distributed to individual household taps in the valleys. Preference was given to the gravity system with smaller GSRs and slow sand filtration plants.

Initially, proposed overhead tanks were subject to thorough technical scrutiny by a team of consultants engaged in advising and assisting in mission implementation. Recognising the challenges posed by the cost and time requirements associated with constructing OHTs, the team opted to maximise the utilisation of hilly topography by replacing them with GSRs. As a result of this scrutiny, approximately 49 OHTs were deemed unsuitable and subsequently replaced by GSRs, aligning with the mission's goals of efficiency and sustainability.

For underground piping, high-density polyethylene

Public Health Engineering Department (PHED) crew work tirelessly to bring water to Gurez, Jammu, after a service disruption

(HDPE) pipe was used. Owing to the seamless nature of the HDPE pipe system, it offers zero leak rate when they are fused. Since they are abrasion and impact-resistant, they were a safe bet. HDPE is about one-eighth the density of steel that is why it does not require heavy lifting equipment at the time of installation, saving cost. The use of HDPE pipes not only expedited the supplies from GI manufacturers but resulted in a saving of about ₹ 455 crores.

In districts like Reasi, Poonch, Rajouri, Udhampur, Doda, and Kishtwar, villages consist of smaller settlements. Working closely with locals, smaller, readily available water sources were identified within these scattered settlements. This eliminated the need for extensive pipeline networks. Smaller water supply schemes were planned, featuring proportionally sized storage facilities to cater to the specific needs of each isolated community.

The UT's water infrastructure has historically faced the harsh realities of both floods and droughts. To combat these challenges and ensure a reliable water supply, a new approach was implemented: flexible intake works. These innovative systems feature an adjustable intake channel or suction pipe. This adaptability allowed the intake to rise and fall with fluctuating water levels, mitigating damage from floods and ensuring functionality during droughts.

Water Access in Palli Village, Jammu

Palli village, located in the Bishnah block of Jammu district, was among the many rural areas in Jammu and Kashmir facing water scarcity. The primary source of water is an open well and, residents endured the challenges of fetching water from distant sources, while health risks loomed due to waterborne diseases. This scenario persisted despite Palli being home to two habitations with a total population of 4377, comprising 1050 SC, 80 ST, and 3247 General Category individuals.59

Accessing water in Palli village was not just a daily chore but a significant hurdle for women and school-going girls. The absence of a reliable water source meant hours spent fetching water, depriving girls of valuable time for education. Moreover, reliance on hand pumps raised health concerns, necessitating urgent intervention. School-going girls, once burdened with fetching water, now had more time to dedicate to their studies. Furthermore, the availability of clean drinking water resulted in a reduction in the consumption of bottled water among children, promoting better health practices.

The Union Territory has made significant strides, achieving a 98% target of providing tap water to schools and anganwadis.[60] Additionally, over 14 lakh households have been equipped with functional tap water connections since the scheme's launch in August 2019.

Tackling Operation & Maintenance

The mission recognised that a robust operation and maintenance (O&M) strategy was crucial for long-term functionality. To ensure everyone receives a fair share of clean water, the mission implemented a system of

[59] JJM Reports. (n.d.). https://ejalshakti.gov.in/JJM/JJMReports/profiles/rpt_VillageProfile.aspx
[60] JJM Dashboard. (n.d.-d). https://ejalshakti.gov.in/jjmreport/JJMState.aspx

Noreen Afzal Champions Water Testing in Rajouri

Noreen Afzal Lone, a graduate of Jammu University, underwent specialised training as a water analyst after her graduation. She then joined a NABL accredited laboratory under Jal Jeevan Mission. Previously, water samples were collected by Junior Engineers and lab technicians. However, as it lacked closer community engagement and building of trust, it struggled to address the complex challenges posed by water contamination.

Noreen at a NABL-accredited lab

To overcome this, Noreen endeavoured to raise awareness among villagers about the importance of water testing and helped empower them to take proactive measures to safeguard their health. The training centred on organising a series of workshops in villages, targeting a diverse range of community members, including women, men, and youth.

These workshops served as platforms for interactive discussions, where Noreen shared her expertise on water quality assessment and educated participants about common contaminants such as E. coli bacteria. The bacteria pose significant health risks, primarily through gastrointestinal infections such as diarrhoea, abdominal cramps, nausea, and vomiting, often leading to dehydration and electrolyte imbalances, especially among women.

Noreen also played a key role in instilling a sense of environmental responsibility among villagers. Understanding the detrimental effects of contaminants like turbidity on aquatic ecosystems, community members became more mindful of their actions, leading to reduced pollution of water sources and improved overall environmental health. If the water sample tested was found to be contaminated, an alert was sent to concerned PHED/ RWS officials, DWSM members and also VWSC members to initiate remedial action and public health assessment.

Villagers, once passive recipients of water testing services, became actively engaged in monitoring the quality of their drinking water. As a result, there has been a significant increase in the number of individuals bringing water samples for analysis, especially during the rainy season when waterborne diseases are more prevalent.

separate supply lines for different contours. The first step involved dividing the community into distinct zones based on elevation. This stratification ensured that areas with similar heights were grouped. Each elevation zone received its own dedicated supply line. These lines were specifically designed and engineered to account for the pressure requirements of the area they serve. This ensured that water could be delivered uphill effectively, overcoming the limitations inherent in traditional single-network systems.

One major hurdle was the threat of sub-zero temperatures. Freezing temperatures could turn intake points fed by springs or streams into solid blocks of ice, disrupting the entire water supply. To address this, the mission implemented a strategic mix. Spring water was combined with water sourced from streams (nallahs) making the water source less susceptible to freezing shut during the harsh winter.

Freezing temperatures wreaked havoc on pipelines, causing them to freeze and burst. The challenge of snow accumulating more than three feet also persisted. The pipelines were placed in depths with insulators below the freezing line, ensuring impounding at headworks. JJM also implemented

Pani Samiti Brings Flow of Joy to Bandipora

In the foothills of the Himalayas lies Chak-e-Arsala Khan (CA Khan) village in Bandipora, where murky wells were the norm, leaving the 159 households and approximately 1,275 residents desperate for a sustainable solution.[62] For women in the village, fetching water was a daily struggle apart from being plagued by water crisis, consuming both time and energy. However, a wave of change rippled through the community, spearheaded by the Jal Jeevan Mission and the unwavering spirit of its residents.

A crucial element of this initiative was the formation of the Pani Samiti, a community-led water committee. The Pani Samitis became the voice of CA Khan's community in water management as the village head (Sarpanch) led it with a mandate for at least 50% women's participation. Further, these committees were equipped with the knowledge and skills needed to monitor, plan, and take ownership of the water supply system through regular awareness campaigns and training camps.

Moreover, the mission conducted regular awareness and training programmes for the Pani Samiti as it recognised the importance of empowering the community. These programmes equipped the committee with the knowledge and skills necessary to monitor water usage, plan for future needs, and actively manage the village's water supply system. A turning point came when the Pani Samiti, working collaboratively with JJM, identified a natural glacier-fed spring. This discovery offered a reliable and sustainable water source for the village, a significant step towards alleviating the water crisis.

Further, infrastructure development followed. With JJM's support, the village constructed a 20,000-gallon Pre-Settling Tank (PST) to further enhance water quality. Additionally, the Village Panchayat, prioritising public health, implemented regular water quality testing to ensure clean and safe drinking water for all residents. Now, more than 150 households enjoy clean, safe drinking water at a rate of 55 litres per capita per day (lpcd).

The story of CA Khan's success is one of community spirit. CA Khan's success story inspired neighbouring villages like Gundiqasir and Khairpore. Seeing the positive change, they too followed suit. CA Khan is a shining example of what can be achieved when government initiatives and community spirit join forces, from water woes to a future brimming with clean, stable and sustainable water.

winter water schedules, supplying water during warmer hours to maintain essential water access for residents even during colder months.

Interestingly, according to a WHO report titled 'Estimating potential health gains from increased access to safely managed drinking water services following the Jal Jeevan Mission initiative', with access to clean tap water at home, rural women can save 5.5 crore hours daily.[61]

Renovating Water Bodies

Capturing rainwater for later use offers a sustainable solution. The mission encouraged the construction of rainwater harvesting structures in the UT, allowing residents to collect and store rainwater for household needs, and reducing dependence on other water sources during dry periods.

Water bodies like ponds and lakes play a vital role in water storage. The mission undertook the renovation

[61] Estimating health gains from increased access to safely managed drinking-water services following Government of India's Jal Jeevan Mission. (2021). https://jaljeevanmission.gov.in/sites/default/files/2023-09/study-report-of-estimating-health-gains-from-increased-access-to-safely-managed-drinking-water%20services.pdf

of 2,353 water bodies, increasing their capacity and enhancing their ability to regulate the water cycle in the region. Additionally, it promoted the construction of soakage pits – simple, on-site systems that do not allow greywater (household wastewater excluding sewage) to infiltrate the ground. This not only reduced the burden on freshwater resources but also helped recharge groundwater reserves. With 53,564 soak pits constructed during 2023-24, the mission continues to encourage this sustainable practice at a large scale.

Public awareness campaigns and community engagement are crucial. The mission has overseen the completion of over 9,309 water conservation works during 2023-24, empowering residents to use water wisely and reduce overall demand.

Jammu and Kashmir have made remarkable progress in the implementation of JJM, achieving coverage of 15.32 lakh (80%)[62] households with tap water connections within the premises.

[62] As of August 2024- https://ejalshakti.gov.in/jjmreport/JJMState.aspx

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Water Supply in Uttarakhand & Himachal Pradesh

The Himalayan region of India encompasses 13 states and union territories in North India, stretching over 2,500 km. This delicate mountain range, with its hilly terrain and unpredictable weather conditions, poses significant challenges to the communities residing there. The region's mighty river systems are heavily dependent on glaciers for their water supply. However, these glaciers are themselves fed by the region's spring systems.

For the Himalayan communities, springs are not merely sources of water; they are held in reverence and often considered sacred. These springs provide the essential daily water supply for the local population and are deeply intertwined with cultural practices and heritage. The springs are celebrated in local traditions and worshipped, reflecting their crucial role in both the physical and spiritual sustenance of the Himalayan people.

Situated in the Himalayan region, the state of Uttarakhand is rich in biodiversity and cultural heritage. The state is broadly divided into two regions – Garhwal and Kumaon. Increased urbanisation has resulted in differential growth between the plain and the valley as most of the economic activities are concentrated in the plain leaving the hilly region underdeveloped.

Innovative planning and implementation approaches have been undertaken under the Jal Jeevan Mission (JJM) such as gravity supply system, deep bore-wells, and the use of natural sources such as springs to address water scarcity and eventually reach 100% households with assured Functional Household Tap Connections (FHTC).

There are around three million springs in the Himalayan region that are the main source of water for the community. According to a United Nations Developmental Programme (UNDP) Report's estimate, about 260,000 springs provide 90% of the drinking water sources in Uttarakhand. Another report by NITI Aayog[63] on the Inventory and Revival of springs in the Himalayan region reveals the drying up of 50% of the springs. The loss of water in the springs increases the drudgery of women in the collection of water. Springs are found in diverse environmental regions of mountains and they are a permanent source of water.

Role of Water Level Recorders

In Uttarakhand, springs account for 94% of the rural water supply; hence, it is critical to enhance the spring shed to ensure a sustainable water supply. Tata Trusts and Himmotthan Society implemented integrated water management in numerous Himalayan villages using a community-based participatory approach. In some villages, locals contributed 10-15% of the project cost bringing a sense of ownership. Water level recorders (WLRs) have been installed at several spring sources to help with water shortages and springshed management. WLRs give precise information about spring hydrology. It helps local communities to manage water resources scientifically and develop a water security plan. The technology promotes decentralised management of water by encouraging community as they incorporate local wisdom with scientific approaches.

[63] NITI Ayog was established by the Government of India in 2015 replacing, Planning Commission as apex Government public policy think tank.

Springs

A Natural Freshwater Source: Springs are natural discharge from the ground water aquifer serving as a source of fresh water for rural communities to meet various purposes such as domestic, agricultural and livestock. Springs are associated with heritage and cultural mores of community and considered safe by local community as it flows through deep aquifers and usually free of contaminants. Springs are part of culture of the mountain community and since ancient times they have been using their own hydraulic technology in forms of Naulas and Bawri's specifically in regions of Uttarakhand and Himachal Pradesh.

Concept of Springshed

A springshed is a set of watersheds and aquifers that integrate into a system that supplies water to a group of springs. Whereas a watershed drains water from a ridgeline into the valleys (drainage lines) that converge to a common point – possibly at the confluence of a river. It is common in mountains like the Himalayas to have a spring and its springshed in two different valleys. It requires knowledge of hydrogeology and meticulous mapping. Mapping of springs requires the 'valley-to-valley' approach that is integrated through the existing springshed approach that combines watersheds, aquifers and all other elements.

The recent changes in the Himalayan ecological system have raised concerns about water scarcity in the spring-based water supply system. NITI Aayog has highlighted evidence of springs drying up and a reduction in their discharge rates in the Himalayan region. The Himachal Pradesh Council for Science, Technology, and Environment has also reported that only 30% of springs are being recharged, indicating that 70% of springs may dry up in the future. This alarming trend threatens the replenishment of spring-sheds across the region, posing significant risks to the communities dependent on these vital water sources.

The government introduced various schemes to support the community with water supply. Initially, these schemes were 'demand-driven' and implemented in areas where demand was raised by the beneficiaries, later 'community driven development' approach replaced it. The Rural Water Supply and Sanitation project was first implemented in Uttarakhand, then part of undivided Uttar Pradesh.

Innovations to Reach Every Home

The houses in the mountainous regions are generally scattered, and it would be fiscally unfeasible for the government to reach every household through a regular pump-based pipeline system as followed in plain areas.

Due to the extreme weather conditions in the Himalayan region, water pipelines sometimes freeze, obstructing the community's water supply for months. To ensure a regular water supply in such challenging environments, the JJM encouraged innovative practices tailored to hilly and mountainous regions like the Himalayas. These include the Gravity Feed System and solar-based pumping systems.

To prevent pipelines from freezing, measures such as using insulated pipes, placing taps inside premises in cold regions, and deep boring of pipelines have been adapted in low-temperature areas. Additionally, deep lakes, large ponds, and water collection from infiltration galleries near the water surface, which do not freeze during low temperatures, are utilised.

Furthermore, the JJM promoted the use of multiple water sources and the interlinking of these sources in hilly regions to ensure sustainable water supply, even if one source fails. One of the most widely used methods for household water supply in mountainous regions is the utilisation of the natural gravity flow of water. The gravity feed system leverages the elevation of the terrain to facilitate the distribution network and water supply. This piped water supply system, often implemented in rural areas, is typically a straightforward gravity system with an intake structure. It comprises a conveyance main, storage reservoir, distribution network, house water connections, and several standposts that serve as water collection points for households. Water is

collected from a perennial river, usually situated at a distance from the village. The gravity-based single village schemes, where the source is up to 5 km away, are managed by the Gram Panchayat.

Additionally, water pumping systems are also employed in mountainous terrains. These systems involve one-stage or multi-stage pumping from a perennial river source. The structure includes a conveyance mainline, storage reservoir, distribution network, and sustainable Functional Household Tap Connections (FHTCs), along with some standposts for household water supply.

In addition, rainwater harvesting-based water supply systems are considered in areas with high precipitation. Himalayan states receive substantial rainfall during the monsoon season, ranging from 1530 mm in Shimla, Himachal Pradesh, to 3050 mm in Darjeeling, West Bengal. This abundant rainfall is harnessed by storing rainwater at suitable depressions using stone masonry or reinforced cement concrete (RCC) dams. The stored water helps to cover the deficiency during water-scarce seasons. These large-capacity reservoirs store gravity-fed piped water, as well as rooftop water, supplementing the supply system during the monsoons.

Under JJM regular water testing by FTK's to detect any contamination is mandated. The water is tested at regular intervals both from the source and from the beneficiary's home. Although the natural water from the hills believed to be comparatively less contaminated, in case of any bacteriological and geogenic contamination, it would be detected through testing at block/district level NABL[64] accredited labs and by FTKs.

One of the key features of water supply in hilly regions is the storage of water in a main tank, which is then distributed to nearby households via village sub-tanks managed by the community (CBM)[65]. This system ensures proper operation and maintenance, with shared responsibility between the community and the implementing agencies.

There have been interventions in the area with schemes to improve potable water supply, but the quantity of water was limited to 25-40 lpcd[66].

Field Testing Kit (FTK) training in Radu Gram Panchayat, Chakrata block in Dehradun district, Uttarakhand

[64] NABL: National Accreditation Board for Testing and Calibration Laboratories.
[65] CBM: Community-based Management.
[66] LPCD: Litres per capita per day.

However, the implementation of JJM saw changes in prioritisation of 55 LPCD for each household.

For community ownership and sustainability pertaining to the water supply schemes, contribution by beneficiary families as a user charge was an essential task. The regularisation of user charges in FHTC has been full of challenges. Despite these challenges, the state reached up till 1.2 million (93.8%) coverage in May 2024.

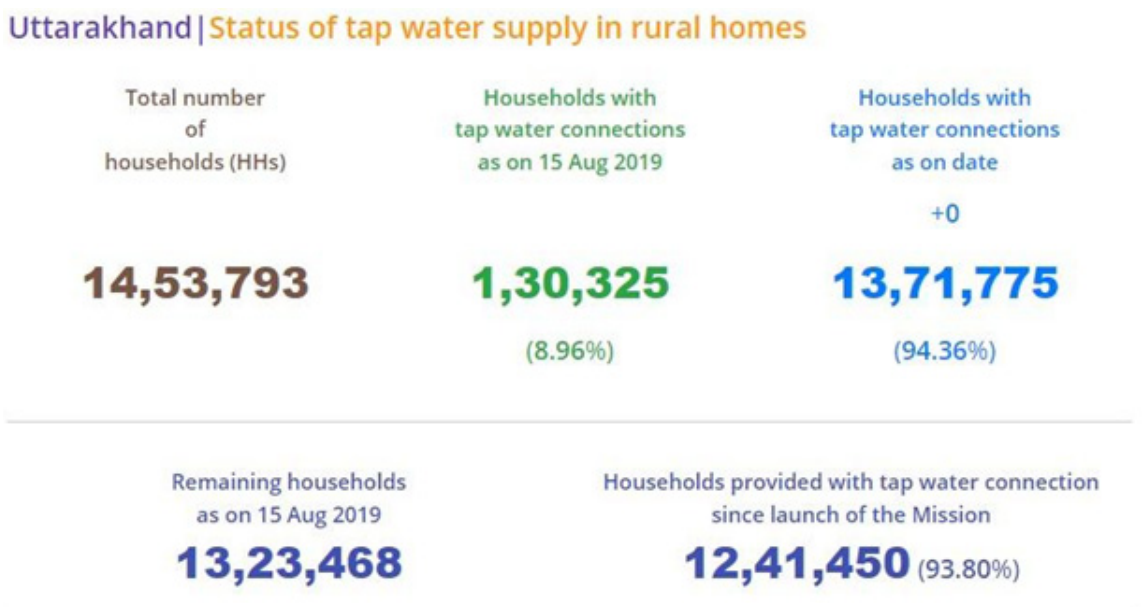
Here, Every Household has Tap Water

Himachal Pradesh became the first among the hilly states to achieve 100% water connections in rural households in July 2023. In Himachal Pradesh, the goal of reaching every family has been accomplished considerably ahead of schedule and the speed was exceptional, despite the state's dispersed population and steep, mountainous terrain. The state ranks among the top nine states nationally for coverage of Functional Household Tap Connection (FHTC) attained under the Jal Jeevan Mission. Owing to the state's remarkable performance in reaching every household in the hilly areas, the central government had approved an incentive grant of Rs 2.21 billion in 2020-21[68]

Silkyara Tunnel Disaster

On 12 November 2023, a section of the Silkyara Bend-Barkot tunnel connecting National Highway 134 to the Uttarkashi district of Uttarakhand caved in while under construction, trapping 41 workers. They were finally evacuated following the tireless effort mounted by the National Disaster Management Authority, Uttarakhand State Disaster Management Authority, Central government, State government, and other technical agencies for 17 days.[67]

Figure 18: Functional Household Tap Connection Coverage in Uttarakhand



[67] Silkyara-Barkot Tunnel (Uttarkashi) Collapsed Disaster. (2023). In Uttarakhand State Disaster Management Authority. https://usdma.uk.gov.in/PDFFiles/Silkyara_Report.pdf

[68] As per Press Release by Government(https://pib.gov.in/PressReleasePage.aspx?PRID=1715499)

The state identified its key priority areas such as Aspirational Districts, tribal areas and quality-affected areas, for better implementation of the scheme. Due to its geography, JJM supplies water either directly to homes or through overhead tanks or sumps. For the conservation of natural water sources such as springs and the rejuvenation of groundwater, interventions such as rainwater harvesting, check-dams and mud-pond development are being taken up in convergence with other departments.

Challenges of Being a Popular Tourist Destination

Himachal Pradesh is regarded as a deeply religious place. Many ancient stone and wooden temples can be found punctuated across the state. Its rich culture and traditions make Himachal Pradesh a unique state. Snow-capped mountains and serene water bodies make it an ideal tourist destination.

Being a popular tourist destination, the state has a considerable floating population. Hence, the department in Himachal Pradesh undertakes checking and cleaning of water sources before and after monsoons. Similarly, leakages in pipelines are checked just before the summer season and after monsoon to prevent wastage of drinking water.

Booming tourism has increased pollution in the region due to the unplanned dumping of waste, single-use plastics, leftover food from restaurants, etc. Besides, burgeoning instances of open defecation, particularly close to riverbed areas, further contaminates the region's water sources and spiralling the incidences of water-borne illnesses including diarrhoea and dysentery, particularly among children. It is not unusual for water supplies to become contaminated with E. coli bacteria due to biological contaminants such as sewage and faeces in the area.

The effort to provide functional tap water connection to every household in the complex terrains of Himachal Pradesh has been difficult. Dealing with chilly weather conditions along with snowfalls and landslides made construction work and transportation of materials challenging for JJM.

As the state has numerous perennial water resources, it is imperative to revive and reuse them to ensure a regular and long-term water supply to rural households. In Himachal Pradesh source sustainability is supplemented through convergence with other schemes such as MGNREGA (Mahatma Gandhi Rural Employment Guarantee Act)[69], LAD (Local Area Development)[70] , and 15th Finance Commission,[71] etc. Sustainability is also ensured by training the stakeholders like the Village Water Sanitation Committees (VWSC) on water quality, surveillance and operations of the scheme.

A crucial component of JJM is to ensure the provision of safe water to every household. Most often, water contamination is invisible to the naked eye. Such contaminants can only be detected through appropriate water testing methods. The Jal Shakti Vibhag, Himachal Pradesh[72], initiated a campaign in October 2022 to create awareness about water quality, FTKs (Field Testing Kits) and water testing labs, so that people can get their water tested. As a result, a favourable environment has been built wherein communities have increasingly taken a more proactive effort in the process which has promoted water quality testing and surveillance and ensured the supply of clean water.

[69] MGNREGA: Mahatma Gandhi Rural Employment Guarantee Act is a flagship scheme of the Government of India that aims to guarantee 'right to work' notified in 2005. It is implemented by the Rural Development Department, Government of India, and aims to provide notified work to every job seeker in their village.

[70] LAD: Local Area Development fund is given to Government of India to its Member of Parliament to fund development schemes of their area. It is around 5 crores in a year.

[71] 15th Finance Commission recommends funds to be allocated to rural areas by Central Government for developmental works like drinking water, sanitation etc. to rural local bodies for implementation. According to Ministry of Finance, 8,192 crores was allocated to Himachal Pradesh in 2022-23.

[72] Jal Shakti Vibhag, Himachal Pradesh is a government body constituted by the state government to manage water supply in the state. It includes an online portal for bills, connection applications, a grievance portal, and a water testing and citizens portal.

This also includes water quality testing from the sources in schools, AWC (anganwadi centres), and Panchayat Bhawans. A cadre of Water Quality testing volunteers, SHG (Self-help group) members, chemists and field agents were trained through TOTs (Training of Trainers) and capacity-building sessions. This helped in checking water contamination both by FTKs and through NABL-accredited[73] laboratories at the district level.

During the first and second phases of the campaign by the Jal Shakti Vibhag, 5000 rural women were trained in water quality testing. A total of 90,956 water samples were tested in the accredited lab in the state and 62,157 samples were tested by Field Testing Kits. When JJM was launched in 2019, there were 44.64% of rural households had functional tap water connections, which has increased to 100% coverage in 2024. All 12 districts have achieved the JJM target of 'Har Ghar Jal'. As a next step, the state is now focusing on source sustainability and water quality to ensure water is supplied to every home in the long run.

In a bid to create awareness about water conservation and prioritising judicious use of water under the Jal Shakti Mission, the Government of Himachal Pradesh released a calendar vowing drinking water conservation. The calendar had the slogan of 'Aadat banayen, boond boond bachayen' (Make it a habit, save every drop).

Providing Regular Water Supply at Heights

The first concern while developing a plan for the challenging, remote, hilly terrains of the Himalayan region was to reach the deprived households. The challenging terrains, height, lack of roads and freezing temperature in these regions hamper the transport of construction materials, pipes, motors, etc. Transportation in some of these regions was possible either through porters or mules. Another concern in these regions was the dependence on surface water sources like springs and nallahs. There were 19 Gram Panchayats dependent on water supply from these small springs and nallahs through 54 WSSs[74]. However, with time, the water flow and discharge in

Water Quality Testing Drive

A campaign was launched in the state to establish public water testing facilities by accredited labs. These public water testing laboratories were set up to test water samples given by any citizen at charges ranging from ₹ 50- ₹ 600. This drive created awareness among ordinary citizens to get their water tested. The success of this drive can be gauged by the fact that the Dharamshala division, Himachal Pradesh alone has generated a revenue of ₹ 88,649 by water testing samples brought by people.

Kanta Devi Leads the Way for Water Security in Chauri

Kanta Devi, Sarpanch of Chauri GP has taken the initiative of engaging women in developmental works, especially water in her GP. Implementation Support Agencies played a crucial role in conveying to the community the essence of mission guidelines, which they can imbibe and share with other stakeholders. The main task for a VWSC member is to engage in dialogue with the community and make sure that their concerns are addressed while preparing the Village Action Plan (VAP). Implementation Support Agencies play the lead role in planning, implementation, and operation and maintenance of the infrastructure created to make sure that no one is left behind, especially women, elderly, and other marginalised communities. Village Water and Sanitation Committee comprising 1015 members was constituted comprising 50% women and 25% people belonging to scheduled caste/ scheduled tribe, during the Gram Sabha meeting held in the presence of PRI members.

[73] National Accreditation Board for Testing and Calibration Laboratories
[74] Water supply system (WSS) is an infrastructure for collection, transmission, treatment, storage and distribution of water.

these water sources reduced considerably to 0.5 LPD (Litres per day)[75] from 1.5 LPD. This was insufficient to meet the requirement of the community and hence the supply of the water was provisioned to alternate days or twice a week.

In addition, the water supply would be cut off during the winter when the pipelines would freeze. The weather pattern in the state is quite challenging with incessant rain in monsoon seasons and heavy and frequent snowfall in winters. The resulting road blockage and hindered transportation system gives a window of about 3 months for construction and maintenance. The harsh weather condition also limits the availability of skilled and unskilled labour in the region. One of the main requirements for the functioning of existing WSS in the region was an uninterrupted supply of electricity for the running of pumps. The reach and supply of electric wires, transformers and poles was a challenge in the hilly state of Himachal Pradesh. This broke the backbone of continuous water supply in the region.

To adequately address the above challenges, a massive effort to create and augment WSS in 28 GPs in Thung tehsil, Mandi district was initiated. This was the first of its kind in the state. At a cost of 121.02 crore, this plan supplies water to 45,000 people in 114 villages within the district through 7,296 FHTCs. The water was lifted using the lift technique from Bhakhail Kahd and three-stage large storage and treatment tanks were constructed at heights of 533 m, 481 m, and 487 m. This WSS will be able to provide 90 LPCD[76] of water to 7294 households in these 28 GPs. The technical system comprises a treatment plant of a capacity of 7.1 MLD[77] and three storage tanks of a capacity of 3,60,000 litres, 4, 86,000 litres and 15,60,000 litres, respectively.

This mega WSS intervention's most significant accomplishment is that it has effectively met 28 villages' needs for safe water and serves as a stellar example of engineering and technical know-how. The filtration chambers along with storage tanks constructed at steep mountain heights are a demonstration of engineering expertise under JJM and ought to motivate and inspire implementers and other stakeholders. Another achievement of the WSS scheme in Mandi is that there have been no reports of interruptions in supply by any consumer since its inception despite the main pipeline being covered under snow for 3 months.

Himachal Pradesh blessed with picturesque ranges brought with itself many challenges of reaching the most remote and challenging locations with FHTC. The implementation of JJM in reaching 100% of households demonstrates the zeal of the national Jal Jeevan Mission, state Jal Jeevan Mission and ground-level soldiers. The state's success in JJM showcases the importance of meticulous planning and implementation. The awareness campaign on water quality testing and groundwater management created a cadre of trained workforce on the ground level. The collaborative efforts of multiagency such as Himachal Road Transport Corporation in reaching out to far-flung locations with technical innovations to combat furies of nature must be lauded. Himachal State is truly an example of an end-to-end safe drinking water solution for hilly terrain with community participation.

[75] LPD: Litres per day
[76] LPCD: Litres per capita per day: It is used to denote litres of water available to each person per day.
[77] MLD: Millions of Litres per day

23

Arunachal Pradesh: Spring Water Reaches Homes via Pipes

Arunachal Pradesh in northeast India appears like a landscape almost untouched by human activities, with two-thirds of its territory cloaked in pristine rainforests. Flowing through this terrain are rivers like Kameng, Siang, and Subansiri, while numerous wetlands such as Bhagajang and Nagula lake dot the landscape, nurturing the state's rich biodiversity. Perennial natural springs and small rivulets serve as the main sources of potable water for the state.

However, the rugged terrain and dense forests are responsible for inadequate road connectivity and challenges to water accessibility. Most tribal communities here are scattered in remote villages. Women are forced to fetch water from distant sources and in some villages, contaminated water is the only source of drinking water, resulting in high incidence of water-borne diseases.

Arunachal Pradesh, known for its heavy rainfall during the monsoon season, also faces the brunt of natural calamities. Cloud bursts can cause significant damage to the region and to water infrastructure, sometimes situated at an elevation of 1,500 feet (457.2 meter) above mean sea level.

Land of Rivers, Springs and Streams, Yet Thirsty

A large part of India's hill population depends on spring water. Arunachal Pradesh too has had traditional reliance on springs and rivulets for water sources. Traditionally, these natural water sources have not only catered to domestic needs but also supported agricultural activities, livestock rearing, and ecosystem health. Nine large Himalayan rivers flow through the state on their course to the plains of Assam, including the mighty Brahmaputra. These rivers and their tributaries form spectacular valleys which remain disconnected from each other and the outer world, due to poor infrastructure and densely forested mountainous terrain.

The state has in recent years experienced climate change-induced water shortage, with dying mountain springs. According to a 2018 NITI Aayog report, more than 200 mountain springs in the state dried up due to decrease in rainfall.[78] With shrinking mountain springs, the water situation in the state became grimmer.

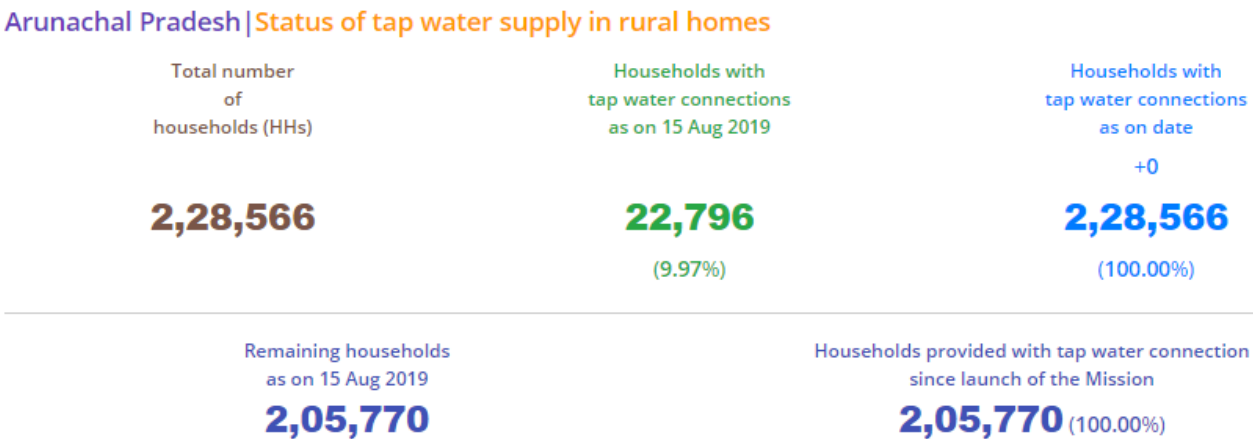
Together with (JJM), a drive was launched to mitigate Arunachal Pradesh's water problems by ensuring Functional Household Tap Connections (FHTCs) to every rural household. In 2019, when the mission started, only 22,796 (9.97%) households out of 2.28 lakh in the state had FHTCs and in 2024, all 2.28 lakh households had FHTCs (see figure 19).[79]

The state established Village Water and Sanitation Committees (VWSCs) in every village following the mission's guidelines. These committees played a pivotal role in facilitating community involvement, development, and self-sustainability. A roadmap was prepared for the effective implementation of the Village Action Plan (VAP) with the active participation of the rural community. Local communities were involved in the planning, implementation, management, operation, and maintenance of water supply systems in villages to ensure long-term sustainability. Skilling

[78] Akshit Sangomla, and Akshit Sangomla. (2021, September 9). Climate crisis in North East India: What is behind water scarcity in the region. Down to Earth. Climate crisis in North East India: What is behind water scarcity in the region

[79] JJM Dashboard. (n.d.-e). JJM Dashboard

Figure 19: Status of the Mission since its Inception and Status as of Sept., 2024



activities were undertaken to train unemployed youth in plumbing, masonry, fitting, electricity, etc. This ensured that a pool of trained human resources was made available at the village level.

Complementing the community empowerment processes, legislative measures were also introduced. The Arunachal Pradesh Protection of Drinking Water Catchment Areas Act, 2023,[80] and operational guidelines served as essential pillars of the JJM. The act aimed to protect the catchment areas of drinking water sources in the state and also to make water catchment more resilient to climate change. This has promoted community-driven conservation efforts, incentivising villages to actively participate in managing conservation endeavours and enhancing water resources while conserving biodiversity.

The launch of the Arunachal Jal Sankalp Programme also instilled a spirit of partnership towards achieving targets. The state government dedicated separate funds to amplify central resources, while a shared responsibility for maintaining larger water systems were established. They also leveraged Corporate Social Responsibility funds. Local contractors were mobilised, as they possessed a deeper understanding of the region's terrain, soil conditions, and existing infrastructure. This helped them design and implement water supply systems that were better adapted to local needs and challenges.

The COVID-19 pandemic exacerbated challenges in the implementation of the scheme. The pandemic-induced lockdowns and restrictions severely hindered the movement of personnel and materials, leading to delays in project timelines and disruptions in the supply chain. Moreover, apprehensions among villagers about the spread of the virus resulted in resistance to the entry of officials and workers into rural areas. The rugged terrain and logistical challenges, including shortcomings in road connectivity, landslides, and adverse climatic conditions, further compounded the complexity of the task. Additionally, the shortage of skilled human resources and experienced contractors posed significant challenges, requiring innovative strategies and considerable courage to overcome.

Adopting a Gravity-fed Water Supply System

Arunachal Pradesh's mountainous terrain necessitated a gravity-fed water supply system. This approach harnesses the natural elevation advantage to transport water from its source to villages located downhill.

[80] The Arunachal Pradesh Protection of Drinking Water Catchment Areas Act, 2023. (2023). In The Arunachal Pradesh Gazette. https://prsindia.org/files/bills_acts/acts_states/arunachal-pradesh/2023/Act5of2023ArunachalPradesh.pdf

An intake structure is built to collect the water from surface sources, which is then conveyed to the village through a pipe system. Earlier, water treatment plants were not considered due to restrictive per capita cost norms. But with JJM, water treatment plants became an integral part of schemes to provide potable water of prescribed quality. Post-treatment, water is collected in a reservoir built above the village, from where water is distributed to FHTCs by a distribution network of pipes. To facilitate equitable distribution in villages of Arunachal Pradesh distribution tanks were provided.

Community Maintains and Protects Water Supply System

Arunachal Pradesh encounters flash floods, cloud bursts, landslides, and erosions due to heavy rainfall during the monsoon season. However, under JJM, the community took responsibility of ensuring that the water supply system is maintained and the infrastructure preserved.

In the Ledum multi-village water supply project, serving Bilat Circle, Oyan-Sille Circle and Ruksin

A resident of Sisen village, Arunachal Pradesh, carries pipes across Siang River to aid community-led water supply efforts

Youth from Bilat Circle lend a helping hand to PHED team in restoration efforts

headquarters, a cloud burst caused a lot of damage. The intake work, situated at an elevation of 1,500 feet above Mean Sea Level (MSL) and 7 km away from the last motorable road point, was severely affected. Additionally, the main pipeline, with a diameter of 250 mm, sustained damage at various river crossings. The magnitude of the destruction posed substantial challenges to restoring the water supply system, exacerbated by constraints such as the unavailability of skilled and unskilled labour due to Covid-19 lockdowns and safety protocols.

Despite the daunting task ahead, approximately 70 motivated youth from Bilat Circle stepped forward to assist the PHED in the restoration works. While the department provided skilled human resources, materials, and logistical support, the community's involvement was instrumental in expediting the restoration process. The collaborative efforts of the community and PHED ensured swift progress in the restoration work by utilising innovative methods such as employing elephants to retrieve scattered and buried DI pipes along the riverbed.

Green Tourism for Water Supply

The state launched integrated tourism as a feature within the multi-village water supply scheme. This innovative fusion not only attracted tourists but also provided a sustainable source of revenue to support the schemes' operations and maintenance. The integrated drinking water project, especially in Chongkham and its surrounding areas, brought essential water supply

services to over 1,289 households, benefiting eight schools and 27 anganwadis.

Utilising solar-based lift water supply systems and a Supervisory Control and Data Acquisition (SCADA) based operation system, the project ensured efficient and sustainable water distribution to the community. In 2020, India's first solar-based Integrated Multi-Village Water Supply Project (IMVWSP) was dedicated to the people of Arunachal Pradesh. The solar-based lift water supply project catered to 39 villages in Lower Dibang Valley district in northeastern Arunachal Pradesh. The project used green energy and pre-fabricated zinc alum storage tanks. It created an amusement park and local villagers took the responsibility to manage the assets of the park, thereby making it more sustainable.

The SCADA helped gather and analyse real-time data. The project went beyond mere water provision, incorporating value-added features to enhance the quality of life for residents. The inclusion of an eco-park with amenities such as a children's park, cafeteria, AC restaurant, an open-air amphitheatre, river jetty, and various recreational spaces is a holistic approach towards tourism. Additionally, the project was able to generate revenue, surpassing its operational costs, and highlighting its self-sustaining nature and long-term viability.

SHGs as Facilitators

In Arunachal Pradesh, Self Help Groups (SHGs) were enlisted as Implementation Support Agencies (ISAs) authorised to guide and assist communities. Their role included facilitating participatory processes for approval, implementation, management, and Operation and Maintenance (O&M) of in-village infrastructure projects by the Gram Panchayat or its sub-committees. To ensure the efficient delivery of results, the ISA received financial backing to assemble a team of 6-8 members tasked with executing project activities.

Transforming Villages, One by One, with People's Participation

In remote regions of Kamle and Upper Siang districts in the state, communities have made remarkable efforts to improve access to clean water through the implementation of gravity-based water systems.[81]

Situated atop a mountain in Tamen-Raga block, Serin village, inhabited by the Nyishi tribe, faced significant hurdles in accessing clean water. With a population of 130 residents, the village was located 22 km away from the nearest road. Procurement of construction materials was arduous. Adopting JJM's community-driven approach, Serin villagers provided the manual labour and logistical support, which ensured sustainable water access for the community.

Dalbing, home to 380 residents across 79 households, nestled at an elevation of 3,300 feet and inhabited by the Adi tribal community, faced severe water scarcity. However, community members mobilised resources to establish a gravity-based water system. Dalbing village exemplified the power of community-led initiatives in addressing water challenges and fostering sustainable development by harnessing local knowledge.

In Upper Karko village, located along the border, the community took steps to improve water infrastructure. Villagers assisted in the transportation and installation of construction materials. They collaborated with the Public Health Engineering Department (PHED) for plumbing work, demonstrating their commitment to collective action. Today, the village not only have clean water but also the local capacities for future water management endeavours.

[81] Jal Jeevan Mission: Arunachal plans 100% tap connections by 2023. (n.d.). https://pib.gov.in/PressReleasePage.aspx?PRID=1639611

SHGs in Etalin and Niusa Ensure Access to Quality Water

In Etalin village, Dibang Valley, the Ayoumeh SHG has emerged as a driving force behind the village's remarkable progress in water access and quality. Through community-led initiatives, the SHG assumed the responsibility for managing the village's water supply system, implementing sustainable water tariffs, and ensuring regular testing and maintenance for clean and safe drinking water. This collaborative and transparent approach has elevated Etalin to a model village for grassroots-led development and effective water management.

Meanwhile, in Niusa Village perched atop a mountain, accessing clean drinking water was once a daunting challenge, particularly for women and children who had to trek long distances daily, often leading to school absenteeism. However, with the implementation of the JJM, the installation of a solar-based lift water supply system has been a game-changer, lifting water from the source to the village top, and overcoming a static head of more than 500 meters. This feat, has brought about transformative change, providing potable water connections to households and ensuring regular school attendance for children. In Longding district alone, over 45 such villages have benefited from solar-based lift water supply systems under the JJM, signalling a brighter and healthier future for rural communities.

Aerial view of solar pannels providing water supply in Niusa illage

Following selection by the Department of Water Supply and Sanitation Management (DWSM), the ISA collaborated with the PHED or Rural Water Supply (RWS) Department to devise an action plan for the allocated villages. This plan delineated quarterly outputs, with payments to the ISA contingent upon adherence to the timeline and achievement of specified outputs quarterly.

EB Project Nature

The 'EB project nature'[82] was initiated as part of water source rejuvenation efforts. Implemented in the serene landscapes of Soi Village, Leparada District, EB Project Nature has not only safeguarded catchment areas but also breathed new life into natural water resources.

The programme equipped participants with skills to build rainwater harvesting structures, restore balance through reforestation in catchment areas, and safeguard biodiversity by protecting native plant species. More than 800 stakeholders, ranging from panchayat members to district officials, underwent specialised training in source protection and spring shed development The impact of EB Project Nature extends far beyond the confines of Soi Village. Villages across Arunachal Pradesh, inspired by the success story, are replicating the model in their backyards. Furthermore, neighbouring states are learning from EB Project Nature to replicate best practices. The EB Project Nature is slated for expansion to all 114 blocks, promising a future where every corner of the state thrives with its natural water resources. Arunachal Pradesh, in february 2024, became the first state in northeast.

[82] Water Conservation. (2020, July 28). https://eb-projectnature.org/digging-of-recharge-pits/

Section G

Synergising with Nature: Becoming Sustainable

A solar operated water pump in a village in Chhattisgarh

24

Harnessing Solar Energy for Water Equity

Jal Jeevan Mission (JJM) sought to harness solar energy that emerged as a viable solution in rural areas which lack electricity infrastructure as solar radiation is amply available across most parts of the country. By bringing 'atmanirbharta' to village communities, the vulnerabilities due to any breakdown in grid especially in forested and hilly areas were targeted as priority.

Solar-based water supply systems (SWPS) were sought to offer a sustainable approach to meeting the drinking water needs of rural communities, whether through standalone setups or grid-tied installations for mini, small, and multi-village schemes. This vast potential for solar photovoltaic power presented a scalable and sustainable solution for India's energy needs.

The use of solar energy also enhances energy security as it is abundantly available throughout the country. Capturing just a small fraction of the total incident solar energy could theoretically fulfil the entire nation's power demands, highlighting the immense potential and viability of solar power as a reliable energy source for India. Considering the ample availability of solar radiation across most parts of the country, JJM sought to harness solar energy that emerged as a viable solution in such areas. Solar-based water supply systems (SWPS) were sought to offer a sustainable approach to meeting the drinking water needs of rural communities, whether through standalone setups or grid-tied installations for mini, small, and multi-village schemes.

Strategically so, the implementation of solar energy-based pumping systems was prioritised to minimise recurring energy costs, particularly in remote areas characterised by challenging terrain and SC/ST-dominated populations. SWPS installation and commissioning were expedited, making them ideal for addressing urgent water supply needs. This made the operations and maintenance for Gram Panchayats/ Village Water Sanitation Committees/ Pani Samitis more affordable as electricity bills got reduced.

Moreover, with a significant portion of rural habitations having populations of 500 or less, there was a clear opportunity to leverage solar water pumping systems to provide safe and potable water affordably. This approach not only aids in achieving the goal of providing Functional Household Tap Connections (FHTC) but also extends water supply to essential institutions like schools and anganwadi centres within a specified timeframe in those areas.

The vision was encapsulated in the mantra of 'One Sun, One World, One Grid', outlining the monumental scale of utilising solar power. In light of this vision and the pressing need for sustainable water solutions, effective planning and design to reach the last mile was ensured by the JJM.

This initiative also addressed the vulnerability of the community during grid breakdown, especially in forested areas The adoption of solar energy also made operations for Pani Samitis and others committes more economical.

Solar Powering the Last Mile

This adoption of solar energy for water supply systems is also aligned with the broader efforts to reduce carbon footprints and mitigate the impacts of climate change. Traditional water pumping systems often rely on fossil fuels, contributing to greenhouse gas emissions and exacerbating climate-related risks. By contrast, solar-powered water supply systems offered a clean and sustainable alternative, harnessing the abundant solar radiation available in various regions. This transition also enhanced the resilience of water infrastructure to the impacts of climate variability.

The marriage of solar energy and water supply

infrastructure held a significant promise for enhancing energy access and promoting socio-economic development, particularly in remote and off-grid areas. In many regions, access to reliable electricity remains a challenge, hindering the operation of conventional water pumping systems.

JJM has exemplified the transformative potential of integrating solar energy into water supply projects i.e. providing piped water connections to all rural households by 2024, with a strong emphasis on sustainability and inclusivity.

Solar Solutions in Chhattisgarh

Chhattisgarh faced significant water scarcity challenges as it is characterised by rural landscape and limited electricity access. The integration of solar-powered water pumping and purification of drinking water not only addresses immediate water needs but also contributes to long-term sustainability and resilience systems to emerge as a sustainable solution. Through the strategic deployment of solar panels and innovative technologies, remote villages in Chhattisgarh now have reliable access to clean water. Understanding the nuances of its implementation sheds light on the evolution of water supply schemes and the efficacy of the JJM.

Solar-Powered piped water supply in Punjab

Punjab's Water Supply and Sanitation Department is leading the way in sustainable rural infrastructure with its innovative solar-based water supply projects. A pioneering example of this initiative can be seen in the villages of Jagrawan-Muradpur and Talwara in the Jalandhar district. In these villages, the department has successfully installed 150-meter deep tube-wells and constructed water tanks with a capacity of 25,000 liters, ensuring a consistent piped water supply to every household. What makes this project truly remarkable is its reliance on solar energy, which powers the entire water supply system, eliminating the need for conventional electricity.

The impact of this solarisation effort is profound, as the local panchayats are no longer burdened with electricity bills for water supply operations. The funds that were previously allocated for these bills are now being reinvested into community development projects, enhancing the overall well-being of the villages. This shift not only underscores the economic advantages of solar energy but also highlights its potential to drive comprehensive rural development. Punjab's innovative approach serves as a model for other regions, demonstrating how renewable energy can transform essential services while fostering sustainability and growth in rural communities.

Uttar Pradesh: Overcoming Challenges with Solar Innovation

Uttar Pradesh, with its vast population and diverse geographical terrain, presented unique challenges in water accessibility. The adoption of solar energy solutions became imperative in bridging the gap between water demand and supply.

As a sustainable solution, it is transitioning from conventional power sources to renewable solar energy for drinking water supply schemes. It has expedited project implementation and meeting ambitious deadlines. Out of the 44,142 schemes under JJM in Uttar Pradesh, an impressive 33,157 schemes have embraced solar-based power, covered 67,013 villages and served a population of approximately 13.30 crores. This transition not only accelerated project completion but also resulted in significant operational cost savings and a notable reduction in carbon emissions, aligning with environmental conservation goals:

i. Extensive awareness campaigns and digital capacity-building initiatives were undertaken to educate stakeholders and beneficiaries about the benefits of solar-powered water supply schemes
ii. The integration of solar power has enhanced the transparency and efficiency of the public delivery system.
iii. Solar-powered water supply schemes have reached approximately 2.07 crore households, benefitted 13.30 crore people and provided access to clean and sustainable energy for drinking water supply.
iv. A comprehensive toolkit comprising case studies, success stories, capacity-building modules, financial models, and best practices manuals

Water Supply Connection Rise in Jharkhand

Pahalghutva Tola, a settlement within Mayal village in the Chitarpur Block of Ramgarh district, Jharkhand, predominantly inhabited by the Mahato community, relied on agriculture. Tola lacked basic amenities, notably safe drinking water and accessibility. There was only a single solar-powered overhead water tank situated at the far end of the cluster of houses. Consequently, all residents, particularly the women, had to travel several hundred meters to fetch water, wasting time and causing inconvenience, especially during adverse weather conditions.

Sarita Kumari, originally from Hazaribagh and married into the Tola three years ago, experienced firsthand like other women the hardships of water scarcity. She undertook the arduous journey to the public stand post located below the overhead water tank whenever water was needed for household chores, often requiring assistance from elderly women during nighttime or inclement weather.

According to the Village Action Plan, a new overhead storage tank with a capacity of 4,000 litres was constructed for Pahalghutva Tola, and tap connections were installed in all 18 households. This transformative intervention brought immense relief and joy to the women of the Tola, fulfilling their long-held aspirations of having potable water readily available within their homes. Now, the women are able to save time and energy, allowing them to focus on self-care and supporting their families in augmenting household income with water accessible at their doorstep.

facilitates replication and dissemination of solar-powered water supply schemes.

v. Director NJJM along with his team during their visit to 34 villages of Saharanpur district, Uttar Pradesh for implementing solar based water supply schemes and reviewing the status.

The inauguration of India's first solar-based water supply project in Arunachal Pradesh in November 2020 marked a significant milestone in the country's efforts towards sustainable water management, particularly in remote and challenging terrains. Commissioned under the JJM, the initiative now serves 39 villages in the Lower Dibang Valley district of northeastern Arunachal Pradesh, addressing long-standing water access issues in the region. The solar-based lift water supply project, with an investment of Rs. 28.50 crore, underscores JJM's commitment to leveraging renewable energy solutions to enhance water security in far-flung areas. As the first of its kind in India, this project sets a precedent for future endeavours to provide equitable access to water resources while embracing renewable energy sources for rural development.

Furthermore, the adoption of solar-powered pumps and purification systems has led to a notable reduction in operational and maintenance costs. In villages like Pahalghutva Tola in Jharkhand, the installation of solar-based water supply systems has alleviated the financial burden associated with conventional power sources. The decreased reliance on diesel generators or grid electricity has not only reduced ongoing expenses but also ensured long-term financial sustainability for these communities. In states like Rajasthan, where solar radiation is abundant, the implementation of solar-based water supply schemes has significantly reduced greenhouse gas emissions, contributing to mitigating climate change.

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Conserving, Harvesting Water for Sustainable Supply

Sustaining water resources is crucial for delivering safe drinking water via pipelines. Hence, water conservation and water harvesting became key pillars for the success of Jal Jeevan Mission (JJM). In addition, local collection and storage of rainwater would ensure regular water supply under JJM. The stored water was utilised for a variety of non-drinking purposes apart from contributing to recharging groundwater.

Under JJM, the task of constructing infrastructure for rainwater harvesting was assigned to public institutions, ensuring that mechanisms for water conservation were in place, at least in government buildings. By April 2022, about 93 thousand rainwater harvesting structures were constructed across the country. Rainwater was collected and stored either above ground or underground, which played a critical role in reducing water stress in areas sensitive to climate change.

The Jal Shakti Abhiyan: Catch the Rain initiative, launched in 2019, was successful in harnessing rainwater and incorporating it into the water recharging mechanisms. This success was evident in states like Uttar Pradesh, where with precise geotagging 39,389 out of a total of 45,389 identified groundwater sources.

In India, many regions that are frequently affected by floods and cyclones often find their groundwater sources contaminated with high Total Dissolved Solids (TDS) values. Rainwater harvesting in these areas aids in reducing the salinity of groundwater when the water is stored in a reservoir that allows it to seep into the ground. An innovative method known as Aquifer Storage and Recovery (ASR) was employed in the Sundarbans area of West Bengal. Here, rainwater from the catchment area was stored and then pumped into saline aquifers, thereby reducing the TDS. This water is then stored underground and can be used during the summer season or in the event of a natural disaster such as a cyclone. This method creates additional storage and provides a buffer for challenging times, making the area self-sufficient during periods of difficulty. The stored water can also be used for agricultural purposes. Crops grown using water with high Total Dissolved Solids (TDS) do not yield well, but those irrigated with 'sweet' water (less than 1000 TDS) can produce a good yield. This comprehensive approach to water management ensures that even in times of scarcity, communities have access to the water they need.

In addition to rainwater harvesting, Greywater Management is another initiative that aimed to sustain water sources. This process involves the treatment and reuse of wastewater generated from non-toilet household activities, including bathing, washing, general cleaning, kitchen activities, livestock maintenance, and other institutional activities. The Jal Jeevan Mission recognised that greywater, which contains fewer impurities and pathogens compared to black water (wastewater from toilets), is easier to treat and reuse. Once treated to meet specific quality criteria, grey water can serve as a sustainable source of water for irrigation and other purposes.

The JJM integrated its resources with national schemes like the Swachh Bharat Abhiyan, which played a crucial role in managing wastewater and maintaining cleanliness. This integration led to the introduction of the Greywater Management methodology for sustaining water sources. Under the SUJLAM campaign, as part of JJM, greywater management was considered a mandatory element for source sustainability. This approach not only reduced the pressure on fresh water sources but also enhanced the cleanliness of villages and prevented pollution of water bodies.

In the realm of sustainable water management,

Rainwater harvesting system in a rural household in West Bengal

innovative and decentralised methods such as the utilisation of soak pits and leach pits emerged. These pits were ingeniously designed to filter greywater, which is relatively clean wastewater from baths, sinks, washing machines, and other kitchen appliances.

The filtration process involved the use of porous materials like rocks, gravel, and sand, which acted as natural filters. The greywater, carrying organic particles, was directed into these pits. Over time, the water settled at the bottom of the pit or tank, while the organic particles underwent a natural process of decomposition. This treated water then gradually seeped into the surrounding soil, contributing to the recharging of the groundwater. However, the effectiveness of these soak pits is contingent on the permeability of the soil. They are most successful in areas where the soil exhibits a high absorption or infiltration rate.

In addition to soak and leach pits, magic pits and kitchen gardens were introduced to support management of water resources. At the community level, interventions were scaled up to include the Community Leach Pit and the Waste Stabilisation Pond. The latter is essentially a human-made basin that facilitates the digestion of organics in greywater, allowing it to seep into the ground thereafter. Another noteworthy nature-based treatment methodology is the Decentralised Wastewater Treatment Systems (DEWATS). This system offers a practical and efficient solution for the treatment of greywater at a community level.

Lastly, Constructed Wetlands were introduced as a natural filtration system. These wetlands, which are filter beds composed of gravel and sand and planted with aquatic vegetation, allow greywater to flow horizontally. This flow facilitated the degradation of the organic component in the water, further purifying it before it is reintroduced into the environment. This method not only treated greywater but also contributed to the creation of green spaces, enhancing the aesthetic appeal of the community.

Under the Sujlam 2.0 scheme, over six lakh villages had seen intense activity on solid and liquid waste management by April 2022. As many as 4.6 lakh kitchen gardens in the anganwadi centres (AWCs) were set up, along with the construction of almost a lakh greywater reuse structures. This comprehensive approach to water management ensures that even in times of scarcity, communities have access to the water they need.

Another method for ensuring source sustainability under Jal Jeevan Mission was to replenish and rejuvenate pre-existing water bodies throughout the country. Amrit Sarovar, an important initiative taken by the central government, was a breakthrough in water conservation. The mission was executed through the states and districts, converging various schemes such as the Mahatma Gandhi National Rural Employment Guarantee Scheme, 15th Finance Commission Grants, and Pradhan Mantri Krishi Sinchayee Yojana sub-schemes like Watershed Development Component and Har Khet Ko Pani. It also incorporated states' own schemes and Corporate Social Responsibility (CSR)

Soak pits for greywater management in a village in Tamil Nadu

funds. The mission encouraged the mobilisation of citizen and non-government resources to supplement these efforts, focusing on water conservation, people's participation, and the proper utilisation of soil excavated from the water bodies to boost infrastructural projects.

System Sustainability

Climate change presents a formidable challenge to the availability of potable water and the functionality of JJM's water delivery system. Unpredictable climatic events such as floods, cyclones, and sandstorms often render villages vulnerable, and disrupt the conventional electricity infrastructure, resulting in power outages. The provision of fresh tap water in homes is intrinsically tied to the availability of electricity. Hence, during calamities usually the marginalised communities are deprived of water supply due to the absence of maintenance personnel.

Recognising these crises, JJM shifted its focus towards making villages self-reliant in terms of electricity. It aimed to achieve this by providing decentralised, eco-friendly, and sustainable sources of energy production. This approach ensures that villages are not solely reliant on an extensive, large-scale, and climate-change-susceptible electricity system.

One such initiative was the introduction of solar-based electricity generation using solar panels and solar pumps. Given India's geographical location, the country receives abundant sunlight throughout the year. Prime Minister of India and the President of France launched the International Solar Alliance (ISA), an intergovernmental organisation, in 2015 at the United Nations Climate Change Conference held in Paris. The ISA is a treaty-based organisation comprising more than 120 signatory countries, most of which are sunshine countries lying either completely or partly between the Tropic of Cancer and the Tropic of Capricorn. The primary objective of the alliance is to work for efficient consumption of solar energy to reduce dependence on fossil fuels. The ISA seeks to address the challenges of climate change and sustainable development by mobilising resources, fostering technology transfer, and facilitating collaboration among solar-rich countries.

The introduction of solar energy to villages and settlements has significantly reduced the reliance on traditional energy sources, such as grid lines. This shift has empowered the communities, making them less susceptible to external factors. The operational and recurring costs associated with conventional electricity provision have been reduced in many regions following the establishment of solar-based infrastructure. This model has been particularly beneficial for tribal communities residing in the most remote and marginalised areas, enabling them to access tap water.

JJM conducts training sessions for locals, teaching them how to maintain the infrastructure. They are

introduced to various tools, equipment, devices, and machinery, and educated on their operation and troubleshooting methods. This is crucial, especially in climate-sensitive regions where access to external help can be cut off due to natural disasters like floods. The training empowers the locals to be self-reliant, take responsibility, and devise solutions for their water needs by maintaining the equipment themselves.

The mission guaranteed that investments are directed towards areas identified as most vulnerable, thereby enhancing community resilience to climate change impacts. The mission's focus on source sustainability, as exemplified by the rainwater harvesting system, Amrit Sarovar, and greywater management system, highlights the importance of water conservation in a world grappling with water scarcity.

Section H

Coming Together for Water

Children in Uttar Pradesh participate in a Clean Drinking Water Campaign

26

Making Water Everyone's Business

The target of Jal Jeevan Mission (JJM) to provide approximately 19 crore households[83] with tap water in rural areas within five years was an ambitious one. For such a massive operation, every institution involved in the programme needed to operate using a 'service delivery' approach, i.e. function like a public utility. With dwindling water sources and the increasing effects of climate change, it was crucial for every stakeholder to understand the value of every drop of water and do their best to conserve it.

The JJM called for a Jan Andolan, a people's movement, where citizens at all levels and age groups would work together to realise this dream. The role of Gram Panchayat and community-based institutions in effective rollout of such missions at a mass scale was critical. Participatory Rural Appraisal (PRA) methods such as social mapping, resource mapping, and transect walk were used in conjunction with the community to map resources, particularly water sources, and engage the community. Additionally, village institutions like the Village Water and Sanitation Committee (VWSC), Pani Samiti, and others contributed to the community's ownership of the water delivery schemes.

The programme's decentralised, demand-driven, community-managed implementation approach instilled a 'sense of ownership' among the local population. It also fostered a climate of trust, and provided transparency that eventually improved the programme's execution and long-term operation and maintenance of water delivery systems.

A wide range of stakeholders are involved in the water supply sector, including user groups, corporations, international agencies, trusts, foundations, non-governmental organisations (NGOs), village organisations (VOs), community-based organisations (CBOs), research and development (R&D) institutions, and passionate individuals. The objective is to make water everyone's business by forming coalitions and working together with all parties to reach each household in mission mode.

In 2019, the Jal Shakti Abhiyaan (JSA) was launched across 1,256 blocks of 256 water-stressed districts of the country. The objective was to harness people's energy (jan shakti) for water conservation. The primary element of JSA interventions in water-stressed areas is rainwater collection, recharging and conservation of water.

Representatives from the national and state levels collaborated with the district-level team and visited local settlements. Over the course of three months, numerous mission-mode trips were made in addition to initiatives aimed at raising awareness and developing capability. Besides, campaigns for JSA awareness, particularly among farmers were made easier by collaborating with Krishi Vigyan Kendras (KVKs). Jal Shakti Kendras (JSK) were established at the district headquarters to serve as 'knowledge centres' and resources for the dissemination of information about water, water conservation strategies, water quality, and grey water management. They also offered technical advice on water quality and management issues to the district government and the local population. The national and state teams work with the district teams in planning, identification and implementation of water conservation structures.

This dedicated campaign led to the involvement of all departments in the states and resulted in an increase of water conservation structures. More than 1.3 crore

[83] Total Households in India (2010 – 2021, Million). (n.d.). Global Data. https://www.globaldata.com/data-insights/macroeconomic/number-of-households-in-india-2096149/#:~:text=India%20had%20302.4%20million%20households%20in%202021.,the%20indicator%20increased%20by%2024.3%25

structures were completed under this campaign[84]. One of the highlights of the campaign was the participation of people across all age groups, women, farmers, village communities and school children in the 'Catch the Rain' campaign across the country. This campaign was a fine example of what can be achieved when a large number of people come together to conserve water.

Fostering Sector Partnerships

India's goal of ensuring that every home has access to clean water required cooperation within government, non-governmental organizations (NGOs) and various agencies and corporations to reach the country's sizable population base. The mission made water everyone's business. Several NGOs, social service organisations and corporations came together to address the challenges on ground, addressing issues like declining water resources, problems with water quality and poor operations and maintenance (O&M).

The National Jal Jeevan Mission (NJJM) involved more than 200 sector partners to join the mission team at national, state, and district levels in an attempt to involve and unify various partners. Sector partners help NJJM in rendering policy advice regarding the mission. Sector partners also provide support in developing training modules and support capacity building of JJM functionaries, PRI (Panchayati Raj Institutions) members, VWSC (Village Water and Sanitation Committee), and others via a cascading approach. They also play an important role in the preparation of quality Information, Education, Communication (IEC) tools, Behaviour Change Communication (BCC) tools and document best practices across the country.

Nagaland – A Shining Example of Convergence

Nagaland is renowned for both its stunning scenery and diversity of cultures. Although the state receives 1800–2500 mm of rain annually on average, water scarcity and effective water management remain a challenge. With its reasonable rainfall patterns, Nagaland is an ideal place for rainwater harvesting, especially in conjunction with the Catch the Rain initiative.

The seeds of the campaign in Nagaland were sown after the Hornbill festival of Nagaland when the Catch the Rain campaign was launched in Nagaland on 10 November 2023.

Public Health Engineering Department, Dimapur, WATSAN (Water and Sanitation) members, District Jal Shakti fellow and Village Council conducted the PRA (Participatory Rural Appraisal) exercise and discussed the benefits of rainwater harvesting. Appropriate Rain Water Harvesting structures for specific sub-soil conditions were also designed and methods such as roof gutters, groundwater recharge pits, groundwater rejuvenation, restoration and management were discussed.

a. Village-level Partners

Various sector partners such as WaterAid, WASH Institute, INREM Foundation, Aga Khan Foundation, All India Institute for Local Self-Government (AIILSG), and others, worked with JJM at the grassroots[85]. The idea of reaching the grassroots with a wide array of stakeholders helped to identify unique grassroots problems and suggested innovative solutions involving community participation. Additionally, some partners, especially region-specific NGOs, supported JJM at the community level. Implementation support agencies (ISA) supported government departments in mobilising the community and capacity building of stakeholders. They also played a critical role in planning, implementation, and maintenance of the village water supply systems under JJM. The ISAs provided crucial support to local governments in spreading programme awareness and also encourage community involvement while preserving the sustainability of interventions.

[84] JSACTR Dashboard. (n.d.). https://jsactr.mowr.gov.in/PublicDashboard.aspx

[85] WaterAid, WASH (Water Sanitation and Hygiene) Institute, INREM (India Natural Resources Economics and Management), Aga Khan Rural Support Programme, AIILSG are non-governmental organizations working at ground level in water sector interventions.

Participatory Rural Appraisal by Implementing Support Agencies for community engagement in Himachal Pradesh

Each ISA is given tasks that fall into one of the following categories: planning, community mobilisation, implementation, and post-implementation.

Gram Panchayats and ISAs play an important role in engaging the community, monitoring of activities and delivering specific results. Sector partners employed the Participatory Rural Appraisal (PRA) technique at the local level to promote the bottom-up planning process. This tool involves community capacity building for participatory analysis, planning, implementation, and Operations and Maintenance (O&M) of the water supply facilities.

b. State-level Partners

State-level partners are organisations that have their own field office in the state and support the JJM through their expertise in specific sectors like awareness campaigns at the grassroots. These sector partners are specific to the state of intervention and have distinct operational territories. For instance, UNICEF and the Aga Khan Rural Support Programme (AKRSP) primarily assist JJM in Gujarat, Bihar, and other states, and Gram Vikas provides support in Odisha. The organisations, like UNOPS, Tata Trusts, WASH ; institutes like WaterAid India led training sessions and workshops, along with supporting state departments in the implementation of JJM.

c. National-level Partners

At the national level, sector partners work in unison to support JJM in underlining successful steps in research, and knowledge management and support innovation in programmes. These include NGOs of national repute, United Nations agencies, educational institutions, and technical institutions such as IITs, amongst many others. They worked towards capacity building of stakeholders, engineers, Public Health Engineering Department (PHED) officials, and others, while providing specialised, tailored training programmes and IEC (information education and communication) materials.

UNOPS Supports JJM in Uttar Pradesh

The United Nations Office for Project Services (UNOPS) provided strategic support for the Jal Jeevan Mission to be implemented in 137 villages across 11 districts in the Uttar Pradesh regions of Vindhya, Prayagraj, and Bundelkhand. Each district has been assigned skilled individuals who shall encourage community mobilisation and involve key stakeholders to achieve the mission's objectives. Participation in 'Community Leave No One Behind' (CLNOB) mapping was encouraged, particularly among women. This was done to understand the importance of drinking water, grey water, and sanitation conditions in local villages.

In regard to monitoring and testing the village's water quality, five engaged women were chosen. The women members received practical training on monitoring water quality using field testing kits and were instructed on how to facilitate community-led action for water quality surveillance. The community worked with PRA tools like social mapping and resource mapping exercises to map the village's resources. This project has now expanded in four more states, i.e. Uttar Pradesh, Tamil Nadu, Rajasthan and Assam.

The Role of Key Resource Centres

Under JJM, government training institutes, civil society organisations, universities and educational institutions

of repute took over the role of Key Resource Centres (KRCs). Apart from capacity building programmes, KRCs supported by building a knowledge base of resources and IEC materials[86]. After the shortlisting of organisations, 104 organisations were empanelled as KRCs in JJM. More details about KRCs can be read in Chapter 9.

With the idea of Jan Andolan, JJM has been able to unite people on the ground for a massive operation. The Gram Panchayat and its subcommittees, VWSC and Pani Samitis, played a critical role in designing, execution, management, operation and maintenance of the campaign. Thus, success of JJM became everyone's business.

India, a vibrant democracy, strives towards inclusive growth – the idea that every voice matters, and every individual has a stake in the nation's progress. This democratic ethos became a key principle for the Jal Jeevan Mission (JJM) with its objective of transforming lives by providing clean tap water to millions of rural households.

In the quest to realise the vision of universal water access in rural India, JJM embraced partnerships as a cornerstone of its strategy. Thus, diverse stakeholders - government agencies, non-governmental organisations (NGOs), civil society groups, academic institutions, corporates, and local communities, were part of this mission. JJM acknowledged the transformative power of collaborative efforts in addressing the complex challenges of rural water supply with its motto 'Building Partnership, Working Together and Changing Lives'.

The mission leveraged the expertise and insights of academic institutions and research organisations to inform its strategies and interventions. JJM tapped into a wealth of knowledge and innovation, harnessing cutting-edge technologies and best practices to address the multifaceted challenges of water supply and sanitation in rural India by partnering with renowned universities, scientific institutions, and think tanks.

Uniting for Water: Sector Partners

JJM created a groundswell of synergy and convergence by fostering open dialogue and knowledge exchange with sector partners. Sector partners is a term used for civil society organisations, UN agencies, Voluntary Organisations (VOs), Non-Governmental Organisations (NGOs), social service & charity organisations which were brought together on a platform to achieve a common objective. Crucially, sector partners were not mere implementers but active participants in JJM's mission. Further, empowered by the Additional Secretary and Mission Director's guidance, sector partners played a multifaceted role in supporting JJM's implementation at various levels, from programme management and capacity building to community mobilisation and documentation of best practices.

Around 175 organisations were invited as sector partners to help establish a robust framework for collaboration, fostering synergy and collective action towards the common goal of 'Har Ghar Jal'. The sector partners play a multifaceted role in supporting the implementation of JJM, operating at the national, state, and district levels. They gave policy advice, supported programme management and capacity building, enhanced community engagement, and assisted in water quality monitoring and knowledge management.

Sector partners, through awareness campaigns and capacity-building programmes, and targeted Information, Education and Communication (IEC) interventions, enabled communities to take ownership of their water delivery systems. By fostering a sense of ownership and responsibility, their role became critical in ensuring the sustainability and longevity of water supply systems.

Implementation Support Agencies

When JJM began, there were many regions where water supply initiatives were being introduced. Implementation Support Agencies (ISAs) emerged as linchpins in the implementation of JJM in such

[86] IEC materials are supporting communication materials which help in awareness creation like poster, calendar or video documents.

regions, providing essential support, fostering collaboration, and empowering communities to take ownership of water supply initiatives. The significance of ISAs became evident in their role as facilitators of community empowerment and providers of essential handholding support. In areas where civil society groups extended their backing, ISAs played a pivotal role in coordinating efforts and ensuring the effective implementation of water supply projects.

In regions characterised by tribal communities and diverse watershed ecosystems, ISAs are playing a vital role in leveraging local knowledge and experiences. By dovetailing existing efforts and schemes and building upon established practices, ISAs ensured that JJM initiatives were tailored to suit the unique socio-cultural and environmental contexts of each region.

They served as expert facilitators, offering specialised training sessions and awareness programmes on various aspects related to water supply, conservation, and management. The community awareness programmes conducted by ISAs helped in fostering a deeper understanding of JJM among Panchayati Raj Institutions (PRIs) members and other stakeholders. Collaborations between ISAs and local authorities, such as the Executive Engineer of the Public Health Engineering (PHE) department, further strengthened the implementation process. The ISA adopted an inclusive approach, involving PRI members, students, and youth from revenue villages. Such actions created a conducive environment for knowledge sharing, innovation, and collective action towards achieving JJM goals.

These ISAs played a crucial role in conducting participatory rural appraisals to mobilise communities, assisting in the formulation of Village Action Plans, and overseeing post-infrastructure construction activities. Currently, approximately 14,000 ISAs are operational and actively involved in on-the-ground operations.

Key Resource Centres

Key Resource Centres (KRCs) have emerged as indispensable partners in JJM, playing a pivotal role in catalysing the mission's success through their multifaceted contributions. Partnerships for knowledge-building are currently being established with a range of esteemed institutions, including government and non-government organisations, universities, deemed universities, administrative and management institutions, engineering colleges, and training centers, which are functioning as KRCs. These KRCs are playing a crucial role in enhancing the drinking water supply sector by engaging in capacity building, reorienting stakeholders, and disseminating knowledge. They are developing high-quality print and audio-visual content, documenting best practices, and driving transformative changes within the sector. KRCs are supporting effective 'change management,' ensuring that water supply systems

Samman Connection by Tata Trusts

Tata trusts partnered with JJM to implement a Social Behavioural Change Communication (SBCC) campaign known as Samman Connection. This campaign utilised various channels such as interpersonal communication, print and digital media, educational programmes to disseminate key messages, raise awareness and promote behavioural change. The SBCC initiatives create long lasting impact by driving behavioural shifts at grassroot level.

The Samman Connection is based on universal truth that regardless of gender, age, caste or class everyone desires respect. It used the power of digital media and tailored communication strategies to build an emotional connection with community. Tata Trusts aimed to promote behavioural change on three fronts: the individual, the household and society. This has created ownership whereby the individual households learn to treat their JJM provided tap connection as their own and use water responsibly. An animation styled film with powerful lyrics, music and soundtrack and four short films were developed by Tata Trusts to engage viewers on issues and encourage them to take up tap connections and use water judiciously.

are being implemented successfully and maintained sustainably for the long term.

Through a spectrum of initiatives, including leadership development programmes, training workshops, and knowledge-sharing platforms, KRCs endeavour to equip public health engineering officials, district administrators, and field-level functionaries with the requisite skills, expertise, and perspectives to navigate the complexities of JJM's mandate effectively.

Beyond traditional training paradigms, KRCs spearhead fostering a culture of innovation, collaboration, and continuous improvement within the water sector. By facilitating exposure visits, promoting convergence with allied programmes, and documenting best practices, KRCs facilitate the exchange of insights and experiences that fuel innovation and inform decision-making processes.

Centres of Excellence

Knowledge centres or Centre of Excellence have been proposed in reputed Indian Universities/ Institutions for conducting continuous research, and studies, providing inputs for policy making, programme development, etc. Universities/ Institutions have been selected based on research achievements, their experience, potential, and other contributions in the field of water and sanitation

These Knowledge Centres will serve as focal points for conducting continuous research, and studies, and providing inputs for policy formulation and programme development related to water supply and sanitation. Their creation is informed by the recognition of the pivotal role that academia plays in advancing knowledge, fostering innovation, and informing evidence-based decision-making processes.

The process of establishing Centres of Excellence under the mandate of JJM involved key steps like:

- **Identification of Reputed Institutions:** The selection of universities and institutions to host Knowledge Centres was based on their research achievements, experience, potential, and contributions in the field of water and sanitation. Institutions with a demonstrated track record of excellence in relevant disciplines are prioritised for partnership.
- **Collaboration and Partnership:** Once selected, the identified institutions enter into collaborative partnerships with the Department or National Mission overseeing JJM.
- **Resource Allocation:** Adequate resources, including funding, infrastructure, and technical support, were allocated to the Knowledge Centres to enable them to fulfil their mandate effectively. This involved financial support from the government, as well as leveraging existing institutional resources and expertise.
- **Establishment of Research Framework:** The centres developed a comprehensive research framework that aligns with the strategic priorities outlining key research areas, methodologies, timelines, and deliverables, ensuring that research activities are targeted, relevant, and impactful.
- **Capacity Building and Training:** Knowledge Centres played a crucial role in capacity building and training initiatives like organising workshops, seminars, and training programmes for government officials, practitioners, and students.
- **Policy Advocacy and Engagement:** These centres engaged with policymakers, government agencies, civil society organisations, and other stakeholders to advocate for evidence-based policies and interventions in the water and sanitation sector.

In addition, a Centre for Excellence has been proposed at IIT Chennai and IIT Gandhinagar to spearhead research and development in water technologies. IIT Gandhinagar leads in the development of water supply systems, emphasising their efficient and sustainable development.

Professor Chairs

The Department of Drinking Water and Sanitation, Government of India, took a significant step in 2012-13 by establishing Professor Chairs on Water and Sanitation (WATSAN) studies. These chairs aimed to foster collaboration with academic and research institutions, facilitating research and innovation in the rural water supply and sanitation sector.

However, recognising the evolving landscape of the sector and the emergence of new focus areas with initiatives like the Jal Jeevan Mission and Swachh Bharat Mission Phase II, the guidelines related to these chairs have been revised. Consequently, the chairs are now known as 'Jal Jeevan Mission Professor Chairs', aligning their objectives with the vision of Har Ghar Jal and 'ODF Plus'.

These chairs, hosted in reputed academic institutions, were tasked with conducting high-quality empirical and applied research. The research outcomes serve as a crucial foundation for evidence-based policy formulation and technological interventions in the sector. The involvement of eminent personalities such as Prof. Bibek Debroy and Prof. K. Vijay Raghavan underscores the importance attached to this initiative.

To conduct rigorous research and tackle sector-specific challenges in rural drinking water and sanitation, Jal Jeevan Mission has established five Professor Chairs in prominent academic institutions such as IIM Bengaluru, IIT Jodhpur, IIT Guwahati, TISS Mumbai, and IIT Kanpur. Professor chairs have been established in five prestigious institutions, each focusing on different aspects crucial to the success of the Jal Jeevan Mission. For instance, IIT Guwahati is dedicated to enhancing water treatment and technology in flood-prone areas. Similarly, IIT Kanpur specialises in leveraging data science for mission objectives, while Jodhpur focuses on identifying sustainable water sources. TISS Mumbai contributes expertise in decentralised governance, addressing critical aspects of community involvement. Moreover, futuristic technologies are being explored at IIM Bangalore to advance the mission's goals.

Notably, the National Syama Prasad Mookerji National Institute of Water & Sanitation (SBM-NIWAS), inaugurated by the Prime Minister, serves as a crucial hub for advancing water-related research and innovation. It is known for its capacity building programmes in states and UTs in public health engineering, drinking water, sanitation, and hygiene through targeted training programmes. These programmes are designed for the front-line workforce involved not just for the Swachh Bharat Mission and Jal Jeevan Mission, but also for the representatives of local bodies in both rural and urban areas.

Greywater Management Workshop by Centre for Science and Environment

India has been tackling challenge of water scarcity since long. In 1951, the per capita water availability was 1700m3 which has now reduced to 1000m3. Due to the impacts of climate change, more than 256 districts in the country have become water stressed. Grey-water management is imperative in this scenario, in which 70-80% water flowing out of kitchen and bathrooms can be saved. The Centre for Science and Environment (CSE), a key resource centre identified under JJM, conducted a two-day training programme on 'Sustainable greywater management and reuse at community level' on 28-29 October 2021. The training was specially designed for middle management officials associated under water supply programme, i.e. superintendent engineers, executive engineers, PHED personnel, and water utility managers. Close to 80 participants from seven states /UTs were trained on basic issues related to grey-water management.

Third Party Inspections & Functionality Assessments

Transparency stands as a foundational principle of the JJM, ensuring accountability and efficiency in rural tap water supply with a sharp focus on service delivery. To achieve this, JJM has implemented robust mechanisms, including third-party assessments, to enable external scrutiny of project progress. These assessments allow independent parties to verify the integrity and effectiveness of JJM's initiatives.

In the ongoing implementation of JJM, every passing moment witnesses the installation of new tap water connections in rural areas across India. This rapid pace underscores the mission's commitment to addressing the pressing need for clean water access. Despite the scale of this endeavour, JJM remains steadfast in its dedication to maintaining high-quality standards and adherence to prescribed guidelines.

JJM mandates the engagement of Third-Party Inspection Agencies (TPIAs) by State Water and Sanitation Missions (SWSMs) to bolster monitoring and evaluation. These agencies play a crucial role in conducting field inspections and ensuring compliance with established quality standards. Their involvement serves to enhance transparency and accountability throughout the project life cycle.

Furthermore, JJM emphasises the deployment of technical personnel at construction sites and encourages the participation of retired officers or experienced individuals to provide technical oversight. This multi-faceted approach ensures that projects are executed with meticulous attention to detail and in accordance with the highest standards of quality.

In addition to these measures, JJM provides construction quality monitoring kits at district and block levels, enabling sample inspections of materials to maintain quality assurance. Moreover, all public water supply assets are geo-tagged, facilitating traceability and accountability.

Key Partners on Mission

A pool of organisations has played an instrumental role in fostering community development and taking the Jal Jeevan Mission forward. Some of these are:

The United Nations Office for Project Services (UNOPS) brings its extensive experience in infrastructure and project management to the Jal Jeevan Mission (JJM). As a partner, UNOPS provides technical assistance and capacity building to various stakeholders involved in the mission. Leveraging its expertise, UNOPS ensures the effective implementation of water supply projects, optimising resources and enhancing project efficiency. Through its support, UNOPS contributes to the mission's goal of providing clean tap water to rural households across India.

The United Nations Children's Fund (UNICEF) plays a crucial role in advocating for children's rights and well-being, including access to clean water and sanitation. In partnership with JJM, UNICEF mobilises resources and support to prioritise the importance of clean water and sanitation for children. Drawing on its vast experience in child welfare and development, UNICEF raises awareness about the impact of waterborne diseases on children's health and advocates for sustainable solutions to address water and sanitation challenges in rural communities.

Tata Trusts, a philanthropic organisation, has been actively engaged in supporting community-led initiatives and providing financial resources for infrastructure development and capacity building under JJM. With a focus on empowering local communities, Tata Trusts collaborates with government agencies and grassroots organisations to implement water supply projects and promote sustainable water management practices. Through its initiatives, Tata Trusts aims to improve the quality of life and well-being of rural communities by ensuring access to safe and clean drinking water.

The WASH Institute, dedicated to promoting research and innovation in water, sanitation, and hygiene (WASH) practices, is a key partner in JJM. Through its expertise and knowledge-sharing initiatives, the WASH Institute contributes valuable insights and solutions to address water and sanitation challenges in rural India. By conducting research, training programmes, and capacity-building activities, the WASH Institute empowers stakeholders and communities to adopt sustainable WASH practices, ultimately contributing to the success of JJM's objectives.

WaterAid, renowned for its advocacy and community empowerment initiatives, collaborates closely with JJM to raise awareness about the importance of clean water and sanitation in rural communities. Through its grassroots programmes and advocacy efforts, WaterAid mobilises support for JJM's objectives, engaging local communities and stakeholders in promoting sustainable water management practices. By empowering communities to take ownership of water supply projects and sanitation initiatives, WaterAid contributes to improving access to clean water and sanitation facilities for rural households across India.

The Centre for Science and Environment (CSE), a leading environmental research and advocacy organisation, is pivotal in advocating for sustainable water management practices and policy reforms in partnership with JJM. By conducting research,

policy analysis, and awareness campaigns, CSE raises awareness about the importance of water security and sanitation issues in rural India. Through its collaborations with government agencies and civil society groups, CSE influences decision-makers to prioritise sustainable water management practices, driving transformative change at the grassroots level.

The Energy and Resources Institute (TERI) and the Water, Sanitation, and Hygiene (WASH) Institute are instrumental partners in promoting IoT-based solutions for water, sanitation, and hygiene initiatives under JJM. Leveraging their technical expertise and research capabilities, TERI and the WASH Institute developed innovative solutions that harness the power of IoT technology to address water and sanitation challenges effectively. By providing manpower support, technical assistance, and training programmes, TERI and the WASH Institute empower stakeholders to deploy and maintain IoT-enabled water infrastructure, ultimately contributing to the success of JJM's objectives.

Together, these organisations have collaborated with government agencies, civil society groups, and academic institutions and local communities to build partnerships that leverage collective expertise, resources, and networks to accelerate progress toward achieving universal access to safe and sustainable drinking water in rural India. Their contributions have been vital in addressing the multifaceted challenges of water scarcity and sanitation, driving transformative change at the grassroots level.

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Way Forward

India has taken decisive steps in recent years to achieve water security for sustainable development and economic prosperity. In fact, the JJM was conceived recognising the stark realities of climate change and the looming spectre of water scarcity particularly affecting the vulnerable and marginalised communities.

The disadvantaged and marginalised stood at the forefront of such risks and bear the cost of inequalities with a modest 32 million out of the 192 million rural households with functional and running clean tap water connections in 2019. Outdated systems in water infrastructure, funding shortfalls, inefficient resources, creaky distribution management, and inadequate storage of existing reservoirs were the concerns sought to be addressed proactively under JJM.

A strong commitment and determined leadership from the government have played an instrumental role in ensuring that 'no one is left out'. The guiding philosophy of 'minimum government and maximum governance' has heightened transparency both in investment and the delivery of water services. The focus has been on ensuring transparency regarding the quantity, quality, pressure, and regularity of piped water supplies, alongside robust grievance redressal mechanisms.

Now, village-wise data is meticulously being captured and local water utilities are being promoted in every village. This data is subsequently reflected on the JJM dashboard, serving as a vital tool for monitoring and evaluation to ensure accountability and transparency.

To bolster grassroots involvement, training initiatives targeting five women in each village have become a defining feature of the mission's success. Efforts are also underway to introduce 'potable water quality testing devices' into the market, ensuring their accessibility to every Village Water and Sanitation Committee (VWSC) or Pani Samiti.

The deployment of sensor-based IoT devices across villages is another critical endeavour that has been achieved. These devices are strategically installed to monitor and manage water supply systems in real-time, ensuring that the mission's goals are effectively met.

By integrating IoT technology, the water distribution networks in villages can be continuously tracked for various parameters such as water flow, pressure, and quality. This real-time data collection allows for immediate detection of issues like leakages, contamination, or irregularities in supply, enabling swift corrective actions to be taken.

Moreover, the data gathered by these sensors are also analysed to optimise water usage, reduce wastage, and ensure equitable distribution among households. The IoT devices also empower local governance by providing them with precise, up-to-date information, which is critical for making informed decisions regarding resource allocation and infrastructure improvements. This technological intervention catalyses the performance of water systems which is now being audited and reported with greater accuracy.

In addition to improving operational efficiency, the deployment of IoT devices has also uplifted community involvement. Villagers are now informed about water usage patterns, which has encouraged them to adopt sustainable practices. Over time, this approach not only strengthens the reliability of water supply systems but also contributes to the overall sustainability of water resources in rural areas, aligning with the broader objectives of the Jal Jeevan Mission.

Also, States are ranked based on their performance and achievements in the Jal Jeevan Survekshan. Scores are periodically updated, and tentative rankings are published on the JJS-2023 dashboard. The final state-level rankings are assessed annually, while provisional rankings are available on a monthly and quarterly basis.

By categorising districts based on their existing

coverage levels and assigning star ratings, the initiative creates a competitive environment that encourages districts to improve their performance. The regular updates of rankings, along with monthly and quarterly assessments, keep districts consistently engaged in making progress. The recognition and reward for districts that graduate to higher categories serve as a powerful incentive, motivating local administrations to prioritise water supply initiatives and overcome challenges.

This structured approach highlights successful models for developing nations to emulate as progress is monitored and publicly shared. Ultimately, the ranking system has accelerated the pace of achieving universal household tap water coverage, ensuring that even the most underserved areas receive the attention and resources they need.

Regarding strengthening the existing system, India, with its staggering population of 1.44 billion, must make substantial investments in nurturing knowledge centres, elevating them into premier technical and policy institutions that rival the best worldwide. This strategic move could propel the country to assume global leadership in the water sector. To materialise this vision, a series of steps such as capacity building, training, and knowledge transfer remain focal points in the water and sanitation sector.

Furthermore, to establish an extensive network of knowledge centres, fostering innovation, research, and consultancy services, collaborative efforts with the help of sector partners, knowledge partners, and Implementation Support Agencies (ISAs) have been strengthened.

Potable water supply is a basic human right and it is becoming the standard across both urban and rural landscapes of the country. In most states and union territories, a single technical department or a parastatal organisation oversees water supply management in both settings. In villages, it is the responsibility of Gram Panchayats or their sub-committees, while Urban Local Bodies (ULBs) manage water supply in towns and cities. Except for approximately 20 major municipal corporations, urban water infrastructure is typically developed and executed by state technical departments or their affiliated organisations.

The Central Public Health and Environmental Engineering Organisation (CPHEEO), operating under the Ministry of Housing and Urban Affairs, establishes the standards for piped water supply, with its manual first issued in 1999. Given the subsequent advancements and evolving understanding within the sector, integrating urban and rural water supply and relocating CPHEEO under the Department of Drinking Water and Sanitation is imperative.

In many professional spheres such as medicine, law, architecture, chartered accountancy, and company secretaryship, individuals undergo qualification examinations before being granted licences to practice. Presently, in the public health engineering sector, individuals typically join government departments and become public health engineers. To overcome the gap, there is a need to establish a 'Council' akin to bodies like the Bar Council and Medical Council, recognising the sector's critical role in public health. This can help with setting standards and conducting examinations to confer certification as Public Health Engineers for a specified duration, thereby instilling professionalism in the sector.

Similarly, to facilitate the development of genuine water utilities and attract private investment in the sector while ensuring water service delivery, there is a call for establishing a 'water service regulator' in each state/UT. This regulatory body can shoulder the responsibility of overseeing the quality of services, pricing, grievance redressal, and sustainability across both urban and rural areas, encompassing domestic and drinking water supply, as well as greywater management.

For a stronger grievance redressal system, FHTCs need to be linked with Aadhar number. When a complaint is raised, authorities can quickly access the specific household's details, including the history of water supply, past grievances, and any interventions that have already been made. This leads to faster resolution of issues, as the relevant data is readily available, eliminating the need for lengthy verification processes.

Water use efficiency is another crucial way to reach water security. Initiating efforts to forge a balance between agriculture and domestic use is a prerequisite. With approximately 85% of water utilised in agriculture and a mere 5% allocated for domestic

and drinking purposes, even slight alterations in agricultural water usage can profoundly impact the availability of water for domestic consumption.

Overall, in coming years comprehensive reforms and collaborative efforts are necessary to address the challenges and opportunities in the water and sanitation sector effectively. These concerted efforts aim to equip India with the expertise and resources needed to navigate the complex challenges of water management in the 21st century.

World-class water services, along with improved sanitation is a pre-requisite to make India a developed nation by 2047, which has been envisioned by the Prime Minister, Shri Narendra Modi. And, in this endeavour, each and every individual and institution has to contribute meaningfully.

Har Ghar Jal
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