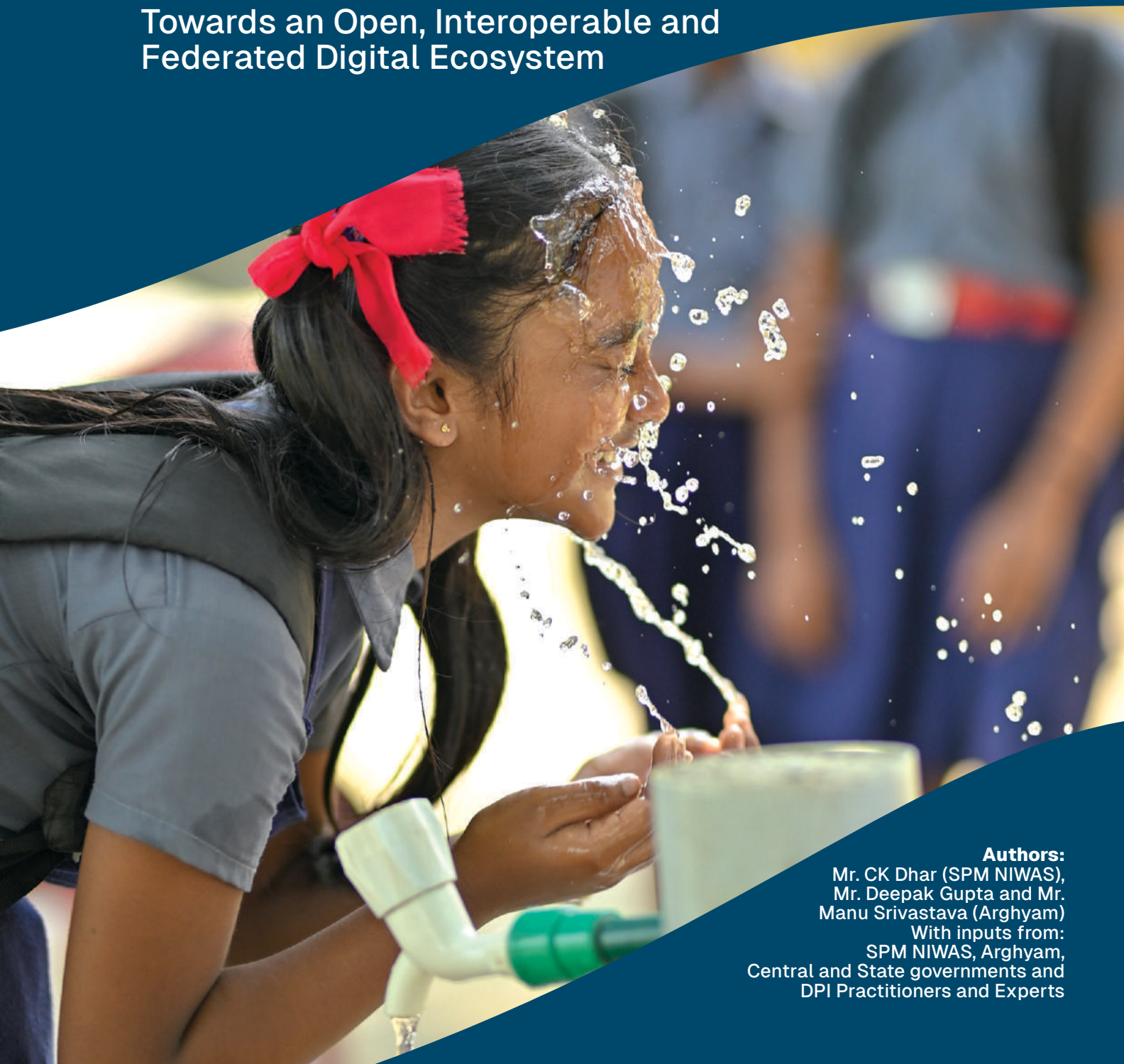




Arghyam

Principles, Architecture and Design for Digital Public Infrastructure in the Rural Drinking Water Sector

Towards an Open, Interoperable and Federated Digital Ecosystem



Authors:

Mr. CK Dhar (SPM NIWAS),
Mr. Deepak Gupta and Mr.
Manu Srivastava (Arghyam)

With inputs from:
SPM NIWAS, Arghyam,
Central and State governments and
DPI Practitioners and Experts

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Abbreviations

Abbreviation	Full form
DDWS	Department of Drinking Water and Sanitation
DPI	Digital Public Infrastructure
JJM	Jal Jeevan Mission
NJJM	National Jal Jeevan Mission
FHTC	Functional Household Tap Connection
VWSC	Village Water and Sanitation Committee
PHED	Public Health Engineering Department
GIS	Geographic Information System
API	Application Programming Interface
AI	Artificial Intelligence
O&M	Operations and Maintenance
NWIC	National Water Informatics Centre
BIS	Bureau of Indian Standards
CPHEEO	Central Public Health and Environmental Engineering Organisation
RPWSS	Rural Piped Water Supply Scheme
GPWSC	Gram Panchayat Water and Sanitation Committee
FTK	Field Testing Kit
SCADA	Supervisory Control and Data Acquisition.
IoT	Internet of Things
PFMS	Public Financial Management System
NRDWP	National Rural Drinking Water Programme
NRW	Non-Revenue Water
CAG	Comptroller and Auditor General of India
NABL	National Accreditation Board for Testing and Calibration Laboratories
OHT	Over Head Tank
IVI/OVI	In Village Infrastructure/Out Village Infrastructure
DPG	Digital Public Good
ABDM	Ayushman Bharat Digital Mission
UPI	Unified Payment Interface

Preface

India's rural drinking water sector is entering an important new phase. The Jal Jeevan Mission has transformed access to piped drinking water across rural India. As the focus shifts from infrastructure creation to assured service delivery, the challenge is to ensure that rural water supply systems continue to provide safe, adequate and regular water over the long term.

The JJM 2.0 Operational Guidelines recognise digital public infrastructure as an important enabler of this transition. Through **Sujalam Bharat DPI**, a proposed national Digital Public Infrastructure for the rural drinking water sector, they set out a federated digital governance framework that brings together interoperable registries, GIS-based asset mapping, transaction systems, citizen participation and data-driven decision-making, while preserving the operational autonomy of States and Union Territories.

This provides an important foundation. The opportunity now is to build on it by creating a digital ecosystem in which systems can interoperate, States can innovate for their own contexts, and communities, civil society, researchers and markets can participate in improving rural drinking water services.

This paper seeks to contribute to that journey. It sets out the principles, building blocks and high-level architecture for Rural Drinking Water Digital Public Infrastructure, drawing on the direction established under JJM 2.0 as well as learnings from the digital journeys of States and the Centre. It does not prescribe a single technology system or application. Rather, it proposes a shared and open digital foundation that can strengthen existing investments, enable interoperability and create space for innovation.

The ideas presented here are intended as a starting point for continued discussion, testing and co-creation. We hope this paper can help bring together governments, local institutions, communities and ecosystem actors around a shared ambition: using digital infrastructure to help make safe and sustainable drinking water a reliable service for every rural household.

Acknowledgements

This publication has benefited from the insights, guidance and contributions of many individuals and institutions.

We are grateful to the Department of Drinking Water and Sanitation, including Secretary Mr. Ashok Kumar Meena; Additional Secretary and Mission Director Mr. Kamal Kishore Soan; Joint Secretary Ms. Swati Meena Naik; the then Director Mr. Pradeep Singh; Deputy Secretary, Ms. Ankita Chakravarty, and the then Deputy Director General, National Informatics Centre, Ms. Seemantinee Sengupta, for their engagement and support.

We are also grateful to Priyatu Mandal, Director, SPM NIWAS, and Mohammad Ishfaq, Advisor, SPM NIWAS, for their guidance through the development of this work. We also thank the colleague at Arghyam especially Anuj Sharma, CEO, Arghyam for his continuous support.

We acknowledge the support and inputs of the Mission Director and teams of State water departments of Gujarat, Rajasthan, Punjab, West Bengal and Assam, whose teams shared their experiences, digital journeys, operational challenges and emerging practices during our consultations and field visits. A special thanks to Mr. Kailash Karthik, Mission Director, Assam, for his sustained engagement and support.

We are thankful to the technical experts and practitioners who contributed their perspectives, including Shankar Maruwada, Pramod Varma, Manish Srivastava, Abhishek Jain, Jagadish Babu, Kiran Anandampillai and Sunita Nadhamuni, as well as colleagues from EY who supported the process.

This work also builds on the research, frameworks and practical experience of practitioners working on Digital Public Infrastructure in India and beyond. Their work has helped shape the broader thinking on openness, interoperability, federated architecture and ecosystem participation that informs this publication.

We gratefully acknowledge the Public Health Engineering Department (PHED), Assam, for providing the photographs featured in this publication.

Executive Summary

Jal Jeevan Mission has achieved something remarkable. In five years, tap water coverage has grown from 17% to over 80%, reaching more than 15 crore rural households. JJM 2.0 builds on this with an enhanced outlay of Rs. 8.69 lakh crore, a strengthened institutional framework, and a clear focus on the transition from infrastructure creation to sustained service delivery.

This paper addresses the challenge posed by this transition. Sustaining service delivery at this scale requires institutions that work, communities that are engaged, finances that are sustainable, and information that reaches the right people at the right time. This paper builds upon JJM 2.0's own DPI thinking and extends it, showing how a well-designed digital foundation can strengthen institutions, deepen community participation, and support financial sustainability, enabling the infrastructure built under JJM to deliver safe water for decades to come.

Where Things Stand

The digital journey in rural water supply is already well underway. NJJM has been developing the Sujalam Bharat framework, creating a system of persistent digital identifiers that connects rural piped water supply schemes, service areas, sources and assets. The Sujalam Bharat ID provides an overarching identifier linking Source and Asset IDs, while the Sujal Gaon ID identifies the service area through its linkage with the RPWSS (Rural Piped Water Supply Scheme) Infra ID and Service Area ID. Together with GIS-based asset mapping and the transactional layer being created through the Sujal Gaon Utility App, these provide important foundations for a national digital ecosystem for rural drinking water.

States have been building their own IT systems in parallel. Assam, Gujarat, Kerala, Punjab, Tamil Nadu, Uttar Pradesh, West Bengal, Rajasthan, and Karnataka have each invested in digital platforms suited to their contexts. The momentum is real and the innovations are genuine. What this landscape reveals is a significant opportunity: state systems and the national foundation are being built simultaneously. Establishing common principles, open standards, and interoperable interfaces now means every investment made from this point forward contributes to a coherent national ecosystem. The timing to act is right.

What This Paper Proposes

This paper sets out the principles, architecture, and design of a Digital Public Infrastructure for rural drinking water. It is not a proposal for a new system. It is a framework for completing and opening what has already been started.

The principles establish what the DPI must achieve and how it must be built: service centricity, frontline empowerment, inclusivity, and a federated architecture that respects state ownership of data while enabling national coherence.

The architecture defines the building blocks: six interlinked registries that build on

Sujalam Bharat's foundational identifier framework to cover the full service delivery chain, standards and specifications that create a common language across devices and systems, domain services that open the transactional layer to any conforming application, an open data layer that makes aggregated water supply information available to citizens and researchers, and shared AI assets that states and innovators can build on without developing from scratch.

The design provides practical pathways for states at every level of digital maturity to participate, starting from where they are, protecting existing investments, and building toward a connected national ecosystem over time.

What This Makes Possible

When the DPI is working, a VWSC in Rajasthan knows her scheme is underperforming before a household complaint reaches the district office. A district engineer in Assam starts her day with a clear picture of which schemes need attention rather than reconciling data from disconnected systems. A startup builds a leak detection solution once and offers it across multiple states because the underlying standards are the same everywhere. A citizen checks whether her water was tested last month and what the results showed.

None of this is far off. It requires the right foundation, consistently built and genuinely open.

For NJJM and the Centre, the DPI delivers visibility into service delivery across the country, not because every state uses the same platform, but because every platform speaks the same language. For states, it protects existing investments while opening the door to national innovations. For communities, it provides the information needed to genuinely participate in governing their water supply. For markets and innovators, it opens a sector that has remained largely closed to new ideas and new entrants.

The Invitation

India has the institutional experience, the digital ecosystem, and the momentum to make rural water supply one of the best governed public services in the country. The foundations are being laid through Sujalam Bharat and JJM 2.0. What is needed now is the collective commitment to complete them, open them, and build on them together.

Digitization in the rural drinking water sector is inevitable. But whether it becomes inclusive, innovative, and empowering is not. This paper is an invitation to make sure it does.

Introduction to Digital Public Infrastructure (DPI)

Digital Public Infrastructure (DPI) refers to a set of foundational digital systems, shared standards, protocols, registries, and platforms that enable governments, businesses, and citizens to interact efficiently, securely, and at scale. Unlike standalone applications developed for a specific purpose, DPI provides reusable digital building blocks upon which multiple services and innovations can be built. It functions as a public good, similar to physical infrastructure such as roads, electricity, or telecommunications networks, enabling a wide range of digital services to operate seamlessly.

Globally, DPI has emerged as a key enabler of inclusive digital transformation. Examples include digital identity systems, payment networks, health information exchanges, and data-sharing frameworks. India has demonstrated the transformative potential of DPI through initiatives such as Aadhaar, Unified Payments Interface (UPI), DigiLocker, and the Ayushman Bharat Digital Mission (ABDM). These platforms provide common digital foundations that support innovation, improve service delivery, reduce transaction costs, and foster ecosystem participation by governments, private enterprises, civil society, and citizens.

The core objective of DPI is not to create a single centralized application, but to establish interoperable digital foundations that allow diverse solutions to work together. Through open standards, common identifiers, trusted registries, and secure interfaces, DPI promotes interoperability, innovation, competition, transparency, and accountability while preserving institutional autonomy and local flexibility.

As governments increasingly shift from infrastructure creation to service delivery and sustainability, DPI provides a powerful approach for building resilient digital ecosystems capable of supporting long-term governance, operational efficiency, and citizen-centric outcomes.

Principles and Architecture of Digital Public Infrastructure

A Digital Public Infrastructure is guided by a set of foundational principles that ensure scalability, interoperability, inclusiveness, and sustainability.

Core Principles of DPI

Public Good Orientation:

DPI is designed as a shared digital foundation that benefits the entire ecosystem rather than any single institution or application.

Interoperability:

Open standards, common data models, and standard APIs enable different systems, organizations, and applications to communicate and exchange information seamlessly.

Federated Architecture:

Data and operational ownership remain with the institutions closest to the service, while common standards enable nationwide coordination and interoperability.

Open Ecosystem:

Governments, private enterprises, academia, civil society organizations, and innovators can build solutions on top of the shared infrastructure, fostering innovation and competition.

Trust and Security:

Strong governance, privacy protection, cybersecurity controls, authentication mechanisms, and auditability ensure trust in digital transactions and data exchange.

Inclusivity and Accessibility:

DPI should be designed to serve diverse populations, including rural communities, marginalized groups, and digitally underserved regions, ensuring equitable access to services.

Minimalism and Reusability:

Only foundational capabilities are built into the DPI. Sector-specific applications and services are developed by ecosystem participants using the common building blocks.

Generic DPI Architecture

A typical DPI architecture consists of four interrelated layers:

1. Foundational Layer

- Unique digital identities
- Registries and master data repositories
- Authentication and authorization mechanisms
- Governance and trust frameworks

2. Interoperability Layer

- Open APIs
- Interoperability and Data Exchange Standards, including Domain-Specific Vocabularies, Taxonomies, Ontologies, and Metadata Schemas
- Messaging protocols
- Consent and access-control mechanisms

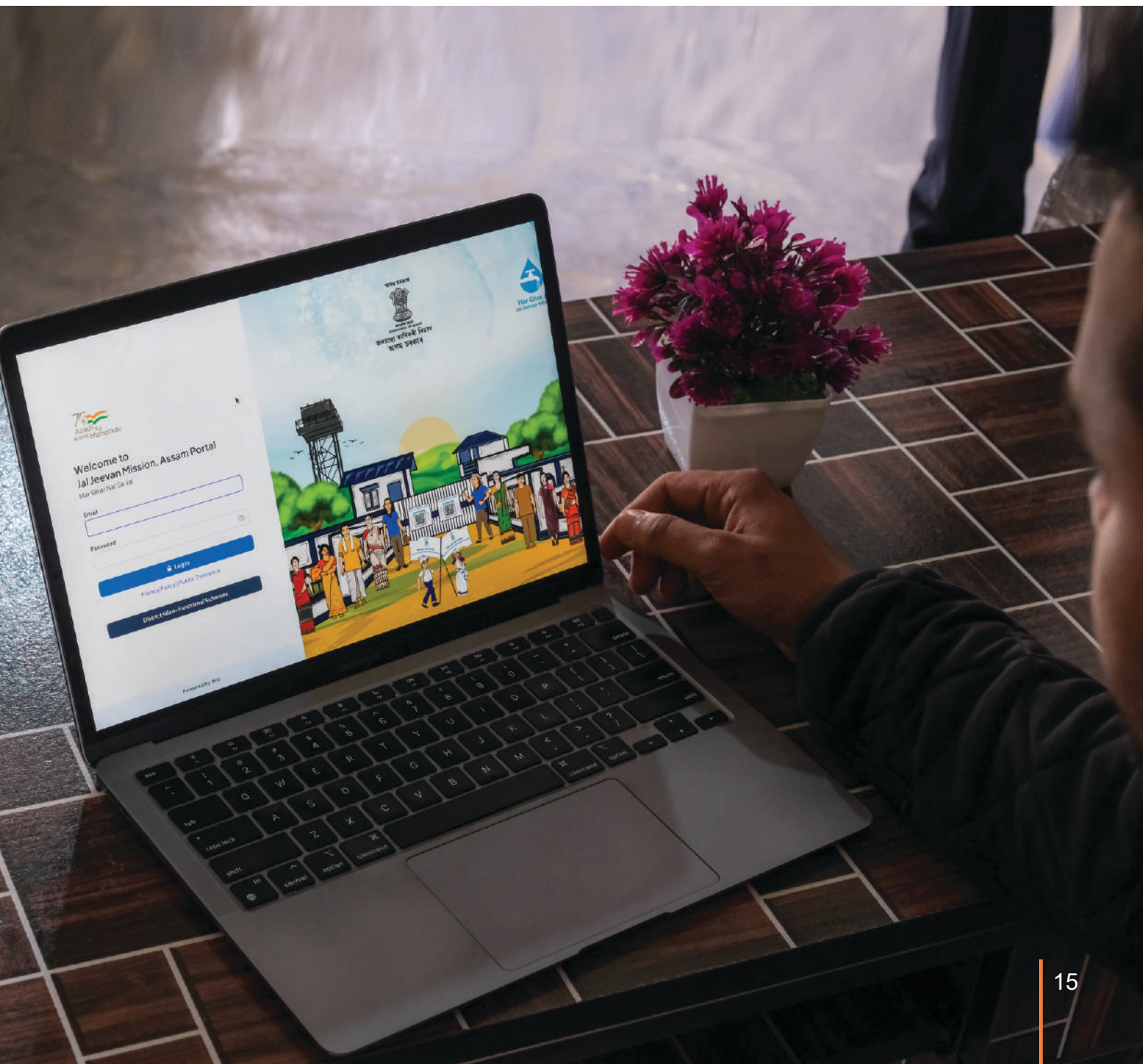
3. Service Layer

- Domain-specific services and transaction platforms
- Business workflows
- Monitoring and reporting systems
- Decision-support services

4. Open data and research ecosystems

- Third-party applications
- Analytics platforms
- Artificial Intelligence and Machine Learning services
- Open data and research ecosystems

Together, these layers create a digital ecosystem in which multiple stakeholders can collaborate, exchange trusted information, and deliver citizen-centric services without requiring a single monolithic platform. The architecture promotes innovation while maintaining consistency, interoperability, and governance across the ecosystem.





2

A Promise that must be kept

India set out in 2019 to do something no country had attempted at this scale — pipe safe drinking water directly into every rural home, with an individual household tap connection delivering clean water every day. By most measures, the progress has been remarkable. Coverage has gone from 17% to over 80% in five years. More than 15 crore households have connections they did not have before. Entire states have declared 100% coverage.

JJM 2.0 has raised the total outlay to 8.69 lakh crore with the central assistance enhanced from 2.08 lakh crore to 3.59 lakh crore. The investment reflects a commitment of unprecedented scale.

What follows is not a critique of what has been built. It is a question about what happens next.

The Gap That Now Matters

A tap connection and a functioning water supply are not the same thing. The 2024 JJM functionality assessment of the households that had a tap connection made this visible. Yet only 84% were receiving water regularly, and only 80% were getting adequate quantity. These are not small gaps. Only 76% had potable water. Overall functionality was only 76%. Millions of households have taps that exist but do not reliably deliver water.

Table 2: Results of Functionality Assessments

Parameters	2021*	2022*	2024*
Working tap connections (Found working on the day of the survey)	94%	91%	87%
Adequate Quantity (i.e., 55 lpcd)	84%	88%	80%
Full Regular Supply (% HH) (as per declared supply schedule)	87%	84%	84%
Potable (Quality) (% HH)	61%	90%	76%
Overall Functionality	48%	69%	76%

*Survey outcome for Har Ghar Jal villages.

And this was in 2024, when the infrastructure was relatively new. Pumps age. Pipes corrode. Groundwater levels fall. Without sustained operation and maintenance, the gap between connection and service will widen. We have seen this pattern before.

The CAG's 2018 performance audit of the predecessor NRDWP found that the programme achieved only 44% of its coverage target. The experience also underscored the wider challenge of weak institutions, poor maintenance, and no systems to detect and respond to failures in time to sustain the rural water infrastructure once it is created.

JJM learnt from those failures, and JJM 2.0 operational guidelines have responded with detailed provisions across institutional architecture, capacity building, financial sustainability, citizen centricity and operations. But the risk of repeating them in a new form is real and worth taking seriously.

A key operational challenge, therefore, is the absence of a reliable and continuously verifiable view of whether drinking water facilities are functional and delivering the intended level of service as promised in the Jal Jeevan Mission.

What Sustaining This Actually Requires

Sustainability at this scale requires several things to work together: not sequentially, but simultaneously, as has been articulated well in the JJM 2.0 guidelines. It needs the right institutional architecture, a utility-based approach and coordination between institutions, and citizen centricity through genuine Jan Bhagidari. It needs the right capacities at every level, and an ecosystem to build and sustain them. Together, these are what will determine whether the schemes built under JJM remain operational and financially viable for decades to come.

And across all of this, the information challenge is real. Financial plans not linked to actual scheme data produce unrealistic budgets. Maintenance that goes untracked leaves no institutional memory. Community oversight without visibility into scheme performance produces disengagement. JJM 2.0 recognises this and calls for digital tools linked to Sujalam Bharat IDs for financial planning, data-driven O&M budgeting, and real-time monitoring to catch issues early.

Information does not replace financial resources or institutional capacity. But without it, both tend to break down in ways that stay invisible until they are already expensive to fix.

One Country, Many Realities

Any honest conversation about sustaining rural water supply in India has to begin with acknowledging that there is no single problem to solve. The hydrology alone makes this clear. A scheme drawing from a perennial river in Punjab has almost nothing in common with one dependent on a borewell in Bundelkhand. Arsenic in West Bengal and Bihar, fluoride in Rajasthan and Andhra Pradesh, salinity along the coasts — each demands different technical responses, different monitoring priorities, different community approaches.

The institutional landscape is just as varied. Some states have water departments with decades of experience. Others are building capacity almost from scratch. Some Village Water Sanitation Committee (VWSCs) are genuinely active. Others were constituted to meet a programme requirement and have never really functioned. And the digital starting points range from Assam's integrated JJM BRAIN and Gujarat's ERP to states still working from spreadsheets and paper registers.

This diversity is not a problem to be overcome. It is a reality that needs to be understood, respected and designed for. What is needed is a foundation common enough to enable coordination and learning across the country, while leaving genuine space for states, districts, and communities to build solutions that fit their specific situations.

That is what the rest of this paper sets out to build.

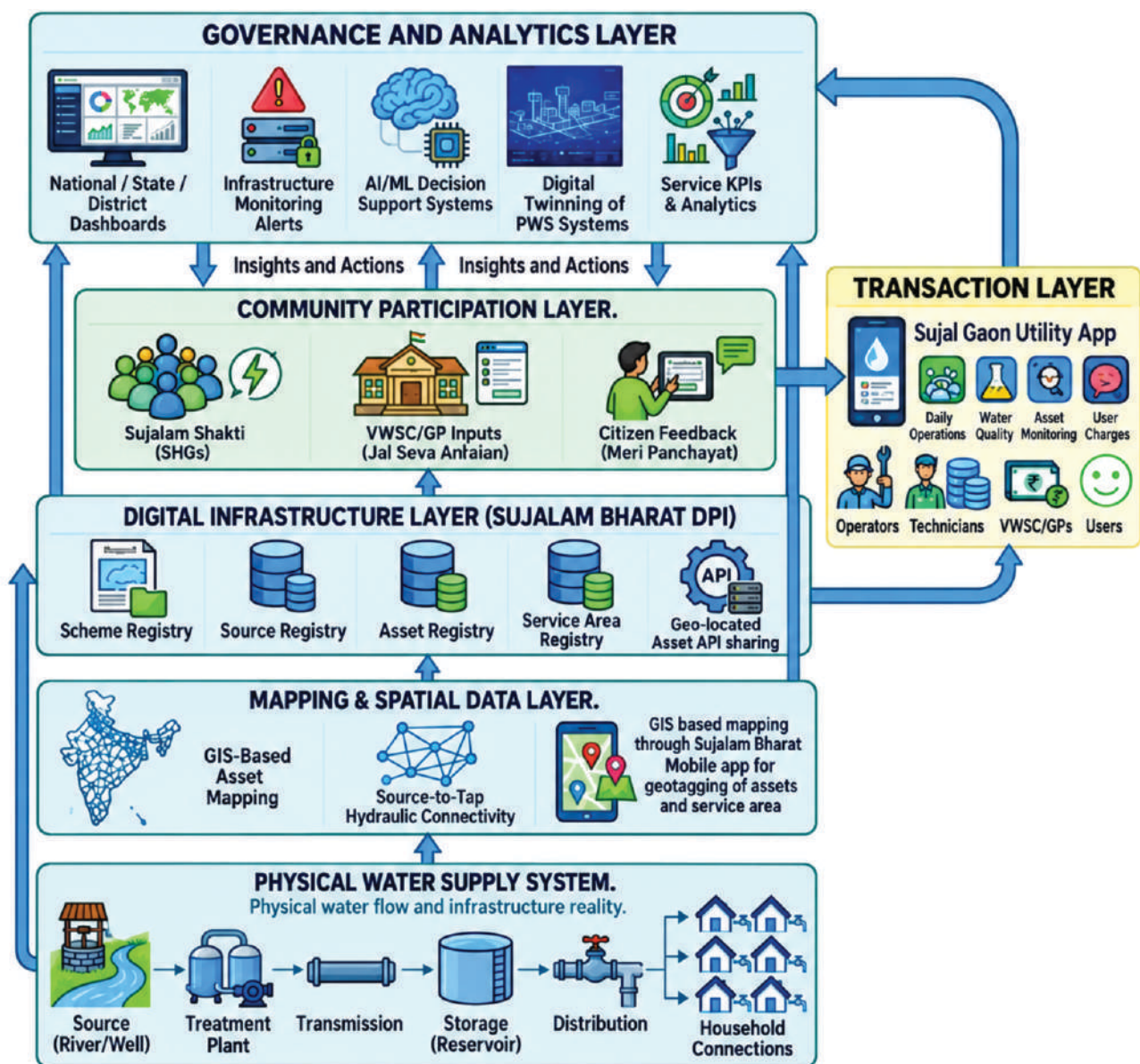
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Where we stand: The Digital Landscape today

India's rural drinking water sector has not been standing still on the digital front. Over the past decade, and accelerating significantly under JJM, real investments have been made in technology at both the Centre and in states. Understanding what has been built, what is working, and where the gaps are is the starting point for understanding why a different kind of digital foundation is needed now.

Sujalam Bharat: The Foundation Being Laid

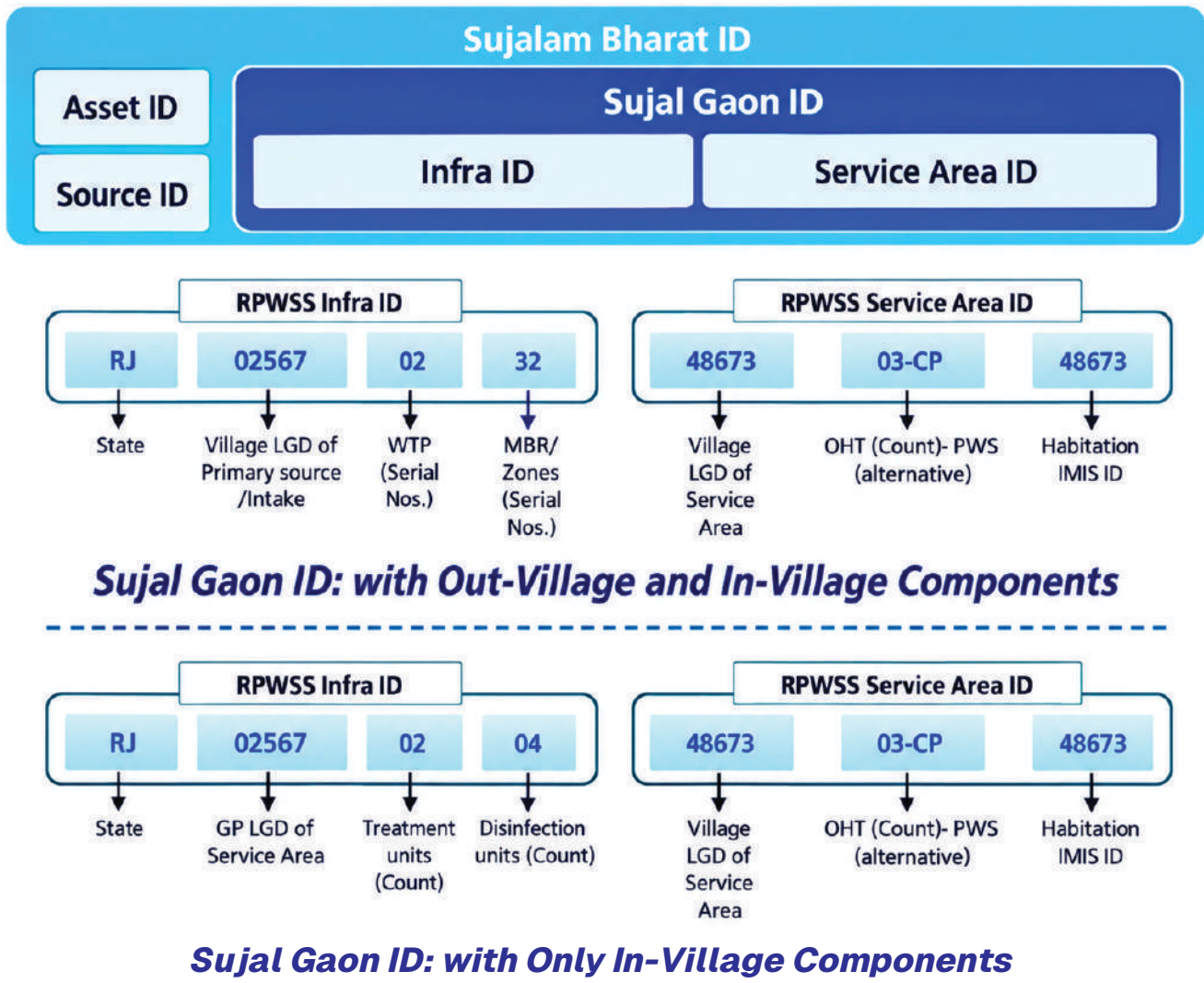
Figure 12: Functional Framework for Sujalam Bharat



Recognising that the shift to service delivery requires a different kind of digital backbone, JJM 2.0 visualizes **Sujalam Bharat as a federated Digital Public Infrastructure for India's drinking water sector**. It is designed to provide an interoperable digital foundation that connects asset registries, geospatial mapping, transaction systems and decision-support systems while maintaining the operational autonomy of States and Union Territories.

At its core is a system of persistent digital identifiers that connects the physical water supply system to its digital representation. The **Sujalam Bharat ID** provides the overarching identifier through which Source IDs and Asset IDs are mapped, while the **Sujal Gaon ID** links the RPWSS infrastructure to the service area it serves. Assets from source to last-mile distribution are geo-tagged and linked through this identifier framework, creating end-to-end digital visibility of rural piped water supply systems.

Figure 13: Relationship between Sujalam Bharat ID, Source ID, Sujal Gaon ID, Service Area ID, Infra ID and Asset ID



As part of the Rural Pipeline Water Supply Schemes (RPWSS) generation process, the system creates the Sujalam Bharat ID, which acts as a single unique identifier by mapping the Asset IDs and Source IDs. All Pipeline Water Scheme (PWS) assets in a scheme from source to tap are registered and geotagged against this unique system-generated Sujalam Bharat ID.

Built on this foundation, the Sujal Gaon Utility App serves as the transactional layer, enabling frontline workers, VWSCs, operators, and technicians to capture daily operational data on water supply, water quality, asset condition, finances, and grievances in near real time. Integrated with national and state platforms through open APIs, it creates a unified role-based transactional layer for village-level O&M. The framework also envisions Digital Twin capabilities, virtual replicas of water systems that can simulate flow dynamics, support preventive maintenance planning, and enable data-driven governance from the Gram Panchayat to National Jal Jeevan Mission (NJJM).

This is exactly the kind of authoritative identifier and transactional layer that a functioning digital ecosystem needs. Sujalam Bharat has laid the foundation. The question the rest of this paper addresses is what gets built on top of it, and how.

What States Are Building

Alongside the Centre's efforts, states have been independently developing their own digital systems, a development that reflects healthy local autonomy and genuine innovation. The picture that emerges from a detailed study of five states is one of real progress alongside real fragmentation.

Assam has built JJM BRAIN, a unified digital platform that integrates scheme monitoring, consumer feedback, and AI-assisted pilots. Gujarat has implemented a robust ERP system alongside bulk water transfer monitoring, grievance redressal, and consumer feedback tools. Punjab has advanced laboratory information systems and piloted IoT-enabled schemes. West Bengal has made notable progress in consumer-facing digital platforms. Rajasthan has leveraged the broader state digital ecosystem, integrating across government systems.

Across states, the momentum is clear and encouraging. But so are the patterns of fragmentation. Systems built in one state cannot easily be adopted by another. Systems built within each state also don't work seamlessly with each other. Data formats differ. Innovations proven in Assam cannot travel to Rajasthan without being rebuilt from scratch. And at the other end of the spectrum, many states are still managing scheme data through spreadsheets and paper registers, creating blind spots in national oversight that compound over time.

What the Landscape Reveals

Three gaps run through this landscape, and they will widen if not addressed.

The first is the **federation gap**. Central and state systems struggle to communicate, not just because of technical incompatibilities but because of deeper differences in how systems were designed and owned. Data cannot flow freely between scheme operators, district managers, and national dashboards. Early warning signals get lost in translation. Innovations developed in one state remain confined there, unable to scale into national assets.

The second is the **innovation gap**. Unlike health, agriculture, or education, the drinking water sector has a limited ecosystem of startups, researchers, or private innovators. Without common building blocks, open standards and accessible interfaces, even willing innovators have to build and rebuild solutions for each state. The result is a sector dependent on a small number of large system integrators, with limited competitive pressure to improve quality or reduce costs.

The third is the **standards gap**. Without shared standards for data formats, device protocols, and system specifications, every integration becomes a difficult engineering exercise. Each new device or solution requires bespoke work, progressively locking governments into vendor-dependent systems with no easy path to upgrade or extend.

A single well-designed national platform, consistently implemented, could address many of these gaps. States would have a ready-made tool rather than building their own. VWSCs and frontline workers would have a standard interface. Data would flow to national dashboards without custom integration. Citizens would have a feedback channel. These are real benefits, and they should not be understated.

But a single platform, however well designed, has limits that become more visible over time.

It cannot fully accommodate India's diversity. One application serving six lakh villages across every hydrological context, every institutional arrangement, and every level of digital maturity will inevitably fit some situations well and others poorly. The pressure to make one tool work for everyone tends to produce compromises that serve nobody particularly well.

It does not open the sector to innovation. If the platform is the system, then innovation happens only when the platform evolves. There is no room for a startup to build a better solution for a specific context, no incentive for competition, and no mechanism for good ideas emerging at the state level to find their way into a shared national resource.

And it creates a single point of institutional dependence. If the platform stalls due to technical, financial, or political reasons, the entire sector stalls with it. Resilience requires diversity, not uniformity.

What the sector needs is not a choice between fragmented state systems and a single national platform. It needs a third option: a common digital foundation of open standards, shared identifiers, and interoperable building blocks on which both the national platform and diverse state and local solutions can run together. A foundation where Sujalam Bharat's identifiers and transactional layer become the anchoring spine, and where states, innovators, communities, and civil society can build what works for their specific context on top of it.

This is the DPI approach.

4 The DPI Approach - What it is and why it is relevant

There is a way of building digital systems that has transformed how India delivers services at scale. It does not work by building one perfect system and asking everyone to use it. It works by building a minimal shared foundation of common standards, shared identifiers, open interfaces and then letting governments, innovators, communities, and markets build what they need on top of it. The result is not uniformity but coherence: Many different solutions that can work together.

India has done this before with Aadhaar, UPI and ABDM. Aadhaar created a shared identity layer that health, welfare, banking, and dozens of other sectors have built on. UPI did not build one payment app. It built the rails on which hundreds of payment apps now run, serving over 20 billion transactions a month. ABDM is doing the same for healthcare. Not by replacing existing systems, but creating the digital foundation on which patient records, insurance, and care delivery can connect. In each case, the approach was the same: establish a minimal, open, shared foundation, define the standards and identifiers that everyone must use, and let the ecosystem build.

This is what Digital Public Infrastructure means. A whole-of-society approach where government sets the foundation, markets innovate on top of it, and communities are active participants rather than passive recipients.

In the rural drinking water context, the DPI will establish the trusted digital rails through which drinking water assets and services can be uniquely identified, linked, discovered and interoperably managed across their lifecycle.

Why Now

The rural drinking water sector is at the moment when this approach matters most. States have already made significant digital investments and will continue to do so. AI led development is hastening the speed of change. Sujalam Bharat has established the foundational identifier and asset-mapping framework. The hardest part is already underway. The window now is to ensure that what is being built becomes a foundation that the entire ecosystem can build on, before the current momentum locks into a pattern that is difficult to change.

What DPI Makes Possible That a Single System Cannot

A common digital foundation changes what is possible for every actor in the ecosystem.

For states with limited technical capacity, it means a ready-to-use reference application built and maintained by the Centre that they can adopt directly without building from scratch. This is an important and legitimate role for the Centre, and the DPI approach fully supports it. What it adds is that underneath this reference application sits an open foundation of standards and identifiers, so that states which want to build their own solutions, or innovators who want to build sector-specific tools, can do so without fragmentation.

For innovators and markets, open standards mean a startup can build a solution once and offer it across multiple states. The kind of competitive innovation that has transformed health and agriculture can finally reach the rural drinking water sector.

For the Centre and NJJM, it means genuine visibility into service delivery across the country, not because every state is using the same platform, but because every platform is speaking the same language.



5 The DPI Vision

At the end of every argument about institutions, systems, and digital foundations, there is a family in a village for whom safe water every morning is not a policy outcome but simply how the day begins. That is what this is about. And that is where the vision starts.

The Vision



“ To build a national Digital Public Infrastructure for Rural Drinking Water that enables safe, adequate and regular water to reach every rural household by empowering communities and institutions, fostering innovation, and enabling accountable, citizen-centric service delivery through open, interoperable digital systems. ”



This is not a vision about technology. It is a vision about what rural communities deserve: water that flows safely, every day, for decades to come and about what it will take institutionally and digitally to deliver that.

Objectives



The vision sets the direction. These objectives define what achieving it actually looks like.

- To establish a trusted, authoritative, and interoperable digital foundation where every scheme, source, asset, laboratory, service provider, and household connection has a persistent digital identity.
- To enable every state to participate in the ecosystem and deliver water services more effectively, regardless of where they are starting from.
- To open the sector to innovation from markets, civil society, and research institutions by providing common standards, identifiers, and open interfaces.
- To make service delivery visible and accountable at every level of governance, based on verified data rather than aggregated reports.
- To put communities at the centre as active participants in governing their water supply, not passive recipients of it.

What This Looks Like When It Is Working

It is worth pausing to imagine what this vision looks like in practice, because the risk with any digital initiative is that it becomes an end in itself rather than a means to something real.

When the DPI is working, a VWSC member in a small village in Rajasthan does not find out that her scheme has been underperforming for three weeks when a household complaint finally reaches the district office. She sees it early, in a simple interface in her language, before it becomes a crisis. She knows what the problem is and who is responsible for fixing it.

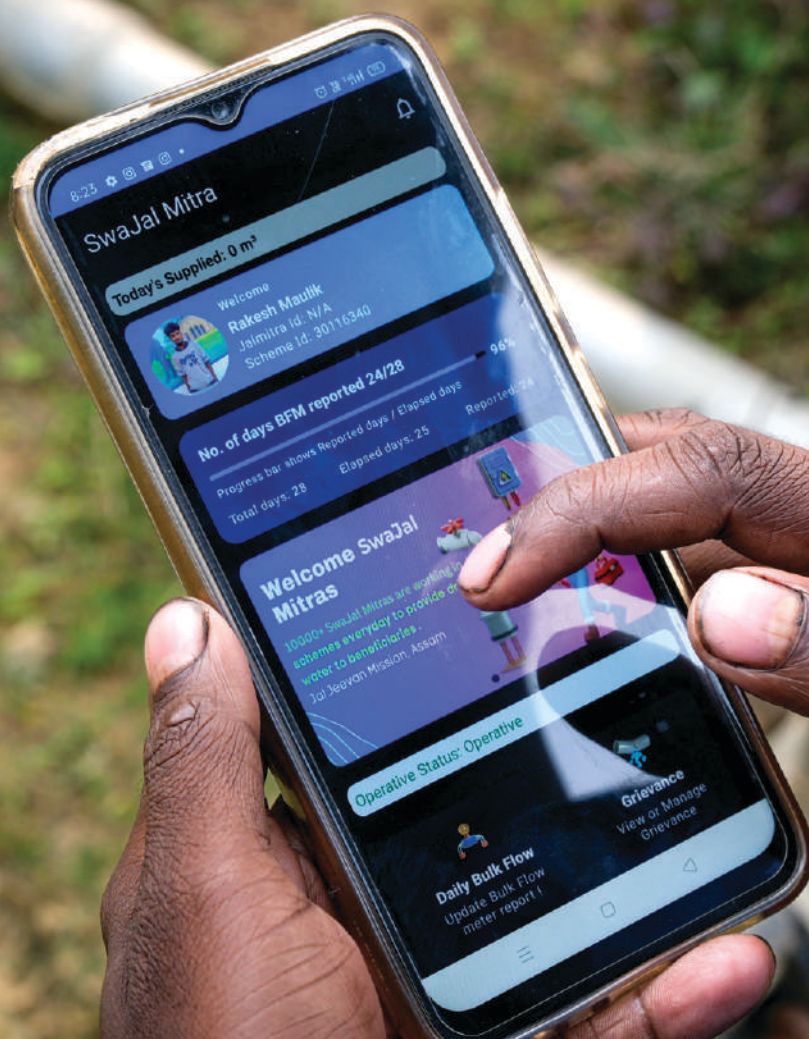
When the DPI is working, a district engineer in Assam managing 300 schemes does not spend her mornings reconciling data from multiple systems. She starts her day with a clear picture of which schemes are at risk, where the water quality alerts are, and which assets need attention.

When the DPI is working, a startup can build a sensor-based leak detection solution and offer it to water departments across multiple states, because the underlying standards and registries are the same everywhere. She does not need to build and integrate her solution for each state.

When the DPI is working, a citizen in Rajasthan can look up whether the water from her tap was tested last month, what the results were, and who to call if there is a problem.

None of this requires futuristic technology. It requires the right foundation.

That is what the DPI is designed to enable. The next chapter sets out the principles that should guide how it is built.



6

The Principles of DPI

The DPI for rural drinking water is guided by two kinds of principles

Domain Principles: That define what it should achieve

Technology Principles: That define how it should be built.

Domain Principles

Service Centricity Every component of the DPI must connect to one outcome — safe, adequate, and regular water reaching every rural household. If something being built does not contribute to better service delivery, it should not be a part of the DPI.

Frontline Empowerment The pump operator, the Field Testing Kit (FTK)-trained woman, the VWSC are the people on whom service continuity actually depends. The DPI must be designed to strengthen their ability to do their job, make decisions locally, and be accountable to the communities they serve.

Inclusivity and Adaptability A scheme in the flood plains of Assam and a scheme in the arid regions of Rajasthan have different needs, institutions, and communities. The DPI must work for both and for every state regardless of where it is starting from digitally. This means building a foundation flexible enough that diverse solutions can be built on top of it, each suited to its context while remaining part of a coherent national ecosystem.

Catalysing the Ecosystem The role of the DPI is to create the conditions for many actors to solve problems, rather than make any one institution the sole provider of digital solutions. The Centre may provide reference applications where needed, while enabling States and ecosystem actors to build and use alternative solutions on the same shared foundation. The measure of success is not how much the Centre builds, but how effectively the DPI enables innovation, choice and reuse across the ecosystem.

Incentives, Not Mandates Sustained digital participation cannot depend on mandates alone. Frontline workers, local institutions, States and citizens should see clear value in contributing data and using digital systems. The DPI should therefore reduce effort, support better decisions and align incentives so that accurate and timely participation becomes useful to the people being asked to participate.

Technology Principles

Federated Architecture States own their data. Local institutions maintain the registries for which they are responsible. The Centre provides common standards, shared identifiers and reference applications without requiring every state to use the same system. Interoperability is achieved through shared protocols and APIs, while States retain the flexibility to build and operate solutions suited to their own context.

Authoritative Source of Truth Data in the DPI must be trusted. Every scheme, source, asset, laboratory, and connection must have a persistent digital identity maintained by the institution best placed to keep it accurate.

API First APIs should be designed as part of the foundation, not added after applications are built. Reference applications, State systems and ecosystem solutions should use the same standard interfaces to submit/access data and transactions. This ensures that interoperability is built in from the start and that no single application becomes the only route into the DPI.

Interoperable Open Standards Common standards for data formats, identifiers, devices and exchange protocols should be defined before solutions are scaled. Any system or device built to these standards should be able to participate without bespoke integration. This prevents vendor lock-in, enables choice and allows an innovation proven in one State to be adopted in another without rebuilding from scratch.

Minimalism The DPI should build only what is essential. Every addition increases complexity for states and maintenance burden for the Centre. If something can be built by the ecosystem on top of the DPI rather than into it, it should be.

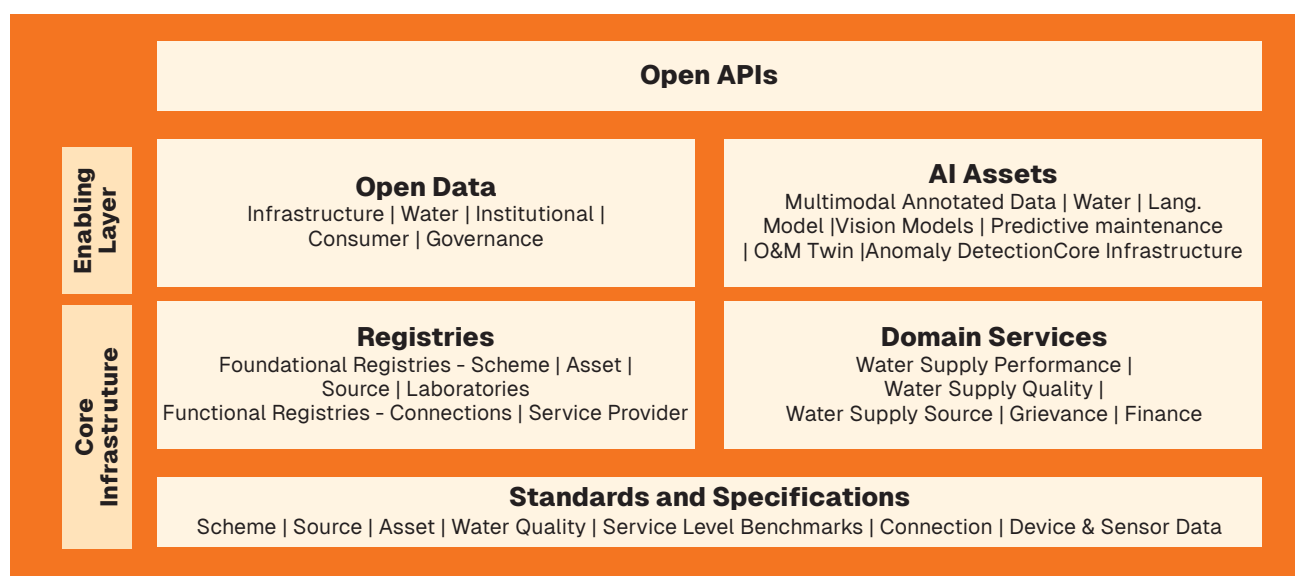


7 The Building Blocks

The principles in the previous chapter define what the DPI should achieve and how it should be built. This chapter describes the concrete digital components that together form the shared foundation on which the ecosystem can build.

The building blocks fall into two layers. The core infrastructure layer, comprising registries, standards, and domain services, forms the authoritative backbone of trusted data and transactions. The enabling layer, comprising open data and AI assets, sits above it, making that core accessible and useful to the broader ecosystem. Running across both layers are Open APIs, not a standalone building block but the access mechanism through which every actor, from a state government to a startup to a civil society organisation, connects to whatever the DPI holds.

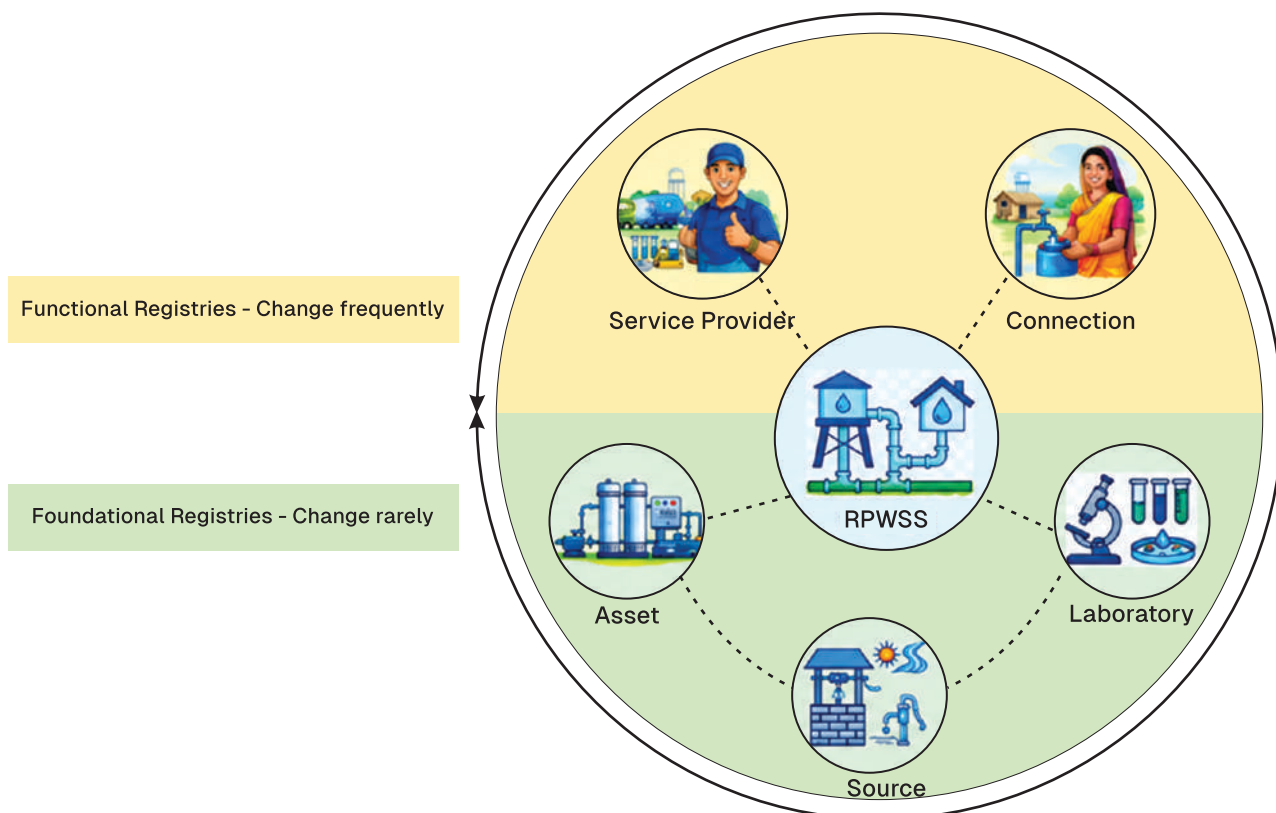
Building Blocks



Registries

Registries are the foundation of the DPI. They are authoritative, persistent, and interoperable sources of truth for the key entities involved in rural drinking water service delivery. When a scheme is registered, it gets a unique identity that every other system in the ecosystem can reference. When an asset is geo-tagged and linked to that scheme, the connection between physical infrastructure and its digital record is established for the first time. When a household connection is registered, the promise of service delivery becomes traceable to a specific family in a specific location.

The six registries of the DPI are organised into two groups: foundational registries and functional registries. Foundational registries form the identity backbone of the system. They record what exists, where it is, and how it connects. Everything else in the DPI references them.



Functional registries support specific functions of service delivery, covering last-mile coverage tracking, institutional accountability, and quality assurance. They build on the foundational layer and extend it toward the actors and transactions that determine whether water actually reaches households safely and reliably.

Sujalam Bharat has already established the core identifier layer for the foundational registries. The Sujalam Bharat ID acts as the single unique identifier that maps Asset IDs and Source IDs together. The Sujal Gaon ID assigns a system-generated alphanumeric identifier to each service area, structured around the RPWSS Infra ID and the RPWSS Service Area ID, enabling complete source-to-tap digital mapping of rural piped water supply schemes. The DPI builds on this foundation, opening it to the ecosystem through common APIs, and extending it through the functional registries to cover the full service delivery chain from scheme to household. Incorporating the functional registries is the essential next step in completing what Sujalam Bharat has started.

Foundational Registries

RPWSS Registry

The RPWSS Registry is the master anchor of the DPI. It records every Rural Piped Water Supply Scheme in the country, capturing its type, whether Single Village, Multi-Village, or Retrofitted, design capacity, service coverage, operational status, and linkages to sources, assets, and connections. It captures scheme identity including the unique Sujalam Bharat ID and Sujal Gaon ID, geo-referenced administrative boundaries from state to habitation level, infrastructure summaries with hydraulic flow linkages, and lifecycle attributes covering creation, augmentation, and restructuring over time. Through its linkages with the source and asset registries, the RPWSS Registry acts as the integration point for physical infrastructure, service delivery, and governance data across the ecosystem.

Registrar: The RPWSS Registry is maintained by the State Rural Water Supply Department, whether PHED, RWSD, or WSSD depending on the state, supported by State and District Water and Sanitation Mission Committees.

Source Registry

Source sustainability is one of the most critical and least tracked dimensions of rural water supply. A scheme whose source is depleting or deteriorating will fail regardless of how well the infrastructure above it is maintained.

The Source Registry records all drinking water sources, including groundwater sources, surface water sources, spring sources in hilly regions, and bulk water supply from regional or multi-village schemes. It captures the location, type, classification, operational status, demand coverage, water quality baseline parameters, and sustainability indicators for each source and links each source to the schemes it serves. Where available, it integrates with National Water Informatics Centre (NWIC) identifiers for groundwater and surface water bodies, enabling cross-sectoral visibility into water resource sustainability.

Registrar: The registrar for local sources is the village institution, whether VWSC or GPWSC, which is closest to the source and best placed to monitor it. For multi-village scheme sources, the State Rural Water Supply Department serves as registrar.

Asset Registry

The Asset Registry records every physical component of the water supply infrastructure across the following categories: water source assets, treatment assets, storage assets, transmission and distribution assets, pumping assets, and monitoring and control assets. Every asset captures a common set of core elements including a unique Asset ID linked to the Sujalam Bharat ID, geo-coordinates, operational status, installation date, and expected lifespan, alongside type-specific attributes that enable lifecycle tracking and maintenance planning.

A key capability of the Asset Registry is its ability to model hydraulic flow through dynamic linkages between assets, enabling accurate representation of complex network topologies and laying the foundation for digital twin capabilities over time.

Sujalam Bharat's GIS-based asset mapping has already begun building this layer. The DPI extends this work by standardising the data model and opening the asset data to the broader ecosystem through APIs. This also creates the foundation for financial accountability, linking fund releases to geo-verified, operationally confirmed assets through Asset IDs that connect expenditure to physical reality.

Registrar: The Asset Registry is maintained by State Rural Water Supply Departments and District agencies for the Out Village Infrastructure and GPs/VWSC for the In Village Infrastructure to ensure data quality and integrity.

Laboratory Registry

Safe drinking water depends on regular, reliable water quality testing. The Laboratory Registry records every water testing laboratory in the drinking water ecosystem, covering government laboratories, private laboratories, and mobile testing units, along with their accreditation status, certified testing parameters, location, and service areas. Every laboratory water quality test result in the DPI is linked to a registered laboratory, creating accountability for the results.

Registrar: The Laboratory Registry is maintained by the State Rural Water Supply Department.

Functional Registries

The Sujalam Bharat framework envisages the foundational registries which lay down the authoritative trusted information about the infrastructure. Operations and Maintenance of the water supply schemes will need foundational information about 2 key entities in the system. The Service provider and the connections which serve the consumer. Connections functional registries will enable multitude of digital solutions reaching consumers and households directly including Connection Lifecycle management, Digital Billing and Payments and Feedback and Satisfaction. The Service Provider Registry shall enable solutions that bring accountability to the service delivery.

Connections Registry

The Connections Registry records every household and institutional tap connection to a Rural Piped Water Supply Scheme. It captures the connection type, functional status, location including geo-coordinates, and consumer details (while respecting the PII). This closes the loop between scheme-level infrastructure and individual household service delivery, making granular, evidence-based monitoring of coverage and equity possible for the first time.

Registrar: Because tap connections are dynamic and hyper-local, the VWSC or GPWSC, the institution closest to the household and should maintain the connection registry.

Service Provider Registry

The Service Provider Registry records the village level micro utility responsible for the daily operation and management of drinking water services and front line pump operator responsible for operating the scheme on a day to day basis. This provides a clear and auditable record of who is accountable for service delivery in each village.

While in its initial scope, the registry covers micro utilities, the architecture will be designed to extend to district and state-level service providers as the ecosystem matures.

Registrar: The registrar is the GP and VWSC, reflecting the principle that the institution closest to the service relationship is best placed to maintain its accuracy.



Figure. Registries

The figure presents a structured view of the core registries within the Rural Drinking Water DPI, showing how each registry is designed to address a specific need across the water service delivery value chain. It highlights their role in enabling visibility from source sustainability and infrastructure performance to institutional accountability and household-level service delivery.

Standards and Specifications

To ensure consistency, interoperability, and data-driven governance across the rural water supply ecosystem, the Drinking Water DPI defines a core set of data standards covering the foundational and functional registries, source and water quality measurements, and smart devices. These standards establish a common language for capturing, exchanging, and analyzing data across platforms and stakeholders, thereby preventing fragmentation, reducing costs, and enabling innovation. By ensuring that every device, dataset, and application can seamlessly integrate into the national ecosystem, this standards-driven approach keeps the DPI inclusive, scalable, and vendor-neutral.

At its foundation, the framework has two standards: **semantic and technical**. Semantic standards define the meaning and interpretation of key entities—such as schemes, assets, water quality parameters, service levels, and household connections. This ensures uniform understanding across states and systems. Technical standards complement this by defining how these concepts are structured and exchanged digitally through various mechanisms. These are unique identifiers, standardized schemas and data exchange protocols. Together, they ensure that data generated at different levels remains consistent, comparable, and machine-readable, forming the backbone for effective interoperability and advanced analytics.

To strengthen semantic interoperability, the Drinking Water DPI may progressively develop a standardized sectoral vocabulary and ontology framework covering key entities such as schemes, sources, assets, water quality parameters, service delivery

indicators, O&M events and institutional entities. This would provide machine-readable definitions and relationships among sectoral concepts, and relationship, enabling different State platforms, registries, IoT/SCADA systems and applications to interpret exchanged data consistently. Such a semantic layer would complement the common identifiers, data standards and APIs of the DPI and provide a foundation for future knowledge graphs, advanced analytics and AI-enabled applications.

As an early priority, the DPI initiative may undertake the development and harmonisation of a core drinking-water domain vocabulary and semantic standards, building wherever possible on existing sectoral terminologies and standards, including the Metadata and Data Standards for Rural Drinking Water and Sanitation, the Technical Expert Committee Report on measurement and monitoring of water service delivery in rural areas, NWIC draft standards for groundwater and surface water bodies, and BIS IS 10500 for drinking water quality. Where existing standards are adequate, the DPI adopts them. Where they need extension or contextualisation for the rural drinking water sector, the DPI develops what is needed through a participatory process involving states, technical institutions, and the ecosystem.

Device and sensor standards deserve particular attention. As IoT-based monitoring becomes more common in rural water supply, the absence of common device protocols has meant that sensors and meters from different manufacturers cannot connect to state or national platforms. The DPI addresses this by defining standard data formats and communication protocols for smart devices including flow meters, pressure sensors, water quality monitors, and SCADA systems, creating the plug-and-play environment that the sector has been missing.

1. Scheme Standards Defines standardized scheme types (e.g., IVI, OVI) and lifecycle stages for uniform understanding across systems. Aspirational Benefits Users What if every user and system across India had a common understanding of schemes and their life cycles? Governance What if this created a unified understanding across states at the national scale?	2. Asset Registry Standard Defines asset taxonomy with asset categories, subcategories and base attributes for consistent asset management. Lifecycle tracking across systems and digital Twins. Aspirational Benefits Users What if every pump, pipeline, or tank had a unique identity and status linked to the scheme it serves? Governance What if asset-level analytics and lifecycle tracking were possible across systems?	3. Water Quality Standards Defines parameters (fluoride, arsenic, turbidity, etc.), measurement units and permissible limits for safe drinking water. Aspirational Benefits Users What if water safety could be universally understood and acted upon by communities and practitioners alike? Governance What if AI and analytics could reliably compare water quality across regions?
4. Service Level Benchmark Standards Define key service indicators such as regularity, functionality, supply hours, pressure, and reliability while leaving the exact Aspirational Benefits Users What if citizens could hold the system accountable for the Service Level Benchmarks? Governance What if performance-based governance and benchmarking became automatic?	5. Consumer Connection (FHTC) Standard Unique geo-tagged Connection ID's with connection type linked to consumers and. Aspirational Benefits Users What if every household connection was uniquely identifiable and trackable? Governance What if service delivery and coverage gaps could be analyzed at granular levels?	6. Device and Sensor Data Standard Device IDs, metadata standards, and data exchange protocols aligned with global unit standards. Aspirational Benefits Users What if affordable real-time monitoring devices giving consistent and reliable data became a reality? Governance What if IoT systems across vendors could seamlessly integrate?

Figure. Standards and specifications

Domain Services

Domain Services are the transactional layer of the DPI. Where registries manage identity and attributes, domain services manage events and transactions: what happened, when, and who recorded it. Every transaction submitted through a domain service is automatically linked to the relevant registry records, creating a traceable chain from event to scheme to asset to service provider.

The DPI extends and opens this transactional layer by standardising the APIs through which these events and transactions are reported. Any conforming application, whether built by the Centre, a state, or a third party, can connect to the same foundation without bespoke integration. What is standardised is the interface, not the process. How states manage alerts, escalations, and response cycles is their own institutional decision.

The DPI defines five core domain services.

Water Supply Performance

Captures daily operational data on supply hours, flow volume, and operational status, submitted by frontline workers or automatically through connected flow meters. Every reading is linked to the RPWSS Registry and to the Service Provider Registry, creating a continuous auditable record of whether each scheme is delivering water, at what volume, and for how long.

Water Quality

Captures water quality test results from field test kits, mobile testing units, and accredited laboratories. Each result is linked to the Laboratory Registry to confirm which institution conducted the test, creating a traceable chain of custody from sample collection to published result.

Source Status Monitoring

Captures water level readings and source condition data from manual entry, a groundwater level recorder, or an IoT sensor. Regardless of the mode, the service receives the same structured data. Every reading is linked to the Source Registry, building over time a continuous record of source health that enables early detection of stress before a scheme fails.

Grievance Management

Captures complaints, service failures, and community feedback raised through any conforming application. Every grievance is automatically linked to the Connections Registry and the RPWSS Registry, associating the complaint with the specific household and the scheme serving it, and enabling monitoring of resolution timelines across the system.

Financial Transaction Tracking

Captures user charge collections, O&M expenditure, and fund utilisation at an aggregate level, linked to the RPWSS Registry through the RPWSS ID. This creates the connection between financial data and scheme identity that currently does not exist, enabling monitoring of financial sustainability at the scheme level.

The Sujal Gaon Utility App is already building this transactional layer, enabling frontline workers, VWSCs, operators, and technicians to capture operational data on water supply, water quality, asset condition, finances, and grievances. The DPI envisions this app, and any other conforming application, connecting to the domain services through standardised APIs — so that data captured at the village level flows into the same national foundation regardless of which application was used to capture it.

Over time, additional domain services can be added by the ecosystem on top of the same foundation without requiring central development.

Open Data

The Open Data Layer makes non-personal, anonymised, and aggregated rural drinking water data publicly available in structured, machine-readable formats.



The figure presents a five-category Open Data Framework for the Water DPI, classifying the types of data that must be standardised, registered, and made openly accessible to unlock value across the drinking water sector. Infrastructure Data provides transparency on water supply assets and facilities to support planning, monitoring, and O&M. Water Data enables groundwater management, sustainability tracking, and public health monitoring through source and quality datasets. Consumer Data tracks coverage metrics and household-level service availability to monitor equity and mission progress. Institutional Data provides visibility into service providers and laboratories, strengthening governance transparency and accountability. Governance Data supports system reliability monitoring and citizen-centric feedback loops through O&M performance data. Together these categories span every layer of the water system, from physical assets to service quality to service coverage to institutional accountability to participatory governance.

This ensures that every layer of the water system is visible, verifiable, and open for use by planners, innovators, and citizens alike. When citizens, administrators, civil society and researchers can analyse service delivery patterns from local to national scale, accountability shifts from being centralised to being distributed across the entire ecosystem.

The Open Data Layer does not publish everything. Household-level connection data and beneficiary personal information are accessible only to authorised actors through role-based access controls. What is open is what should be open: scheme-level and aggregate data that enables transparency and accountability without compromising privacy. All datasets follow the Government of India's National Data Sharing and Accessibility Policy.

AI Assets

As the DPI matures, artificial intelligence offers significant potential to enhance service delivery, not as a futuristic aspiration but as a practical tool for specific, well-defined problems. The AI Assets building block is a shared resource layer that provides curated, reusable, domain-specific datasets and models that states and innovators can build on rather than developing independently.

The framework of six AI asset categories that form the intelligence layer of the DPI, each representing a distinct class of AI capability that the drinking water sector needs to build, share, and reuse across states and service providers.

The first three categories establish the foundational inputs and perception tools: Multimodal Annotated Data provides the structured, geotagged, and labelled datasets — images, sensor readings, and audio — needed to train and benchmark AI systems; Vision Models enable automated infrastructure inspection through image-based analysis, making leak detection, asset damage identification, and meter reading possible with just a mobile camera; and Water-Specific Language Models deliver contextual, multilingual AI assistance to frontline workers and citizens, trained on O&M manuals, SOPs, and local language queries to bridge the knowledge gap at the last mile.

The remaining three categories represent the operational and predictive intelligence that transforms water supply from a reactive to a proactive system. Predictive Maintenance Models use historical and real-time data to forecast pump and pipeline failures before they occur, optimising maintenance schedules and reducing costly downtime. O&M Knowledge Twins create live digital replicas of water schemes by combining infrastructure data, performance records, policies, and SOPs enabling frontline workers and simulation-based planning and diagnostics. Anomaly Detection Models continuously monitor supply, pressure, and quality data streams to flag unusual patterns early, enabling pre-emptive interventions before failures escalate into service breakdowns or public health risks.



Figure. AI Assets

Together, these six AI asset categories are made available as shared, reusable building blocks accessible to every operator, innovator, and planner across India's rural water ecosystem.

Open APIs

Open APIs are the window through which the DPI becomes accessible to the external world. They are not a separate layer of content but the access mechanism that runs across every building block — registries, domain services, open data, and AI assets — making each one available to the ecosystem in the appropriate form and with the appropriate controls.

The DPI's API framework is designed around four access points, each corresponding to a building block.

Registry APIs will allow external systems to query and reference the authoritative data held in the RPWSS, Source, Asset, Connections, Service Provider, and Laboratory registries. This is how a state government connects its existing planning or monitoring system to the national identity layer.

Domain Service APIs will allow authorised actors to submit and retrieve operational transactions through any application that conforms to the DPI's standards. A state-built application, the Sujal Gaon Utility App, or a third-party tool can all report water supply performance readings, quality test results, grievances, and maintenance logs through the same interface. This is what makes the transactional layer genuinely open rather than locked to any single application.

Open Data APIs will make aggregated, non-personal datasets available in machine-readable formats to anyone with appropriate access. This is the transparency layer through which researchers can analyse service delivery patterns and citizens can access information about their scheme and water quality.

AI Asset APIs will allow states and innovators to access shared models and datasets without having to develop them independently. This is what makes the AI Assets layer a genuine public good rather than a capability available only to those with the resources to build it themselves.

Access across all four categories will be role-based. Some APIs will be open to anyone. Others will require registration. Others will be restricted to authorised government actors. The framework will be built on open standards and fully documented, so that any actor who wants to build on the DPI can do so without negotiating bespoke access arrangements.

These building blocks do not operate independently. The next chapter shows what becomes possible when they work together.



8 DPI In Practice - Some real world use cases

The building blocks described in the previous chapter are only meaningful if they change something real on the ground. This chapter brings the DPI to life through three use cases, each showing how the foundation changes what is possible for a specific actor in a specific situation. Each use case builds on what Sujalam Bharat has already established and shows what becomes possible when that foundation is opened, extended, and connected.

Financial Accountability in Real Time

Asset-Linked Financing to Eliminate Shadow Works in Jal Jeevan Mission

Using Water DPI to trace every rupee to a real asset

The Problem: Fund Diversion and Ghost Works

The DPI Solution: Asset-Linked Fund Trail

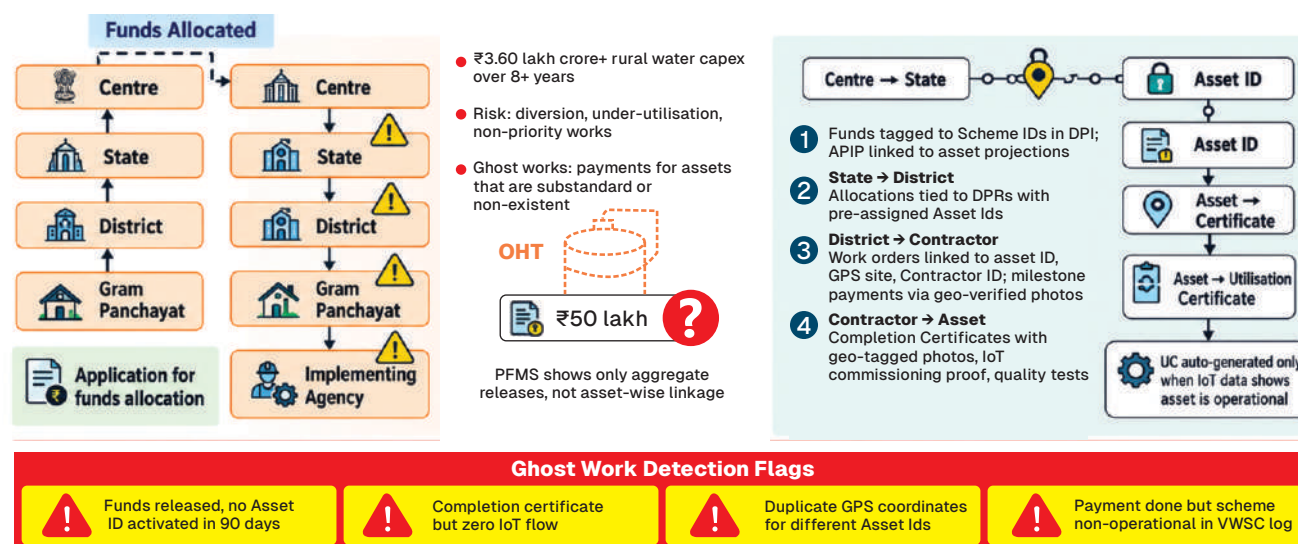


Figure. Fund Disbursement from Center to States for Infrastructure

JJM financial architecture currently operates through a multi-tier fund flow mechanism — Centre to the State → District → Gram Panchayat → Implementing Agency — where money moves in aggregate at each level with no systematic linkage to specific physical assets at the central level. With over Rs. 3.60 lakh crore allocated across 8+ years, this creates significant exposure to diversion, under-utilisation, and payment for shadow works — assets that are substandard or entirely non-existent. The Public Financial Management System (PFMS) tracks releases at an aggregate level but cannot link a specific payment to a GPS-verified asset (because of no cross checking mechanism), a registered contractor, or an independently confirmed operational status. The result is a structural accountability gap where an overhead tank worth Rs.50 lakh can be billed, paid, and certified without ever delivering a drop of water.

The DPI closes this gap by making every rupee traceable to a real, verifiable, and operationally confirmed asset through four sequential linkages - funds tagged to RPWSS IDs at the Centre, allocations tied to pre-assigned Asset IDs at the District, work orders linked to Contractor IDs and geo-verified milestone photographs, and Completion Certificates requiring IoT commissioning proof before a Utilisation Certificate is auto-generated. Four automated detection flags further reinforce this accountability layer: an alert when funds are released but no Asset ID is activated within 90 days; a flag when a Completion Certificate is submitted but IoT sensors show zero flow; a duplicate GPS coordinates check that identifies two asset claims from the same location; and a cross-verification against VWSC operational logs when payment has been processed but the community reports no water supply. Together, these mechanisms transform financial accountability from a post-audit exercise into a real-time governance system — where the conditions for shallow works are eliminated by design, not discovered after the fact.

JalSoochak - From Photo to Service Signal

Knowing whether water actually reached a household on any given day has always been harder than it sounds. Field visits are not feasible at scale. Digital Apps depend on whoever fills them in. IoT sensors are expensive and require maintenance.

JalSoochak, an open source product developed by Arghyam, takes a different approach. A frontline worker photographs the bulk flow meter at their scheme using a mobile phone. An AI vision model reads the meter image and converts it into a verified, auditable flow reading with over 92% accuracy even in difficult field conditions. No specialist equipment or manual data entry. Just a photograph and a confirmed reading.

What makes this work at national scale is the DPI foundation underneath it. Every submission is linked to a Scheme in the RPWSS Registry, anchoring the reading to a verified scheme record. The frontline worker is identified through the Service Provider Registry, creating an auditable record of who captured the readings. The reading is submitted through the Water Supply Performance Domain Service, a standardized API that any conforming application can use, without bespoke integration with each state's systems.

The annotated meter images JalSoochak generates become part of the DPI's Multimodal Annotated Data layer, available to other developers building computer vision solutions for the water sector. The vision model itself, trained and validated at scale, becomes part of the shared AI Assets layer that any state or innovator can build on.

The water supply performance data captured through JalSoochak feeds into the Open Data layer as anonymised, aggregated scheme-level datasets. This creates a nationally consistent and publicly accessible signal on actual service delivery across rural water supply schemes for communities, researchers and policy makers.

The Informed VWSC

Village Water and Sanitation Committees carry significant responsibility. They are meant to oversee daily operations, collect user charges, manage local maintenance, and ensure water reaches every household. In practice, most VWSCs work without the information they need to do this well.

When a pump stops working, the VWSC finds out when a household complains. When a connection has been inactive for weeks, nobody knows until someone asks. When the source is showing signs of stress, there is no early signal.

The DPI changes this by giving the VWSC visibility into what is actually happening across their scheme.

The Connection Registry shows how many households have active connections, how many are inactive, and where the gaps are. The Water Supply Performance Domain Service captures daily operational data so the VWSC can see whether the scheme supplied water today and whether performance has been declining. The Source Registry provides early signals on source health before a problem becomes a crisis. When something goes wrong, the VWSC can raise it through the Grievance Domain Service and track whether it has been acted on.

What the DPI does not do is make the VWSC's job automatic. Collecting user charges, managing the pump operator, building trust with households — none of that happens because of a registry. What it does is remove the information barrier that has made it hard for even a committed VWSC to govern their scheme effectively.



The DPI for rural drinking water is a national public infrastructure. Its governance must be transparent, federated, and institutionally grounded to ensure that the infrastructure remains trustworthy and accountable to all who depend on it.

Effective governance rests on a clear separation between those who set policy and those who build and operate the infrastructure. JJM 2.0 already provides an institutional foundation for such an arrangement by positioning NPMU-IT/NJJM as the National Drinking Water Data Governance & Intelligence Centre. The governance framework proposed here builds on this mandate, while extending it towards the stewardship of an open, federated digital ecosystem.

Governance Philosophy

- Federal by design: States retain full ownership and control over their data and systems. Interoperability is enabled through shared standards.
- Transparent and accountable: Key datasets are accessible to all stakeholders with appropriate privacy safeguards, so that performance is visible and responsibility is clear.
- Open and participatory: Standards, APIs, and tools are developed through multi-stakeholder processes and made available for reuse across the ecosystem.
- Institutionally clear: Governance roles are unambiguously defined across policy leadership, platform operations, and ecosystem enablement.

Governance Structure

DDWS / NJJM — Policy Leadership and Stewardship

The Department of Drinking Water and Sanitation, through the Ministry of Jal Shakti, provides strategic direction and stewardship of the DPI — acting as an enabler rather than an operator. Key responsibilities include:

- Setting national policy goals and priorities for the Water DPI
- Issuing guidelines for state adoption, financing, and institutional readiness
- Facilitating convergence across ministries and related schemes
- Convening the participatory standards governance process

NPMU-IT / NJJM — DPI Operations and Ecosystem Enablement

JJM 2.0 designates NPMU-IT/NJJM as the National Drinking Water Data Governance & Intelligence Centre, responsible for interoperability standards, data quality and national-level insights.

Building on this mandate, NPMU-IT/NJJM can steward the shared DPI foundation by:

- maintaining common registries, standards, APIs and reusable digital assets;
- supporting States in integration, adoption and capacity building;
- enabling participatory evolution of standards and shared tools; and
- providing reference implementations and sandbox environments for States and innovators.

This builds on the institutional architecture already established under JJM 2.0, while strengthening its role in supporting an open, federated digital ecosystem.

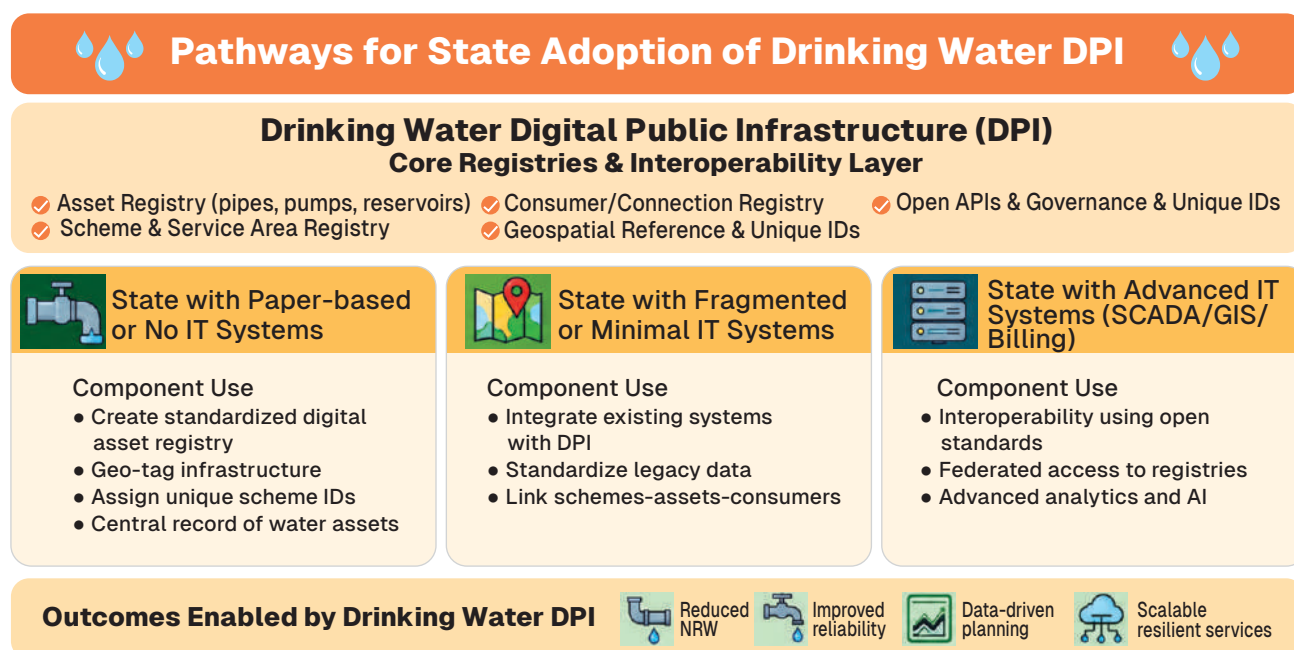
This two-actor model ensures the DPI remains policy-led, institutionally grounded, and ecosystem-enabled.



10 Pathways to Adoption

Rather than mandating a single monolithic rollout, the DPI will let each state pick and choose the specific registries, services, and interoperability layers it needs, and add more over time. This flexibility will turn digital transformation from a one-time project into a continuous journey: start small, connect what exists, and scale incrementally at their pace.

The figure below sets out three practical pathways reflecting the diversity of digital maturity across states.



Option 1: States with paper-based or no IT systems will be able to begin by adopting the foundational registries and reference applications built and hosted by the NJJM, including those built through the Sujal Gaon Utility App. They will not need to build anything. The RPWSS Registry, asset mapping workflows, and Water Supply Performance Domain Service will be available as ready-to-use tools. This will provide first-time visibility of the water system, establish a central source of truth, and create the foundation to build on as capacity and confidence grow.

Option 2: States with fragmented or minimal IT systems will be able to select the components from the DPI building blocks required to automate and strengthen their processes. They will also be able to break the silos in their own application by adapting them to DPI standards. This will create a unified view that links sources, schemes, assets, and consumers. Monitoring will become more consistent across the service chain and decisions will become faster and more evidence-based.

Option 3: States with advanced IT systems will be able to select components to implement from the DPI building blocks as required and connect existing systems to the DPI using common standards. Once connected, states will be able to use better data analysis, AI tools, and new applications built by others across the ecosystem. Existing investments will continue to be used and improved rather than replaced.

11 Invitation to build together

The challenge of rural drinking water in India has fundamentally shifted. The question is no longer whether infrastructure can be built. It has been, at a scale unmatched in the world. The question now is whether that infrastructure can be governed with the transparency, and responsiveness that sustained service delivery demands. The answer depends, in large measure, on the quality of the digital foundation beneath it.

The Digital Public Infrastructure proposed in this paper is a shared foundation of interoperable registries, open standards, federated data ownership, and shared AI capabilities that makes rural water supply visible, accountable, and open to innovation in ways that isolated and centralized systems never can.

The cost of not building this foundation is real and it compounds. Every year without a common digital framework deepens fragmentation. States duplicate investments. Accountability gaps widen. Chronic non-functionality goes undetected. Water quality risks accumulate without early warning. These are not problems inherent to the sector. They are addressable. And India's digital ecosystem has the tools and institutional experience to address them.

The Sujalam Bharat framework demonstrates that this transformation has already begun. The Sujal Gaon ID and the Sujalam Bharat ID together create the unique, persistent digital identities for every scheme and every asset from source to tap that are the foundational requirement of a functioning Water DPI. The Sujal Gaon Utility App establishes the transactional layer. The asset mapping programme is building an authoritative geo-referenced record of rural water infrastructure. This is not a sector starting from scratch. It is a sector that is already laying the foundation and is ready for the next step.

For the rural families whose daily lives depend on a functioning tap, this foundation offers a concrete promise: that problems will be detected earlier, that accountability will be traceable, that water quality results will be linked to certified laboratories, and that service delivery will be governed by verified facts rather than estimates.

Digitization in the rural drinking water sector is inevitable. But whether it becomes inclusive, innovative, and empowering is not. We have a choice.

This is an invitation to complete what has been started: by building the registries that extend Sujalam Bharat to the full service delivery chain, by co-creating the standards that make every system interoperable, by supporting states wherever they are in their journey, and by opening the foundation to the innovators, researchers, and communities whose participation will determine whether this succeeds.

The foundations are being laid. What is needed now is the collective commitment to build on them, purposefully, at scale, and in service of every rural household that deserves safe water, every day.

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Annexure: How the Building Blocks Work Together - Source Registry as an Example

One of the most useful ways to understand the DPI building blocks is to trace how they work together for a single, specific entity. The water source — a borewell, a river intake, a spring — is a good place to start because it touches every building block and because source sustainability is one of the most critical and least digitally tracked dimensions of rural water supply today.

The Source Registry

The Source Registry is where a water source gets its persistent digital identity. Every source, whether a borewell in Rajasthan, a river intake in Assam, or a spring in the hills of Meghalaya, is registered with a unique Source ID that links it to the scheme it serves through the RPWSS Registry.

The core attributes every source record captures are:

- A unique Source ID, linked to the Sujalam Bharat ID of the scheme it serves.
- Geo-coordinates, latitude and longitude, precisely locating the source on the ground.
- Administrative linkage from state down to Gram Panchayat level.
- Source type, whether groundwater, surface water, spring, or bulk transfer.
- Operational status, whether active, seasonal, or defunct.
- And a sustainability classification, safe, semi-critical, critical, or overexploited, drawn from NWIC groundwater assessments where available.
- Link to NWIC source id if available

Beyond these common attributes, each source type captures type-specific attributes. A borewell records depth, casing details, static water level, and pumping water level. A surface water source records river or reservoir name, intake elevation, and seasonal flow data. A spring records discharge rate and seasonal reliability.

The registrar for local sources is the VWSC or GPWSC, the institution closest to the source and best placed to keep the record accurate. For multi-village scheme sources, the State Rural Water Supply Department serves as registrar.

Standards and Specifications for the Source

For the Source Registry to be useful across states and across systems, the data it captures must mean the same thing everywhere and be structured in the same way.

Semantic standards define what terms mean. What counts as a borewell versus a tubewell. What the sustainability classifications, safe, semi-critical, critical, overexploited, actually mean in terms of groundwater levels and extraction rates. What constitutes a seasonal source versus a perennial one. Without these definitions, data from two different states cannot be compared or aggregated.

Technical standards define how the data is structured and exchanged. The Source ID format. The coordinate reference system, WGS84, so every geo-coordinate is comparable. The data schema, the fields, their data types, and their permissible values. The API format through which a state system submits or retrieves a source record.

Device and sensor standards define how monitoring equipment reports data into the system. A groundwater level recorder from one manufacturer and a sensor from another should produce data in the same format, with the same units, at the same reporting frequency. Without this, every new device requires bespoke integration.

Domain Services for the Source

The Source Registry captures what a source is. Domain services capture what a source is doing, the events and transactions that tell you whether it is performing as expected.

The primary domain service for a source is Source Status Monitoring. This service captures water level readings, the most critical indicator of source sustainability, from whatever mode is available.

A manual reading entered by a VWSC member or Jal Mitra through a village-level application. A reading from a groundwater level recorder, a mechanical or electronic device that logs water levels at regular intervals. A reading from an IoT sensor that transmits data automatically.

Regardless of the mode, the domain service receives the same structured data: Source ID, timestamp, water level reading, and the method of capture. The interface is standardised. The process of capture is not. A state can choose manual entry, a recorder, or a sensor depending on context and budget, and all three feed into the same foundation.

The domain service also captures water quality readings at the source, including pH, turbidity, TDS, and contaminant parameters, linked to the Laboratory Registry to confirm which accredited laboratory processed the sample.

AI Assets for the Source

With time-series water level data flowing consistently through the domain service and stored against source records in the registry, a new class of capability becomes possible.

An anomaly detection model can monitor water level trends across sources in a district or state and flag sources showing unusual patterns. A borewell that has been declining faster than seasonal norms, or a surface water source whose level has dropped earlier in the year than historical data would suggest. These are early signals of stress, detectable weeks or months before a scheme fails.

A predictive model trained on historical water level data, rainfall patterns, and extraction rates can forecast which sources are likely to become semi-critical or critical in the coming season, enabling proactive planning. Identifying alternative sources, rationing extraction, or accelerating augmentation works before a crisis develops.

A vision model can assist field workers in reading analogue water level gauges from photographs, making manual recording faster and more accurate in areas where digital sensors are not yet deployed.

These models are built once, trained on data from across the national ecosystem, and made available as shared AI assets that any state or innovator can use, rather than each state independently building the same capability.

Open Data for the Source

Not all source data is sensitive. Aggregated, anonymised information about source health across the country is a public good, useful to researchers, civil society, policymakers, and communities.

The Open Data layer for sources would make available:

Time series water level data for individual sources, at a level of granularity appropriate for public access. Monthly averages rather than daily readings, for example, enabling researchers to study groundwater trends across geographies and seasons.

Aggregate sustainability data at district or state level, covering what proportion of sources are safe, semi-critical, or critical, enabling policymakers and civil society to identify where groundwater stress is concentrated.

Source-scheme linkage data, showing which schemes depend on which sources, enabling analysis of which water supply systems are most at risk from source stress.

All of this is published in machine-readable formats through the Open Data APIs, with supporting documentation so that any researcher, developer, or civil society organisation can use it without negotiating access with individual state departments.

How It All Connects

When these building blocks are working together, here is what becomes possible for a single source, say a borewell serving a village scheme in Rajasthan.

The borewell is registered in the Source Registry with its unique ID, geo-coordinates, and sustainability classification. A sensor submits weekly water level readings through the Source Status Monitoring Domain Service, conforming to the device standard for groundwater sensors. An anomaly detection AI model flags that the borewell's water level has declined 15% faster than the same period last year. An alert is generated and linked to the scheme record in the RPWSS Registry and to the VWSC in the Service Provider Registry. The VWSC sees the alert through their village-level application and contacts the District Technical Unit. Aggregate data on borewell stress levels across the district is published through the Open Data layer. A researcher at a hydrology institute accesses the time-series data to study groundwater depletion patterns across western Rajasthan.

None of this requires a new application to be built from scratch for each state. The standards ensure the sensor data is comparable. The domain service ensures the reading is linked to the right source record. The AI asset provides intelligence that no individual state has the capacity to build independently. And the open data layer ensures the knowledge generated is not locked within a government system.

That is what the building blocks, working together, actually make possible.



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