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FOREWORD

It is with great pride and deep appreciation that I present the As-Is Study Report on State IT Systems of **DWSS Punjab**. It is prepared under the Jal Jeevan Mission (JJM) as part of a national effort to assess, document, and strengthen the digital capabilities of rural drinking water departments across India. This report has been prepared in collaboration between SPM Niwas and Arghyam. It helped in bringing together institutional expertise in rural water governance and philanthropic commitment to water security. A partnership that reflects the shared conviction that data-driven decision-making is fundamental to achieving universal and sustainable access to safe drinking water.

Punjab's Department of Water Supply and Sanitation (DWSS) stands as a strong example of outcome-driven governance supported by purposeful digital adoption. The state has demonstrated remarkable progress under the Jal Jeevan Mission, achieving 100% rural household tap water coverage while simultaneously strengthening its digital ecosystem. Through the deployment of online water quality management systems, IoT-enabled real-time monitoring of infrastructure, and enterprise-level project management tools, Punjab has embedded technology into core service delivery processes.

This approach reflects not just the use of digital tools, but a clear institutional focus on efficiency, transparency, and reliability. The consistency of execution and emphasis on measurable outcomes has positioned Punjab as a leading example of how technology can effectively support large-scale transformation in rural drinking water service delivery.

This report is organised around a comprehensive Digital Maturity Model for Rural Drinking Water. It is a structured framework developed to systematically measure the state IT capabilities across five layers of key stakeholders along the guiding principles of Citizen Centricity, Frontline Workers Empowerment, Agencies Efficiency, Departments Effectiveness and State Functionaries Interoperability. There are additional two layers for Technology Foundation and Infrastructure. Together, these capabilities provide a holistic picture of where Punjab stands today, and where it must go next.

I extend my sincere appreciation to the DWSS Punjab team, the field functionaries, and all stakeholders who contributed their time, knowledge, and institutional experience to this study. I also place on record my gratitude to **Arghyam** for their partnership, intellectual contribution, and steadfast commitment to the mission of universal water access. Their collaboration has meaningfully strengthened both the depth and the credibility of this report. I acknowledge as well the dedication of the technical team whose rigorous field interactions and analytical work have made this assessment possible.

It is my earnest hope that this report serves not merely as a record of the present, but as a compass for the future. This will help in guiding Punjab towards a fully digital, equitable, and sustainable rural drinking water system where every citizen has access to safe water, and every decision is driven by data.



Priyatu Mandal, IAS,
Director SPM-NIWAS

MESSAGE

Water is not merely a resource; it is a right. And the ability to govern it well, to monitor it transparently, and to deliver it reliably to every household is one of the most meaningful tests of a state's institutional commitment to its people. It is in this spirit that Arghyam is proud to have partnered with SPM NIWAS in the preparation of this As-Is Study Report on State IT Systems — DWSS Punjab.

At Arghyam, our work has always been rooted in the belief that lasting change in the water sector requires more than infrastructure. It requires knowledge, accountability, and the systems to sustain both. This collaboration with SPM NIWAS is a natural expression of that belief. By bringing together the programmatic depth of SPM Niwas and Arghyam's long-standing engagement with water governance, this study offers something that neither institution could have produced alone. That includes a credible, field-grounded, and analytically rigorous picture of where Punjab stands in its digital journey, and what it will take to go further.

What stands out most about Punjab's Department of Water Supply and Sanitation (DWSS) is not any single application or technology, but the outcome-oriented institutional approach that underpins them. The state's ability to achieve universal rural tap water coverage while simultaneously strengthening its digital ecosystem reflects a clear focus on execution, accountability, and service reliability. Initiatives such as real-time water quality monitoring, IoT-enabled infrastructure tracking, and structured project management systems are not isolated interventions, but part of a broader effort to embed technology into everyday governance. This is not a system that adopts technology for its own sake, but one that uses it purposefully to deliver measurable outcomes. That clarity of intent is a strong foundation for sustained digital transformation. The path forward is therefore one of thoughtful enhancement—building greater cohesion and intelligence into existing systems while continuing to reinforce efficiency, transparency, and service delivery outcomes.

This is precisely where studies like this one matter. Understanding the current state with clarity and without defensiveness is the prerequisite for purposeful transformation. We hope this report gives DWSS Punjab, its leadership, and its partners the shared language and common baseline needed to prioritise investments, align efforts, and move with intention.

I am grateful to the DWSS Punjab team for their openness and engagement throughout this process, and to the SPM-NIWAS team for their partnership and rigour. I also wish to acknowledge the technical team whose field interactions, institutional conversations, and analytical work gave this report its texture and credibility.

Arghyam remains committed to walking this journey alongside the states and institutions working to make safe water a lived reality for every Indian. We hope this report is a useful step on that path.



Anuj Sharma
CEO Arghyam

PREFACE

India's rural drinking water sector is undergoing a profound transformation. The Jal Jeevan Mission (JJM), launched in 2019, marked a decisive shift by committing to providing safe and adequate drinking water to every rural household. As the Mission transitions from its initial phase of rapid infrastructure creation to a phase focused on assured and sustained service delivery, the role of digital systems becomes increasingly critical. Ensuring reliability, quality, and accountability at scale requires a strong foundation of data-driven governance.

While flagship initiatives such as the Jal Jeevan Mission (JJM) have substantially expanded rural drinking water infrastructure across the country, ensuring equitable, reliable, and measurable service delivery at scale now requires a fundamentally stronger digital foundation. The next phase of transformation depends not merely on asset creation, but on building an interoperable, intelligent, secure, and scalable digital ecosystem capable of enabling data-driven governance, service monitoring, institutional coordination, and citizen-centric delivery.

In this context, the need for a sectoral Digital Public Infrastructure (DPI) for rural drinking water has emerged as a strategic national requirement. To support this objective, SPM-NIWAS and Arghyam jointly undertake a baseline assessment of existing digital solutions, platforms, and governance practices in the rural drinking water sector across selected states. The study aims to evaluate current digital maturity, identify interoperability gaps and sectoral challenges, and recommend appropriate DPI principles, characteristics, and architectural considerations to inform the sector's future vision, approach, and strategic roadmap.

India's experience with foundational and sectoral DPIs such as Aadhaar, Unified Payments Interface (UPI), and emerging digital ecosystems in health and agriculture demonstrates the transformative potential of federated, open, and interoperable digital architectures. In the rural drinking water sector, a DPI can enable seamless data exchange, improved coordination, and informed decision-making across stakeholders ranging from water sources and household taps to frontline functionaries and national institutions.

However, such a DPI must evolve from existing operational realities rather than be designed in isolation. It should build upon effective systems, address fragmentation, and strengthen areas that are inadequate. Accordingly, the As-Is Study of State IT Systems was undertaken as a foundational step toward developing a robust and contextually relevant DPI architecture for the sector.

This As-Is Study is conceived not as an audit, but as a diagnostic and collaborative exercise. The study seeks to identify existing gaps, assess institutional capacities, and understand operational realities across the sector. It adopts a multi-pronged approach comprising structured questionnaires across States and Union Territories, virtual consultations for broader stakeholder engagement, and in-person visits to selected states for deeper field-level insights.

To support a comprehensive assessment, a customized Digital Maturity Model for the rural drinking water sector has been developed. The model evaluates digital capabilities across multiple stakeholder layers, including citizens, frontline workers, implementing agencies, departments, and state-level functionaries, thereby enabling a holistic understanding of the ecosystem and informing future digital transformation strategies.

Among the states studied, Punjab was identified for an in-depth assessment due to its strong performance in rural water service delivery and its consistent use of digital tools to enhance efficiency, transparency, and monitoring. The Department of Water Supply and Sanitation (DWSS), Punjab, represents a well-progressed digital ecosystem in the sector, supported by the successful implementation of the Jal Jeevan Mission and achievement of 100% rural household tap water coverage. The state's investments in digital water quality monitoring systems, IoT-based real-time infrastructure tracking, and enterprise-level project management tools reflect a structured and outcome-oriented approach to technology adoption. These initiatives provide valuable insights into how digital systems can be effectively leveraged to strengthen service delivery at scale.

At the same time, Punjab's experience highlights an important and forward-looking opportunity: as digital systems expand in functionality and reach, there is scope to further enhance standardization, interoperability, and advanced analytics capabilities. Strengthening data consistency across platforms, improving last-mile digital accessibility, and leveraging predictive insights can help unlock greater value from existing systems. These are natural next steps in the evolution of a system that has already demonstrated strong operational performance and digital maturity, and they offer relevant learnings for other states pursuing similar transformation journeys.

This report presents a comprehensive understanding of the existing digital ecosystem of DWSS, Punjab, based on stakeholder consultations, field interactions, system demonstrations, and analysis of available documentation. The findings recognize the state's significant progress in building a responsive, technology-enabled, and community-oriented water service delivery framework. At the same time, they point to opportunities for further strengthening integration, enhancing citizen-facing accessibility, and advancing data-driven decision-making, including improvements in grievance redressal mechanisms and predictive system capabilities.

It is hoped that the insights and recommendations presented in this report will support the department in its ongoing digital transformation efforts and serve as a reference for other states undertaking similar journeys. More broadly, this study aims to contribute meaningfully to the design and development of a unified, resilient, and scalable Rural Drinking Water DPI, one that builds on existing strengths, addresses systemic gaps, and advances the long-term goal of ensuring safe, reliable, and sustainable drinking water for every rural household.

ACKNOWLEDGEMENT

The successful completion of this As-Is Study has been made possible through the invaluable support, cooperation, and openness of the Department of Water Supply and Sanitation (DWSS), Punjab. The department's willingness to engage deeply and share insights into its existing IT systems, processes, and institutional practices has been instrumental in enabling a comprehensive and meaningful assessment.

The openness in sharing detailed insights into digital applications, operational workflows, and implementation experiences greatly contributed to the depth and quality of this study. The opportunity to engage in in-person discussions and interactions with departmental leadership, technical teams, and field functionaries enabled a comprehensive understanding of the digital ecosystem and its role in strengthening rural water service delivery across the state.

Special acknowledgement is due to **Dr. Pallavi Kaur, Head of Department, DWSS, Punjab**, for her leadership and guidance. Sincere appreciation is extended to **Shri Karanbir Singh** (Superintendent Engineer Technical), **Shri Rohit Kumar** (Executive Engineer, MIS & SNK), **Ms. Gurjot Kaur** (Executive Engineer, Water Quality), **Shri Rajesh Bajaj** (Training Head), **Shri Varun Kumar** (IT, DWSS Punjab), **Shri Pankaj Kumar** (NIC Punjab), **Shri Paramveer Singh** (Water Quality), **Shri Harsh Goyal** (SDM-Inclusion), **Ms. Mamta Bakshi** (SDM-Inclusion), **Ms. Amrita and the Social Team, and Shri Tejpal Singh** (CIMCon – IoT Vendor) for their valuable inputs and technical insights during the study.

The department extended full support in facilitating structured interactions, system walkthroughs, and detailed discussions throughout the engagement. Their openness and responsiveness enabled seamless access to systems and teams, which proved essential in developing an evidence-based understanding of the state's digital landscape.

This collaboration reflects the department's strong commitment towards advancing digital transformation and strengthening water service delivery systems. Their insights and cooperation have significantly enriched this study and contributed to shaping a grounded and forward-looking assessment.

TECHNICAL NOTE

Towards Making a Drinking Water Digital Public Infrastructure (DW-DPI): Conceptualising the Digital Water Ecosystem of India

India's rural drinking water sector stands at a transformative juncture. Following the rapid expansion of infrastructure under the Jal Jeevan Mission (JJM), the sector's focus is now shifting toward long-term sustainability, operational efficiency, water quality assurance, and citizen-centric service delivery. This transition requires not only physical assets but also a robust digital foundation capable of enabling real-time governance, interoperability, accountability, and innovation across the ecosystem.

In this context, the need for a sectoral Digital Public Infrastructure (DPI) for rural drinking water has emerged as both a strategic and operational imperative. To inform this transition, these studies were undertaken to assess the sector's current digital maturity, identify interoperability gaps, understand operational and institutional challenges, and define key principles, architectural considerations, and building blocks required for a future-ready ecosystem.

Accordingly, detailed field studies and stakeholder consultations were conducted across multiple states. Comprehensive "As-Is Study Reports" were developed for Assam, West Bengal, Punjab, Gujarat, and Rajasthan, along with a consolidated national report. These studies document existing digital systems, institutional processes, data flows, governance mechanisms, and technological maturity within the sector. The insights derived from these reports serve as foundational inputs for shaping the strategic vision, implementation roadmap, and policy framework for a National Drinking Water Digital Public Infrastructure (DW-DPI).

The findings indicate that the next phase of sectoral transformation must be anchored in a federated, interoperable, and standards-driven digital ecosystem. The objective is not to build another centralized platform, but to establish common digital rails that connect schemes, assets, laboratories, institutions, field functionaries, and citizens. Such an approach enables seamless data exchange, reduces fragmentation, and fosters innovation across states and ecosystem participants.

A key priority in this journey is the creation of authoritative digital registries for water assets, schemes, laboratories, service entities, and sources. These registries will act as trusted “single sources of truth,” enabling lifecycle management, traceability, and data consistency across administrative and technological boundaries. Complementing this, the sector must adopt common metadata standards, open APIs, device interoperability specifications, and shared vocabularies to ensure seamless collaboration.

The integration of emerging technologies—including IoT-enabled monitoring, GIS-based asset mapping, SCADA systems, AI-driven analytics, and advanced water quality surveillance—will further strengthen operational resilience and enable proactive decision-making. However, technology adoption must remain aligned with field realities, sustainability considerations, and long-term maintainability.

Equally critical is the need for strong data governance, cybersecurity, and trust frameworks. As digital systems and operational technologies converge, ensuring secure, reliable, and privacy-aware data exchange becomes essential. Robust mechanisms for access control, auditability, and authentication will be key to building confidence across stakeholders.

The transformation must also prioritize the empowerment of frontline institutions. Village Water and Sanitation Committees, Gram Panchayats, engineers, and field operators form the backbone of service delivery. Providing them with mobile-first, multilingual, and user-friendly tools—supported by capacity building and institutional strengthening—will be central to success.

Finally, an open and interoperable DPI ecosystem can catalyze participation from innovators, startups, research institutions, and civil society, enabling scalable solutions without fragmentation or vendor lock-in.

The journey toward DW-DPI is ultimately a governance transformation—shifting the sector from reactive operations to proactive, data-driven service delivery. By building trusted digital foundations today, India can ensure safe, reliable, and sustainable drinking water for all.

“Think Federated, Build Trusted, Scale Sustainably.”

The Technical Team consisting of Mr. C.K. Dhar, Chief Technology Officer, SPM-NIWAS; Mr. Manu Srivastava, COO, Arghyam; Mr. Deepak Gupta, Director Digital Infrastructure, Arghyam, Dr. Purna Pandey, Consultant Arghyam, which undertook this study under the active guidance of Mr. Ashok Kumar Meena , Secretary; Mr. Kamal Kishore Soan, Additional Secretary & Mission Director; Ms. Swati Meena, Joint Secretary (JJM); Pradeep Singh, Director; Ms. Ankita Chakravarty, Deputy Secretary, Department of Drinking Water and Sanitation (DDWS) extends its sincere gratitude to the officers of DDWS, Mr. Mohammad Ishfaq , Advisor, SPM-NIWAS, Mr. Prasenjit Paul, Consultant, SPM-NIWAS and all participating individuals, institutions and State officials who actively contributed to the study through their valuable insights, experiences and continuous support during the process.

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Glossary

JJM	-	Jal Jeevan Mission
LPCD	-	Litres Per Capita Per Day
DWSS	-	Department of Water Supply and Sanitation
FHTCs	-	Functional Household Tap Connections
WQMS	-	Water Quality Monitoring System
FTK	-	Field Test Kit
LIMS	-	Laboratory Information Management System
GIS	-	Geographic Information System
IoT	-	Internet of Things
LMS	-	Learning Management System
iGOT	-	Integrated Government Online Training
O&M	-	Operations and Maintenance
MIS	-	Management Information System
SDPM	-	Service Delivery Parameters Module
DDWS	-	Department of Drinking Water and Sanitation
VWSCs	-	Village Water and Sanitation Committees
DMM	-	Digital Maturity Model
SNK	-	Shikayat Niwaran Kendra
DGR	-	District Grievance Redressal
GPs	-	Gram Panchayats
UID	-	Unique Identification
SDM	-	Service Delivery Monitoring
OTP	-	One-Time Password
SCADA	-	Supervisory Control and Data Acquisition
BOQs	-	Bill of Quantities
DPRs	-	Detailed Project Reports
EPMS	-	E-Project Monitoring System
RTUs	-	Remote Terminal Units
OHSRs	-	Overhead Storage Reservoirs
WQDLs	-	Water Testing Laboratories
DPI	-	Digital Public Infrastructure

Executive Summary



Punjab has emerged as a frontrunner in implementing the Jal Jeevan Mission (JJM), achieving **100%** rural household tap water coverage and declaring the state to have Har Ghar Jal (water in every household) by 2024. Starting from a base of **74.5% coverage** in 2019, the state has consistently exceeded performance benchmarks, with over **95% households** receiving 70 LPCD (and in some cases 100 LPCD) and **94% of water samples** meeting potability standards.



94%

WATER SAMPLES
MEETING POTABILITY STANDARDS.

95%

HOUSEHOLDS RECEIVING 70 LPCD

100%

RURAL HOUSEHOLD TAP
WATER COVERAGE

Highlights

Punjab's Department of Water Supply and Sanitation (DWSS) has been actively leveraging Information Technology (IT) to enhance the management and delivery of rural drinking water services, particularly under the ambit of the Jal Jeevan Mission (JJM). These advancements aim to improve efficiency, transparency, and sustainability in water resource management.

1. Online Water Quality Management System (WQMS)

Punjab utilises comprehensive digital platforms to manage water quality testing. This includes online reporting of field test kit (FTK) results by trained community members, uploading laboratory test results, and displaying the water quality status, ensuring continuous monitoring and prompt action in case of contamination. The state water quality lab has advanced features like machine-to-machine communication technologies for uploading water test results in the Laboratory Information Management System (LIMS) directly from the testing machines without human intervention.

2. Internet of Things (IoT) for Real-time Monitoring

Punjab is increasingly deploying IoT sensors to monitor key parameters like water flow, pressure, water levels in overhead tanks, and even groundwater levels. This real-time data allows for proactive identification of issues like leaks, low pressure, or excessive drawal, leading to more efficient operation and maintenance.

3. Grievance Redressal

The Grievance Redressal mechanism in DDWS is a good example of achieving extraordinary results with high process adherence and a great sense of ownership by the SNK team, even though the IT systems used in SNK are very basic at present. The Department is in the process of procuring a next-generation multi-channel grievance redressal solution with built-in AI capabilities for smart routing and predictive analytics.

4. Streamlined Project Management via EPM (Engineering & Project Management)

- An **EPM module**—part of an enterprise IT solution—is used by engineering departments, including the DWSS.
- It supports end-to-end workflows: estimate preparation, technical sanction, bidding, tendering, contract management, measurement, workflow automation, billing, and asset maintenance.

These IT advancements collectively contribute to a more efficient, transparent, and responsive rural drinking water supply system in Punjab, aligning with the broader vision of digital governance and empowering communities in water resource management.

Strategic improvement area



While Punjab has made commendable strides in IT advancement for rural drinking water, there are always areas for further improvement to ensure that its systems are robust, inclusive, and truly transformative. Here are key areas where IT advancement can be further strengthened in the rural drinking water space in Punjab:

1. Enhancing Last-Mile Digital Literacy and Adoption

- **Challenge:** Despite increased smartphone penetration, digital literacy remains a significant barrier for many rural residents and even some frontline workers, particularly older individuals or those with limited formal education. This impacts the effective use of mobile apps for data collection, grievance redressal, or accessing training.
- **Improvement:** Implement more intensive, localized, and hands-on digital literacy training programs, possibly leveraging local youth or community facilitators. Develop highly intuitive, vernacular-language interfaces for applications with strong visual cues to minimize learning curves.

2. Addressing Connectivity and Infrastructure Gaps

- **Challenge:** Reliable internet connectivity, especially in remote villages, can still be intermittent or slow, hindering real-time data uploads, the smooth functioning of online platforms like LMS, and effective IoT sensor data transmission.
- **Improvement:** Invest further in improving last-mile internet infrastructure (e.g., through BharatNet, local Wi-Fi hotspots). Design applications to function effectively in offline mode, with seamless synchronization when connectivity is restored, reducing dependence on constant internet access.

3. Standardization and Interoperability of Data

- **Challenge:** While systems like IMIS and iGOT exist, there are variations in data collection formats, definitions, and reporting across different schemes, districts, or even within the same department. This leads to data silos and hinders holistic analysis.
- **Improvement:** Develop and strictly enforce granular data standardization protocols for all parameters (e.g., water quality, consumption, asset details, and O&M records). Prioritize open APIs and robust interoperability frameworks to ensure seamless data exchange between different IT systems, both within DWSS and with other relevant departments.

4. Leveraging Advanced Analytics and Predictive Maintenance

- **Challenge:** While data collection is ongoing, the full potential of this data for predictive analytics is underutilized. Most dashboards show the current status rather than predict future issues.
- **Improvement:** Move beyond descriptive analytics to predictive models. Use historical data on breakdowns, water quality fluctuations, and consumption patterns to predict potential equipment failures, water scarcity, or contamination events, enabling proactive maintenance and resource allocation.

By focusing on these areas, Punjab can further mature its IT ecosystem in the rural drinking water sector, making it more effective, resilient, and user-centric, ultimately contributing to better service delivery and achieving the goals of water security for its citizens.

Measurement of IT Advancement Capabilities



The development of IT applications in the rural drinking water sector across India is a mixed bag, with some States/UTs showcasing robust digital ecosystems, while others have yet to fully embrace the use of digital technology. Therefore a States Information Systems Digital Maturity Model (DMM) has been developed to systematically measure, improve, and manage the States/UTs IT Capabilities in rural drinking water sector over time. DMM is a structured framework for assessing the maturity of advancements in IT systems & applications in States Rural Drinking Water Management. The model would provide structured inputs in IT governance and strategic digital transformation planning of States/UTs.

The model adopts a holistic, stakeholder-centric view of the rural water supply ecosystem, organizing stakeholders into five layers with citizens at the core: **Citizens, Frontline Workers, Agencies, Departments, and State Functionaries.**

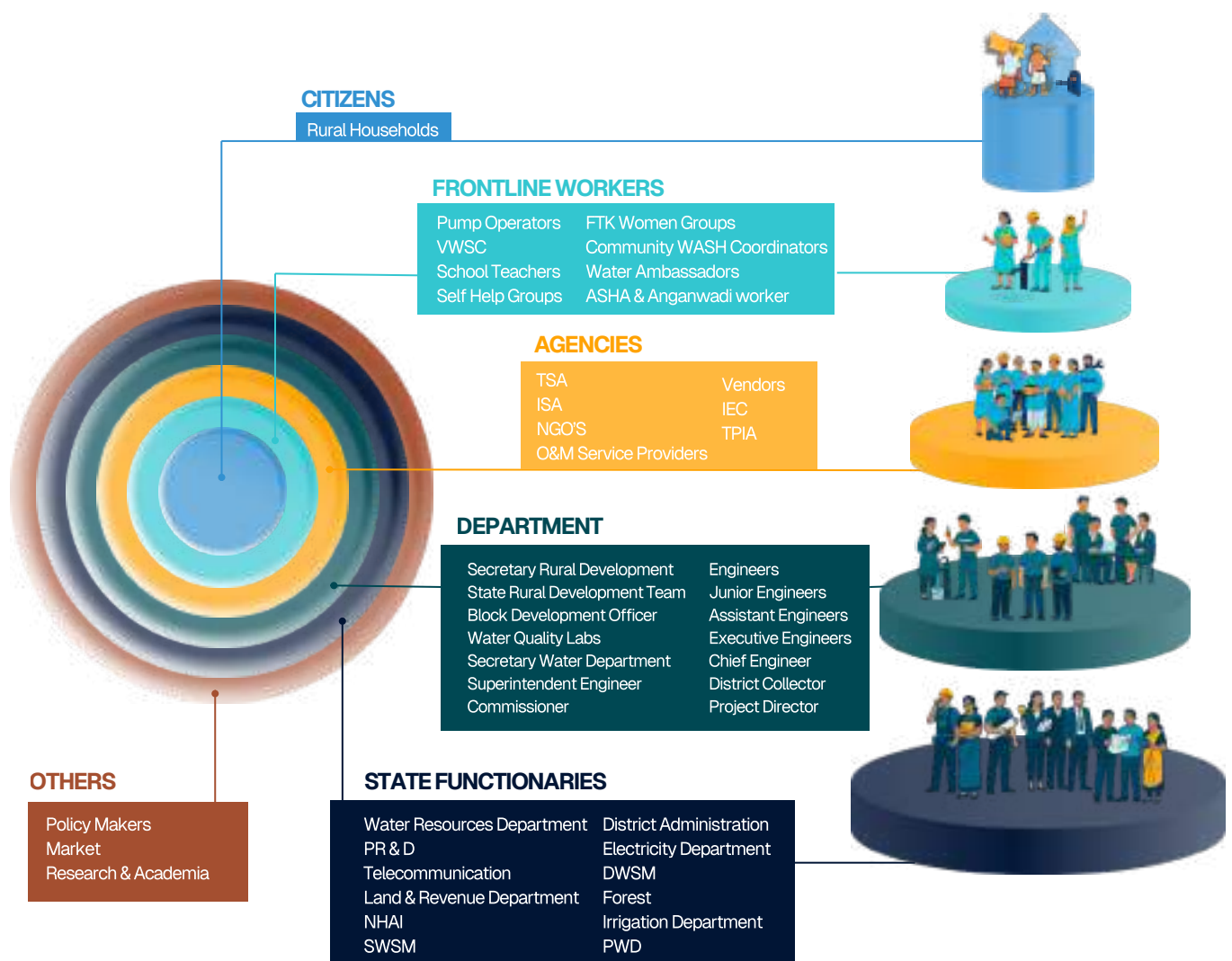


Figure 1: Stakeholders Mapping - State IT Systems

Based on a comprehensive analysis of water departments across several states, the above figure illustrates a holistic view of stakeholders involved in the rural water management ecosystem. While the specific names and number of stakeholders may vary by state, this representation broadly captures the full spectrum of actors typically engaged in the system.

Guiding Principles

The Digital Maturity Model (DMM) is built on six foundational principles that ensure digital transformation efforts in the rural drinking water sector under the Jal Jeevan Mission (JJM) are effective, inclusive, and sustainable.



Figure 2: DMM Guiding Principles

These guiding principles ensure that digital maturity assessment under the DMM remains not just technically robust but also socially relevant and mission-aligned. The model defines seven distinct capability areas per layer, resulting in forty-two unique capabilities system-wide. In addition, seven common capability areas, applicable across the ecosystem, are grouped under a separate layer of **Common Capabilities** to avoid duplication. Two foundational layers further support this model: the **Technology Foundation** layer covering seven core application-related capabilities, and the **Infrastructure** layer, which includes seven capabilities related to hardware and connectivity. Departments have fourteen distinct capabilities and are excluded from this enumeration.

In total, the model defines sixty-three capabilities across eight layers, with each capability evaluated against four maturity levels: **Not Assessed, Aspiring, Performing, and Leading.**

NOT ASSESSED	ASPIRING	PERFORMING	LEADING
<p>Information not available</p> <ul style="list-style-type: none"> • No data or documentation available to evaluate the status of this capability. • Capability has not been explicitly reviewed, implemented, or reported on. • Further inquiry or stakeholder engagement is needed to assess this area. 	<p>Early-stage Maturity</p> <ul style="list-style-type: none"> • The capability is either non-existent or in pilot stage, with limited institutional adoption • Processes are manual or partially digitized, lacking standardization and consistency • Ownership, governance, and user awareness around the capability are low or informal. 	<p>Operational Maturity</p> <ul style="list-style-type: none"> • The capability is functioning at scale with documented processes and routine usage by intended stakeholders • Systems or tools supporting this capability are integrated into workflows, and data is used for monitoring and reporting. 	<p>Strategic Maturity</p> <ul style="list-style-type: none"> • The capability is interoperable, scalable, and aligned with open standards or DPI principles • Data-driven insights, automation, or innovation are embedded in the capability's functioning. • The state actively shares learnings, tools, or assets with other regions.

Figure 3: DMM Maturity Levels

Digital Maturity Model (DMM)

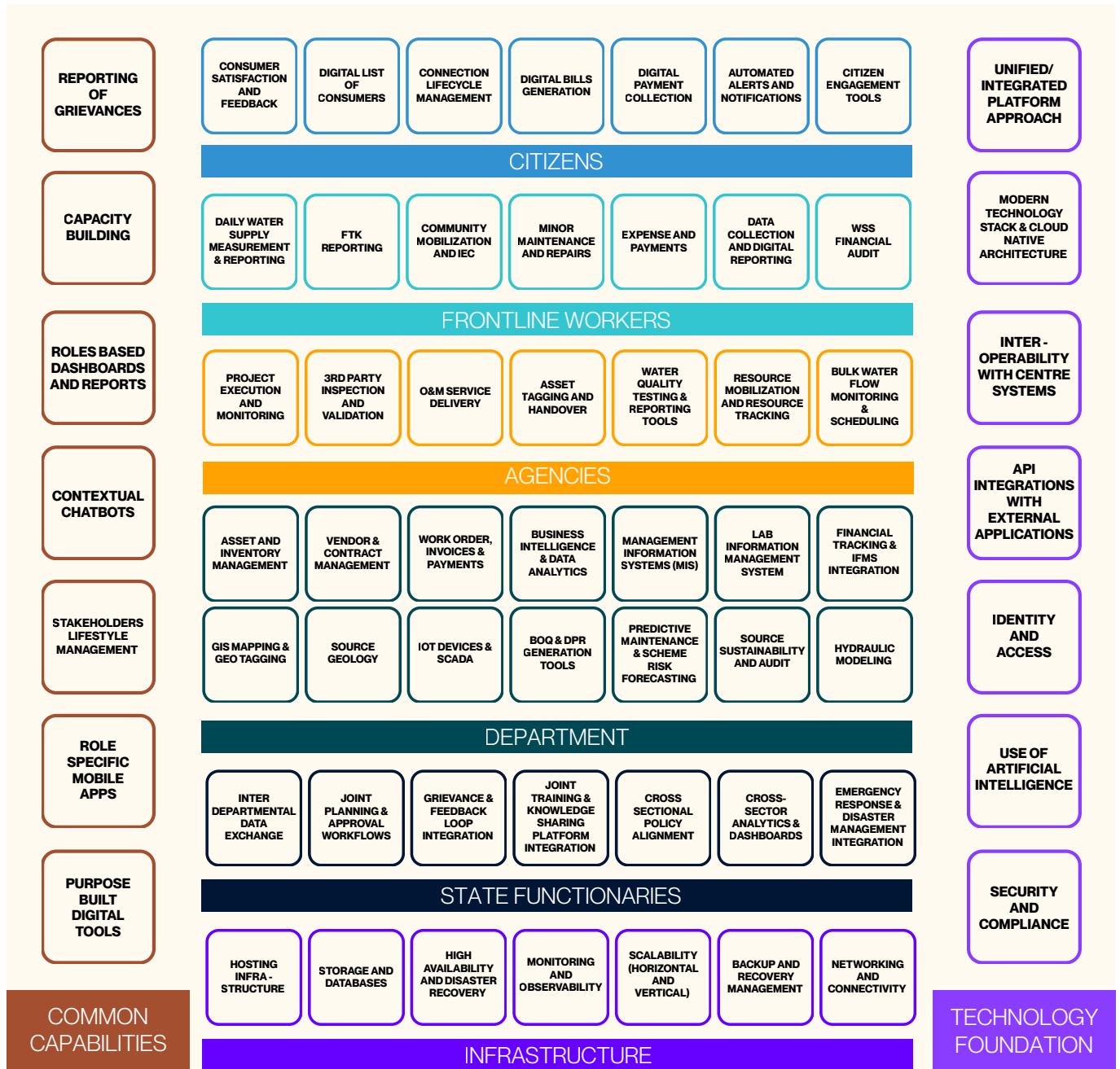


Figure 4: State IT Systems- Digital Maturity Model (DMM)

Punjab IT Capabilities Mapping

Based on a two-day on-site As-Is Study visit to DWSS, this report attempts to map the capabilities of the Punjab DWSS IT systems onto the DMM scorecard, as depicted in the figure below.

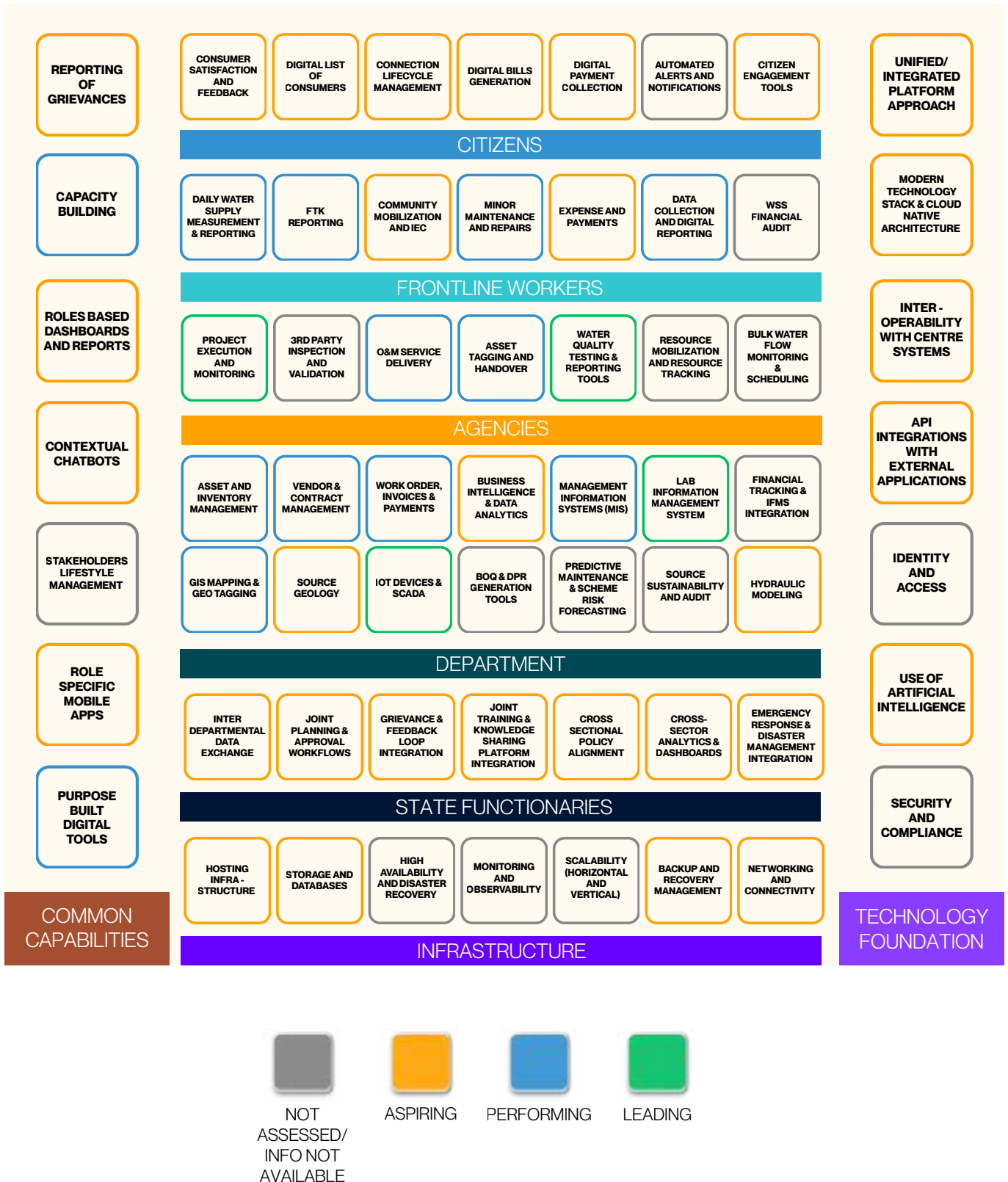


Figure 5: State IT Systems- Punjab PHED IT Capabilities Scorecard

Citizens Applications



Capability Matrix

Below table outlines the mapping of a Capability from DMM to the Punjab IT systems for consumers/citizens.

CONSUMER SATISFACTION SURVEY/FEEDBACK	Call centre agents at SNK collect oral feedback during or after complaint resolution. There is no structured, recurring consumer satisfaction survey conducted department-wide.
DIGITAL LIST OF CONSUMERS	The digital list of consumers is not available.
CONNECTION LIFECYCLE MANAGEMENT	At present, there is no conducive process and digital tools to manage the life-cycle of water connections.
DIGITAL BILLS GENERATION	There is no digital bill generation since sunsetting mGramSeva.
DIGITAL PAYMENT COLLECTION	At present, no active platform supports online bill payment for consumers.
AUTOMATED ALERTS AND NOTIFICATIONS	No information is available.
CITIZEN ENGAGEMENT TOOLS	No public-facing tool is available to access scheme-level details, operator information, or awareness content.
REPORTING OF GRIEVANCES	The Shikayat Niwaran Kendra (SNK) operates through a centralized voice-based grievance redressal system. Complaints are manually logged, assigned, and closed by call centre agents.
CAPACITY BUILDING	Awareness programs are conducted through IEC campaigns, school programs, and community meetings focusing on safe water, hygiene, conservation, and tariff awareness; activities are offline with no dedicated digital platforms.
ROLE-BASED DASHBOARDS AND REPORTS	DWSS has internal dashboards for scheme monitoring, but no public dashboards are published for consumers to track scheme performance, complaints, or water quality.

CONTEXTUAL CHATBOTS	No chatbot or AI-based interface is available for consumers, frontline workers, agencies and the department. The SNK system is purely voice-based, with no WhatsApp or digital bot integration currently operational.
STAKEHOLDER LIFECYCLE MANAGEMENT	No information is available.
ROLE SPECIFIC MOBILE APPS	There is no system for managing the lifecycle of consumer engagement (onboarding, usage, payment history, complaint history, exit, etc.) across systems.
PURPOSE-BUILT DIGITAL TOOLS	Not applicable.

Shikayat Niwaran Kendra (SNK)

The Shikayat Niwaran Kendra (SNK) represents DWSS's primary grievance redressal mechanism, currently operating through a basic telephonic system with manual processes established since 2009.

The existing system, while functional, faces significant limitations in scalability, data management, and citizen engagement. The department has recognized these constraints and is planning to develop a modernized Citizen Service Management System that will transform the grievance handling process through multi-channel integration, automated workflows, and enhanced tracking capabilities.

This modernization initiative reflects the broader digital transformation occurring within Punjab DWSS and aligns with national efforts to improve rural water service delivery through technology-enabled solutions.



Current SNK System Architecture and Operations

The SNK currently operates as a centralized grievance redressal system with a fundamentally manual operational framework. The system's primary interface consists of a telephony-based call centre where dedicated agents receive citizens' complaints through toll-free numbers. Upon receiving a call, the telephony agent manually creates complaint records in the system, capturing essential details about the grievance, including complainant information, the nature of the problem, and location specifics.

The complaint registration process follows a strictly manual workflow where agents are responsible for creating SMS notifications to complainants and confirming receipt of their grievance. The system's assignment mechanism relies entirely on manual decision-making, with agents selecting appropriate officers based on their judgment of the complaint category and geographical jurisdiction. This manual assignment process introduces potential inconsistencies in complaint routing and may result in delays or misallocated responsibilities.



Communication protocols within the current system are heavily dependent on traditional methods, with SMS messages sent to relevant officers to notify them of new complaints requiring their attention. The closure mechanism operates through informal channels, where officers inform the SNK call centre via email or telephone once they have addressed the complaint. Subsequently, call centre agents contact complainants to confirm resolution before formally closing the complaint in the system. This multi-step manual process creates numerous opportunities for communication gaps and delays in complaint resolution.



The data management infrastructure of the current SNK system presents significant limitations in terms of scalability and accessibility. All complaint data is stored on a single main computer located at the SNK facility, creating a centralized point of failure and limiting system accessibility. The system contains historical data dating back to 2009, representing over a decade of citizen grievances and departmental responses. However, the current architecture lacks robust backup mechanisms and distributed access capabilities that would enable efficient data utilization and analysis.

One of the most significant operational constraints of the existing system is its lack of flexibility in complaint lifecycle management. Once a complaint is marked as closed, the system does not provide mechanisms to reopen it, even if the issue resurfaces or the initial resolution proves inadequate. This limitation undermines the system's ability to handle complex or recurring problems effectively and may result in citizen dissatisfaction with the grievance resolution process.

Proposed Citizen Service Management System

The proposed Citizen Service Management System represents a comprehensive modernization of the SNK platform, designed to address the limitations of the current system while introducing advanced capabilities for citizen engagement and service delivery. The proposed system embraces a multi-channel approach that significantly expands citizen access points beyond the traditional toll-free number model.

The new system architecture incorporates diverse communication channels including SMS, web portals, WhatsApp integration, QR code functionality, email interfaces, and dedicated mobile applications. This multi-channel strategy recognizes the varying technological preferences and accessibility constraints of rural and urban populations, ensuring that citizens can engage with the grievance system through their preferred communication medium.

User authentication mechanisms in the proposed system introduce accountability and security measures that are absent in the current manual system. Citizens will be required to authenticate themselves before registering complaints, ensuring that all grievances are traceable to verified individuals. Each complaint will receive a unique tracking identifier, enabling citizens to monitor the progress of their grievances in real-time through web portals or mobile applications. Automated notification systems will keep citizens informed of status updates, eliminating the need for manual follow-up calls and reducing the administrative burden on call centre staff.



Integration capabilities within the proposed system extend beyond internal DWSS operations to encompass external government platforms. The specification includes provisions for integration with the Department of Industries and Commerce portal and the DGR (District Grievance Redressal) system. This inter-departmental connectivity ensures that water supply-related complaints originating from other government platforms are automatically routed to the appropriate DWSS personnel, creating a seamless citizen experience across government touchpoints.

Integration with Broader DWSS Digital Ecosystem

The SNK modernization initiative operates within the context of Punjab DWSS's comprehensive digital transformation strategy, which includes multiple interconnected systems such as the Management Information System (MIS), Service Delivery Parameter Module (SDPM), and IoT-enabled automation platforms. The proposed grievance system's integration capabilities will enable seamless data exchange with these existing systems, creating opportunities for proactive service delivery and predictive maintenance based on complaint patterns and service delivery metrics.

The relationship between the modernized SNK and the Jal Seva mobile application presents particular opportunities for enhanced citizen engagement. Citizens will be able to submit complaints through the Jal Seva app interface, creating a unified platform for both service monitoring and grievance reporting. This integration supports the department's transition from infrastructure-focused operations to service delivery-oriented management, enabling real-time feedback loops between citizens and service providers.

Data analytics capabilities within the proposed system will complement the department's broader monitoring and evaluation framework, providing insights into service quality trends, recurring problem areas, and departmental response effectiveness. These analytical capabilities support evidence-based decision-making for infrastructure investments, maintenance prioritization, and service delivery improvements.

mGram Seva App

The mGramSeva mobile application was developed as a flagship digital intervention by DWSS Punjab under the Jal Jeevan Mission (JJM) to strengthen financial transparency and operational accountability in rural water supply management. It aimed to digitize billing, monitor user charge collections, and track expenditures at the village level, thereby empowering Gram Panchayats (GPs) and Village Water and Sanitation Committees (VWSCs) to sustain water supply schemes independently.



Figure 6: mGramSeva Mobile App Snapshot

Current Operational Status:

mGramSeva is currently non-operational across Punjab. While the application was initially introduced in all 22 districts and piloted in numerous single and multi-village piped water supply schemes, sustained usage has ceased due to a combination of operational, technical, and institutional challenges. Adoption rates have declined significantly, and field-level usage has been discontinued in many areas.

Key Functional Components (Previously Operational)

1. Digital Billing and User Charge Management

- Auto-generated monthly bills linked to household records and unique consumer IDs.
- Tariffs are differentiated by scheme type and predefined in the system.

2. Revenue Collection Tracking

- Manual or offline digital entries of collections by Panchayat officials.
- Timestamped transaction logs with syncing on internet availability.
- Revenue dashboards for GPs, blocks, and districts.

3. Expenditure Monitoring

- Entry of scheme-level expenditure under predefined O&M categories.
- Entries are reviewed by Junior Engineers (JEs) or block officers, depending on the threshold.

4. Financial Reporting and Scheme Health Monitoring

System-generated financial indicators:

- Revenue-to-expenditure ratio
- Outstanding dues
- Monthly balance (positive/negative)
- Scheme performance reports via the web dashboard

Adoption Metrics (Historical)

- Over 1.2 million rural households were enrolled.
- More than ₹10 crores of user charges were recorded.
- Active billing and data entry were conducted across all districts during the initial implementation phase.

Workflow Overview (When Active)

- **Bill Generation:** Monthly, auto-triggered based on scheme-specific tariffs.
- **Payment Entry:** Manual (cash) or digital (UPI, where available)
- **Expenditure Entry:** By GP, reviewed by JE.
- **Verification:** Cross-checking at the block and district levels.

The mGramSeva reflects a significant step by DWSS Punjab towards digitizing financial operations at the village level. While its phased rollout showed early promise, the absence of robust digital readiness, sustained support, and seamless system integration curtailed long-term viability. The platform now remains inactive, pending re-strategization or a system overhaul aligned with JJM 2.0's DPI goals.

Architectural Diagram

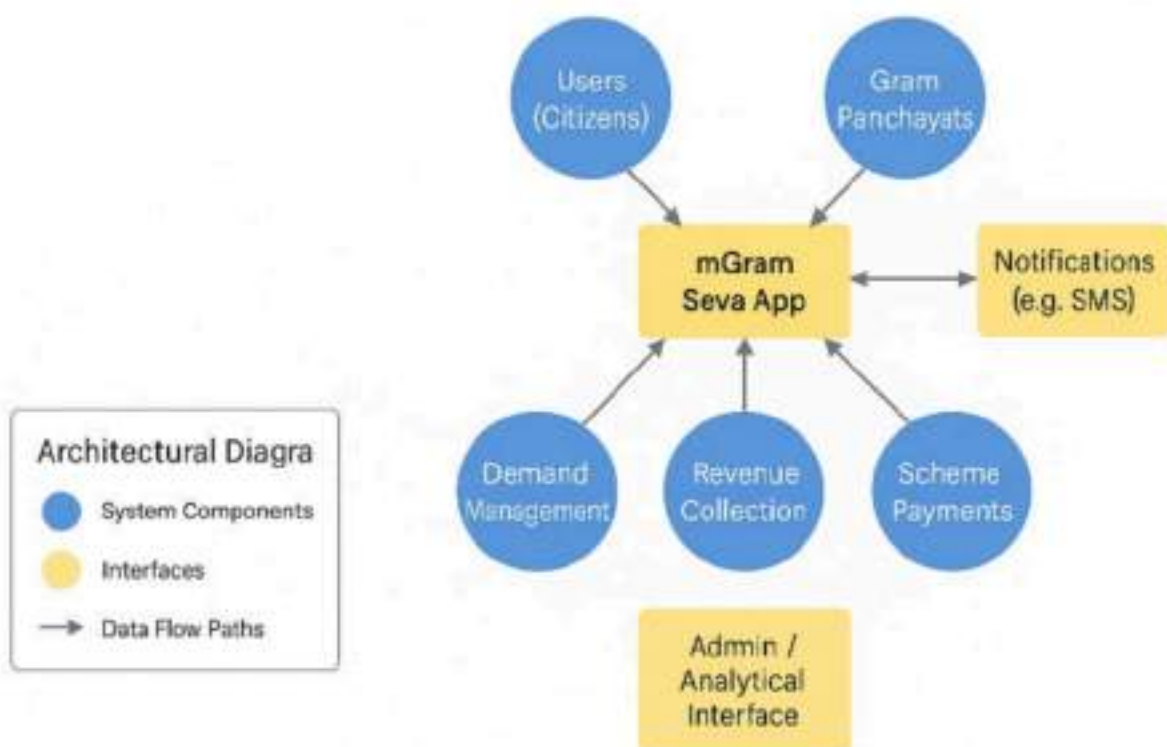


Figure 7: Architecture Diagram of mGramSeva Application

Frontline Workers Applications



Capability Matrix

Below table outlines the mapping of a Capability from DMM to the Punjab IT systems for frontline workers.

DAILY WATER SUPPLY MEASUREMENT & REPORTING	Jal Seva app captures daily water supply hours, disruptions, and operational status across schemes via monthly structured surveys by Junior Engineers. Data syncs with the MIS when connectivity is available.
FTM REPORTING (FIELD TEST KIT REPORTING)	Jal Seva app records chlorine residual readings and water quality indicators submitted by field staff. It captures data on disinfection status and treatment practices.
COMMUNITY MOBILIZATION & IEC	Community engagement is conducted offline via Jaldoots and VWSC activities. No digital tools in Jal Seva or LMS support structured IEC campaign management or impact monitoring.
MINOR REPAIRS MANAGEMENT	Field-level issues like pump breakdowns and equipment faults are documented via Jal Seva's technical module. Geotagged photos and GPS tagging enable visual verification. Resolution tracking remains semi-manual.
EXPENSE AND PAYMENT MANAGEMENT	Jal Seva records O&M-related expenditures manually entered by JEs (e.g., repairs, electricity). No digital integration exists with treasury systems or vendor payment platforms.
DATA COLLECTION AND DIGITAL REPORTING	Jal Seva captures more than 45 parameters across technical, institutional, general, and financial domains monthly. Offline-first design ensures functionality in rural areas. Data is partially synced to MIS but lacks real-time dashboarding and analytics.
WSS FINANCIAL REPORTING	No information is available.
REPORTING OF GRIEVANCES	Grievances are managed via SNK, a centralized voice-based system, but are not integrated with Jal Seva. Jal Seva does not provide a grievance registration interface as of now.
CAPACITY BUILDING	DWSS uses a department-wide Learning Management System (LMS) integrated with iGOT Karmayogi. It offers blended learning for engineers, frontline workers, and VWSC members. The LMS tracks progress and completion rates, and supports offline access.

ROLE-BASED DASHBOARDS AND REPORTS	<p>Jal Seva-generated data is available to internal users only via restricted dashboards. No public dashboards accessible to consumers or Panchayats exist for transparency or community oversight.</p> <ul style="list-style-type: none"> • Revenue dashboards for GPs, blocks, and districts.
CONTEXTUAL CHATBOTS	<p>No chatbot interface is available within Jal Seva or the LMS. SNK does not currently support WhatsApp-based grievance reporting either.</p>
STAKEHOLDER LIFECYCLE MANAGEMENT	<p>No stakeholder management system exists across Jal Seva or the LMS to track individual users (consumers, VWSCs) across their service journey or engagement lifecycle.</p>
ROLE-SPECIFIC MOBILE APPS	<p>The Jal Seva mobile app is role-specific for Junior Engineers, allowing scheme-wise reporting, asset tagging, and monitoring. The LMS is role-segmented across technical staff and community members.</p>
PURPOSE-BUILT DIGITAL TOOLS	<p>Jal Seva is the department's core field monitoring application. The LMS supports structured training. The tools are specialized but not yet fully interoperable.</p>

Jal Seva Mobile Application

The Jal Seva mobile application represents Punjab DWSS's primary digital tool for transitioning from infrastructure development to service delivery monitoring in rural water supply schemes. Launched statewide on March 4, 2021, this Service Delivery Monitoring (SDM) system enables field-level data collection across forty-five parameters covering general, financial, technical, and institutional aspects of water supply schemes.



While the application successfully captures operational data from Junior Engineers and facilitates basic monitoring functions, significant limitations exist in data analytics capabilities and integration with broader departmental systems, highlighting both the potential and constraints of current digital infrastructure in rural water service delivery.

System Overview and Strategic Context

The Jal Seva mobile application emerged as a direct response to the evolving priorities of rural water supply governance in Punjab, specifically addressing the shift from infrastructure creation to service delivery monitoring mandated under the Jal Jeevan Mission framework. The application, although currently non-functional due to certain operational issues, represents a critical component of Punjab DWSS's digital ecosystem, designed to capture service delivery indicators from field operations and translate this data into actionable insights for departmental decision-making processes.

The strategic positioning of Jal Seva within Punjab's water sector digitization efforts reflects broader national trends toward data-driven governance in rural infrastructure management. The application was developed by Origami using a web-based PHP Zend framework with an Ionic mobile application interface, indicating a hybrid approach to cross-platform compatibility. The application's development timeline coincided with the intensification of service delivery monitoring requirements under national rural water supply programs, positioning it as both a compliance tool and a mechanism for enhancing operational efficiency.

Functional Architecture and Core Modules

The Jal Seva application operates through a modular architecture comprising five primary functional areas: scheme data, baseline information, survey updates, asset tagging, and dashboard reporting. This modular approach enables field officers to navigate between different operational contexts while maintaining data integrity across multiple water supply schemes under their jurisdiction.

JAL SEVA

Scheme data

Baseline information

Survey updates

Asset tagging

Dashboard reporting

The scheme switching functionality allows users to transition between assigned water supply schemes, with each scheme displaying essential identification parameters including the scheme name, scheme code, office code, and responsible officer details. This capability proves essential in Punjab's multi-scheme operational environment, where individual Junior Engineers often oversee multiple water supply installations across different villages and administrative boundaries. Baseline information management constitutes a foundational element of the application's data architecture, enabling field officers to update technical parameters, general information, and infrastructure specifications for each scheme.

The system accommodates various scheme types and allows for the addition of multiple tubewells through an expandable interface design, reflecting the heterogeneous nature of rural water supply infrastructure in Punjab's diverse geographical regions.

The survey update module represents the application's core operational functionality, facilitating monthly data collection across four categorical frameworks: general operations, financial management, technical parameters, and institutional governance. This systematic approach to data categorization aligns with national service delivery monitoring standards while addressing Punjab-specific operational requirements and regulatory compliance needs.

Data Collection Framework and Parameters

The Jal Seva application implements a comprehensive data collection framework encompassing forty-five distinct parameters across four categorical domains, reflecting the multidimensional nature of rural water service delivery monitoring. The general category captures fundamental operational metrics, including scheme functionality status, daily water supply duration, supply interruption patterns, and pumping operation schedules, providing essential baseline information for service assessment.



Financial parameters within the application address critical sustainability indicators, including bulk water meter installations, electricity consumption patterns, power factor measurements, billing compliance, revenue collection rates, and operation and maintenance expenses.

This financial monitoring capability represents a significant advancement in Punjab's approach to water supply scheme sustainability, enabling systematic tracking of cost recovery and operational viability metrics previously managed through manual reporting systems.

Technical data collection encompasses water quality monitoring, chlorination testing, equipment functionality assessments, and infrastructure performance indicators. The inclusion of residual chlorine measurement at tail ends demonstrates alignment with national water quality standards while addressing local public health requirements. The system also captures equipment-specific information such as Reverse Osmosis installations and functionality status, reflecting the increasing technological complexity of rural water treatment systems.

Institutional parameters focus on governance mechanisms, particularly the Gram Panchayat Water and Sanitation Committee's meeting frequencies and community engagement indicators. This emphasis on institutional monitoring recognizes the critical importance of community participation and local governance structures in ensuring sustainable water service delivery, aligning with national policy frameworks emphasizing participatory management approaches.

User Interface and Experience Design

The Jal Seva application employs a user-centric design approach optimized for field-level operations by DWSS personnel, particularly Junior Engineers who serve as the primary operational interface between the department and community-level water supply infrastructure. The application's landing page provides clear role-based navigation options, distinguishing between officer access for operational data entry and public access for information transparency and feedback submission.



The login mechanism utilizes One-Time Password (OTP) authentication through registered mobile numbers, ensuring secure access while accommodating the technological literacy levels typical among field personnel. This authentication approach balances security requirements with practical usability considerations, recognizing the operational constraints faced by field officers in rural environments with variable network connectivity.

The survey update interface utilizes colour-coded progress indicators, with completed sections marked by green tick marks and preview options available only after completing all required categories, ensuring data completeness and quality control.

Asset tagging functionality incorporates GPS location capture and photographic documentation, enabling comprehensive asset inventory management with geographical reference points.

Operational Implementation and Field Usage

Field implementation experiences reveal that while the application successfully captures operational data and facilitates basic monitoring functions, its utility for advanced analytics and predictive insights remains limited due to systemic constraints in data processing and analysis capabilities.



Junior Engineers constitute the primary user base for operational data entry, with citizen engagement limited to feedback submission and informational access. This user distribution reflects the current operational reality of rural water supply management, where technical personnel serve as intermediaries between community needs and departmental responses, though it may limit direct community participation in monitoring processes.

Technical Infrastructure and Integration Challenges

Database management: The Jal Seva app uses a backend developed on the PHP Zend Framework, which typically connects to a MySQL or PostgreSQL database for storing and managing data. This database holds key operational information such as daily water supply hours, pump performance logs, chlorine residual levels, and geotagged photos of infrastructure repairs submitted by field staff.

The app supports both online and offline data entry, with synchronization occurring once internet connectivity is available. Data captured through the mobile app is eventually synced to a central database, which is partially integrated with the department's main MIS (Management Information System), allowing higher-level users to track scheme performance and field activity in near real-time.

The structure ensures that even in low-connectivity rural areas, data is preserved and contributes to the department's operational visibility once synced.

Data is shared with the DWSS's main MIS system to update scheme-level records.

Network requirements

The Jal Seva app is designed to function effectively in both connected and remote environments, making its network requirements relatively flexible. For field use, the mobile app—developed using the Ionic framework—supports offline data entry, allowing users such as Junior Engineers (JEs) to record water supply hours, pump status, and chlorine levels even without internet access.

Once a network connection is restored, the app automatically syncs this data with the central server via secure HTTP(S) APIs. While a stable 3G or 4G connection is recommended for real-time syncing and timely updates, the app's offline-first design ensures continuous usability in rural and low-bandwidth areas. On the other hand, the web-based administrative interface accessed by supervisors and department officials requires a consistent internet connection to enable dashboard viewing, data management, and cross-system updates.

Integration with broader departmental IT infrastructure

The Jal Seva app is partially integrated with the broader departmental IT infrastructure of DWSS Punjab, specifically with systems like the Management Information System (MIS) and the Scheme & Project Monitoring (SDPM) module. Through this linkage, key field data such as daily water supply hours, pump maintenance status, and chlorine residual levels can be synced and reflected in the MIS for monitoring scheme performance.

However, the integration is currently limited and not real-time, as the systems do not communicate through standardized APIs or middleware. There is no direct integration with other important systems such as LIMS (for lab water quality data), SNK (for grievance redressal), or mGramSeva (for billing and user data), which leads to data silos and manual duplication.

Performance Monitoring and Quality Assurance

Approval and rejection workflows enable supervisory review of submitted data, with higher-level officers authorized to validate or reject survey submissions based on data quality and accuracy assessments. This hierarchical review process introduces quality control measures while maintaining accountability chains within the departmental structure, though it may also introduce delays in data processing and feedback provision.

GPS location verification for asset tagging activities ensures spatial accuracy in infrastructure inventory management, while photographic documentation provides visual verification of asset conditions and installations.





Challenges and Limitations in Current Implementation

Despite its operational deployment across Punjab's water supply infrastructure, the Jal Seva application faces several significant limitations that constrain its effectiveness as a comprehensive service delivery monitoring tool. The absence of advanced data analytics capabilities represents a fundamental constraint, preventing the extraction of meaningful insights from collected operational data and limiting the system's contribution to evidence-based decision-making processes.

Integration challenges with national monitoring systems, particularly JJM IMIS, create administrative inefficiencies through required dual data entry processes. These integration failures reflect broader systemic issues in interoperability between state and national digital infrastructure, highlighting the need for standardized data exchange protocols and common technical specifications across different administrative levels.

The application's limited citizen engagement functionality restricts community participation in monitoring processes, potentially missing opportunities for enhanced transparency and participatory governance.

While citizens can access basic information and submit feedback, the system lacks mechanisms for direct community reporting of service issues or participation in data validation processes.

Manual bill generation and user fee collection processes indicate incomplete digitalization of financial management functions, requiring parallel manual systems that reduce operational efficiency and increase administrative burden. This limitation affects the application's utility as a comprehensive service delivery management platform and highlights the need for integrated financial management capabilities.

Learning Management System (LMS)

The Department of Water Supply and Sanitation (DWSS) in Punjab plays a critical role in providing safe drinking water and sanitation facilities to the state's rural population, especially under initiatives like the Jal Jeevan Mission (JJM). To effectively manage and sustain these vast public service endeavours, capacity building of its workforce and community stakeholders is paramount.

Recognizing this need, DWSS Punjab has embraced digital learning solutions, including the deployment of a Learning Management System (LMS).

This LMS serves as a foundational platform for comprehensive training and skill development programs targeting a diverse range of personnel. From engineers and technical staff (Group C and D, like plumbers, fitters,



electricians, and pump operators) to frontline workers and members of Village Water & Sanitation Committees (VWSCs)/Pani Samitis, the LMS caters to various learning needs. It aims to bridge knowledge gaps, introduce new technologies and best practices, and ensure a standardized understanding of operational procedures and quality control measures vital for water infrastructure management.

A key aspect of this digital learning ecosystem is its integration with the **iGOT (Integrated Government Online Training) system**. iGOT Karmayogi, a flagship program of the Government of India, is designed to enhance the skills and competencies of civil servants across various levels and departments. This integration allows DWSS Punjab to leverage a broader national repository of learning content and standardized competency frameworks, aligning its training efforts with national capacity-building goals. It signifies a move towards a unified approach to civil service development.

The integration with iGOT provides several benefits. Firstly, it offers a wider array of curated courses and learning modules that might not be available on a standalone departmental LMS, providing access to best practices and cross-sectoral knowledge. Secondly, it enables a more personalized learning experience, as iGOT features like "My iGOT" can tailor training courses based on individual capacity-building needs identified through competency assessments. This ensures that training is relevant and impactful for each learner's role.



Furthermore, the LMS, bolstered by iGOT integration, facilitates blended learning programs, combining traditional classroom training with online components. This approach offers flexibility and convenience, allowing employees to learn at their own pace and from various locations, minimizing disruptions to their field duties. Such flexibility is crucial for a department like DWSS, where a significant portion of the workforce operates in remote or dispersed rural settings.

Moreover, the digital nature of the LMS allows for efficient monitoring and evaluation of training effectiveness. Data on course completion, assessment scores, and skill acquisition can provide valuable insights for refining future training modules and identifying areas where further capacity building is needed. This data-driven approach supports evidence-based policy formulation and resource allocation for human resource development within the department.

Ultimately, the Learning Management System in DWSS Punjab, with its crucial integration with the iGOT platform, represents a significant stride in modernizing public sector training. It embodies the vision of digital transformation for governance, empowering the workforce with the knowledge and skills necessary to achieve the ambitious targets of missions like Jal Jeevan, ensuring a healthier and more prosperous future for the citizens of Punjab.



Agencies Applications

Capability Matrix

Below table outlines the mapping of a Capability from DMM to the Punjab IT systems for Agencies.

PROJECT EXECUTION & MONITORING	<p>The EPMS (Public Works Department’s E-Project Monitoring System) is used for estimate preparation, bidding, measurements, e-MBs, and progress tracking. It is integrated into the DWSS workflow for civil engineering works and infrastructure build-out.</p>
THIRD PARTY INSPECTION & VALIDATION	<p>No information is available.</p>
O&M SERVICE DELIVERY	<p>The Gram Panchayat Water & Sanitation Committee (GPWSC) operates the system, collects a monthly tariff from each household, which fully covers O&M expenses. It also manages meter reading, and grievance resolution.</p>
ASSET TAGGING AND HANDOVER	<p>The mission integrates with platforms like PM GatiShakti to share geospatial infrastructure data (e.g., pipelines, and reservoirs) for coordinated planning and asset tagging.</p>
WATER QUALITY TESTING & REPORTING TOOLS	<p>The LIMS is fully functional across 33 labs for chemical and microbiological testing. Data are logged into JJM IMIS. However, there is no sensor-based real-time water quality tracking integrated with SCADA or Jal Seva. Chlorine sensor data are used for alerts but are not linked to LIMS or public platforms.</p>
RESOURCE MOBILIZATION AND RESOURCE TRACKING	<p>No data is available.</p>
BULK WATER FLOW MONITORING & SCHEDULING	<p>No data is available.</p>
REPORTING OF GRIEVANCES	<p>SNK is a voice-based, manual grievance redressal system. No integration exists with SCADA, Jal Seva, or MIS. There is no digital public interface or automated routing system.</p>

CAPACITY BUILDING	No dedicated mobile or digital tool exists for structured field inspections or audits. Monitoring is done via field visits and informal reporting.
ROLE-BASED DASHBOARDS AND REPORTS	No live, publicly accessible dashboards are available for IoT SCADA, LIMS, EPMS, or scheme-level performance. Internal dashboards exist within SCADA and MIS, but are not exposed to citizens.
CONTEXTUAL CHATBOTS	No chatbot or automated conversational interface is deployed for consumers, operators, or engineers on any digital platform under DWSS (e.g., Jal Seva, SCADA, SNK, EPMS).
STAKEHOLDER LIFECYCLE MANAGEMENT	No unified platform exists for managing the lifecycle of stakeholders (households, VWSCs, engineers) across schemes, training, billing, or grievances. Systems operate in silos (IoT, LIMS, HRMS, SNK, LMS).
ROLE-SPECIFIC MOBILE APPS	Jal Seva (currently inactive) was role-specific for Junior Engineers. No active mobile app exists for engineers, supervisors, or consumers to interact with SCADA, LIMS, or MIS data.
PURPOSE-BUILT DIGITAL TOOLS	<p>DWSS has deployed multiple purpose-built tools</p> <ul style="list-style-type: none"> • SCADA + IoT system for real-time monitoring • LIMS for lab testing • EPMS for project execution • HRMS & e-Office for internal management <p>These tools serve distinct functions but lack cross-platform integration.</p>

IoT-Based Automation

Punjab's Department of Water Supply and Sanitation (DWSS) has implemented one of the country's most expansive IoT-enabled automation systems for rural drinking water supply management. This initiative marks a notable advancement in technology-driven service delivery, encompassing 346 multi-village surface water and groundwater-based schemes across 23 blocks, spanning 897 villages, and benefiting approximately 9.1 lakh rural residents.



23

BLOCKS

897

VILLAGES

9.1L

RURAL RESIDENTS BENEFITTED

The system enables real-time monitoring and automated control of critical components in water distribution schemes. Implemented by CIMCON Software India Pvt. Ltd., around 240 of these schemes are currently fully automated. Due to localized resistance in some regions, the initial target was revised from 346 to 300 schemes. Despite this adjustment, a majority of the implementation has been completed across all three zones—Central, Southern, and Northern Punjab—including key districts like Bathinda, Ferozepur, Amritsar, and Jalandhar.

Importantly, surface water schemes that already had existing SCADA setups were excluded from this initiative to avoid duplicity and optimize deployment resources. This reflects a strategic focus on enhancing infrastructure where real-time monitoring was previously inadequate.



Figure 8: Online Scheme Monitoring via various IoT sensors

System Architecture and Functional Components

The IoT framework operates through a layered architecture, comprising field-level sensors, data communication infrastructure, and centralized cloud-based SCADA management:

1. Field Devices & Sensors

- **Groundwater Sensors:** Hydrostatic depth sensors track static and dynamic groundwater levels, enabling drawdown monitoring at tubewells.
- **Tank Monitoring:** Float switches and water level transmitters provide automated control triggers for pump operations based on tank status.
- **Flow Measurement:** Mechanical flow meters (IoT-enabled) record discharge volumes and supply duration at village-level outlets.
- **Water Quality Sensors:** Residual chlorine sensors are placed at tail-end delivery points to ensure compliance with chlorination norms.
- **Valve Automation:** Electrically actuated butterfly valves manage water distribution lines per set schedules or manual overrides.
- **Pump & Energy Monitoring:** Remote Terminal Units (RTUs) include soft starter panels and energy meters that regulate pump operation and track power consumption.

2. Communication Layer

- **Data Transmission:** Sensor data are transmitted via secure MQTT protocols over 2G/4G GSM networks. In low-connectivity regions, solar-powered LoRaWAN gateways ensure seamless data relay.
- **RTU Memory:** Devices are equipped to store sensor data for up to 90 days in case of network outages, ensuring data continuity.

3. Cloud & Centralized Control System

- **AWS IoT Core:** The system processes approximately 2.5 million sensor data points daily from over 7,000 field devices.
- **SCADA Interface:** A web-based SCADA platform enables real-time visualization through mimic screens and supports both automated and manual controls.
- **Control Centres:** A central monitoring hub oversees state-level operations, supplemented by district-level control units at 22 divisional offices.

4. Monitoring, Alerts, and Control

- **Alert Mechanisms:** Threshold breaches (e.g., pump failures, chlorine under-dosing, and low tank levels) trigger immediate alerts via mobile notifications to relevant engineers.
- **Automated Scheduling:** Pumps operate based on real-time tank and groundwater levels, minimizing over-extraction and electrical inefficiencies.
- **Manual Overrides:** Local staff can manually override automated operations when necessary.
- **Energy Optimization:** Integrated energy meters allow detailed analysis of power factor, voltage, current, and overall electrical efficiency.

5. Deployment Footprint and Sensor Use Cases

- **Groundwater Level Sensors:** Track aquifer behaviour across 1,842 tubewells at 15-minute intervals, particularly in over-exploited blocks such as Moga and Patiala.
- **Chlorine Sensors:** Deployed at 589 treatment locations, ensuring adherence to residual chlorine norms (0.2–1 ppm).
- **Pressure Transmitters:** Installed at tail-end distribution points for continuous pressure monitoring and issue flagging.

6. Operational Efficiencies and Observed Impact

- **Energy Savings:** Through controlled pump scheduling and discharge tracking, the system has reduced energy consumption and prevented pump overuse.
- **Reduced Human Dependency:** Automated operations have significantly minimized routine manual interventions.
- **Pump Health Monitoring:** Electrical parameter tracking supports predictive maintenance strategies.
- **Service Continuity:** Overflow prevention and equal pump runtime distribution have enhanced equipment longevity and water supply reliability.

6. Integration with Jal Seva and Monitoring Framework

While the current IoT system operates primarily as a standalone platform for technical monitoring, data from this automation are anticipated to complement the broader **Service Delivery Parameters Monitoring (SDPM)** system. Field engineers currently use the Jal Seva mobile app to input qualitative observations such as scheme disruptions or supply feedback, which aligns with sensor-based data streams. Though Jal Seva is temporarily non-operational, field-level insights remain essential for validating sensor readings and providing a triangulated service delivery assessment.

Department Applications



Capability Matrix

Below table outlines the mapping of a Capability from DMM to the Punjab IT systems for Department.

ASSET & INVENTORY MANAGEMENT	Enabled through EPMS (PWDIMS) – covers asset tagging, eMB, and maintenance modules.
VENDOR & CONTRACT MANAGEMENT	Functional under EPMS – includes digital workflows for bidding, approvals, and contract management.
WORK ORDER, INVOICES & PAYMENTS	Digitized under EPMS – supports measurement book entries, billing modules, and workflow management.
BUSINESS INTELLIGENCE & DATA ANALYTICS	Business intelligence and data analytics do not exist.
MANAGEMENT INFORMATION SYSTEMS (MIS)	Fully implemented three-tier MIS – manual entry from the field, centralized data layer, and reporting in PDF/Excel.
LAB INFORMATION MANAGEMENT SYSTEM	Fully implemented in 33 labs – digital data entry, result validation, integration with JJM IMIS, with manual dependencies (e.g., no GPS or mobile app).
FINANCIAL TRACKING & IFMS INTEGRATION	No information is available
GIS MAPPING & GEO TAGGING	<p>Currently, no public or internal GIS-based water scheme mapping system is available within DWSS for field access or asset visualization. GIS-based interfaces are not integrated with Jal Seva, SCADA, or MIS.</p> <p>However, geotagging of the assets is going on, data on which are getting stored in the PM GatiShakti portal.</p>
SOURCE GEOLOGY	Lithological data of borewells/tubewells are not captured digitally or linked to schemes or groundwater monitoring tools. No systematic integration exists with groundwater drawdown sensors.



IOT DEVICES & SCADA

The **IoT-Based Automation System** by DWSS Punjab digitally monitors and controls rural water supply schemes across **346 sites** (897 villages, ~9.1 lakh population), with ~240 schemes fully automated by **CIMCON Software**.

Core Features:

- **Sensors:** Groundwater, flow, chlorine, pressure, and energy meters.
- **Connectivity:** MQTT over 2G/4G; LoRaWAN for low-signal areas.
- **Control:** AWS IoT Core + SCADA with central and district-level units.

Functions & Benefits:

- Real-time alerts (e.g., pump/chlorine failure, low tank levels).
- Automated pump scheduling and energy optimization.
- Reduced manual tasks and improved service reliability.

Integration Status:

- Standalone system, aligned with Jal Seva and SDPM for monitoring.
- Jal Seva app supplements sensor data (currently inactive).

BOQ & DPR GENERATION TOOLS

No data is available.

PREDICTIVE MAINTENANCE & SCHEME RISK FORECASTING

No data is available.

SOURCE SUSTAINABILITY AND AUDIT

No data is available.

HYDRAULIC MODELING

No hydraulic modelling is happening currently.

REPORTING OF GRIEVANCES

SNK is a voice-based manual grievance redressal system. There is no integration with SCADA, Jal Seva, or MIS. No digital public interface or automated routing system is present.

CAPACITY BUILDING

Internal dashboards are active under MIS; there are no publicly accessible dashboards live currently.

ROLE-BASED DASHBOARDS AND REPORTS

No chatbot or automated conversational interface is deployed for consumers, operators, or engineers on any digital platform under DWSS (e.g., Jal Seva, SCADA, SNK, EPMS).

CONTEXTUAL CHATBOTS	<p>No unified platform exists for managing the lifecycle of stakeholders (households, VWSCs, engineers) across schemes, training, billing, or grievances. Systems operate in silos (IoT, LIMS, HRMS, SNK, LMS).</p>
STAKEHOLDER LIFECYCLE MANAGEMENT	<p>Jal Seva app (for JEs) exists but is currently non-functional; there are no apps for WUCs, Gram Panchayats, or citizens.</p>
ROLE-SPECIFIC MOBILE APPS	<p>MIS & SDPM: Monitoring physical and financial progress of schemes</p> <ul style="list-style-type: none"> • LIMS: End-to-end lab water quality tracking. • EPMS: Tracks engineering estimates and project implementation. • HRMS: Staff service lifecycle management. • e-Office: Department-wide file and communication workflow.
PURPOSE BUILT DIGITAL TOOLS	<p>N/A</p>

Management Information System (MIS)

The Management Information System (MIS) implemented by DWSS serves as the digital nerve centre for tracking financial and physical progress across rural water supply schemes. Built on a three-tier architecture and hosted on the Punjab State DGGIT infrastructure, the MIS provides statewide visibility into infrastructure development and scheme performance.

Key Components - three-layer architecture:

- **Data Capture Layer:** Inputs are manually captured by field officials via Google Sheets, the Jal Seva mobile app, and web portals.
- **Data Consolidation Layer:** Data is centralized in a **PostgreSQL** database, covering asset tracking, financial flows, and project workflows.
- **Reporting Layer:** Generates downloadable reports (PDF/Excel) focused on scheme-level progress, financial utilization, and compliance metrics.



Service Delivery Parameters Module (SDPM)

The **Service Delivery Parameters Module (SDPM)** is a digital reporting tool implemented by DWSS Punjab to track key performance indicators related to rural drinking water supply schemes. It functions as part of the department's Management Information System (MIS) suite, supporting regular monitoring of scheme-level service delivery and institutional performance.

Features and Implementation Status

1. Web-Based Interface

SDPM is implemented as a web application developed using the .NET Framework, accessible to DWSS field and supervisory staff.

2. Operational Indicator Tracking

The module allows for **manual entry** of key performance indicators such as:

- Daily water supply hours
- Breakdowns and repair status
- Scheme-wise functional status
- Residual chlorine availability
- Revenue collection updates (as reported by staff)



3. Data Entry and Validation

- Field-level data is primarily entered manually by Junior Engineers and other staff at the sub-division or division levels.
- The system includes basic validation checks but currently lacks real-time integration with IoT platforms or automated devices.

4. Access and Reporting

- Role-based access allows block, division, district, and state-level officials to view and export reports.
- Reports can be filtered by scheme, village, district, or administrative boundary.
- Output formats typically include **PDF and Excel**, used for performance reviews and internal evaluations.

5. System Hosting

The application is hosted on **state-managed infrastructure**, with data stored on government-secured servers (primarily PostgreSQL backend).

Punjab's SDPM-MIS integration demonstrates the viability of standardized service delivery metrics (e.g., LPD supply, chlorine levels) for national benchmarking.

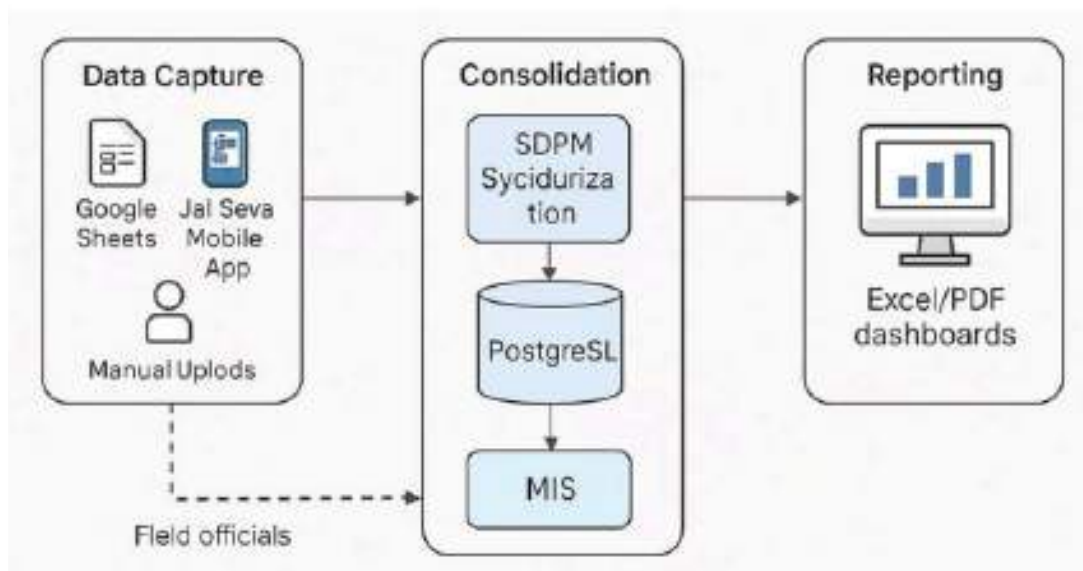


Figure 9: Integrated Management Information System (IMIS)

Lab Information Management System

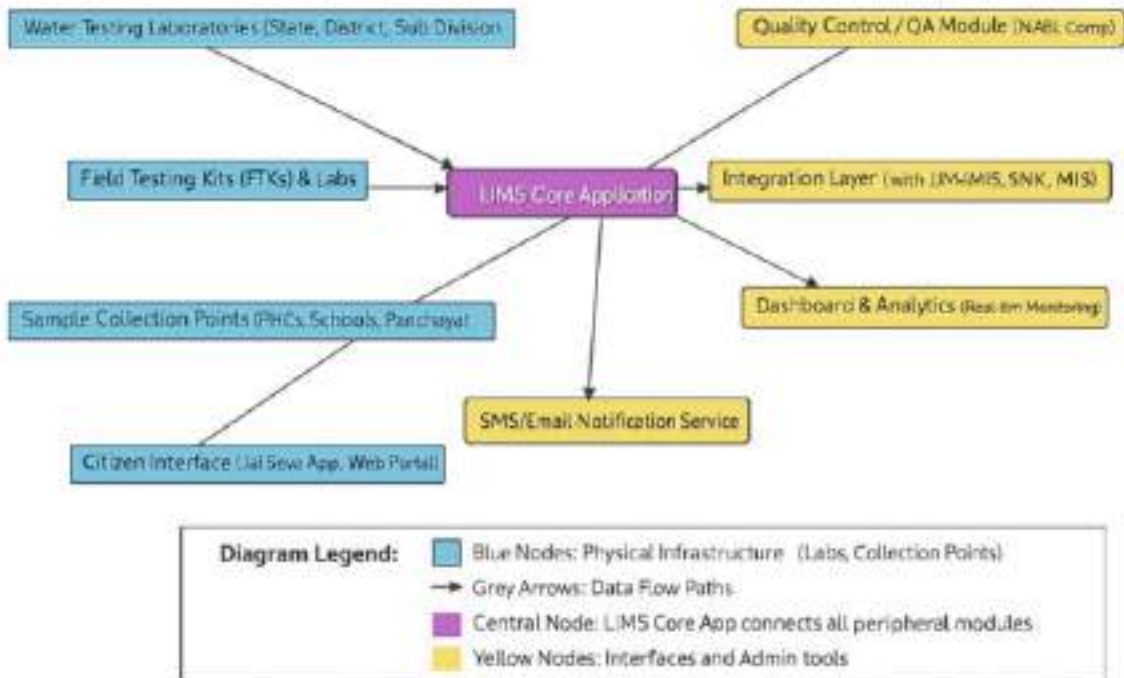


Figure 10: Lab Information Management System (LIMS)

The Laboratory Information Management System (LIMS), currently operational in Punjab serves as a centralized digital platform for managing the end-to-end water quality testing and reporting process across the state. It is an integral component of the state's compliance with Jal Jeevan Mission (JJM) norms, particularly the requirement to maintain regular and transparent water quality surveillance. LIMS is actively used by government water testing laboratories at the State and District levels, facilitating structured sample management, test result reporting, and submission to the national JJM IMIS portal.

Coverage and Laboratory Network

Punjab's LIMS is implemented across:

- 1 state-level Water Testing Laboratory
- 22 district-level Water Testing Laboratories (WQDLs)
- 10 sub-divisional and Mobile Water Testing Laboratories

As per official records, Punjab operates a total of 33 water quality testing laboratories. These laboratories are at varying stages of digital integration for sample data reporting, quality monitoring, and regulatory compliance through the LIMS platform. The system supports both chemical and biological water quality testing, with a focus on key contaminants such as arsenic, fluoride, nitrate, iron, turbidity, and microbiological parameters (e.g., coliforms and E. coli).



Figure 11: Photo of State level Laboratory

Core Functionalities

Sample Registration and Tracking

- Samples from village sources (tubewells, OHSRs, taps) are assigned a unique sample ID at the point of collection.
- Each sample record includes details such as scheme name, source type, GPS Coordinates, sample date, and collector's identity.
- Barcode labels or physical forms are manually managed and later digitized at the lab.



Figure 12: Photo describing the number of tests conducted in the State Lab

Laboratory Testing and Data Entry

- Water samples are tested at designated laboratories using standard procedures outlined by the Bureau of Indian Standards (BIS - IS 10500:2012).
- Results are entered manually into the LIMS dashboard via laboratory login credentials.
- **Parameters tested typically include:**
 - pH, turbidity, TDS, nitrate, fluoride, iron, chloride, hardness, alkalinity
 - Microbiological tests: total coliform, E. coli
- **For each test, the system records:**
 - Test value
 - Unit of measurement
 - Permissible limits
 - Pass/fail status

Result Validation and Reporting

- After data entry, the results are reviewed and digitally signed by the laboratory-in-charge officers.
- Approved results are then uploaded to the JJM Water Quality Dashboard, accessible at <https://ejalshakti.gov.in>.

Water Quality Test Reports (WQTRs) are shared with DWSS field staff for corrective action if needed.

Integration with JJM IMIS

- Punjab's LIMS supports water quality reporting.
- District-wise monthly testing targets and village coverage rates are monitored in real time through the JJM portal.

Data Accessibility and Use

- The LIMS interface is role-based, allowing access to:
 - Lab Technicians (data entry)
 - District Water Quality Coordinators (report generation)
 - State Water Quality Cell (oversight and compliance)
- LIMS-generated data is used to:
 - Monitor safe drinking water coverage in rural areas.
 - Identify priority areas for infrastructure repair or source substitution.
 - Support the Information, Education, and Communication (IEC) wing for community-level awareness on water safety.

Manual Components and Dependencies

While the LIMS forms the digital backbone of Punjab's water quality management, the system has several manual dependencies:

- Field sample collection and transportation still rely on physical forms and are not GPS-synchronized in real time.
- No mobile-based interface currently exists for sample data entry from field locations.
- Data flows from FTK (Field Test Kit) users, such as Gram Panchayat representatives, are not linked to LIMS at this stage.
- No automated alerts are generated for contamination events; all follow-ups are manually initiated based on test results.
- Laboratories maintain offline backup records to mitigate risks of server or connectivity failures.



LIMS and Water Quality Surveillance Integration

1. Results from the LIMS are fed into scheme-level dashboards for decision-making.
2. LIMS data informs planning for:
 - a. Replacement of contaminated sources
 - b. Installation of RO plants or chlorination systems
 - c. Awareness campaigns on safe water usage

Electronic Project Management System (EPMS)

EPM of PWDIMS (Public Works Department Integrated Management System) has been implemented for better monitoring of engineering works of DWSS. The module envisages covering the various processes of the State Engineering Departments, encompassing the estimate preparation based upon the CSR, electronic MB, preparation of bidding documents, and project management. The detailed functions that have been covered under this automation are as follows:

- Preparation of an estimate for administrative approval and the approval of the administrative draft proposal.
- Preparation of an estimate for technical sanction and sanction estimation management.
- Preparation of a bidding document, its approval, and project management (scheduling and monitoring).
- Preparation of NITs and their approval.
- Measurement.
- Billing management.
- Workflow management.
- Asset maintenance and management.



Different modules of the system -

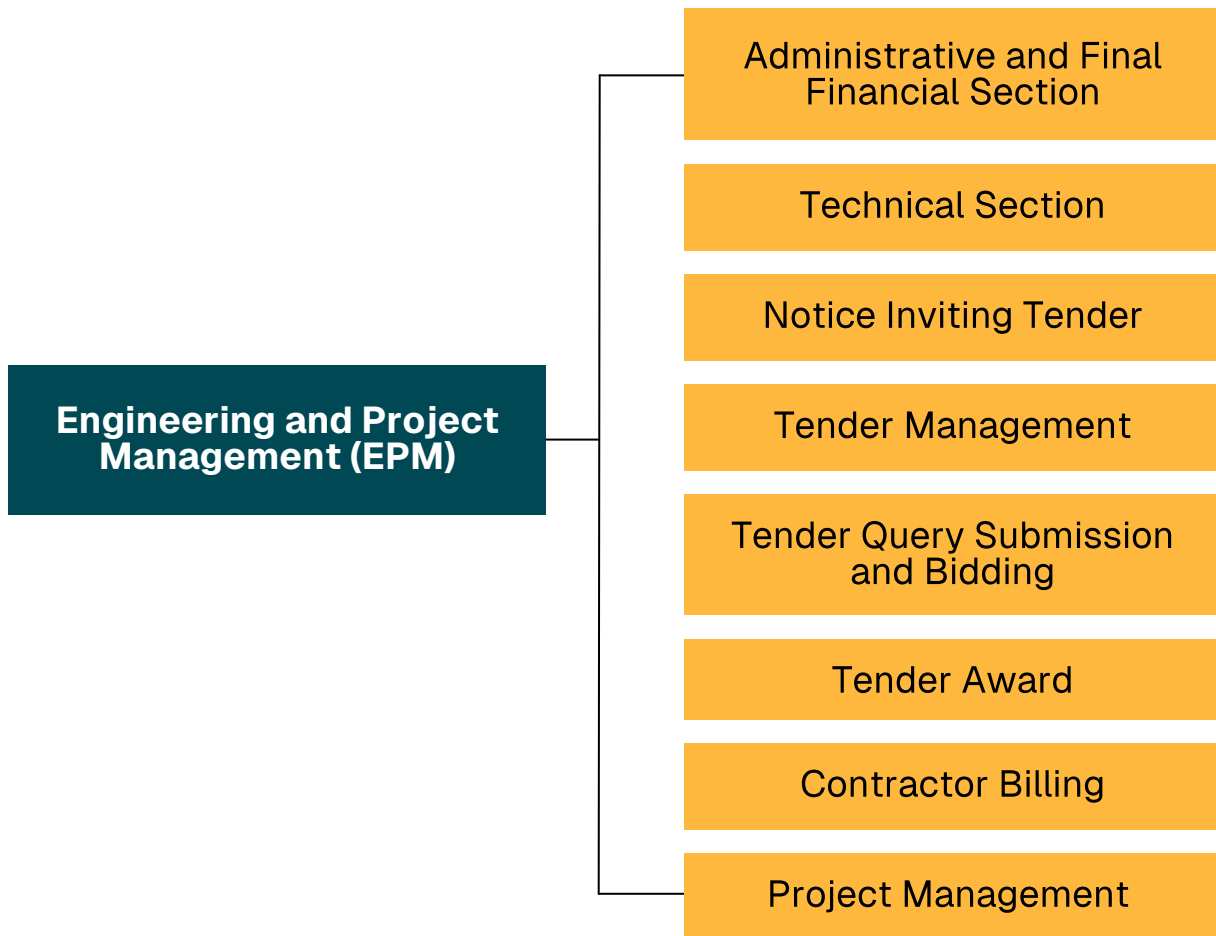


Figure 13:Functional Diagram of EPM

File Management System

An eFile is a workflow-based system that replaces the existing manual handling of files with a more efficient electronic system. This system involves all stages, including the electronic diarization of inward correspondence, the creation of files, the movement of correspondence and files, and finally, the archiving of records.

Receipts	Files
<ul style="list-style-type: none"> • Diarization – Electronic • Acknowledgement Generation • Receipt to Receipt and File Attachment • VIP Letter Tracking • Signing on remarks • Legends on priority • Advanced Search on metadata • Receipt Status Monitoring System • Closing of Receipts 	<ul style="list-style-type: none"> • File Creation – Electronic • Noting's (Green and Yellow Note) • Correspondence • Draft for Approval (DFA) • Referencing • Digital Signatures on Noting and DFA • File to File and Receipt Attachment • Linking of File & Closing of File • Advanced Search on metadata

Figure 14: Functionality of File Management System

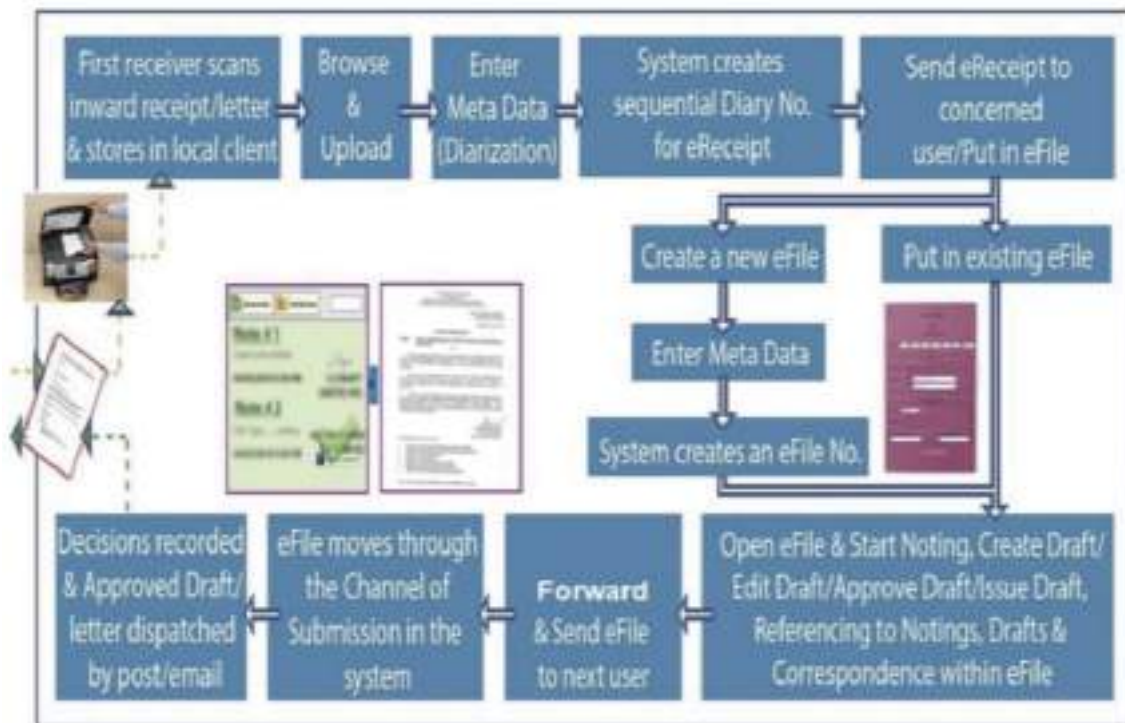


Figure 15: Workflow Diagram of File Management System

Integrated Human Resource Management System

The iHRMS (Integrated Human Resource Management System) is a web-based HR system designed and developed by NIC Punjab under the guidance of the Punjab Government to make the HR system uniform in the state, across all departments, boards, corporations, etc. This platform manages various aspects of employees through various modules, viz. service book, salary, and GPF management, etc., from service inception to service maturity.

HRMS was implemented in DWSS in the year 2017 and currently, 7024 employees are registered on HRMS. URL: <https://hrms.punjab.gov.in/>

e-Office

An e-Office is a digital workplace solution with a vision to achieve a simplified, responsive, effective and transparent working in government offices by providing a convenient way for officials to access information related to every aspect of their work and facilitating knowledge sharing through a single gateway to information and services.

The e-office software was implemented in HoD/Head Office in January 2020 and in the field offices of DWSS in July 2020. URL: <https://eofficepbstate.punjab.gov.in/>

State Functionaries



Capability Matrix

Below table outlines the mapping of a Capability from DMM to the Punjab IT systems for State Functionaries.

INTER-DEPARTMENTAL DATA EXCHANGE	There is no API-based real-time integration yet.
JOINT PLANNING & APPROVAL WORKFLOWS	Integration across departments is limited to core DWSS functions; cross-department linkages remain manual.
GRIEVANCE & FEEDBACK LOOP INTEGRATION	Grievances are managed via SNK, which operates through a centralized helpline and manual ticketing. Citizen feedback is collected but not fully digitized or integrated with mobile apps and dashboards. Plans for modernization exist but are yet to be rolled out.
JOINT TRAINING & KNOWLEDGE SHARING PLATFORM INTEGRATION	There is no dedicated digital platform for training, skill development, or inter-department knowledge sharing. Training is handled through physical workshops and circulars, with no centralized e-learning or collaboration portal.
CROSS-SECTORAL POLICY ALIGNMENT	There is no formal digital mechanism for aligning water policies with other sectors (like health, agriculture, or disaster management). Alignment occurs through manual coordination and inter-department meetings rather than a digital workflow.
CROSS-SECTOR ANALYTICS & DASHBOARDS	Cross-sectoral analytics (e.g., linking water data with health outcomes) are not yet implemented.
EMERGENCY RESPONSE & DISASTER MANAGEMENT INTEGRATION	There is no integrated digital framework for emergency response or disaster management linked with water supply operations. Emergency measures are largely manual, activated during crises through departmental instructions.

Punjab's Department of Water Supply and Sanitation (DWSS) engages in periodic data exchange with national platforms like JJM IMIS for scheme reporting and Public Financial Management System (PFMS) for financial tracking. While structured templates ensure consistency, the process remains largely manual, without API-based real-time integration. Planning and approvals are partly digitized via e-Office and EPMS, enabling electronic file movement and tracking; however, these tools are mostly confined to core DWSS workflows, with limited inter-departmental integration. Grievances are handled through the SNK centralized helpline using manual ticketing, and while citizen feedback is collected, it is not yet fully digitized or connected to dashboards or mobile applications. Joint training and knowledge sharing are still conducted through physical workshops and circulars, with no centralized e-learning or collaboration platform.

Cross-sector policy alignment and analytics capabilities are minimal, with coordination occurring through manual meetings rather than digital mechanisms, and analytics focusing solely on sector-specific data without linking to health, agriculture, or other outcomes. Similarly, there is no integrated digital emergency response framework for water supply operations, and crisis management remains a manual process triggered by departmental instructions. While DWSS leverages JJM dashboards and its internal MIS to monitor physical and financial progress, modernization plans for real-time interoperability, digital grievance handling, e-learning, and cross-sectoral integration are yet to be implemented, indicating significant opportunities for advancing towards a more robust Digital Public Infrastructure (DPI) model.



Technology Foundation

Capability Matrix

Below table outlines the mapping of a Capability from DMM to the Punjab IT systems for Technology Foundation.

UNIFIED / INTEGRATED PLATFORM APPROACH	<p>Current applications operate in silos without a unified architecture, leading to limited interoperability and fragmented data flows.</p>
MODERN TECHNOLOGY STACK & CLOUD NATIVE ARCHITECTURE	<p>Applications use mixed stacks (.NET, Java, PHP, Flutter, MS SQL), which may cause maintenance and scalability challenges.</p>
INTEROPERABILITY WITH CENTRE SYSTEMS	<p>There is limited integration with IMIS and WQMIS; partial API-level integration between LIMS and WQMIS is hindered by technical and coordination issues.</p> <p>It also integrates with platforms like PM GatiShakti to share geospatial infrastructure data (e.g., pipelines, reservoirs) for coordinated planning. It also uses PFMS for transparent financial management.</p>
API INTEGRATIONS WITH EXTERNAL APPLICATIONS	<p>Partial API integration has been attempted (LIMS–WQMIS) but progress is uneven; broader external API integration is minimal.</p> <p>JJM platforms aggregate data from IoT systems, mobile apps, and other mission portals, indicating some level of cross-system data sharing.</p>
IDENTITY & ACCESS	<p>No information is available.</p>
USE OF ARTIFICIAL INTELLIGENCE	<p>There is no evidence of AI use.</p>
SECURITY AND COMPLIANCE	<p>No information is available.</p>

Over the years, the Department of Water Supply and Sanitation (DWSS), Punjab, has developed multiple point-based automation applications to support various aspects of rural drinking water service delivery. However, these applications have largely evolved in silos, without a unified architectural vision or platform strategy. As a result, interoperability across systems remains limited, with fragmented data flows and constrained user experiences.

Integration with central systems such as the Integrated Management Information System (IMIS) and the Water Quality Management Information System (WQMIS) has also been minimal. Notably, while there has been an effort to enable API-level integration between DWSS's Laboratory Information Management System (LIMS) and the Centre's WQMIS, progress has been uneven due to technical and coordination-related challenges.

Furthermore, the department's application ecosystem is built using heterogeneous technology stacks, including platforms and languages like .NET, Java, PHP, Flutter, and MS SQL Server. This diversity adds to the complexity of maintenance, scalability, and integration, making it difficult to establish a seamless digital backbone for real-time data, service delivery, and monitoring.

To move toward a more future-ready and efficient digital infrastructure, there is a growing need to adopt a platform-oriented, standards-based approach, enabling modularity, interoperability, and alignment with Digital Public Infrastructure (DPI) principles.



Infrastructure

Capability Matrix

Below table outlines the mapping of a Capability from DMM to the Punjab IT systems for Infrastructure.

HOSTING INFRASTRUCTURE	There is a mix of on-premise servers and state data centre services. There is no unified hosting setup.
STORAGE AND DATABASES	There are multiple local databases; there is no central data lake or standardized storage architecture.
HIGH AVAILABILITY & DISASTER RECOVERY	Data is not available.
MONITORING & OBSERVABILITY	Data is not available.
SCALABILITY (HORIZONTAL & VERTICAL)	Data is not available.
BACKUP AND RECOVERY MANAGEMENT	Data backup practices exist but are inconsistent and not standardized.
NETWORKING AND CONNECTIVITY	Connectivity is inconsistent at field locations in terms of IoT devices; real-time data flow from the last mile is often affected.

The Department of Water Supply and Sanitation (DWSS), Punjab, has developed a foundational but fragmented IT infrastructure to support various operational, monitoring, and citizen-facing functions. The department maintains a combination of on-premise servers and services hosted by the state data centre, though there is limited standardization across systems. Applications and data repositories are spread across multiple environments, with no unified hosting or central data lake architecture in place. Connectivity to field locations, such as block offices or water testing labs, is often inconsistent, affecting the real-time flow of data from the last mile.

End-user devices (desktops, laptops, tablets) are available at most district and sub-division offices. However, many frontline users still rely on manual reporting or basic mobile apps with intermittent sync capabilities. Data backup practices, cybersecurity measures, and system redundancy protocols are evolving but not uniformly enforced across applications. Additionally, the department uses a mix of local databases and lacks a centralized identity and access management system, making role-based access and accountability difficult to enforce.



Conclusion

Punjab's progressive journey in digitizing rural drinking water services under the Jal Jeevan Mission marks a foundational stride towards robust Digital Public Infrastructure (DPI) adoption. The successful deployment of digital monitoring tools, online water quality management systems, GIS mapping, and the integrated Learning Management System (LMS) with iGOT exemplifies a strong commitment to building a digital backbone for essential public services. These initial deployments are pivotal steps in establishing a basic DPI for the sector, enhancing transparency and efficiency in service delivery to every rural household.

Moving forward, the strategic roadmap for fully realizing the potential of DPI in DWSS Punjab necessitates focused efforts in several key areas. A critical first step involves strengthening foundational digital literacy and ensuring ubiquitous, reliable connectivity in all rural areas, thereby democratizing access to and effective utilization of digital tools by all stakeholders, particularly at the last mile.



Simultaneously, the roadmap must prioritize rigorous data standardization and robust interoperability frameworks across all existing and future IT systems within DWSS and with external partners. This ensures seamless data exchange, eliminates silos, and enables a truly unified view of water resource management. Building secure and well-documented APIs will be instrumental in achieving this integration.

Furthermore, future phases of the roadmap should strategically focus on leveraging advanced analytics and artificial intelligence for predictive maintenance and informed decision-making. This moves beyond merely collecting data to actively utilizing it to anticipate challenges like infrastructure failures or water scarcity, ensuring proactive interventions and optimizing resource allocation.

Crucially, embedding robust cybersecurity measures at every layer of the evolving DPI is non-negotiable. As digital infrastructure becomes more interconnected, safeguarding critical operational technologies and sensitive citizen data from potential threats is paramount to maintain trust and service integrity. This also extends to integrating financial management systems to provide a holistic view of scheme sustainability.

Finally, the roadmap underscores the importance of continuous user feedback loops and agile development methodologies for all digital tools. This iterative approach ensures that the DPI evolves in direct response to the on-ground needs and challenges faced by frontline workers and rural communities, ensuring the solutions remain relevant, user-friendly, and truly impactful in achieving sustainable water security for Punjab. This comprehensive approach will cement Punjab's leadership in transformative public service delivery in the rural drinking water sector.

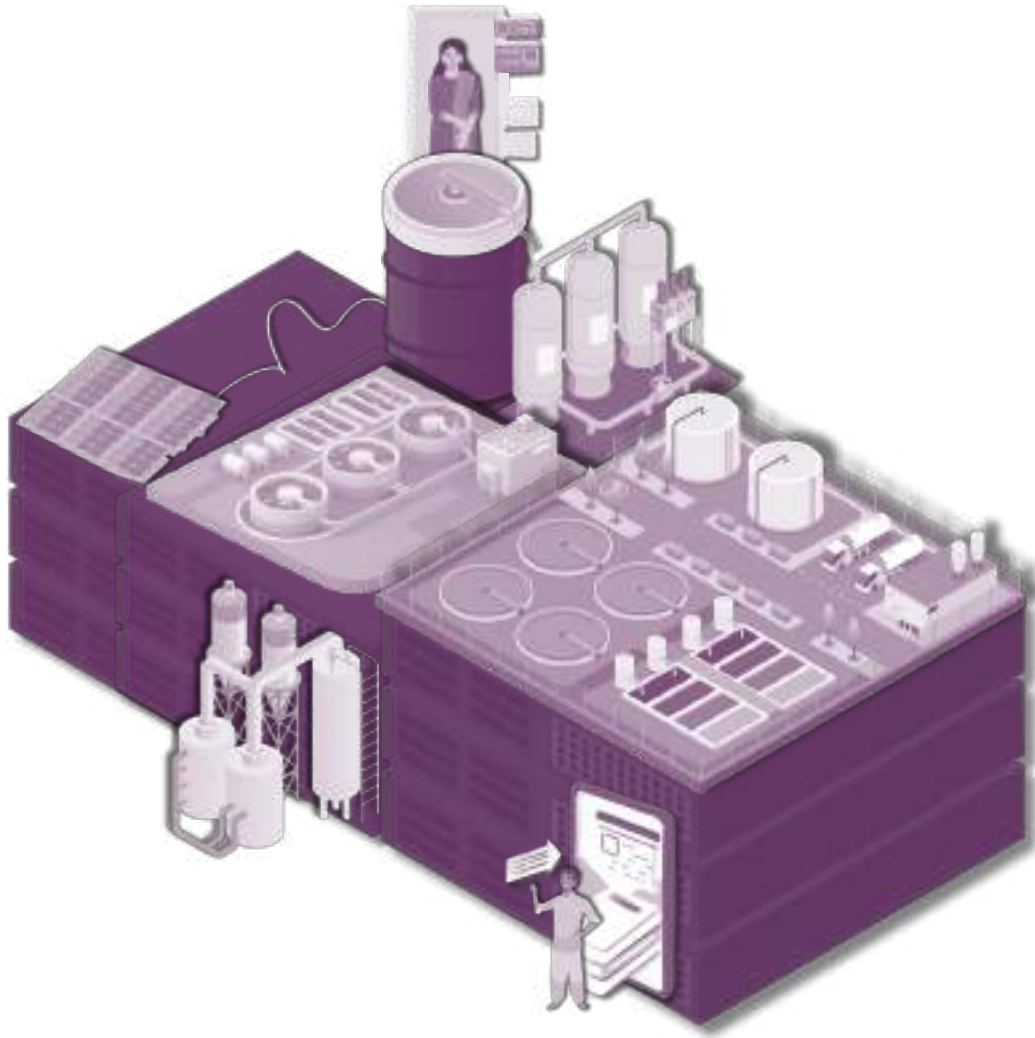
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