Building a Digital Backbone for Sustainable Water Management in Assam: A Perspective from Jal Jeevan Mission Assam

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<u>Abstract:</u>

Jal Jeevan Mission (JJM), an ambitious program launched by the Prime Minister of India on August 15, 2019, aims to ensure every rural household has a sustainable supply of safe drinking water. The National Jal Jeevan Mission (NJJM) has created foundational platforms like the JJM Management Information System (NJMMIS) and Water Quality Management Information System (WQMIS), providing essential solutions, data, and APIs for states to adopt and customize.

Assam's Jal Jeevan Mission has developed the JJM BRAIN (Building Resilient & Analytical Information Network) platform, a comprehensive water management system designed to empower local frontline workers, Water User Committees (WUCs), Gram Panchayats (GPs), and government officials. This platform utilizes real-time data, predictive maintenance tools, and decision support systems to enhance the efficiency, ownership, and accountability of water supply schemes for long-term sustainability.

This paper shares our learnings on building upon the infrastructure provided by the center from the state's perspective. The centralized infrastructure gives a leg up to all the states in the adoption of the technology tools and data infrastructure. While the center is primarily interested in the overall information on physical, financial progress and sustainability of the schemes, the states need diverse systems and processes to execute them. The well architected and designed systems can help imagine and unlock the power of technology to solve complex problems. Our learnings show that collaboration between the center and the states to define open standards, shared federated registries as a single source of truth and open published APIs that allow seamless flow of information from states to center and back with a governance framework that addresses the needs of all the stakeholders can provide autonomy and diversity to state level agencies to build diverse contextual solutions, catalyze market innovation while providing the overall information to the center.

<u>**Detailed Abstract:**</u>

Introduction

The Jal Jeevan Mission (JJM), launched across India on August 15, 2019, aims to provide safe, adequate drinking water to every rural household through individual household tap connections by 2024. This ambitious mission prioritizes water conservation, sustainable infrastructure, and active community participation, targeting a daily supply of 55 liters per person in rural households. Before the launch of JJM, only 1.6% of Assam's rural households—approximately 1.1 lakh homes—had Functional Household Tap Connections (FHTCs), placing it as the lowest among all states and far below the national average of 17% at the time. Despite this challenging baseline, according to recent data from the Jal Shakti portal, Assam has achieved a remarkable transformation with FHTC coverage now reaching nearly 72 lakh rural households(81% coverage) and aims to achieve 100% coverage by Dec 2024. This achievement is notable given the state's unique obstacles, including its diverse terrain, recurring floods, and limited awareness regarding water quality.

Successfully implementing JJM in Assam required seamless coordination among the central and state governments, local authorities, and multiple implementing agencies. This complexity posed challenges in maintaining consistent quality standards and reliable data reporting, both of which are critical for a mission of this scale. To address these needs, JJM Assam leveraged foundational tools provided by the central government, such as the Integrated Management Information System (IMIS), Water Quality Management Information System (WQMIS), and IoT-enabled platforms. These tools, combined with JJM Assam's locally developed digital solutions under the digital first policy, led to the creation of JJM BRAIN (Building Resilient & Analytical Information Network), a comprehensive platform designed to streamline the management and monitoring of rural water supply schemes, empower frontline workers, and enable real-time tracking of scheme progress.

The JJM BRAIN platform supports a robust digital ecosystem of stakeholders, including beneficiaries, contractors, Implementing Support Agencies (ISAs), and Water User Committees (WUCs). By unifying data through common registries and integrated systems, JJM Assam has not only demonstrated the effectiveness of digital solutions in water management but also surfaced critical insights regarding challenges in scalability, interoperability, data protection, and decentralized data ownership. These learnings underscore the potential for Digital Public Infrastructure (DPI) in the water sector, which can be adopted by other states to address local challenges, drive engagement, and sustain water resources for the long term.

State of JJM management in Assam (Pre-JJM BRAIN)

The implementation of Jal Jeevan Mission is funded through a 90:10 split between the central and state governments for northeastern states. While the central government focuses on monitoring the physical and financial progress of schemes, JJM Assam handles location selection, vendor coordination, stakeholder training, and community engagement. In the absence of supporting digital tools, these responsibilities were time-intensive, resource-heavy, and prone to inconsistencies due to their largely manual nature.

For instance, scheme execution and monitoring relied on physical paperwork before the advent of JJM BRAIN. Once Detailed Project Reports (DPRs) were finalized, they were submitted for Administrative Approval (AA) and Technical Sanction (TS). These approvals, granted by high-level authorities within the Mission Directorate and the Public Health Engineering Department (PHED), required multiple layers of authorization, resulting in significant delays. After approval, work orders were issued to contractors, who also encountered bureaucratic challenges, including multiple compliance checks and manual approvals that required interdepartmental coordination and extensive follow-ups. Additionally, the billing process was cumbersome and offline, leading to increased costs, time delays, and unforeseen expenses. The lack of traceability in documentation, coupled with the risk of document loss or tampering, created further obstacles.

Inconsistent data collection practices hindered effective decision-making at the state level and delayed timely interventions. Without a unified view of ongoing activities and resource needs across regions, it was challenging to ensure inter-departmental coordination, resulting in duplicated efforts and sometimes overlooked responsibilities, such as regular maintenance and infrastructure inspections. From a community engagement perspective, there was limited involvement from beneficiaries, impacting scheme sustainability due to a lack of ownership. No established system existed for ongoing water quality monitoring, nor was there a reliable method for disseminating information on contamination issues to communities.

The absence of a state-level digital system also delayed data convergence with central platforms, diminishing the effectiveness of central systems like IMIS and WQMIS. The lack of accurate, timely data inflow from the state level often resulted in reporting gaps and outdated information, reducing the transparency and responsiveness of central monitoring efforts.

JJM BRAIN: Assam's Digital Backbone for Comprehensive Water Management

To address these challenges, JJM Assam developed the JJM BRAIN platform—a system engineered for end-to-end scheme management, covering implementation, monitoring, and sustainability. Built with feedback from multiple stakeholders, the platform was developed incrementally to ensure alignment with on-ground needs and the capability of seamless data exchange with central platforms like IMIS, WQMIS, and the JJM Dashboard. JJM BRAIN's well-defined APIs facilitate data interoperability with other departmental systems, such as the Assam Power Distribution Company Limited (APDCL) and the PM Gati Shakti portal.JJM BRAIN stands out from other digital platforms due to its thoughtful design, crafted to extend its utility well beyond the mission's lifespan. By generating valuable data such as lithology and resource mapping through GIS, it provides actionable insights that benefit a range of other systems.

In its initial phases, JJM BRAIN focused on modules that addressed the practical challenges of implementation. Over time, the design evolved to include features that encourage community ownership and ensure the sustainability of water schemes. Key modules in JJM BRAIN include:

1. **Granting of Administrative Approvals and Technical Sanctions**: Streamlines approval processes to reduce bureaucratic bottlenecks, enabling efficient project initiation.
2. **Contractor Management**: This module tracks task assignments, execution statuses, and generates reports through an electronic Measurement Book (eMB) and an e-Bill submission system, facilitating timely payments and accountability in project delivery.
3. **Centralized Scheme Monitoring**: Real-time updates on project timelines, material procurement, and financial expenditures provide actionable insights for responsive management.
4. **Asset Management**: Predictive and preventive maintenance tools to minimize operational disruptions, reduce expenses, and optimize resource allocation.
5. **Performance Guarantee Management**: By tracking performance guarantees, warranty periods, and contractual obligations, JJM BRAIN ensures accountability, facilitates dispute resolution, and upholds contract compliance.
6. **Public Grievance Redressal System (Jal Kosh)**: QR code-enabled grievance submission allows community members to report issues directly, fostering transparency and timely issue resolution.
7. **Geographic Information System (GIS) Mapping**: GIS mapping allows users to visualize scheme locations and their geographical context, enhancing spatial analysis and data-driven planning.
8. **WUC Operation & Maintenance Management**: WUCs can record maintenance activities, financial transactions, and beneficiary details through the Nal Jal Seva app, ensuring transparency in scheme management.
9. **Lab Management**: Digitized lab records to streamline stock management, inventory transfer, and decision-making for water quality testing.
10. **Litholog Management**: Digitizing lithologs (soil characteristic cross-sections) to create a rich groundwater resource database to inform sustainable water use strategies.
11. **Jal Doot Program**: A novel program that empowers and digitally engages school going kids as "water champions" to spread community awareness on judicious use of safe drinking water and act as social auditors of the Pipe water supply schemes (PWSS). This initiative has been widely acclaimed and will be implemented in all CBSE schools throughout India

Roadblocks Encountered During JJM BRAIN Implementation

While JJM BRAIN introduced a digital solution to enhance water management, its implementation was not without challenges. The diversity in digital literacy among stakeholders, including Jal Mitras, WUCs, and Gram Panchayats, posed a barrier to full adoption, especially for features requiring real-time data entry or predictive maintenance. Inconsistent data inputs from less digitally savvy users compromised data accuracy and insights.

Assam's challenging terrain and poor internet connectivity in remote areas also hindered the platform's real-time functionality, limiting timely updates and restricting the effectiveness of predictive tools. Integrating legacy systems, like the Scheme Management Tool (SMT), was

complex due to incompatible data formats and standards, which delayed consolidation and prevented a unified view of water schemes.

As the platform scaled to serve more users, increased data volumes highlighted the need for performance upgrades to maintain responsiveness. Community engagement and trust remained critical, necessitating continuous outreach and education campaigns to build local accountability and trust in the platform's role in sustainable water management. Persistent issues with API and payload errors between central and state-level systems underscored the importance of efficient interoperable systems. Because of the absence of federated architecture where data ownership is decentralized, data related to water quality tests and user tariff collections is directly pushed to central systems while the state has to rely on the center to route that data back to it, reducing the effectiveness of local decision-making and sometimes causing delays.

The Way Forward for JJM BRAIN

JJM BRAIN has excelled in digitizing scheme management, reducing paperwork, and enhancing data integrity by making processes modular and easy to monitor. This shift from manual to digital operations has improved transparency and allowed timely data exchange with central systems and other departments.

As JJM Assam transitions to the Operation and Maintenance (O&M) phase, the focus of JJM BRAIN will also experience a gradual shift. The platform is set to come up with a Minor **Repairs Module** to assist Jal Mitras (scheme level operators) and WUCs in handling routine repairs through SOPs, promoting self-sufficiency in O&M activities. JJM Assam has also developed a **Five-Star Rating Framework** to monitor scheme performance, allowing officials to track ratings through dashboards and analytics tools. This framework assesses the performance of a PWSS on five parameters - Water Quality, Water Quantity, Water Regularity, Operational Sustainability and Financial Sustainability. The **Nal Jal Seva app** will facilitate community-driven tariff collection, an essential step toward financial sustainability.

Modules like **Jal Doot** and **Jal Kosh** have proven effective in engaging communities and promoting water stewardship. However, JJM BRAIN has further potential as a foundational model for Digital Public Goods (DPGs) and Digital Public Infrastructure (DPI) in the water sector, which could be scaled for use by other states.

Journey towards Digital Public Goods

JJM BRAIN's modular nature and regional customization make it an ideal candidate for DPG and DPI transformation. To achieve this, JJM Assam aims to identify key modules and adopt a "sliver approach" to develop them as DPGs, which will then serve as building blocks for DPI across states. Key considerations include:

- **Open Source code:** With an open-source framework, other states can access, modify, and build upon JJM BRAIN's digital tools and modules, allowing them to tailor functionalities to their unique requirements without starting from scratch. Additionally,

open-source code encourages collective troubleshooting and innovation. For JJM, this means faster, cost-effective scaling of reliable water supply infrastructure and streamlined processes, as well as broader stakeholder participation in achieving long-term water sustainability.

- **Decentralized Data Ownership**: Decentralized data ownership will enable JJM Assam to improve the effectiveness and responsiveness of water scheme management by allowing the state greater autonomy in managing, accessing and acting on region-specific data. This model ensures that granular, real-time data such as scheme progress, water quality updates, and maintenance records is readily available to state program managers, enhancing local decision-making while ensuring sharing of data with the center happens only for the purpose of central oversight. This shared ownership also reduces the burden on national systems preventing overload from localized transactions and telemetry.
- **Interoperable APIs with Open Standards**: The platform's design includes interoperable APIs that enable integration with both state and central systems, allowing JJM BRAIN to function as a connected ecosystem. Open standards further facilitate this interoperability, enabling smooth data exchanges and fostering cross-departmental collaborations. These standards will also allow JJM BRAIN's DPGs to be easily adopted and deployed by other states, enhancing the flexibility of water management solutions at a national level. For JJM Assam, interoperable APIs mean streamlined data sharing with national platforms, reduced redundancy, and improved resource allocation. As water management becomes increasingly data-driven, seamless integration and real-time access will be pivotal for informed decision-making and sustainable practices.
- **Improving Trust Between State and Citizens**: Building trust between the government and communities is essential for the sustainability of water schemes. When citizens trust that the government is invested in maintaining reliable water infrastructure, they are more likely to assume responsibility for scheme upkeep. Through modules like **Jal Doot** and **Jal Kosh**, JJM BRAIN allows citizens direct access to data on water quality, scheme functionality, and complaint resolutions, thereby increasing transparency and community involvement. Such initiatives reinforce the idea of shared responsibility, aligning with the vision of Digital Public Goods as tools for public empowerment and community collaboration. For JJM Assam, maintaining trust with the citizens will ensure that schemes handed over to communities are well-maintained, thereby reducing dependency on external resources and fostering a sustainable model.

Conclusion and Future Vision

JJM BRAIN has laid a solid foundation for digital water management in Assam, tackling critical challenges in data collection, scheme monitoring, and community engagement. By digitizing processes and embedding them into a centralized platform, JJM Assam has improved operational efficiency, transparency, and resource allocation in ways that were previously difficult with manual methods. However, as the mission transitions to focus more on Operation and Maintenance (O&M), the evolution of JJM BRAIN into a modular, scalable DPG for the water sector could significantly enhance its impact.

With the proposed sliver approach, JJM Assam aims to transform certain mature modules—such as Litholog, Jal Doot, and Jal Kosh—into standalone DPGs that other states can adopt and adapt to local needs. This approach will further enhance the platform's reach and reliability, positioning JJM BRAIN as a replicable, adaptable solution for sustainable water management across India. As more states leverage these DPGs, a unified Digital Public Infrastructure for water can emerge, fostering collaboration, innovation, and long-term resilience in India's water sector.

In summary, the success of JJM Assam and the JJM BRAIN platform demonstrates the importance of integrating digital tools, community engagement, and localized data ownership into water management strategies. With continued advancements, this initiative has the potential to serve as a model for DPI in water, addressing regional challenges while contributing to India's broader sustainability goals.