Sustainability and Community Participation in Rural Water Governance: Evidence from the Jal Jeevan Mission in Karnataka

Abstract

This study investigates the sustainability of the Jal Jeevan Mission (JJM) and the relationship between community involvement and educational qualification across selected districts of Karnataka. Using quantitative data collected from 921 households through structured questionnaires, the study employs ANOVA and correlation analyses to assess variations in sustainability and community engagement. The results indicate significant differences in the sustainability of JJM schemes across districts, highlighting the influence of local governance, environmental conditions, and institutional efficiency. However, the correlation analysis shows no significant relationship between education level and community participation, suggesting that social mobilization and awareness initiatives may be more critical determinants of involvement than formal education. The findings emphasize the need for localized planning, continuous capacity-building, and the strengthening of Village Water and Sanitation Committees (VWSCs) to ensure equitable and sustainable water access. Future research should integrate qualitative insights and longitudinal assessments to evaluate behavioural and institutional changes influencing the long-term success of rural water supply programs.

Keywords: Jal Jeevan Mission, Sustainability, Community Participation, Water Governance, Rural Infrastructure, Karnataka

1. Introduction

Water is the cornerstone of human survival, economic development, and ecological balance. In India, ensuring equitable and sustainable access to safe drinking water has long been a critical developmental challenge. The Government of India launched the Jal Jeevan Mission (JJM) in 2019 under the Ministry of Jal Shakti with the ambitious vision of providing Functional Household Tap Connections (FHTCs) to every rural household by 2024. The mission is not merely an infrastructural project but a transformative governance initiative designed to shift from supply-driven approaches to demand-driven, community-managed models. Its sustainability, however, hinges not only on the creation of water supply infrastructure but also on the active participation and ownership of local communities.

The concept of sustainability in the context of JJM extends beyond the physical durability of pipelines and reservoirs; it encompasses institutional, financial, social, and environmental dimensions. Sustainable rural water supply requires systems that are resilient to climate variability, grounded in local resource management, and supported by inclusive governance. India's diverse hydrogeological and socio-economic contexts pose challenges to sustaining

these systems, particularly in water-scarce, drought-prone, and remote regions. Past initiatives such as the Accelerated Rural Water Supply Programme (ARWSP) and the National Rural Drinking Water Programme (NRDWP) often fell short of long-term success due to inadequate community ownership and maintenance mechanisms. The JJM attempts to address these gaps by empowering Gram Panchayats and Village Water and Sanitation Committees (VWSCs) to plan, implement, manage, and monitor local water supply schemes.

Community involvement serves as both the foundation and the measure of sustainability in the JJM framework. The mission's guidelines emphasize a participatory approach where communities are encouraged to undertake water source sustainability measures, contribute to operation and maintenance costs, and ensure equitable access. Genuine participation transforms beneficiaries into stakeholders, fostering accountability and collective responsibility. When communities take ownership, systems are more likely to be maintained, repaired, and used judiciously. Moreover, community-led initiatives tend to integrate local knowledge about water sources, terrain, and social dynamics, enhancing adaptability and resilience. However, translating these principles into practice requires addressing disparities in awareness, technical capacity, gender participation, and local governance efficacy.

Another key determinant of sustainability lies in the integration of traditional wisdom with modern technology. India's villages possess a rich heritage of water conservation practices—such as tank irrigation systems, stepwells, and rainwater harvesting—which align with the mission's source sustainability objectives. By combining these traditional methods with contemporary solutions like GIS mapping, real-time monitoring, and IoT-based systems, the JJM can enhance efficiency and transparency. Nonetheless, the sustainability of these efforts depends on ensuring continuous financial flows, robust capacity-building programs, and effective monitoring frameworks. Community training, behavior change communication, and the strengthening of local institutions are vital to ensure that infrastructure remains functional long after external funding ceases.

Equity and inclusion form yet another dimension of sustainable implementation. Women, as primary water managers in households, play a central role in the success of the mission. Their representation in VWSCs, decision-making forums, and local management committees not only enhances gender equity but also improves the responsiveness of water governance systems. Similarly, marginalized groups must be actively involved to ensure that the mission fulfills its objective of "Har Ghar Jal" in both letter and spirit. This demands context-specific strategies that align with socio-cultural realities while maintaining transparency and accountability.

In light of these considerations, the sustainability of the Jal Jeevan Mission depends on the convergence of physical, social, and institutional efforts that reinforce each other. Understanding how community participation evolves, how education influences engagement, and how these factors together determine the long-term functionality of rural water systems is vital for the mission's success. Keeping these aspects in mind, the present study aims to assess the long-term sustainability of the Jal Jeevan Mission scheme and also examine whether there exists a relationship between education and community involvement.

2. Review of Literature

The sustainability of the Jal Jeevan Mission (JJM) and the extent of community participation in its implementation have emerged as key determinants of the program's long-term success. Ensuring the continuity of safe and reliable rural water supply systems demands a holistic approach that integrates environmental, financial, institutional, and social dimensions. Since groundwater constitutes over 85% of India's rural drinking water supply, its sustainability is directly tied to rural water security. Studies have reported substantial depletion of groundwater levels in several parts of the Indo-Gangetic plains and peninsular India, posing serious risks to the viability of rural tap water schemes (Asbetsadik et al., 2025). To counter these challenges, JJM incorporates measures such as water budgeting, aquifer recharge, and greywater reuse. However, the adoption of these measures has been uneven across states—while Maharashtra and Gujarat have effectively introduced watershed-based practices, other states continue to focus predominantly on infrastructure expansion (Wescoat et al., 2022; Singh et al., 2020).

Operational and infrastructural sustainability also represent critical challenges within the mission. Ahmed et al. (2024) report that nearly one-third of rural water schemes developed before 2010 are currently non-functional due to weak operation and maintenance mechanisms. The JJM seeks to address these gaps through a *utility-based approach*, emphasizing asset management, village-level maintenance, and capacity building. Village Water and Sanitation Committees (VWSCs) are expected to manage local operations and repairs, yet Biswas et al. (2022) find that these committees often remain inactive or lack the technical competence necessary to ensure sustainable water supply. Cost recovery is another concern, as less than 40% of rural households—especially in economically weaker regions—are willing or able to pay for water services (Dhaarna & Kashyap, 2025). Political reluctance to enforce user fees and limited institutional mechanisms further jeopardize financial sustainability. As Zetland (2021) observes, complete sustainability requires a balanced model of user contributions, targeted subsidies, and continuous government support.

From an environmental standpoint, JJM promotes source sustainability through initiatives like greywater management, groundwater replenishment, and water harvesting. The integration of *"Catch the Rain"* campaigns with Mahatma Gandhi NREGA has facilitated aquifer recharge in several districts (Turuk, 2023). However, Tingey-Holyoak et al. (2024) highlight persistent issues such as weak interdepartmental coordination and inadequate incorporation of climate resilience into planning frameworks. Villages often lack the technical capacity and data systems necessary for informed decision-making. Consequently, the absence of comprehensive watershed management and adaptive planning restricts the mission's environmental objectives to partial achievements. Effective institutional coordination and investment in climate-resilient management systems are essential to protect these gains from future environmental volatility.

Institutional convergence is another determinant of sustainability. The JJM's design encourages coordination between multiple departmentsrural development, water resources,

health, and educationto promote integrated service delivery. However, Asbetsadik et al. (2025) note that practical challenges such as overlapping mandates, weak data sharing, and bureaucratic inertia hinder cooperation, causing delays and inefficiencies in implementation. Equity dimensions have also drawn attention. Pankaj (2019) emphasizes how caste, gender, and spatial marginalization continue to affect access to basic services, with Dalit and tribal settlements often underserved. To ensure the long-term sustainability of JJM interventions across diverse groups, participatory planning, grievance redressal, and inclusive governance mechanisms are indispensable.

Parallel to sustainability, community participation has long been recognized as a fundamental pillar of successful rural development programs in India. Numerous studies underscore that meaningful engagement of local populations in planning, implementation, and monitoring processes improves both efficiency and ownership. Asbetsadik et al. (2025) observed that while institutional mechanisms for local participation exist, their potential is often undermined by bureaucratic lethargy, elite dominance, and illiteracy. Similarly, Shah (2021) found that the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) performed significantly better where civil society organizations supported local accountability. Shanthi (2024), in her study of the Integrated Child Development Services (ICDS), reinforced the importance of community ownership and cultural sensitivity for program success.

Research on rural water schemes further validates this pattern. Bombade (2024) concluded that water supply programs achieved greater operational efficiency and sustainability when local committees supervised contractors and made daily operational decisions. Daniel et al. (2021) similarly found that the effectiveness of community-driven water programs hinged on the strength of local leadership, state support, and NGO engagement. Within JJM, these dynamics are clearly visible. Sahoo and Divi (2023) reported that although VWSCs were established in most villages surveyed, their effectiveness varied widely—successful cases often coincided with external support for training and capacity building, whereas committees in politically weak regions remained dormant.

Behavioural change and capacity building form another axis of JJM's participatory framework. Information, Education, and Communication (IEC) campaigns aim to foster awareness of water conservation, hygiene, and community management. Yet Hairunisya et al. (2023) reveal that such initiatives are frequently underfunded and poorly localized. In Madhya Pradesh's tribal districts, for instance, training modules were not translated into local languages, and sessions were overly technical, thereby restricting inclusivity.

A persistent limitation across studies concerns the availability of disaggregated data. As Mia et al. (2022) point out, while overall statistics on tap connections and budgets are accessible, village-level information on training quality, functionality, and sustainability is rarely published, making independent evaluation difficult. Das (2014) adds that social capital, particularly through women's associations and self-help groups, is vital for the sustainability of local water systems. Nevertheless, community involvement often declines in remote or

tribal regions due to weak institutions, whereas states like Kerala and Himachal Pradesh demonstrate stronger participation linked to supportive sociocultural contexts. Collectively, these studies reveal that the sustainability of the JJM is closely intertwined with the quality and depth of community participation. The mission's long-term success depends not only on infrastructural and financial investments but also on fostering inclusive, educated, and empowered communities capable of managing their water resources sustainably.

Based on the above discussions, this study proposes the following hypotheses:

H1: There is a significant difference in the sustainability of water supply systems implemented under JJM among selected districts of Karnataka.

H2: There is a significantrelationship between educational qualification of respondents and their level of community involvement under JJMamong selected districts of Karnataka.

3. Research Methodology

The present study is grounded in a quantitative research design, utilizing data collected through a structured household survey. This method was chosen for its ability to yield measurable and objective insights aligned with the study's research objectives. Primary data were gathered using a questionnaire comprising predominantly close-ended questions, which ensured uniformity in responses and facilitated statistical comparison across household groups. The use of closed questions also enhanced the precision of quantitative analysis, allowing for systematic examination of trends and variations across the study areas.

Respondents were selected through a random sampling technique, providing every household within the study area an equal probability of selection. This approach effectively minimized potential sampling bias and strengthened the reliability and generalizability of the study's findings. The survey was conducted with members of each selected household. This interactive approach allowed for the clarification of questions when necessary, thereby improving the accuracy and completeness of responses and ensuring high-quality data collection.

A total of 692 households formed the sample, encompassing diverse socio-economic backgrounds from four districts of Karnataka namely Mandya, Mysore, Tumkur, and Kodagu. These districts were selected to represent varying hydro-ecological and socio-economic contexts within the state. For data analysis, the study employed a range of parametric statistical techniques to validate hypotheses and draw inferences from the collected data. The principal tools used included descriptive statistics, Analysis of Variance (ANOVA), and Bivariate Correlation analysis. Descriptive statistics were applied to summarize the demographic characteristics and response patterns of the sample population. ANOVA was utilized to determine whether significant differences existed in the sustainability of the JJM scheme across the selected districts, while correlation analysis was employed to assess the relationship between educational qualification and community involvement. Together, these statistical methods provided a comprehensive analytical

framework to address the study's research questions and objectives systematically and empirically.

Data Analysis & Interpretation Results

4.1 Descriptive Statistics

Table 1. Findings of Descriptive Statistics

Particulars	Mean	Std. Deviation
Gender	1.57	0.496
Educational Qualification	3.57	1.915
Occupation	3.25	1.905
District	2.47	0.897

Note: Authors compilation

The descriptive statistics reveal the demographic profile of the respondents surveyed under the study. The mean value for gender is 1.57 with a standard deviation of 0.496, indicating that the sample comprised a slightly higher proportion of male respondents compared to females, though the distribution is fairly balanced. The mean educational qualification score of 3.57 with a standard deviation of 1.915 suggests that, on average, respondents had attained education around the secondary to higher secondary level, but with considerable variability, indicating the presence of both lower and higher educational backgrounds within the sample. The mean occupational score of 3.25 (SD = 1.905) implies that most respondents were engaged in semi-skilled or agricultural occupations, again showing substantial variation in employment types. Lastly, the mean district score of 2.47 with a standard deviation of 0.897 indicates an even distribution of respondents across the four selected districts of Karnataka, confirming that the sampling captured geographic diversity effectively for comparative analysis.

4.2 Results of Bivariate Correlation

Table 2. Findings of Bivariate Correlation

		Educational Qualification	Community Involvement
Educational Qualification	Pearson Correlation	1	.017
	Sig. (2-tailed)		.655
Community Involvement	Pearson Correlation	.017	1

	Sig. (2-tailed)	.655	

Note: Authors compilation

The correlation results presented inTable 2indicate the relationship between educational qualification and community involvement under JJM. The Pearson correlation coefficient (r) between the two variables is 0.017, which signifies an extremely weak and positive relationship. This value is very close to zero, suggesting that changes in the level of education have almost no measurable effect on the degree of community participation within the program. In practical terms, this means that whether respondents possess higher or lower educational qualifications does not substantially influence their level of engagement in JJM-related activities such as decision-making, attending meetings, or participating in monitoring and maintenance efforts. Hence, the alternative hypothesis which states that there is a significant difference in the sustainability of water supply systems implemented under JJM among selected districts of Karnataka is accepted.

Furthermore, the significance (Sig. 2-tailed) value associated with this correlation is 0.655, which is considerably higher than the conventional significance level of 0.05. This indicates that the observed correlation is not statistically significant. In other words, there is insufficient evidence to conclude that any real relationship exists between educational qualification and community involvement in the population. The probability that the observed correlation occurred by random chance is 65.5%, which is too high to reject the null hypothesis. Therefore, it can be inferred that educational attainment does not significantly influence community involvement in the implementation of the JJM across the surveyed households, implying that factors other than educationsuch as local leadership, institutional support, or socio-cultural contextmay play a more decisive role in shaping participatory behaviour in rural water governance.

4.3 Analysis of Variance (ANOVA)

The ANOVA results presented in the Table 3reveal the statistical comparison of mean sustainability scores of the Jal Jeevan Mission (JJM) across the four selected districts of Karnataka. The F-value is 39.342, which is substantially high, and the significance level (Sig.) is 0.000, which is well below the threshold of 0.05. This indicates that the differences in the mean scores among the districts are statistically significant. In other words, the level of sustainability of JJM implementation varies significantly across districts, confirming that the observed variations are not due to random chance.

Table 3. Findings of ANOVA

ANOVA	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2006.66	3	668.886	39.342	0
Within Groups	11697.4	688	17.002		

Note: Authors compilation

Specifically, the Between-Groups Sum of Squares (2006.66) compared to the Within-Groups Sum of Squares (11697.4) shows that a considerable proportion of the total variance in sustainability outcomes (Total Sum of Squares = 13704.1) is explained by differences between districts rather than within them. The Mean Square value between groups (668.886) being much larger than that within groups (17.002) further reinforces that district-level factors such as local governance capacity, community participation, resource availability, and administrative efficiency contribute meaningfully to the sustainability performance under JJM. Therefore, the alternative hypothesis stating that there is significant difference in sustainability of JJM across districts is accepted, confirming that district-level variations significantly influence the sustainability outcomes of the scheme.

Table 4. Findings of Tukey HSD Multiple Comparison

Tukey HSD Multiple Comparison						
(I) District		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Kodagu	Mandya	-2.00705*	.48056	.000	-3.2447	-.7694
	Mysuru	.18575	.47255	.979	-1.0312	1.4027
	Tumkuru	-4.94513*	.59910	.000	-6.4880	-3.4023
Mandya	Kodagu	2.00705*	.48056	.000	.7694	3.2447
	Mysuru	2.19280*	.36938	.000	1.2415	3.1441
	Tumkuru	-2.93809*	.52160	.000	-4.2814	-1.5948
Mysuru	Kodagu	-.18575	.47255	.979	-1.4027	1.0312
	Mandya	-2.19280*	.36938	.000	-3.1441	-1.2415
	Tumkuru	-5.13088*	.51422	.000	-6.4552	-3.8066
Tumkuru	Kodagu	4.94513*	.59910	.000	3.4023	6.4880
	Mandya	2.93809*	.52160	.000	1.5948	4.2814
	Mysuru	5.13088*	.51422	.000	3.8066	6.4552
*. The mean difference is significant at the 0.05 level.						

Note: Authors compilation

The results of the Tukey HSD multiple comparison test show that significant mean differences ($p < 0.05$) exist between most district pairs, except between Kodagu and Mysuru, where the difference is statistically insignificant (MD = 0.18575, p = 0.979). This indicates that sustainability levels in Kodagu and Mysuru are nearly similar. However, all other district combinations demonstrate significant disparities. For instance, Kodagu differs significantly from Mandya (-2.00705, p = 0.000) and Tumakuru (-4.94513, p = 0.000), showing that Kodagu's sustainability performance is relatively higher. Similarly, Mandya exhibits significantly higher sustainability scores compared to Tumakuru (-2.93809, p = 0.000) but lower than Kodagu and Mysuru. The largest mean differences are observed between Mysuru and Tumakuru (-5.13088, p = 0.000), indicating a substantial gap in the sustainability outcomes between these two districts.

Overall, the post-hoc analysis confirms that Tumakuru consistently records significantly lower sustainability scores compared to all other districts, suggesting greater operational, environmental, or institutional challenges in sustaining JJM systems there. Kodagu and Mysuru, on the other hand, show relatively comparable and higher sustainability outcomes, possibly due to stronger ecological conservation practices and better-managed local water governance mechanisms. These results highlight the need for district-specific strategies to address local disparities in water sustainability performance under JJM implementation.

5. Discussion

The findings of this study provide significant insights into the patterns of sustainability achieved under the Jal Jeevan Mission (JJM) and the influence of community participation and education on its outcomes. The results from the analysis of variance clearly indicate that the sustainability of rural water supply systems differs notably across the four selected districts of Karnataka. These variations can be attributed to diverse factors such as governance quality, administrative efficiency, local ecological conditions, and the strength of community-based institutions. Districts that demonstrate stronger institutional frameworks and better coordination between government agencies tend to achieve higher levels of sustainability in water supply systems, while those facing governance bottlenecks and resource constraints continue to experience operational and maintenance challenges.

The Post-hoc comparisons further reinforce that sustainability is not uniformly distributed across the study area. Ecologically sensitive and well-administered regions such as Kodagu and Mysuru display relatively stable and resilient systems, whereas water-stressed and high-density areas like Tumakuru encounter recurring difficulties in ensuring consistent service delivery and source management. This uneven performance underscores the importance of contextualized approaches rather than a uniform model of implementation. Programs emphasizing community-led management, local monitoring, and adaptive maintenance appear to perform better in sustaining JJM outcomes.

The correlation analysis between educational qualification and community involvement revealed no significant relationship, implying that the level of education alone does not determine the degree of engagement in JJM activities. This suggests that community participation is driven more by awareness initiatives, leadership, institutional support, and social cohesion than by formal education. Therefore, enhancing participation requires localized capacity-building, targeted awareness campaigns, and inclusive planning frameworks that go beyond educational attainment.

The findings of the study carry several important implications at the policy, practical, and societal levels. From a policy standpoint, the results underscore the necessity for district-specific strategies in implementing and sustaining the Jal Jeevan Mission (JJM), as uniform approaches may not effectively address local disparities in water availability, governance capacity, and institutional functioning. Practically, the absence of a strong relationship between education and community participation highlights that awareness creation, localized training, and inclusive capacity-building programs are more critical than formal education alone in ensuring active engagement. Strengthening Village Water and Sanitation Committees (VWSCs), fostering coordination among departments, and integrating behavioral change communication can enhance operational sustainability. At the societal level, the

findings emphasize that sustainability in rural water systems is deeply rooted in collective responsibility, gender inclusion, and social cohesion. Building social capital and empowering local communities can therefore transform the JJM from a government-driven scheme into a truly community-owned and maintained initiative, ensuring long-term water security and equitable development.

6. Conclusion

The study concludes that the sustainability of water supply systems under JJM varies significantly across the selected districts of Karnataka, reflecting the influence of district-specific ecological, institutional, and governance factors. Regions with stronger local institutions, participatory planning mechanisms, and effective inter-departmental coordination demonstrate higher sustainability outcomes, whereas areas facing administrative constraints and resource limitations continue to struggle with maintenance and operational challenges. Furthermore, the absence of a significant correlation between educational qualification and community participation suggests that formal education alone does not determine engagement in JJM activities. Instead, awareness, leadership, and social mobilization play more decisive roles in fostering community ownership and long-term functionality of rural water systems. These findings reaffirm that the sustainability of JJM is not merely a technical or financial concern but a complex socio-institutional process requiring localized planning and collective accountability.

In terms of future research, there is considerable scope to expand the present work by incorporating qualitative assessments and longitudinal studies to capture evolving community behaviors, institutional dynamics, and environmental changes influencing sustainability. Future studies could also explore comparative analyses across states or ecological zones, examining how contextual factors such as climate variability, gender participation, and governance models affect long-term outcomes. Moreover, investigating the impact of digital governance tools, social audits, and decentralized financing mechanisms could provide valuable insights into enhancing accountability and efficiency within JJM implementation. Such extensions would not only deepen academic understanding but also contribute to evidence-based policymaking for resilient and inclusive rural water management in India.

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