INSTITUTIONAL DIMENSIONS OF RURAL WATER SUPPLY: INSIGHTS FROM PUMP OPERATORS UNDER THE JAL JEEVAN MISSION

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Abstract

Access to safe and reliable drinking water in rural India depends not only on infrastructure but also on robust institutional mechanisms. This study explores the *institutional dimensions of rural water supply* under the Jal Jeevan Mission (JJM), drawing insights from pump operators across six Tamil Nadu districts Dharmapuri, Kallakurichi, Perambalur, Ranipet, Tirupathur, and Tiruvannamalai. The findings reveal that all 24 pump operators are male, reflecting the complete absence of women in operational roles. Most operators (62.5%) are below 50 years, while 79% possess over 20 years of experience, indicating an aging but experienced workforce. Employment insecurity remains a major issue, with 79% serving on temporary contracts and experiencing significant salary disparities between districts. These institutional gaps irregular pay, lack of technical training, and minimal administrative support directly affect service quality and sustainability. The study concludes that achieving the goals of JJM requires strengthening institutional frameworks through job regularization, standardized wages, gender inclusion, and continuous skill development. Reinforcing the role of pump operators as key institutional actors is essential for sustainable, equitable, and efficient rural water governance in India.

Keywords: Jal Jeevan Mission, Rural Water Supply, Institutional Governance, Pump Operators, Gender Inclusion, Employment Security, Tamil Nadu, Water Management.

Introduction

Access to safe drinking water remains a major development challenge in rural India. The Jal Jeevan Mission (JJM) was launched with the objective of providing universal household tap connections, but its success depends not only on infrastructure creation but also on the effectiveness of local institutions.

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Day-to-day management of rural water systems is determined by frontline actors, particularly pump operators and village-level functionaries, whose perspectives on infrastructure availability, remuneration, and institutional support are often neglected in policy discussions. Their challenges—irregular salaries, lack of spare parts, poor training, and limited technical assistance—directly affect the sustainability of water delivery.

Existing studies highlight that governance and institutional arrangements are as important as technical inputs. Madhav (2021) found that low awareness, political interference, and limited community involvement weaken village water committees, while Jacob (2019) observed that local bodies lack financial and administrative capacities to manage water resources effectively. Rout (2014) further noted that political conflict and inadequate funding reduce the impact of JJM in rural areas. International frameworks, such as the STEER approach proposed by Pahl-Wostl et al. (2020), stress that failures in water governance are often due to poor coordination and systemic weaknesses rather than a lack of infrastructure.

At the local level, Panchayati Raj Institutions and Gram Sabhas play a central role in accountability. Evidence suggests that women leaders prioritize investments in drinking water (Chattopadhyay & Duflo, 2001; Mahi Pal, 2023), while case studies in Telangana (Jagir, 2024) show how Gram Sabhas can ensure equitable access to treated water. Yet these successes depend on the capacity of operators and technical staff to maintain systems, highlighting the need for institutional backing.

Environmental pressures such as rainfall variability and groundwater depletion (Poratim & Saha, 2023; Ghosh & Anand, 2023) add further complexity, while economic assessments demonstrate the wider benefits of effective supply, including savings in time and health expenditure (Mohanty & Wadhawan, 2023). These findings underline that reliable water access cannot be achieved without addressing the institutional challenges faced at the operational level.

Review of Literature:

Institutional and water supply:

Effective water supply in India relies heavily on strong institutional frameworks and active local governance. Programs such as the Jal Jeevan Mission aim to provide universal access, but their outcomes are shaped by community

engagement, the involvement of women leaders, and the role of Gram Sabhas and Panchayati Raj Institutions. Persistent challenges—such as political influence, limited awareness, inadequate maintenance, and climate-related pressures often hinder their success.

M. Venu Madhav 2021 explores the critical role of community participation in achieving sustainable water governance in rural India. By using a multi-stage purposive sampling method, data were collected from 224 households through structured schedules to examine awareness and involvement in local governance, particularly Gram Sabhas and Village Water and Sanitation Committees (VWSCs). The findings reveal inadequate public water supply, heavy reliance on private sources like RO plants, and limited community involvement due to low awareness, political barriers and social exclusion. The study concludes that for sustainable and equitable access to water, there is a pressing need for more inclusive governance, increased public awareness, and stronger local institutional support.

Claudia Pahl-Wostl et.al 2020 presents the STEER framework, a comprehensive and participatory diagnostic tool designed to analyse and strengthen coordination in complex water governance systems. Despite widespread adoption of Integrated Water Resources Management (IWRM), the authors argue that persistent implementation failures are due to weak inter-sectoral and multi-level coordination. The STEER approach combines theoretical insights with empirical case studies and stakeholder engagement to evaluate governance performance across variables like institutional structures, policy coherence, governance modes, and ecosystem-service interactions. Ultimately, the article concludes that transformative change in water governance requires not just technical improvements but systemic, inclusive, and context-sensitive strategies tailored to specific socio-environmental settings.

Nitya Jacob 2019 studied on evolving role of local governance in urban and rural water management in India, highlighting the limitations of both state-led top-down approaches and under-resourced local institutions. The analysis is qualitative, based on policy reviews, case studies, and observations of urban and rural water governance systems and projects across India. The chapter utilizes service level benchmarks, institutional mapping, and case study analysis, including grassroots planning tools like WUMP (Water Use Master Plan) and

community mobilization strategies. It finds that while national and state governments control water governance, local bodies lack the financial, technical, and administrative capacities to effectively manage water delivery and protection of local water bodies. Urban governance is supply-driven, inequitable, and often politicized, while rural governance suffers from technical gaps and lack of autonomy.

Rout,S(2014) found that institutional variation and poor implement in JJM scheme in rural areas were due to absence of community participation and no funds were allocated by the union government, and political influences between the ruling and the opposition parties will affect the institutional failure. It has been suggested that there should be coordination between the state and local government for implementing the JJM.

Hutchings 2018 observed that panchayat presidents must take care of the implementation of the Jal Jeevan Mission to the village water supply projects. Technology must be used to complete the projects.

Johanna Koehler et.al 2018 analysed the drinking water risk and institutional changes they used cultural theory. He tested the theory in Kenya in Africa, a sample of 3500 families were examined. The final results were the cooperative institution and panchayat have the responsibility to supply water.

Davis and Brikka (2000) analysed that poor operational and maintenance of the rural water supply system lack of equipment's materials inadequate work man ship overlapping responsibilities illegal tapping of water, inadequate training of personnel were the major reasons for the poor maintenance of water supply.

Mahi pal 2023 conducted a study in three districts in Haryana state , the study concluded that women were elected as members and chair persons at different panachayatraj institutions in the state, many of them belonging to SC/STs community the labour participation rate in rural Panchayats was 75 percent. He concluded that women have been preparing plans for economic development and providing water supply to al marginalized groups in rural areas.

Chattopadhy and Duflo 2001, a study of 150 gram panchayats in West Bengal state the objectives of the study are to provide water to the panchayats community. They concluded that women panchayats presidents invested more in pipe drinking water connection and women education.

Raabe etal 2010 by using sample of 80 Google pay app collected a sample of 966 households in 12 districts of Karnataka. He found out the effective local governance and services deliver are mainly determined by social economic and institutional factors, he suggested that women panchayat leaders must have institutional support to carry out their responsibilities more effectively.

Jay deep Sexena 2023, concluded that gramshabha should takes key decisions such as estimated demand for drinking water quantity sources and type and nature of water supply scheme, the study suggested that panchayats should act as a user free charges and people's participation in water management practices.

Bakaram Jagir 2024, explained that Gram panchayat Rangrareddy in Telangana state the gramsabha has made provisions to provide filtered water to the primary schools and the angan wade free of cost, now almost all the households in the study area are consuming safe and treated drinking water. Institutional factors play an important role in water supply.

Neelam Patel and Tanusethi 2023, analysed the water availability and estimated water demand in India for different sectors and the study suggested that water conservation and efficient management of water resources across states were required.

Tripathy 2023 he advocated that community must play an important role in participation in planning and execution of various types of water supply to the rural households in the country.

Partha Poratim and Saha, 2023, concluded that growing demand for water and depletion of water due to climate change and competitive extraction. So there for efficient and sustainable use of scarce water a resource is very important. He suggested that local institutions have to play a role in achieving water sufficient villages, a nationwide water literacy programme is the need of the hour.

Souvik Gosh and Shreya Anand 2023 concluded that increased climate variability has made rainfall pattern erratic, they suggested that the local panchayat must conserve rain water system and they must focus on watershed development scheme so that water problems can be solved.

A study by Mohanty and Wadhawan 2023, found that USD120.86 million was saved from JJM, which is estimated as the income lost per annum on account of working days spent by women in collecting water from distant sources. In

addition they can save and estimated USD, 1.34 billion per annum for reduction in medical expenditure on the treatment of water borne diseases. The JJM has also planned to create various kinds of jobs in rural areas, such as in plumbing water quality testing, community mobilization and water treatment operations.

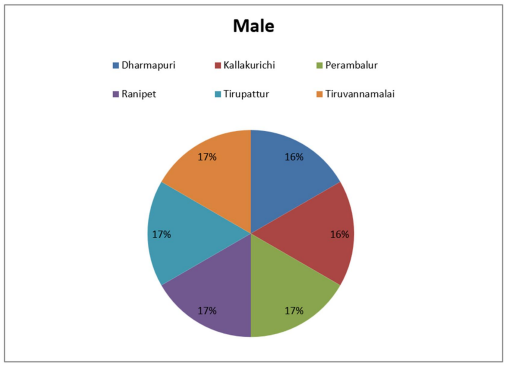
Conclusion

Research indicates that water services improve when institutions are participatory and well-supported. Achieving lasting and fair access to water requires better coordination, stronger local capacities, water conservation initiatives, and the wider adoption of successful community-led practices, alongside infrastructure expansion under schemes like JJM.

Institutional Measures:

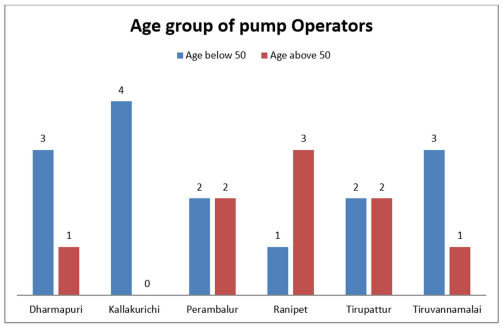
Pump Operators

Figure 1: Gender distribution of pump operators



The graph 1 presents the gender distribution of pump operators across six districts, namely Dharmapuri, Kallakurichi, Perambalur, Ranipet, Tirupathur, and Tiruvannamalai. In each district, there are four male pump operators, accounting for 16.67 percentage of the total in each case. Altogether, there are 24 male pump operators, comprising 100 percentage of the total sample. This clearly indicates that all pump operators positions in the surveyed areas are held exclusively by males, highlighting a complete absence of female representation in this occupation across the selected districts.

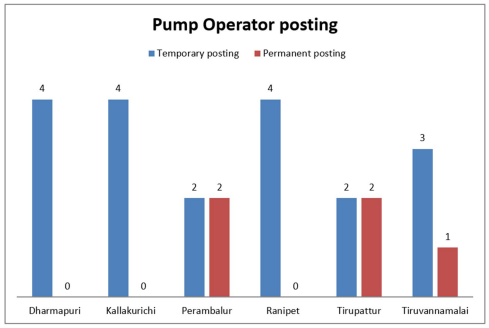
Figure 2: Age category of pump operators



The figure 2 shows the age-wise distribution of pump operators across six districts, categorized as below 50 years and above 50 years. Out of the total 24 pump operators, 15 (62.5 percentage) are below 50 years, while 9 (37.5 percentage) are above 50 years. In Dharmapuri, 3 operators (20.00 percentage) are below 50 and 1 (11.11 percentage) is above 50. Kallakurichi has all 4 operators (26.67 percentage) below 50, with none above 50.

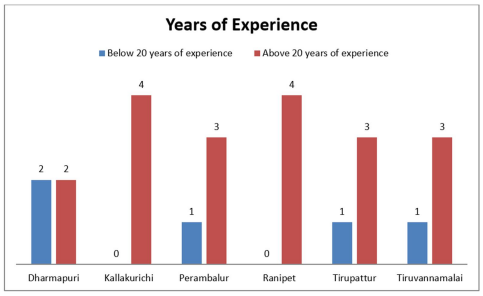
Perambalur has 2 operators (13.33 percentage) below 50 and 2 (22.22 percentage) above 50. In Ranipet, only 1 operator (6.67 percentage) is below 50, while 3 (33.33 percentage) are above 50. Tirupathur has 2 operators (13.33 percentage) below 50 and 2 (22.22 percentage) are above 50. Tiruvannamalai has 3 operators (20.00 percentage) below 50 and 1 (11.11 percentage) is above 50. This distribution reveals that a majority of pump operators are below 50 years, with a significant presence of elder operators in districts like Ranipet and Perambalur.

Figure 3: Employment status of pump operators



The figure 3 highlights the employment status of pump operators across six districts, categorized into temporary and permanent postings. Out of the total 24 operators, 19 (79.17 percentage) are on temporary posting, while only 5 (20.83 percentage) hold permanent positions. In Dharmapuri, Kallakurichi, and Ranipet, all the 4 operators in each district are employed temporarily, each contributing 21.05 percentage to the total temporary category. Perambalur and Tirupathur have 2 operators each (10.53 percentage) in temporary roles and 2 each (40.00 percentage) in permanent roles. Tiruvannamalai has 3 operators (15.79 percentage) on temporary posting and 1 (20.00 percentage) with a permanent posting. The data clearly indicate that the majority of pump operators are employed on a temporary basis, reflecting limited job security in most districts, with only a few districts like Perambalur and Tirupathur offering relatively higher permanent placements.

Figure 6.4: Experience period of pump operators



The above table presents the work experience of pump operators across six districts, divided into two categories: below 20 years and above 20 years of experience. Out of the 24 operators, 5 (20.83%) have less than 20 years of experience, while a majority of 19 (79.17%) have more than 20 years. In Dharmapuri, 2 operators (40.00%) fall

under the below 20 years category and 2 (10.53%) in the above 20 years. Kallakurichi and Ranipet have all 4 operators (21.05% each) with over 20 years of experience. Perambalur has 1 operator (20.00%) with less than 20 years and 3 (15.79%) with more. Tirupathur and Tiruvannamalai show a similar pattern, with 1 operator (20.00%) each below 20 years and 3 (15.79%) each above 20 years. The overall data indicate that most pump operators have long-term experience, suggesting a workforce dominated by individuals with over two decades of service.

Figure 6.5: Average Salary of Temporary pump operators across Districts

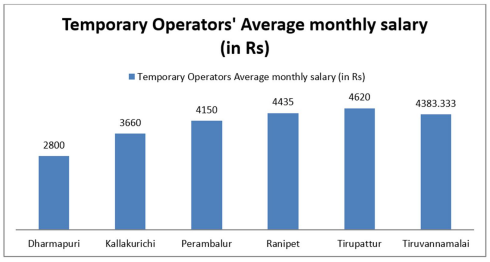
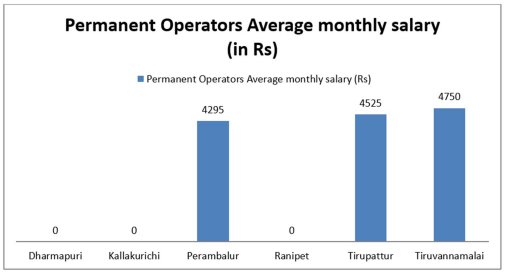


Figure 6.6: Average Salary of Permanent pump operators across Districts



The above graph presents detailed information about the average monthly salary of pump operators in six districts, distinguishing between temporary and permanent positions. A clear difference is observed in both the number of operators and the salary structure across employment categories.

In Dharmapuri and Kallakurichi, all operators are employed temporarily, earning ₹2,800 and ₹3,660 respectively. There are no permanent operators in these districts. The salary for temporary staff in Dharmapuri is the lowest among all districts, indicating relatively poor compensation for short-term workers in that area. In contrast, Kallakurichi shows a modest improvement in payment for temporary operators, though still lower than in other districts.

Perambalur provides a balanced picture with 2 temporary and 2 permanent operators. Here, temporary operators receive an average monthly salary of ₹4,150, while permanent staff earns ₹4,295. The difference of ₹145 suggests a small advantage for permanent staff, reflecting better pay linked to job security.

Ranipet, with 4 temporary operators and no permanent staff, offers an average salary of ₹4,435 for its temporary workforce, one of the highest in the temporary category. The absence of permanent staff makes direct comparison difficult, but the relatively high pay for

temporary workers may indicate higher local wage standards or additional responsibilities.

Tirupathur shows an interesting case where temporary staffs (2 operators) earn ₹4,620 per month, slightly higher than ₹4,525 received by the 2 permanent operators. This reversal of the expected trend suggests that in certain areas, temporary postings may offer competitive, even higher, remuneration possibly due to lack of benefits or longer working hours.

In Tiruvannamalai, the average salary for 3 temporary operators is ₹4,383.33, while the sole permanent operator earns ₹4,750. This district exhibits the widest gap between temporary and permanent staff salaries, with permanent employment providing ₹366.67 more per month, reflecting better compensation aligned with stability and service duration.

Overall, across all six districts, temporary staff are more in number (19 out of 24), but they generally receive lower average monthly salary compared to their permanent counterparts. The data highlight that while temporary postings are more common, permanent positions tend to offer slightly higher and more stable income, emphasizing the value of employment security in public utility roles. However, exceptions like Tirupathur point to variability in wage structures that may depend on local conditions or administrative practices.

Conclusion:

The analysis across six districts emphasizes the critical yet often overlooked contribution of pump operators in maintaining rural water supply under the Jal Jeevan Mission. Their demographic and employment characteristics reflect deeper institutional patterns within rural governance. A key finding is the complete absence of women in operational roles, which illustrates a continuing gender disparity in technical positions. While women have gained visibility in decision-making through Panchayati Raj Institutions, their exclusion at the operational level points to a persistent "gender gap" in rural service delivery.

The age and experience distribution reveals a workforce dominated by older and long-serving operators. On one hand, this ensures valuable knowledge and practical expertise; on the other, the absence of younger recruits raises concerns about generational continuity and skill transfer. Similar challenges have been identified in rural infrastructure systems, where sustainability depends on structured workforce renewal.

Employment insecurity stands out as a major constraint. Nearly four-fifths of operators work on temporary contracts, exposing them to unstable income, limited benefits, and reduced motivation. Such contractual arrangements, common in rural governance, have been shown to weaken accountability and compromise service efficiency. Salary disparities across districts further highlight uneven institutional practices, with some operators earning considerably less despite performing similar duties. These variations underscore the fragmented nature of local governance structures.

Institutional support in the form of training, monitoring, and fair compensation appears inadequate. Since pump operators form the crucial link between infrastructure and households, their effectiveness directly determines the reliability of water supply. Strengthening this frontline workforce is therefore essential for achieving the mission's goals. Evidence from rural service delivery research suggests that sustainability is not only a matter of infrastructure investment but equally of institutional strengthening and workforce stability.

In conclusion, the findings point to the urgent need to rethink the institutional framework governing pump operators. Ensuring job security, standardizing wages, promoting gender inclusion, and building operator capacity should be central to policy reforms. Addressing these institutional issues would enhance both the effectiveness of rural water supply and the long-term sustainability of the Jal Jeevan Mission.

Policy Recommendations

To strengthen rural water governance under the Jal Jeevan Mission, institutional reforms targeting pump operators are essential. Employment security should be enhanced by offering permanent or long-term contracts, reducing the vulnerabilities of temporary postings. Standardized wages across districts would ensure fairness and attract younger recruits. Gender inclusion must also extend to operational roles, with training and recruitment drives for women pump operators. Regular capacity-building and technical training would improve efficiency, while mentorship from experienced operators can address workforce renewal challenges. Finally, stronger institutional support through monitoring, grievance redressal, and timely provision of resources will enable operators to maintain reliable services. These measures, collectively, would transform pump operators from

undervalued frontline workers into key institutional actors, ensuring both sustainability and equity in rural water supply systems.

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