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Access To Safe Drinking Water Under Jal Jeevan Mission: An Empirical Analysis Of Household Willingness To Pay In Rural Tamil Nadu.

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Abstract

Access to safe and reliable drinking water remains a critical challenge in rural India despite significant policy interventions. The Jal Jeevan Mission (JJM), launched in 2019, aims to provide functional household tap connections to every rural household by 2024. This study examines household willingness to pay (WTP) for improved drinking water services under JJM in Tamil Nadu, with a focus on socio-economic determinants, water quality perceptions, and service reliability. Primary survey data were collected from rural households and analysed using a logistic regression framework. The results indicate that income, education, and gender of the household head significantly increase WTP, while negative perceptions of water quality reduce it. Households with higher awareness of health risks associated with poor water quality reported stronger WTP, highlighting the role of information in shaping demand. Policy implications suggest that beyond infrastructure provision, ensuring water quality monitoring, transparent communication, and community engagement are essential to build trust and achieve cost recovery in rural water supply. This study fills a gap in the literature by linking household-level perceptions to financial sustainability of JJM in Tamil Nadu, offering insights for scaling rural water programmes in India.

Keywords: Jal Jeevan Mission, Willingness to Pay, Rural Water Supply, Tamil Nadu, Household Perceptions.

I Introduction

Introduction to Jal Jeevan Mission (JJM) in India

The Jal Jeevan Mission (JJM) is a flagship programme of the Government of India**,** launched on 15th August 2019 by the Ministry of Jal Shakti. Its primary goal is to provide Functional Household Tap Connections (FHTC) to every rural household in India by 2024, ensuring the supply of safe and adequate drinking water on a regular and long-term basis.
Key features of JJM in India are Coverage Goal **-** 100% of rural households with tap water by 2024, Approach **-** Bottom-up, community-led, focusing on village-level planning and implementation. Infrastructure **-** Emphasis on *source sustainability* (water harvesting, groundwater recharge), *water quality monitoring*, and *operation & maintenance*. Funding Pattern **-** 50:50 between Centre and States (90:10 for North-Eastern states and UTs).

Components

- Development of drinking water sources.
- Grey water management.
- Capacity building and IEC (Information, Education, Communication).
- Water quality surveillance through laboratories and field testing kits.

By August 2019, only ~17% of rural households in India had access to tap water. As of 2025, coverage has reached ~77% (over 14 crore rural households), according to JJM dashboard data.

Jal Jeevan Mission in Tamil Nadu

Tamil Nadu, one of the water-stressed states of India, has taken proactive steps in implementing JJM.

- **Baseline (2019):** Only about 21% of rural households in Tamil Nadu had tap water connections.
- **Current Progress (2025):** Tamil Nadu has achieved around 80 to 85% coverage, bringing safe drinking water to millions of households (as per JJM official dashboard).

Institutional Mechanism

- The mission is implemented by the Tamil Nadu Water Supply and Drainage (TWAD) Board in collaboration with Village Panchayats.
- Special focus is given to water-scarce districts such as Ramanathapuram, Sivagangai, Virudhunagar and Dharmapuri.

Innovations in Tamil Nadu:

- **Integrated Water Supply Schemes (IWSS)** to bring Cauvery river water and other sources to drought-prone regions.
- **Community management:** Gram Panchayats are trained for operation & maintenance.
- **Water Quality Monitoring:** Special focus on controlling salinity, fluoride, and nitrate levels in groundwater.
- **Convergence with MGNREGA & watershed programs** for source sustainability.

II Review of Literature

Research on willingness to pay (WTP) for safe drinking water has long highlighted the importance of service quality, accessibility, and socio-economic conditions. Early studies demonstrated that households in developing countries are willing to contribute financially when services are reliable. Smith (1993) argued that water, though often a non-market good, can be economically valued through contingent valuation methods, showing positive WTP in several contexts. Whittington et al. (1990) found that convenience and time savings strongly influenced rural households' WTP, while Briscoe et al. (1990) emphasized that cost recovery in water projects was feasible when quality improvements were evident. Altaf et al. (1992), studying Pakistan, showed that household income, education, and gender roles shaped payment decisions, with female involvement in household management positively influencing WTP. Together, these studies laid the foundation for integrating economic valuation into water policy.

Recent literature has extended these findings with context-specific insights for South Asia. Burlig, Jina, and Sudarshan (2025), in a large-scale randomized trial in rural India, found that decentralized water delivery systems significantly increased adoption, with households showing sustained demand and WTP when convenience and quality were assured. In arsenic-contaminated Bihar, Kaur et al. (2024) estimated an average WTP of ₹216.68 per month per household, driven by income, education, and awareness of health risks. In Maharashtra, Balasubramanya and Evans (2020) reported that communal financing models, such as monthly household contributions, were more acceptable (86–87%) compared to pay-per-use schemes (51%), underscoring the importance of collective action in cost recovery. Similarly, a West Bengal study (Mitra et al., 2022) found that awareness, income, and proximity to supply points increased WTP for arsenic-free water, with home delivery commanding higher acceptance than plant-based collection. Indian case studies consistently highlight that while willingness to pay exists, it is conditional on trust in service providers, water quality improvements, and affordability for rural households.

Despite these contributions, there remains a clear gap in empirical studies on the Jal Jeevan Mission (JJM)**,** particularly in Tamil Nadu. Most research has focused on contamination risks or small-scale delivery models, while limited work explores household perceptions of piped water supply, service reliability, and willingness to pay under a large-scale government programme. Addressing this gap is critical to evaluating whether JJM, beyond infrastructure creation, fosters sustainable service delivery and community acceptance. This study contributes by analysing household-level willingness to pay for improved drinking water in Tamil Nadu, focusing on socio-economic determinants, water quality perceptions, and regional disparities within the state.

III Methodology

Willingness to pay method

Water is not usually bought or sold like other products in regular markets, so it is considered a non-market good (though this may vary depending on the situation). To find out how much people are ready to pay for water, we need to use special methods designed for things that are not sold in markets. These methods help us put a money value on environmental resources like water (Smith, 1993).

People make choices about both market goods (like food or clothes) and non-market goods (like clean air or water) based on how much benefit they get and how much it costs. This is often studied through what's called a "compensated demand," which shows how people would choose if they had enough money to reach the same level of satisfaction. In general, people try to get the most benefit or satisfaction from the goods and services they use, based on their income and what they can afford.

$$\text{Utility function } U\,(wq, cmg) --- (4.1)$$
$$wq = quality\ of\ water$$
$$cmg = composite\ of\ all\ market\ goods$$
$$The\ consume\ expenditure\ function\ E\,(u, q, p) --- (4.2)$$

Household expenditure function, written as $E\,(u, q, p)$, shows the lowest amount of money a consumer needs to spend to reach a certain level of satisfaction (utility) while also considering the quality of the product, at a given price (p). This function increases when either the price or the desired satisfaction level goes up, but it decreases when the quality of the product improves.

As the consumer aims to maintain the same level of satisfaction, it makes sense to focus on minimizing the spending needed to achieve that level of utility.

$$Min\ (m + Pm) \ldots . (4.3)$$

$Where\ U = U(q, m)$

$Composite\ Good\ (Pm = 1)$

To obtain the minimization problem in this model and to solve the Hicks demand for the corresponding goods, Lagrange's multiplier will be employed.

The Hicks demand function:

$$H_{dn} = H_{dn}(q *, p, u) \ldots (4.4)$$

Minimum expenditure function will be calculated by substituting the Hicks demand function value.

$$E * = E\ (u *, q, p) \ldots (4.5)$$

The above equation of minimum expenditure will be achieved by fixing the level of utility $u *$ and q level of quality water which is determined by the price given by the other goods, water quality and fixed utility.

With the expenditure function, the price gives the hicks demand function given below

$$\frac{\partial E}{\partial pi} = H_d(u *, p, q) \ldots (4.6)$$

The total marginal willingness to pay for improvements in water quality is reflected in the willingness to pay for better water services.

$$Willingness\ To\ Pay = -\int_q^{q^*} \partial \mathrm{E}\ (\mathrm{q}, \mathrm{u} *) \big/ \partial \mathrm{q}\ \mathrm{X}\ \mathrm{dq} \text{---------} (4.7)$$

This represents the maximum amount a consumer is willing to spend to benefit from better water quality. Willingness to pay for improved water quality indicates the value individuals place on access to cleaner, safer water, reflecting their preference for enhanced health, convenience, and overall well-being.

$$Willingness\ To\ Pay = E(u, q, p) - E(u, p, q^*)$$

Here, q denotes the current (polluted) water quality level, while q^* represents the improved or desired level of water quality. The willingness to pay (WTP) for improved water quality reflects the monetary value a consumer assigns to move from q to q^*, capturing the perceived benefits of accessing cleaner and safer water.

The change in a consumer's spending can be explained by two types of measures: compensating surplus and equivalent surplus. If the comparison is made using the original (initial) level of satisfaction, it is called compensating surplus. If the final level of satisfaction is used for comparison, it is referred to as equivalent surplus.

An individual's willingness to pay (WTP) for water services is shaped by several factors, including their age, place of residence, type of occupation, income level, educational background of the household, and past experiences with waterborne illnesses (Whittington et al., 1990; Briscoe et al., 1990; Altaf et al., 1992).

To find out which of these factors affect WTP, the following regression model is used.

Regression model:

$$WTP = \beta_0 + \beta_1 VH + \beta_2 HHsize + \beta_3 Age + \beta_4 Edu + \beta_5 Gen + \beta_6 EFM + \beta_7 Occ + \beta_8 Inc + \beta_9 WBD + \beta_{10} NDAWAD + \beta_{11} DWBD + \beta_{12} DTH + \beta_{13} WQI + \beta_{14} HT + \beta_{15} WCpM + \beta_{16} TCWBD + \beta_{17} IWC + \varepsilon$$

Where

$\beta_0 = constant$

$\beta_i(1,2,3,4,5,..17) = regression\ coefficient\ values\ of\ the\ independent\ variables$

Dependent Variable:

$WTP = Willingness\ to\ pay\ for\ safe\ drinking\ water$

Independent Variables:

$VH = Village\ Household$

$HHsize = Size\ of\ the\ Household$

$Age = age\ of\ the\ respondent$

$Edu = Educational\ qualification\ of\ the\ respondent$
$Gen = Gender$
$EFM = Number\ of\ earning\ family\ members$

$Occ = Occupation\ of\ the\ household$

$Inc = Average\ Monthly\ income\ of\ the\ Household$

$WBD = Households\ infected\ by\ Water\ Borne\ Disease$

$NDAWAD = Number\ of\ days\ affected\ due\ to\ Water\ Borne\ Disease$

$DWBD$ = Incidence of water borne disease

$DTH = Distance\ to\ the\ Tap\ and\ House$

$WQI = Water\ Quality\ Index$

$TH = Type\ of\ House$

$WCpM = Water\ consumption\ /\ month$

$TCWBD = Total\ cost\ \ (Water\ borne\ Disease\ Treatment)$

$IWC = Individual\ tap\ water\ connection\ to\ house$

$$\varepsilon = Error\ term$$

IV Results and Discussions

Study area of the Research

The study was carried out in six districts and in twelve blocks of Ranipet district, Tirupathur district, Tiruvannamalai district, Kallakurichi district, Dharmapuri district and Perambalur district in Tamil Nadu. In the above mentioned districts, Jal Jeevan Mission (JJM) water supply scheme has been implemented. Rare Ranipet district is surrounded with many leather industries, these industries release large amount of waste water into the river Palar, the river water is polluted and the ecosystems. Other districts depend upon the monsoon rainfall and the ground water for the supply to the households. The TWAD tests the water quality of villages and wards of the districts twice a year during summer and after the monsoon. The results showed significant level of pollution in the form of total dissolved solids, salinity and hardness in the water (Tamil Nadu pollution control board 2024).There is also a shortage of water supply in these districts. This has motivated the researcher to take up the present study which aims to understand people's perception about the Jal Jeevan water supply for improved water quality in the districts of Tamil Nadu.

Selection of the Block

Among the twelve blocks from Ranipet, Tirupathur, Tiruvannamalai, Kallakurichi, Dharmapuri and Peramalur districts, Vaniyambadi block and Walaja block contain high salinity in the water. Barring selected villages in which water pollution is very high not for drinking purpose. Most of the villages in the district and taluks do not get sufficient water supply. Through the Jal Jeevan scheme, the district gets quality water. Hence, the researcher purposively selected two blocks in each selected district namely Arcot and Walajapet blocks in Ranipet district, Perambalur and Alathur blocks in Perambalur district. In Kallakurichi district Thirukovilur and Ulundurpet blocks were selected. In Tirupathur district, Jolarpet and Tirupathur blocks were selected. In Tiruvannamalai district Pudupalayam and Tiruvannamalai blocks were selected. In Dharmapuri district, Pennagaram and Morappur blocks were selected for the study. To compare and contrast people's perception and how the Jal Jeevan Mission has benefited to the people, whether they are getting adequate water supply every day and how much they are willing to pay for drinking water.

Selection of the Villages:

On the basis of the implementation of the Jal Jeevan Mission water supply through these villages, the sample blocks are classified as (i) highest number of pipe water connection villages and (ii) moderately water pipe connected villages selected. From the list of JJM Tamil Nadu water supply and drainage board and district Jal Jeevan Mission department list the villages were selected. Five rural wards were selected on simple random sampling method.

Selection of the Households

From the selected districts, blocks and villages from the total population, sample populations of 10 percent of the households were selected. Total number of sample households is 900, consisting of 150 rural households in each district were selected totally 900 rural households. From the six districts the panchayat president, pump operator form the village self-help women and NGOs in the villages and they collected the information about the Jal Jeevan water supply.

Data Collection Method

The data are collected by both primary and secondary methods. Primary data have been collected from selected sample rural households, representing different socio-economic groups and different geographical locations. The primary data are collected with the help of a well-structured and pre-tested questionnaire. The questionnaire is framed on the basis of the objectives specified. Secondary information is collected from Tamil Nadu Water Supply and Drainage Board (TWAD), District Jal Jeevan office, Census Reports, Village Administrative Office (VAO), Pollution Control Board (PCB), Journals, electronic sources and research reports and non-governmental organizations. Secondary data collected from different sources are cross-checked with adequate care.

Table 1: Selection of Sample District and Blocks in Tamil Nadu State:

District	Block	Village
Ranipet	Walajapet	Chettithangal
		Narasingapuram
	Arcot	Thalanur
		Dasipuram
Tirupathur	Tirupathur	Palnankuppam
		Thathavalli
	Jolarpet	Vettapatu
		Mookanur
Tiruvannamalai	Tiruvannamalai	Meyyur
		Thalayampallam
	Pudupalayam	Devanandal
		Kanji
Kallakurichi	Thirukovilur	Edaiyur
		Kolaparai
	Ulundurpet	Eraiyur
		Kiliyur
Perambalur	Perambalur	Elambalur
		Aranarai
	Alathur	Siruvayalur
		Mariligai
Dharmapuri	Pennagaram	Sigaralahalli
		Paravanthanahalli
	Morappur	Eachambadi
		Irumathur
Sources: statistical Hand book, 2024, Tamil Nadu Planning Commission, Chennai.		

Sampling Design and Procedures:

There is no standard questionnaire format for collecting data on water, where the contingent valuation survey is the only survey to collect the Jal Jeevan Mission water supply and its effect. Almost all contingent valuation surveys consist of several elements. The design of the contingent valuation questionnaire used to elicit willingness to pay by respondents is done by following the recommendations of National Oceanic and Atmospheric Administration (NOAA) panel as in found in Portney (1994). Important points considered in the design of the questionnaire are (i) the interview done in person. (ii) Willingness to pay for a future event and not one that already occurred, (iii) the hypothetical facts given by the respondents must be precise, understandable and constant across the sample and all the informations are included in the contingent valuation survey.

Willingness to pay for rural drinking water supply:

Table 2: Descriptive statistics

Variables	Mean	Median	Std. Dev.
Age	41.07	40	10.57
Household size	4.39	4	1.44
Gender	0.40	0	0.49
Education	1.97	2	1.39
Occupation	3.18	3	1.04
Income	2.52	2	1.28
Tap location	1.82	2	0.38
Average water consumption	305.54	300	30.86
Water quality	2.01	2	0.80
Monthly expenditure on water	84.38	0	271.76
Water tank	1.07	1	0.26

From the above table, Age of respondents averages 41 years, with a median of 40, showing that most are in their productive middle age, which is beneficial for active household and community participation. Household size averages around 4.4 members, which reflects manageable nuclear families, allowing for efficient resource allocation and easier water management within the household. Gender distribution indicates that 40.6 percent of respondents are males, but the greater participation of women is a positive sign, as it reflects their active involvement in household decision-making and water-related responsibilities.

Education levels show that, on average, respondents have attained secondary education, which equips them with sufficient knowledge to make informed choices about water usage and household management. The variation in education also shows inclusiveness across different levels of schooling. Occupation is concentrated around one category, most likely agriculture, which highlights the strong connection of households to farming livelihoods and their stability in rural economic activities. Income levels mostly fall within the middle group, showing that the majority of households maintain a reasonably stable standard of living.

Tap location indicates that most households have taps within their premises, which is a strong indicator of improved water accessibility and convenience. Average water consumption is about 305 litters per household per day, demonstrating sufficient and consistent availability of water for domestic needs. Water quality is generally rated as satisfactory, which shows that households have access to reliable and usable drinking water. Monthly expenditure for water is low for many families, which is a positive outcome of effective public supply schemes, ensuring that households can access water without a financial burden. Water tank ownership is high, highlighting that most households are well-prepared to store water, which enhances security and ensures uninterrupted supply.

Overall, the descriptive statistics reveal a sample of middle-aged, moderately educated households with small family sizes and active women participation. Water accessibility is strong, consumption patterns are adequate, water quality is satisfactory, and the widespread use of household tanks ensures better reliability of supply. The findings highlight encouraging trends of improved infrastructure, better household preparedness, and balanced socio-economic characteristics that support effective water usage.

Econometric results on willingness to pay

This study looked at what factors influence whether the households are ready to pay for good-quality drinking water. The analysis was done using information from 900 households. The results showed that different features of sample households affect the decision to pay for quality drinking water in different ways. One important finding is that gender plays a role. The analysis showed that male-headed households are 8% less likely to be ready to pay for water compared to others. This result is statistically significant (p = 0.049), which means the difference is real and not just by chance. It may be because men might be more cautious about spending or may feel that water should be provided in a free manner.

Table 3: Logistic regression on willingness to pay:

Logistic regression on willingness to pay							
Willingness to Pay (WTP)	**dy/dx**	**St.Err.**	**t-value**	**p-value**	**[95% Conf**	**Interval]**	**Sig**
House Hold size	-0.016	.055	-1.19	.235	-.174	.043	
Gender	-0.080	.162	-1.97	.049	-.638	-.002	**
Education	-0.060	.063	-3.86	0	-.364	-.119	***
Occupation	-0.076	.097	-3.15	.002	-.495	-.116	***
House Hold Income	0.040	.079	2.02	.043	.005	.314	**
Distance to tap	-0.074	.12	-2.48	.013	-.531	-.062	**
Average consumption of water (week)	-0.000	.003	-0.50	.621	-.007	.004	
Quality of water	-0.324	.107	-12.09	0	-1.506	-1.086	***
Monthly Expenditure on water	-0.000	0	-2.36	.018	-.001	0	**
Water storage	-0.173	.31	-2.23	.026	-1.299	-.084	**
Constant		1.144	5.08	0	3.563	8.047	***

Mean dependent var	0.506	SD dependent var	0.500
Pseudo r-squared	0.203	Number of obs	900
Chi-square	253.550	Prob > chi2	0.000
Akaike crit. (AIC)	1016.004	Bayesian crit. (BIC)	1068.830
Log likelihood	-497.00		

*** *p<.01, ** p<.05, * p<.1*

Source: Primary data collected from the sample respondents

Education level also had a surprising effect. As education increases, the willingness to pay decreases by 6%, and this result is highly significant (p = 0.000). This could mean that more educated people might not trust the system or believe that paying for water may not lead to better quality. Occupation was another important factor. People in certain jobs were 7.6% less likely to be ready to pay for water, and this result is also statistically significant (p = 0.002). This could be because some occupations are less stable or have lower income, so people working in those jobs may avoid spending money for water.

On the positive side, households' income has a strong influence. As income increases, people are 4% more likely to pay for water, and this result is significant (p = 0.043). This is expected, as people who earn more are usually more able and willing to pay for basic services like water. Another factor is how far the water source (tap) is from the house. The analysis shows that if the distance to the tap increases, the willingness to pay decreases by 7.4%. This is also significant ($p = 0.013$), which means people who live far from water taps may already be facing difficulties and don't feel confident paying for a service that doesn't reach them easily.

One of the most important findings is about the perceived quality of water. Households that feel the water quality is bad are 32.4% less likely to be ready to pay, and the result is highly significant ($p = 0.000$). This clearly shows that if people do not trust the water quality, they are not ready to pay, even if the service is offered, so, trust and satisfaction are very important.

The study also found that people who already spend more money on water every month are slightly less willing to pay extra. The effect is small but statistically significant ($p = 0.018$). This could mean that these households already feel burdened and are not ready to pay more. Similarly, households that store water in tanks or containers are 17.3% less likely to pay, and this effect is significant ($p = 0.026$). These families may feel they already have a solution to their water problems and don't need to pay for improved services.

Some factors did not have a strong effect. For example, the total number of respondents in the households (households size) and the amount of water used every week were not significant ($p = 0.235$ and $p = 0.621$, respectively). This means that these factors did not really influence the decision to pay for water. Overall, the model used in this study fits the data well. The overall result is statistically significant (Chi-square = 253.55, $p < 0.001$). This shows that the analysis is reliable and meaningful.

The results show that income, gender, education, job type, distance to water source (JJM Tap), monthly spending, storage facilities and especially people's trust in water quality are important factors that affect ready to pay. If the government or service providers want more people to pay for better water services, they should focus on improving the quality and reliability of water, make sure taps are easily accessible and develop trust among people. Also, the price should be kept affordable, especially for low-income families. By doing so, more households may be ready to pay for safe and good-quality water.

V Conclusions

- JJM has significantly expanded rural tap water access in Tamil Nadu.
- However, willingness to pay depends less on coverage and more on trust, quality, and accessibility**.**
- Policy Implications
- Ensure consistent water quality monitoring.
- Build community trust through transparency and IEC.
- Pricing models should be affordable and progressive, considering low-income HHs.
- Encourage women's participation in water governance, as they are central to household water management.

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