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Economic Valuation of Safe Drinking Water: Evidence from Bonda, Assam

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***Abstract*---**Access to safe drinking water remains a critical challenge in Bonda No.1, Assam, where households rely on self-sourced water due to the absence of municipal supply. This study investigates households' willingness to pay (WTP) for improved water services and their adoption of averting behaviour strategies such as filtration and chemical treatment. Using a multinomial logistic model, the findings reveal that income significantly influences WTP, while education plays a crucial role in shaping water purification practices. Despite variations in water quality and household size, awareness of waterborne risks emerges as a key determinant of purification behaviour. The study underscores the urgent need for policy interventions, including infrastructure development, financial assistance for water treatment solutions, and community-driven awareness programs. Strengthening local governance and integrating technological advancements can further enhance water accessibility and quality, ensuring long-term sustainability.

***Keywords*---**Safe Drinking Water, Willingness to Pay, Averting Behaviour, Water Quality, Public Health Policy.

1. Introduction

Water covers nearly three-quarters of the Earth's surface and is essential for sustaining all life forms. However, increasing pollution from industrial discharge, agricultural runoff, and improper waste disposal has severely affected the quality

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of water sources. Consequently, access to safe drinking water is a critical public health challenge, particularly in developing regions (WHO, 2022).

Groundwater contamination, including nitrate pollution from fertilizers, is a widespread issue in both developed and developing countries (Townsend et al., 2003). Safe drinking water is a fundamental human necessity, and its availability is linked to improved health outcomes, economic development, and poverty reduction (World Bank, 2021). Studies indicate that a 0.3% increase in investment in safe water infrastructure can result in a 1% increase in GDP (United Nations, 2020). Moreover, access to safe drinking water can reduce waterborne disease-related mortality by up to 70% (WHO, 2022).

Inadequate access to safe drinking water has economic implications, including increased healthcare costs, reduced worker productivity, and lower school enrolment rates (Dasgupta, 2004). This issue is particularly concerning in Bonda village, Kamrup district, Assam, where the demand for potable water far exceeds supply. Rapid population growth has exacerbated the scarcity of safe drinking water, highlighting the need for an assessment of household willingness to pay (WTP) for improved water services.

The following are the major objectives of the study:

1. To estimate the willingness to pay (WTP) for improved service levels.
2. To assess the willingness to pay (WTP) for water quality improvement.

2. Literature Review

Access to safe drinking water is a fundamental human right, yet millions worldwide still struggle with inadequate supply and contamination (WHO, 2021). Research on willingness to pay (WTP) for safe water has gained importance, particularly in developing regions where infrastructure challenges persist (Khan et al., 2020). Several studies have explored the determinants of WTP, emphasizing income levels, education, health risk perceptions, and policy interventions.

Roy et al. (2004) analyzed consumer behaviour concerning water quality demand, applying the household production function theory to estimate WTP. Their findings indicate that averting behaviour provides a reliable estimate of WTP, with monthly per capita expenditure, education, and income positively influencing purification expenses. A multiple linear regression model was used to identify the determinants of WTP, confirming a positive correlation between income and investment in water purification. The study also found that consumers willing to pay for improved water services believe that better water quality enhances their well-being.

Abdalla et al. (1992) employed the averting expenditure method to assess the economic costs of groundwater degradation in Southeastern Pennsylvania. Their study revealed that household averting expenditures (AE) vary based on qualitative risk perception and contamination awareness, with higher AE in households with young children. Similarly, Abrahams et al. (2000) analyzed WTP in Georgia using a multinomial logit model, incorporating non-health-related water quality factors such as taste, odor, and appearance. Their findings show that perceived tap water risk, past contamination experiences, income, and race significantly influence consumer choice between bottled, filtered, or unfiltered tap water. Moreover, they concluded that using bottled water expenditures as an averting cost estimate could overstate avoidance costs by 12%.

Consumer risk perception significantly influences WTP. Pattanayak et al. (2019) found that households experiencing frequent contamination issues are more likely to invest in purification methods. Albrini et al. (1997) conducted a Contingent Valuation (CV) survey in Taiwan, estimating WTP based on illness attributes such as duration, number of symptoms, and illness severity. Their findings suggest that WTP increases with prolonged illness duration, higher symptom counts, and higher education and income levels. Moreover, their study compared WTP in Taiwanese households with U.S. households, using benefit transfer extrapolations adjusted for income differences.

Haq et al. (2007) studied WTP for safe water services in Abbottabad District, Pakistan, using both the Contingent Valuation Method (CVM) and the averting behaviour approach. Their results suggest that water service reliability and quality significantly impact WTP. They found that urban households exhibit a higher WTP for improved water services, while households with private water sources were willing to pay higher amounts (Rs. 51-100). Additionally, income significantly affected WTP in the lower income quartiles, while education played a major role in determining demand for safer drinking water.

Sattar et al. (2007) examined household WTP for safe drinking water in Hyderabad, Pakistan, focusing on the impact of formal and informal awareness on demand for home purification methods. Using an averting behaviour approach with a multinomial logit model, they found that formal education and mass media exposure significantly influenced WTP. Their results indicate that education of the household decision-maker is a stronger determinant of WTP than income, emphasizing the role of awareness campaigns in improving public health.

Bergstrom et al. (1996) developed a conceptual model linking groundwater quality changes to household utility. Similarly, Whitehead et al. (1998) explored the averting behaviour approach to valuing drinking water quality, reinforcing the significance of consumer choices in determining WTP.

The role of policy frameworks in influencing WTP has been widely studied. Hensher et al. (2020) emphasized that pricing mechanisms, subsidies, and public-private partnerships significantly impact consumer participation in water service improvement. Ghosh & Ray (2022) highlighted the importance of transparent governance and community trust in service providers in ensuring financial contributions for water safety. Furthermore, Ostrom (2018) suggested that decentralized water management models enhance service reliability and public trust, providing a sustainable approach to water governance.

In conclusion, WTP for safe water is shaped by economic capacity, education, risk perception, and governance structures. Future research should focus on innovative financing models, behavioural interventions, and technological advancements to improve water affordability and accessibility.

3. **Theoretical Framework**

To gauge how much households value safer, better-quality water, researchers typically turn to two theoretical pathways: the direct and indirect approaches (Abdalla et al., 1992). Together, these methods offer a window into consumer preferences and the economic decisions people make when water safety is at stake.

1. The direct approach—often termed the stated preference method—asks individuals outright how much they would pay for improved water services. This is typically done through the Contingent Valuation Method (CVM), where respondents consider hypothetical scenarios and state their willingness to pay based on perceived benefits. CVM has become a cornerstone in environmental economics and policy analysis for estimating public demand for non-market goods like water quality.
2. The indirect approach, also known as the revealed preference method, derives WTP from actual consumer behaviour related to water use and mitigation strategies against unsafe water conditions. Households often adopt coping mechanisms such as purchasing bottled water, installing filtration systems, or boiling water to avoid health risks. The expenses incurred in these adaptive measures, known as averting costs, serve as an implicit estimate of WTP for better water services. This method provides a more behaviourally grounded assessment, as it captures real-world economic decisions rather than hypothetical responses.

Model for CVM

Water is a non-market good, meaning it is not directly traded in conventional markets. As a result, non-market valuation methods are necessary to estimate individuals' willingness to pay (WTP) for improved water services. These methods attempt to assign a monetary value to the benefits society derives from using such resources. People value both market and non-market goods, weaving these preferences into the fabric of their utility. With limited budgets as their boundaries, consumers juggle the quantity and quality of what they consume, striving to craft the most satisfying blend of goods and services.

The utility function $U(q, z)$

q = water quality

z = composite of all market goods

The expenditure function $e(p, q, u)$

The expenditure function captures the minimum spending needed to achieve a target utility (U). It climbs as prices (P) or desired satisfaction (U) rise, yet falls when the quantity of goods (q) increases—balancing cost, desire, and availability in the consumer’s quest for optimal utility. Since consumer want to stay with the same utility, it is appropriate to use

Expenditure minimisation problem.

Min $(z + Pz)$ s.t $U = U(q, z)$ where price of composite goods are equal to one ($Pz = 1$).

The above minimisation problem can be solved using Lagrange's multiplier to obtain Hicksian demand for the corresponding goods.

The Hicksian demand is given by:

$$h_j = h_j (p_q, u^*)$$

Minimum expenditure function can be calculated by substituting the values of corresponding Hickisian demand in the minimum expenditure function:

$$e^* = e^* (p, q, u)$$

Here, e represents the minimum expenditure required to attain a fixed utility level u by consuming water of quality q. The expenditure function depends on the prices of other goods, the fixed utility u, and the water quality q itself. The derivative of expenditure function with respect to price gives corresponding Hicks Compensated demand function for good under consideration.

$$\partial e / \partial p_i = h_i (p_q, u^*)$$

WTP for the change in water services is the integration of marginal TP to achieve water quality from q to q^*

$$WTP = -\int_{q}^{q^*} \partial e (q, u^*) / \partial q \, dq$$

WTP is the maximum amount of money consumer would give up in order enjoy an improvement in quality. The willingness to pay for the improvement in quality is

$$WTP = e (p, q, u) - e (p, q^*, u)$$

Where, q is a degraded level of quality and q^* is an improved level of quality. Changes in expenditure can be viewed through two lenses: compensating surplus and equivalent surplus. When the baseline is the initial utility level, the difference reflects the compensating surplus—the amount needed to maintain original satisfaction amid change. Conversely, if the baseline shifts to the final utility level, the difference captures the equivalent surplus—the value of moving to the new state of well-being.

Willingness to pay (WTP) is influenced by various factors such as income, wealth, household education level, and distance from existing water sources, as noted by Whittington et al. (1990), Briscoe et al. (1990), and Altaf et al. (1992). To analyze these determinants, a multivariate regression model is used.

$$WTP_i = \beta_o + \beta_1 (H_i) + \beta_2 (D_i) + \beta_3 (S_i) + u_i$$

Where:

WTP_i = Households' willingness for continuous and potable water supplies,
H_i = Households characteristics (Highest education level of the HH, income level of the HH),
Di = Number of dependents in the Households,
Si = Households source of water tap, well, fetch from far].

MODEL FOR AVERTING BEHAVIOUR APPROACH

In response to unreliable water quality, consumers often take proactive steps—like installing water filters or using purification chemicals—to shield themselves and secure safer drinking water. These actions contribute to utility indirectly by enhancing health, which, in turn, affects overall well-being. For instance, boiling or filtering water not only provides immediate consumption benefits but also supports long-term health improvements. In the classic averting behaviour model, pioneered by Courant and Porter, these protective actions shape the utility function mainly by affecting health outcomes (Abrahams et al., 2000). This framework highlights the subtle but powerful ways averting behaviors indirectly enhance consumer well-being.

We considered a consumer with a utility function:

$$U(X, H, A, Q) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

Here X represents composite market good, H the health production function, A the averting behaviors (such as installing filters or using purification chemicals), and Q the quality of drinking water. The utility function satisfies $UA>0$ and $UQ<0$, meaning utility increases with averting behaviour—particularly when actions like filtering improve water taste—while it decreases with declines in water quality caused by pollution. Healthy time is generated according to the health production function HHH, which depends on these factors.

$$H = H\,(A, Q; M, K, D) \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

Where, the mitigating behaviour (e.g. doctor visits, medicine) is denoted by M, health capital as K and human capital as D. Mitigating behaviour happens only after someone gets sick, so it doesn't affect how effective averting behavior or water quality is in maintaining health. Because of this, the interaction effects between mitigating behavior and averting behavior or water quality are considered zero—that is, H_{AM}, $H_{QM} = 0$.

The health production function is twice differentiable, with $HA<0$ indicating that health decreases as averting behavior increases—reflecting diminishing returns to such efforts. Conversely, $HW>0$ shows that health improves with better water quality. Importantly, averting behavior and water quality act as imperfect substitutes, each contributing uniquely to health outcomes. By substituting the health production function into the utility function, we obtain a comprehensive expression of utility that depends on a composite commodity, leisure, averting behavior, and pollution—capturing the complex interplay between consumption, behavior, and environmental quality.

$$U = U\,[X, H\,(A, Q), A, Q] \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

Consumers face a budget constraint for market goods and a cost function for the production of healthy time. Income is a function of time spent in the labour market:

$$Y = w\,[T - H] \quad \ldots \quad \ldots \quad \ldots \quad \ldots \; (4)$$

Where Y is income, w is the wage; T is total work time available. The cost equation is the sum of expenditures on composite good X and averting strategies:

$$C = X + P_A\,A \quad \ldots \quad \ldots \quad \ldots \quad \ldots \; (5)$$

Where $P_A = 1$ and P_A is the market price of averting strategy:

$$P_A = P_A + wt_A \quad \ldots \quad \ldots \quad \ldots \quad \ldots (6)$$

Here P represents the market price and t denotes time spent conducting the behaviour. Equating the income and cost equations yields the full income budget constraint:

$$wT = X + P_A + wH(A, Q) \quad \ldots \quad \ldots \quad \ldots \quad (7)$$
$$Y = C$$

The consumer faces the following problem:

$$\text{Max } U = U[.] \text{ s.t } Y = C \quad \ldots \quad \ldots \quad (8)$$

First-order conditions for utility maximisation can be derived from LaGrange function:

$$L = U[X, H(A,Q), A, Q] + \lambda[wT - X - P_A A - wH(A,M,Q)] \quad \ldots \quad \ldots (9)$$

Assuming second-order conditions are satisfied, the first-order conditions for maximum are:

$$L_X = U_X - \lambda = 0 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (i)$$
$$LA = U_H H_A + U_A - \lambda(P_A + wH_A) = 0 \quad \ldots \quad \ldots \quad (ii)$$
$$L_Q = U_H H_Q + U - \lambda w H_Q = 0 \quad \ldots \quad \ldots \quad \ldots \quad (iii)$$
$$L\lambda = wT - P_X X - P_A A - P_M M - w - wH(.) = 0 \ldots \quad \ldots \quad \ldots (iv)$$

Rearranging first-order condition (ii) yields the averting behaviour condition for the utility maximum:

$$\text{ii)} \quad (U_H H_A + U_A)/\lambda - wH_A = P_A + wt_A$$

Whereas the right-hand side of equation (ii) shows its marginal costs, the left-hand side of equation (iv) shows the marginal gains of preventing conduct. People will keep acting in averting behaviour until the overall market and time expenses connected with these activities equal the combined value of healthy time, the marginal advantage of avoiding actions, and the opportunity cost of healthy time. The pay rate seems on both sides of equation (ii), so its exact influence on preventing conduct is unknown. The balance between the time needed to stop operations and the marginal productivity of such actions determines the total effect. Should water quality and mitigating conduct be inadequate substitutes, a quality improvement will lower the marginal utility of avoiding activity. We derive the required quality condition for realising utility maximisation by reorganising the first-order condition in equation (iii).

$$(U_H H_Q + U_Q)/\lambda - wH_Q = 0 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (v)$$

Individuals will avoid pollution until the sum of the marginal value of healthy time, the marginal value of quality and the opportunity cost of healthy time is equal to zero. The first order conditions can be solved for the averting behaviour function:

$$A^* = A^*(P_A, w, Q) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (10)$$

The impact of the pay rate on averting behavior remains uncertain, as salary levels influence both the overall cost of avoidance actions and the opportunity cost of sick time. While higher wages increase the cost of sick leave—potentially encouraging more averting behavior—they also raise the cost of engaging in such behaviors, which could discourage their adoption. Similar dynamics apply to the trade-offs between leisure and mitigating behavior. To capture these relationships, we construct the indirect utility function by substituting the optimal levels of averting and mitigating behaviors, along with leisure, back into the utility function.

$$V = V(P_A, PM, W, Q) \quad \ldots \quad \ldots \quad \ldots \quad (11)$$

The above indirect utility function is decreasing in the prices and increase in the wage and quality. Totally differentiating the indirect utility function yields:

$$dV = V_{PA}\, dP_A + V_W\, dw + V_Q\, dQ \quad \ldots \quad \ldots \quad (12)$$

The total derivative of quality is:

$$dV/dQ = V_W (dw/dQ) + V_Q \quad \ldots \quad \ldots \quad \ldots (13)$$

Holding utility constant, the marginal value of a change in water quality is again:

$$WTP_Q = dw/dQ = -v_{Q/}\lambda \quad \ldots \quad \ldots \quad (14)$$

Since, at the maximum utility level, first-order condition (iii) can be interpreted as the marginal utility of pollution:

(iii) $V_Q = (U_H - \lambda w) H_Q + U_Q = 0$

and since the first-order condition for averting behaviour (ii) can be expressed as:

(ii) $U_H - \lambda w = (\lambda P_A - U_A)/H_A$

Substitution of (ii) into (iii) yields the marginal value of quality:

$$VQ/\lambda = P_A(H_Q/H_A) - (U_A/\lambda)(H_Q/H_A) + U_Q/\lambda \quad \ldots \quad \ldots \quad (15)$$

The study shows that the marginal value of quality is larger in circumstances where there is collaborative manufacturing of an averting good and the marginal utility of environmental quality is non-zero than in cases when there is no joint production and the marginal benefit of quality is zero. When pollution rises under joint production, it triggers an increase in averting behavior, which consequently diminishes the marginal value of environmental quality. This interaction means that, with joint production and a non-zero marginal utility of quality, the marginal value of environmental quality cannot be accurately gauged using only the production function and market prices. By inserting the optimal values of avoiding behaviour $A*(.)$ and market goods $M*(.)$ into the health production function and thereafter performing a complete differentiation to get the marginal value as shown below.

$$dH = H_Q\, dQ + H_A\, dA^* \quad \ldots \quad \ldots \quad \ldots \quad (16)$$

Dividing the total differential by dQ yields the total derivative for the effect of quality on health

$$dH/dQ = H_Q + H_A\,(dA^* /dQ) \quad \ldots \quad \ldots \quad \ldots \quad (17)$$

The total effect of pollution on healthy time (HQ) comprises a direct effect—the marginal impact of pollution on HQ—and two indirect effects: the product of the marginal effect of averting behavior on HQ and the marginal effect of pollution on averting behavior. Multiplying both sides of equation (17) by the wage rate www yields the opportunity cost of illness, capturing the economic value of lost healthy time due to pollution.

$$w\,(dH/dQ) = w\,[H_Q + H_A\,(dA^* /dQ)] \quad \ldots \quad \ldots \quad \ldots \quad (18)$$

This expression shows with averting behaviour in the choice set the opportunity cost of illness is smaller since $H_A\,(dA^* /dQ) > 0$. Rearranging the total differential:

$$dH/dQ - HA\,(dA^* /dQ) - H_M\,(dM^* /dQ) = HQ \quad \ldots \quad \ldots \quad \ldots \quad (19)$$

Multiplying by the first-order condition (iii)

(iii) $(U_H + U_A)/\lambda - w = P_A / H_A$

$$[dH/dQ - H_A\,(dA^* /dQ)]\,[(U_H + U_A)/\lambda - w] = P_A\,(H_Q / H_A) \quad \ldots \quad \ldots (20)$$

and since $P_A = H_A\,[U_H + U_A / \lambda - w]$; from first order conditions (iii) and (iv)

$$WTP_Q = -P_A\,(H_Q / H_A)$$

$$= -(dH/dQ)\,(U_H + U_A)/\lambda + w\,(dH/dQ) + P_A\,(dA /dQ) \quad \ldots \quad \ldots \quad (21)$$

The marginal willingness to pay for quality is the sum of the non-market value of The analysis considers the disutility of non-healthy time, the aesthetic value of quality, the opportunity cost of illness, and the expenditures on averting behavior following optimal adjustments to changes in water quality.

4. Situation Analysis in Bonda

Bonda is a village located in the Chandrapur Block of Kamrup district, Assam. The study was conducted in Bonda No. 1, a region specifically chosen due to the absence of a municipal water supply, compelling residents to rely on their own water sources. The area has an estimated population of 2,300, comprising approximately 700 households. For this analysis, a random sample of 60 households was selected, with each household serving as a sample unit.

Various explanatory variables were considered for the study. One key indicator was the **source of drinking water**. Respondents were asked whether they had access to their own water source. The survey revealed that **86.6% of households** had their own water sources, primarily in the form of **ring wells** located within their premises as shown in Table 1. The remaining **13.3%** of households lacked personal wells and depended on a nearby spring for their water needs.

Another critical explanatory variable was **the highest level of education in the household**, which was used in both the Contingent Valuation Method (CVM) and the Alternative Binary Model (ABM). Educational levels were categorized into five groups: **illiterate, matriculation, higher secondary, graduate (B.A.), and postgraduate (M.A.)**. The percentage distribution of the sampled households across these categories was **0%, 8.3%, 11.6%, 56.6%, and 23.3%,** respectively (Table 1).

Table 1. Distribution of Households and their Percentages

Category	SUBCATEGORY	NOT WTP	WTP < 100	WTP 100-150	WTP > 150	TOTAL	PERCENTAGE (%)
Income (INR)	1,000 - 8,000	2	10	1	0	13	21.66
	8,100 - 12,000	0	1	39	2	42	70.00
	12,100 - 16,000	0	0	1	4	5	8.33
Education Level	Metric	1	3	1	0	5	8.33
	Higher Secondary	1	4	1	1	7	11.66
	Bachelor's (B.A.)	0	4	27	3	34	56.66
	Master's (M.A.)	0	0	12	2	14	23.33
Water Source	Own Water Source	0	5	41	6	52	86.66
	Fetch from Distance	2	6	0	0	8	13.33
No. of Dependents	2	0	3	8	2	13	21.66
	3	2	7	30	4	43	71.66
	4	0	1	3	0	4	6.66

Another crucial indicator was household income, which was categorized into three quartiles: Q1 (₹1,000–₹8,000), Q2 (₹8,100–₹12,000), and Q3 (₹12,100–₹16,000). The distribution of households across these income groups revealed that 21.6% fell within the lowest quartile, 70% belonged to the middle-income group, and only 8.3% were in the highest income bracket.

Additionally, the number of dependents in a household emerged as a significant factor influencing willingness to pay. The survey indicated that 21.6% of households had two dependents, while the majority, 71.6%, had three. A smaller proportion, 6.6%, had four dependents, highlighting variations in household structures and financial responsibilities.

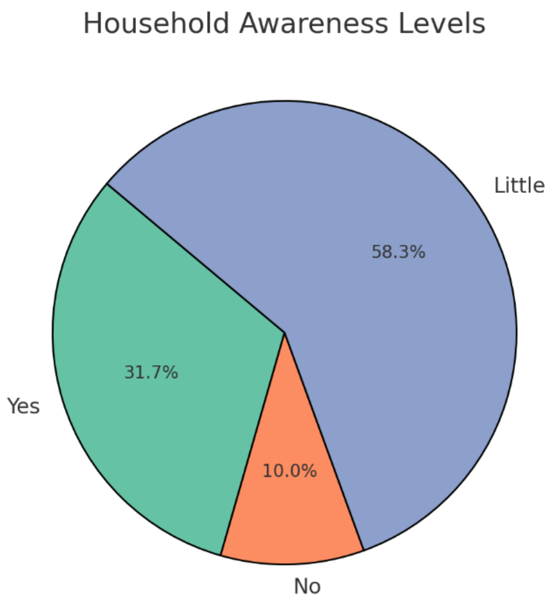

Figure 1. Percentage Distribution of Households according to awareness and quality

Awareness of the health risks associated with consuming polluted water was another key indicator. Respondents were categorized based on their level of knowledge: well-informed, unaware, or possessing only limited awareness. The survey revealed that 31.66% of respondents were fully aware of the harmful effects of contaminated water, while 10% had no knowledge at all. A significant portion, 58.3%, had only a limited understanding of the potential health risks (Fig 1).

Perceptions of drinking water quality also varied among households. About 35% of respondents expressed dissatisfaction due to an unpleasant taste or odor in their water supply. Additionally, 31.6% were concerned about the water's appearance, while 33.3% reported issues with both its taste and visual clarity.

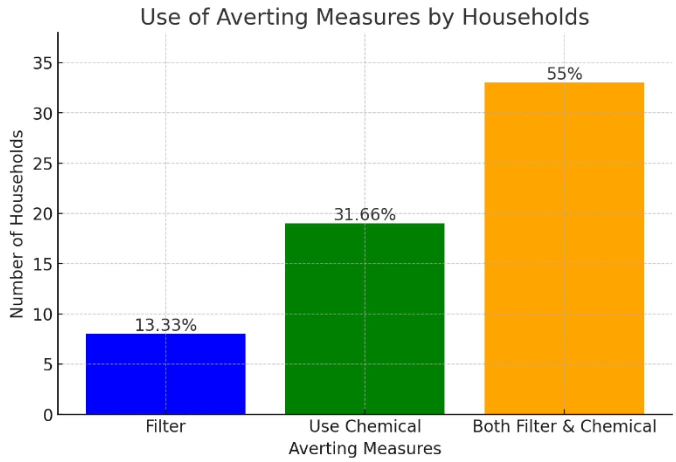

Fig 2. Use of averting measures by the households

The survey revealed that all respondents were well aware of the importance of safe drinking water and the risks associated with consuming polluted water. This awareness was reflected in their adoption of safe drinking water practices, with 100% of respondents following some form of water purification. The most common method was a combination of filtration and chemical treatment, used by 55% of households. Additionally, 13.3% relied solely on filtration, while 31.6% used only chemical treatment (Fig 2).

To assess people's willingness to pay (WTP) for improved water services, responses were categorized into four groups: those unwilling to pay, those willing to pay between ₹1–100, those willing to pay between ₹101–150, and those willing to pay more than ₹150 per month.

5. Empirical Results

5.1. *Contingent Valuation Model*

The multinomial logistic model was used to assess the impact of independent variables on the dependent variable, willingness to pay (WTP), which was classified into four distinct groups. The first category included households willing to pay ₹100 or less for improved water services. The second group consisted of households willing to pay between ₹101 and ₹150, while the third category comprised those willing to pay more than ₹150 per month for enhanced water services.

Table 2. Likelihood Ratio Tests

Effect	-2 LOG LIKELIHOOD OF REDUCED MODEL	CHI-SQUARE	DF	SIG.	SIGNIFICANCE
Intercept	6.284a	0.000	0	.	—
Income	41.823b	35.539	6	.000	**Significant** ($p < 0.05$)

Effect	-2 LOG LIKELIHOOD OF REDUCED MODEL	CHI-SQUARE	DF	SIG.	SIGNIFICANCE
Education	17.062b	10.777	9	.291	Not Significant
Water Source	18.981b	12.697	3	.005	**Significant** ($p < 0.05$)
Dependents	18.014b	11.729	6	.068	Not Significant
Quality	5.580b	3.958	6	.682	Not Significant
Awareness	7.168b	5.546	6	.476	Not Significant

It was observed that household income has a direct and statistically significant impact on willingness to pay (WTP) for improved water services. Higher-income households exhibited a greater willingness to pay, suggesting increased awareness and rational decision-making among those with higher earnings. Conversely, the level of education did not demonstrate a significant effect on WTP. This indicates that regardless of educational attainment, households' willingness to pay remained unaffected by varying levels of education.

Most households had their own water sources, while those without direct access relied on external sources for daily water needs. The availability of a personal water source significantly influenced WTP, as households without direct access were more inclined to pay for improved services.

The number of dependents in a household—categorized as two, three, or four—was considered an explanatory variable. However, it did not have a statistically significant effect on WTP, suggesting that household size does not influence the willingness to invest in better water services (Table 2).

Additionally, factors such as water quality—characterized by unfavourable taste, smell, or appearance—did not significantly impact WTP. Similarly, awareness of the health risks associated with consuming polluted water showed no statistically significant correlation with willingness to pay for improved services (Table 2).

5.2 *Averting Behaviour Model*

Similar to the Contingent Valuation (CV) model, the Averting Behavior Model employs a Multinomial Logistic approach to analyze the impact of various explanatory variables on household choices for water purification methods. The dependent variables in this model include filtration, boiling, and chemical treatment, reflecting the different strategies adopted by households to ensure safe drinking water.

Table 3. Likelihood Ratio Tests

Effect	-2 LOG LIKELIHOOD	CHI-SQUARE	DF	SIG.	SIGNIFICANCE
Intercept	14.171	0.000	0	—	—
Dependents	19.939	5.769	4	.217	Not Significant
Education	27.887	13.716	6	.033	**Significant**

Effect	-2 LOG LIKELIHOOD	CHI-SQUARE	DF	SIG.	SIGNIFICANCE
Income	31.001	16.830	4	.002	**Significant**
Water Source	21.448	7.277	2	.026	**Significant**
Awareness	28.358	11.838	4	.019	**Significant**
Quality	17.178	0.658	4	.956	Not Significant

The empirical findings indicate that education plays a crucial role in determining water purification strategies. Higher levels of education are associated with a greater likelihood of adopting multiple purification methods, suggesting that education influences public decision-making regarding averting behaviours (Table 3).

Income also exhibited a statistically significant impact on the adoption of safe drinking water measures. This suggests that households with higher incomes are more likely to invest in multiple purification techniques, reinforcing the link between financial capacity and health-conscious behaviour.

In contrast, the number of dependents in a household and the perceived quality of water showed no significant effect on the adoption of purification methods. This implies that variations in household size and water quality do not directly influence a household's decision to implement additional water safety measures.
However, demographic factors collectively had a notable impact on the adoption of purification techniques. Furthermore, awareness of the harmful effects of consuming polluted water was found to be statistically significant, indicating that informed individuals are more likely to engage in preventive behaviours to ensure safe drinking water.

6. Conclusion

The existing drinking water system in Bonda No. 1 is neither reliable in terms of service delivery nor adequate in quality to meet household needs. This study evaluates the willingness to pay (WTP) for improved water services and examines household-level averting behaviours to enhance water quality. The findings reveal that both water service reliability and quality are highly valued, as households not only express a willingness to pay for better services but also actively adopt purification measures to improve drinking water safety.

The study highlights that income has a statistically significant impact on WTP, with higher-income households demonstrating a greater willingness to invest in improved water services. Additionally, the source of water plays a crucial role in determining WTP, as households with access to inadequate water sources are more inclined to pay for reliable alternatives.

Regarding averting behaviour strategies—such as the use of filters, chemicals, or a combination of both—the study finds that education significantly influences water purification practices. Households with higher levels of education are more likely to adopt multiple purification techniques. Furthermore, income has a strong effect on the adoption of these strategies, with financially stable households investing more in water purification methods. The source of water, whether from private wells or external collection points, also plays a crucial role in shaping household purification behaviours.

Another key finding is the impact of awareness levels on water purification behaviour. Households with greater knowledge of the risks associated with consuming polluted water are more likely to adopt preventive measures. Awareness campaigns could thus serve as a crucial intervention in promoting safer water consumption practices.

To enhance water security and improve livelihoods, it is crucial to strengthen public water infrastructure, ensuring reliable and safe drinking water access. Subsidized water purification technologies, such as affordable filters and chemical treatments, should be promoted, particularly for low-income households. Public awareness campaigns must be intensified to educate communities on the health risks of contaminated water and the benefits of improved services. Implementing income-based tariff structures can make improved water services more accessible while encouraging responsible usage. Community participation should be fostered through local water management committees and partnerships with NGOs and private sector players. Additionally, investing in research and technological innovations, including decentralized water treatment solutions, can provide sustainable and cost-effective water purification methods. These policy measures collectively aim to improve water quality, public health, and overall socio-economic well-being.

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