Willingness to Pay for Safe Drinking Water: A Case of Shiradhon Village, Dharashiv District, Maharashtra, India

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***Abstract*—Water is an indispensable element for all living organisms. Human beings are fulfilling the need through the available water sources that includes wells, rivers, streams, lakes, reservoirs etc. In recent years diminishing water quality affecting human health is common in both urban and rural areas. Present study is aimed to understand the willingness to pay for safe water in the rural settlement of Shiradhon village in Osmanabad district, Maharashtra, India. Contingent Valuation Method (CVM) is a survey-based technique used to assess the willingness of the people for safe drinking water. Conferring to results, health status of the people of selected area revealed that 34% of the people suffered from diarrhoea within last 4 months. Survey showed that 80% people has taken primary school education, and the income of families are ranging between Rs. 5000 to 20000 per month. The water quality tests were showing presence of nitrates, high TDS and E-coli in the well water samples. The poor health status due to unclean water has strong correlation to the willingness to pay (WTP) for safe drinking water. Individuals with low income and large number of populations with only primary education were also willing to pay for the drinking water. Over 90% of consumers expressed WTP for better water quality and regular supply. The study highlights health status, monthly income, and education as key determinants of WTP, offering valuable insights for decision-making to enhance drinking water access in Shiradhon village, located in the water- scarce district of Maharashtra.**

***Index Terms*—Safe water, Willingness to Pay, Water quality, Well water, Jar Water, Health**

I. INTRODUCTION

Water is the most vital resource for the human development, and it is location specific and non-tradable entity. However, the safe and clean water is basic necessity to all human beings, since it directly relates with the health like common illness, and diarrhea. In 2020, around 1 in 4 people did not have access to safely managed drinking water at home (WHO-UNICEF JMP Report 2021). In 2022, about 2.2 billion people still lacked access to safely managed water services representing roughly 28% of the global population (UNICEF Drinking Water Data Portal). Similarly, the global estimate reveals 1.8 billion people are drinking unsafe water (Edokpayi et al., 2018). The governments in developing nations have often subsidized supplies, typically in an attempt to achieve social and health benefits for low-income households both in urban and rural areas (Van Houtven et al., 2017). Access of improved water resources is basic challenge for low rural settlements and around 663 million people in the world are deprived of safe water (WHO/UNICEF 2015). Ensuring universal and equitable access to safe and affordable drinking water is therefore one of the commitments of the Sustainable Development Goals (SDGs) (United Nations 2014).

India being developing country having high population (>143 Cr.) and the growing economy needs water for its major sectors such urbanization, industry and agriculture. The uneven topography, geology and climate had led to create water stress conditions in various parts. Similarly, it is expected that India will become a moderate water scarce country by 2050 and the water demand is going to be as high as 22% by 2025 and 32% by 2050 (Amarasinghe et al., 2007). In India, around 85% of drinking water relies on groundwater, which is increasingly overexploited, posing serious risks to agriculture, food security, livelihoods, and economic sustainability (World Bank

Report, 2012)

As per NITI Aayog 2018 report, Water quality of both surface and groundwater is diminishing in past few years and shows around 70% of the water is polluted. Drinking water dependency is around 85% in rural areas however 60% irrigation needs completed from it. As per CGWB 2024 report, the groundwater contamination is nearly 30% in the samples collected for survey and it was showing higher concentration levels of nitrate (19.8% of samples), fluoride (9.04%), arsenic (3.1%), uranium, iron, chloride and high salinity. India is currently ranked 120 among 122 countries in the water quality index. In 2018, 44% of India's rural population lacked access to improved drinking water located on premises, underscoring the urgency of the Jal Jeevan Mission's goal to provide safely managed drinking water to every rural household. (Study Report: WHO, 2023).

Considering the need for drinking water the major challenges associated in rural areas are lack of access to the resources and disease burden which leads to a poverty trap (Kaliba et al., 2003). Therefore, it is an immensely important to understand and measure household demand for access to safe drinking water and its quality in the rural areas (Van Houtven et al., 2017). The value of improve drinking water quality in the rural area is expected to influence by their risk perceptions and the severity of health risks associated with consuming contaminated water. Since the quality and accessibility are main challenge of rural areas, present study aims to address the 'willingness to pay' (WTP) in rural area of Maharashtra for improved drinking water facilities and quality. The WTP is depending on diverse socio-economic factors and personal choice (Van Houtven et al., 2017). Hence, the objectives of the study were assessing water quality for potability and survey through contingent valuation method (CVM) for understanding willingness to pay
.
The present study area i.e. Shiradhon, is a village in the drought-prone Tuljapur block of Osmanabad district, Maharashtra, having semi-arid climate leads to water scarcity itself make the study important for decision makers to understand awareness level towards water quality and to pay for the service to get safe drinking water.

II. STUDY AREA

Shiradhon is a small village located in Tuljapur block of Osmanabad district, Maharashtra with total household (HH) 185 and the population is about 1200 in year 2019-2020. Geographically the village is located at Latitude 17.9990663 and Longitude 76.0061133, and the height from the mean sea level (MSL) is 552.7 m. Tuljapur is the nearest town to Shiradhon which is approximately 20km away. Total geographical area of the village is about 594.37 Ha. Fig 1A showing India Map and Maharashtra State, 1B is the Osmanabad district boundary however 1C is the village map showing HH in Shiradhon village.

III. METHODOLOGY

This study has used mixed methodology-based research i.e. both quantitative survey method and qualitative assessment of drinking water parameters. Initially the population divided into smaller subgroups as strata and then a random sampling from each stratum had been carried out. Hence, one-fourth of the households from total 185 villages i.e. around 50 HH were selected for this study. In addition, social hierarchy has also considered include 17 respondents from SC category, 15 general category, 14 OBC category and 4 from ST category were selected.

In the next step a questionnaire consisting of the demographic status of the people (Social category, Economic Category, Occupation and Education level), information about the water source (type of water source, distance travelled from water source, current status of water supply which includes hours of supply, reliability, water quality and satisfaction), the health status of people and WTP for safe drinking water facilities were asked to the respondents. Face- to-face interview of the HH head were conducted.

To understand willingness to pay for the safe drinking water a contingent valuation method (CVM) used in this study (Whittington et al., 1990; Ahmed et al., 2005; Akter et al., 2008; Khan et al. 2014). A diverse socio-economic factors and personal choice is the base for the assessment of WTP (Van Houtven et al., 2017). Across the questionnaire, two types of questions were

asked. The first, open- ended, directly asked about the maximum amount that he/she is willing to pay for the proposed water supply improvement. The second question relates to the different prices or cost for setting up treatment facility. Reason for having these two question formats is to see whether respondents react similar regardless of type of asked question.

For the assessment of physico chemical and biological parameters a Water Quality Field Test Kits (WQFTK) is used. HANNA HI73127 instrument measuring automatic pH, EC, TDS and Temperature parameters of the water samples.

Figure 1A: Showing India Map and Maharashtra State. Figure 1B: Osmanabad district boundary

Figure 1C: Village Map of Shiradhon.

IV. RESULT AND DISCUSSION: DEMOGRAPHIC

The active participation or involvement of women during questionnaire was seem to be less due to rural traditional issues, hence male respondent number was high as compared to women.

Total 50 number of HH survey and its social, economic, occupational and educational categories are represented in following Tables no. 1 to 5. It has observed that the family size is as large as 15 members observed in only one household however 1-5 members are generally present in about 62% of sample. There are only 8% people belong to schedule tribe whereas 30% are general 28% are OBC and 34% are belong to schedule class. Below poverty line percentage is almost 68% i.e. large number of people are either agriculture labourer (62 %) or having small farms (34 %) and only 4% are employed from the sample survey. In the study village, average household income is 20,000 per month. It is evident that farming and wage work were the major occupations. According to the education profiles of respondents show that 80% had gone to primary schools and only 10% completed their secondary school or graduation.

Table 1: Family Size

NO. OF FAMILY MEMBER	PERCENTAGE
1-5	62 (N=31)
6-10	36 (N=18)
11-15	2 (N=1)
TOTAL	100 (N=50)

Table 2: Social Category

SOCIAL CATEGORY	PERCENTAGE
GENERAL	30 (N=15)
OBC	28 (N=14)
SC	34 (N=17)
ST	8 (N=4)
TOTAL	100 (N=50)

Table 3: Economic Status

ECONOMIC CATEGORY	PERCENTAGE
APL	32 (N=16)

BPL	68 (N=34)
TOTAL	100 (N=50)

Table 4: Occupation

OCCUPATION	PERCENTAGE
FARMER	34 (N=17)
LABOR	62 (N=31)
EMPLOYMENT	4 (N=2)
TOTAL	100 (N=50)

Table 5: Education

EDUCATION	PERCENTAGE
PRIMARY	80 (N=40)
SECONDARY	10 (N=5)
GRADUATE	10 (N=5)
TOTAL	100 (N=50)

V. ASSESSING PREFERENCES FOR DRINKING WATER

The preferences for drinking water are based on the accessibility, economic status and awareness about water quality. Study showed that 58% (N=29) respondents use well water for drinking purpose, 14% (N=7) respondents use supplied piped water for drinking purpose and 8% (N=4) respondents are used both supplied piped water and well water. It is observed that the dependency and accessibility of groundwater is comparatively higher in the village. Rest 16% (N=8) respondents were using well water and jar (J1) water for drinking purpose, similarly 4% (N=2) respondents were using well water and jar (J2) water for drinking which they rely as safe.Jar (J1) is the water from water treatment plant located within the village, whereas the Jar (J2) water is coming from outside the village. Treated Jar water cost Rs. 30/- for per 25L of water So, it clearly shows that majority of respondents are used well water for drinking purpose.

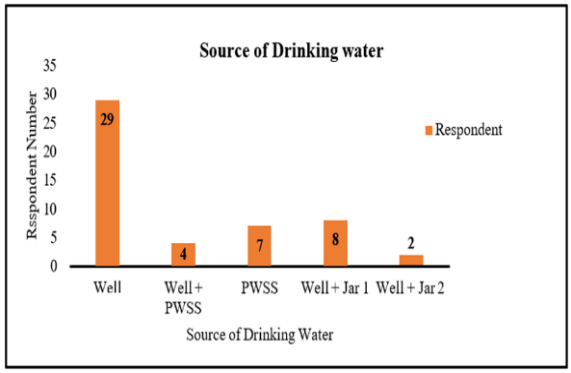


Figure 2: Respondents drinking water sources in Shiradhon village Table 6: Distance between the house and water source

DISTANCE	PERCENTAGE
BELOW 20 m	8 (N=4)
20 – 50 m	10 (N=5)
50 – 100 m	52 (N=26)
ABOVE 100 m	30 (N=15)
TOTAL	100 (N=50)

Drinking water source and its accessibility plays a major role in willingness to pay for drinking water where the quality is secondary preference. In this assessment only 18% people has accessibility within 50 meters however there is 82% people who has to get the water from distance 50 meter onwards.

VI. WATER QUALITY ASSESSMENT

Table 7: Physical Chemical parameters of the water sample assessed

	Physical and Chemical Parameters								
Source	Temp	TDS	EC	pH	DO	Chlorine	Fluoride	Arsenic	Nitrate
Well	24.4	693	1293	7.36	5.2	0	0	0	50
PWSS	21.9	333	665	7.86	5.6	0	0	0	0
Jar 1	24.5	47	110	7.09	5.5	0	0	0	0
Jar 2	22.4	49	98	7.92	5.7	0	0	0	0

It has observed that the temperature, pH and Dissolve oxygen (DO) levels of the water tested for four different samples as shown in Table 7 has no much variation. pH of the samples are mainly alkaline and it is slightly above neutral value. Whereas in case of Chlorine, Fluoride, Arsenic and Nitrate, only Nitrate is observed in the well water sample which was 50 ppm concentration (Figure 3). The agriculture

activities and livestock around the area can be the reason for presence of nitrate in the water sample. The piped water supply system PWSS has to show chlorine but it is 0. This means the chlorination is not carried out or it is not done on regular basis or it may be below detectable level at the time of water sample testing.

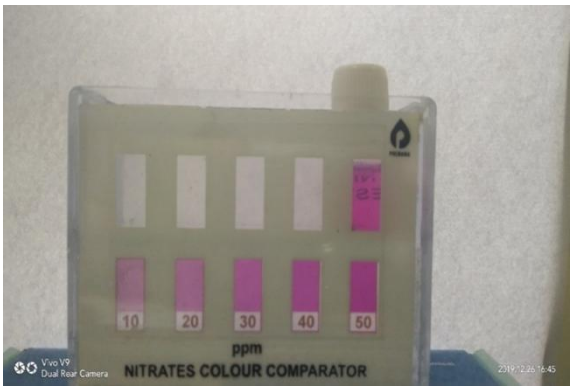


Figure 3: Nitrate Contamination of Well Water

Figure 4 is showing concentration of total dissolved solid in the four sampling sources. The well water sample had shown TDS around 693 ppm which seems to be above permissible limit of BIS i.e. 500ppm.

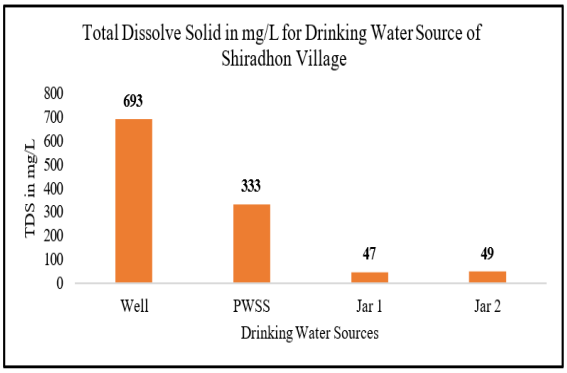
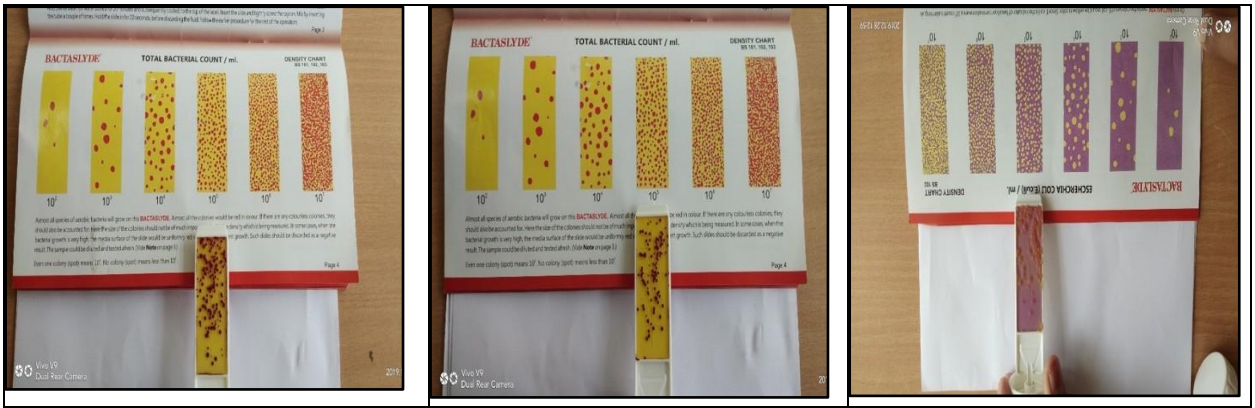


Figure 4: Total Dissolve solid in mg/L for Drinking Water Sources of Shiradhon Village

Figure 5 is showing the assessment of total bacterial count of water sample is 10^5 shown in Plate A and B. Two samples mainly the well water sample and jar (J1) water shows presence of total bacteria. The source such as livestock facilities, septic systems, manure lagoons and household waste water is the main source of contamination. However, the J1 sample was showing presence of E. coli (Escherichia coli) with the count of 10^5 shown in Plate C. Presence of bacteria and E. coli in the water which needs immediate attention for managing the water quality and to avoid human health impacts.



5A. Total Bacterial Count of Well Water | 5B. Total Bacterial Count of Jar 1 Water | 5C. E. coli Count of Well Water

Figure 5: Total Bacterial Count of Well (5A) and Jar 1 Water (5B) and E. Coli Count of Well Water (5C)

Incidence of water borne disease; as per the HH survey it was found that 34% (N=17) respondents are suffering from diarrhea within the last 4 months (Table 8). The respondent of mixed category and largely from Well Water user followed by PWSS and J1 users. The respondents were asked about the diseases like Diarrhea, Jaundice, Cholera, Malaria etc. where the response was only on Diarrhea.

Table 8: Incidence of diseases burden during last 4 months

DISEASES	PERCENTAGE
DIARRHEA	34 (N=17)
TOTAL	100 (N=50)

VII. ASSESSMENT ON WILLINGNESS TO PAY

Table 9: Willingness to Pay for Water

WILLINGNESS TO PAY	PERCENTAGE
YES	94 (N=47)
NO	6 (N=3)
TOTAL	100 (N=50)

Towards a question on willingness to pay for safe drinking water there was 94% (N=47) respondents who were ready to pay whereas remaining only 6% (N=3) respondents not willing to pay. Willingness to pay is term for the highest price a consumer will pay for one unit of a good product or service i.e. the people's interest towards the good quality of water. In present study the willingness assessed towards quality of water and respondent and their family health status. This study showed that 94% of the respondents are willing to pay for good quality of water. It was observed that 20% of the respondents had gone to secondary education or above graduate level and they are willing to pay extra amount towards good quality of water. Rest 80% had gone primary level education and amongst them some of are willing to pay for quality of water those who aware about their health. One respondent is not ready to pay extra amount because of their financial problem and rest 2 of the respondents not ready to pay because they are not satisfied governments previous scheme.

Table 10: Willing to Pay in Rupees per Month

WTP (INR/MONTH)	PERCENTAGE
50-150	44 (N=22)
151-250	22 (N=11)
251-350	6 (N=3)
351-450	4 (N=2)
451-550	14 (N=7)
551 and above	4 (N=2)
Not willing to pay	6 (N=3)
TOTAL	100 (N=50)

Table 10 is showing Willing to Pay in Rupees/Month when it was asked how much amount they are ready to pay for the drinking water. The observations were 44% (N=22) respondents (Maximum Respondents) willing to pay rupees 50-150/- whereas, around 22% of the respondent are ready to pay upto Rs. 250 per month hence more than 50% of the respondents are willing to pay the nominal fees. Similarly, there are 14 respondents whom were ready to pay the extra and some were willing to pay more than Rs. 550 towards safe water though the percentage is very low i.e. 4% (N=2) respondents. This suggests people are more aware and concern about the water quality that the presently get from well or PWSS resource.

VIII. CONCLUSION

Scarcity of safe drinking water is a critical issue in the Osmanabad district of Maharashtra and poses a major development challenge due to its adverse impacts on public health and livelihood. This study reveals that 94% of respondents are willing to pay for access of safe drinking water and 6% are not willing to pay for either the quantity or quality of water currently available to them. The reasons for willingness include awareness of water quality issues and related waterborne diseases, such as frequent occurrences of diarrhea, which motivates most respondents to value improved water quality. Distrust in the system, as two respondents cited previous failures of government-led water distribution schemes in their village, leading to dissatisfaction and a lack of confidence in future initiatives. The study finds that WTP increases with a respondent's awareness of water-related issues and the health risks associated with unsafe drinking water. Therefore, awareness-raising activities highlighting the benefits of safe drinking water could significantly enhance WTP and also promoting better health outcomes. This study provides valuable insights into the demand for safe drinking water in the rural, water-scarce regions of Maharashtra. The findings are expected to assist policymakers in designing more effective and sustainable strategies for improving drinking water supply in the area.

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