Research Paper

Evaluation of willingness to pay toward improving water supply services in Sebeta town, Ethiopia

Hosea Mutanda Eridadi, Inagaki Yoshihiko, Esayas Alemayehu and Moses Kiwanuka

ABSTRACT

Sebeta town is one of the rapidly growing towns in Ethiopia. Its closeness to Addis Ababa city has attracted industrial, urban development, and population growth. This development has created problems with drinking water shortages in the community. This study aimed at determining the household's willingness to pay (WTP) amount toward improving water supply services and analyzing the influencing factors of WTP. A contingent valuation (CV) technique was applied in quantifying the households' WTP and the influencing factors toward the program. The field observations, key informant interviews, and household questionnaire interviews from 250 respondents out of the targeted 280 were employed in collecting field data. Results from CV revealed that 66% of the households were WTP toward improving the water supply services beyond their current monthly water bills. Households were WTP about 20 Ethiopian Birr (ETB) above the average current water bill of 161 ETB. The binary logistic model results statistically demonstrated that independent variables of gender, age, marital status, education level, years in Sebeta, and average monthly income were significantly influencing the household's WTP at $p = 0.01$ and 0.05. This study provides vital hints for further research and baseline information for local administration and communities about the water supply in the area and holistic appropriation of water tariffs in line with government policy.

Key words | binary logistic model, contingent valuation, water supply, WTP

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HIGHLIGHTS

- 250 respondents out of the targeted 280 were used in the study.
- 66% of the households were WTP toward the program.
- Households were willing to add 20.046 ETB above their current monthly water bill.
- Gender, age, marital status, educational level, and monthly income were the influencing factors toward households' WTP.

doi: 10.2166/washdev.2021.204

INTRODUCTION

Access to safe, affordable, and reliable drinking water and sanitation services are fundamental human rights (UNESCO 2019). Upholding the human right to water is an end in itself and a means for giving substance to the wider rights in the universal declaration of human rights and other legally binding instruments (Zelalem & Beyene 2012). Securing access to safe water for all helps reduce diseases caused by the use of contaminated water such as diarrhea, cholera, guinea worm, typhoid, and deaths in society. Water is essential for agricultural, household, industrial, tourism, and cultural purposes and sustenance of the ecosystem (Mark *et al.* 2002; Oloruntade *et al.* 2012; Sriyana *et al.* 2020).

According to UNICEF & WHO (2019), 785 million people still lack the improved drinking water sources of which 144 million get their drinking water directly from rivers, lakes, and surface water sources. It was estimated that water-related investments globally require financing range from $6.7 trillions by 2030 to $22.6 trillion by 2050 (Winpenny 2015; UN 2018), to construct new infrastructures but also operate and maintain existing facilities. Failure to improve water resource management could diminish national growth rates by as much as 6% of Global Domestic Product (GDP) by 2050 (World Bank 2016; UN 2018). In Ethiopia, about 93% of the urban population just have access to the minimum water requirement because the distribution systems in various towns do not function properly due to inadequate arrangements for maintenance and repair (Seifu *et al.* 2012). The construction or rehabilitation of water supply systems plus the operation and maintenance activities of those systems require an enormous sum of money from the institutions.

According to the World Bank (2012), 75% of water investments in developing countries come from loans, grants, or technical assistance. Furthermore, only 15 countries in sub-Saharan Africa committed to a 2% expenditure on water supply and sanitation from their national budget. In Ethiopia, the external agencies support about 56% of the required funds for water supply programs in the entire country, consequently, the government provides only 44% (Tarfasa 2013; Anteneh *et al.* 2019).

The financial requirements and cost recovery from water-related investments in developing nations are difficult to achieve. The water tariffs are so low in many third world countries since water is classified as a public good, not an economic good. To attract more financing by improving the risk-return ratio of water investments, there is a need to identify sustainable revenue sources for operations and maintenance, preferably through charges to those who benefit from the service (World Bank 2016; UN 2018).

Several studies have been conducted to determine residents' participation in water supply projects through willingness to pay (WTP) for water services in Africa. Positive results have been reported. For instance, 95% were WTP toward the management of water supply catchment used by Addis Ababa city (Anteneh *et al.* 2019), while 80% were WTP for improved water supply in Marakwet County, Kenya (Kiprop & Sumukwo 2017).

According to WaterAid, water demand in Sebeta town exceeds the available supplies (Phil & Maric 2010). Also, the recent study by Tariku (2018) in the area revealed that the current water distribution systems do not supply water in the required quantity. Therefore, this study aimed at determining how community involvement could lead to the improvement of water supply services in Sebeta. The study had two objectives: (1) to determine the households' WTP toward improving the water supply services and (2) to analyse and optimize influencing factors of households to pay for improving the water supply services. This initiative will make sure that water available for domestic, commercial, public, and industrial concerning quantity coverage, consistency, and good quality considering the current and future demand of the area.

MATERIALS AND METHODS

The water supply situation in the study area

Sebeta town is one of the Oromia towns and is the capital town of Sebeta Awas district of Oromia special zone surrounding Finfine as shown in Figure 1, situated at about

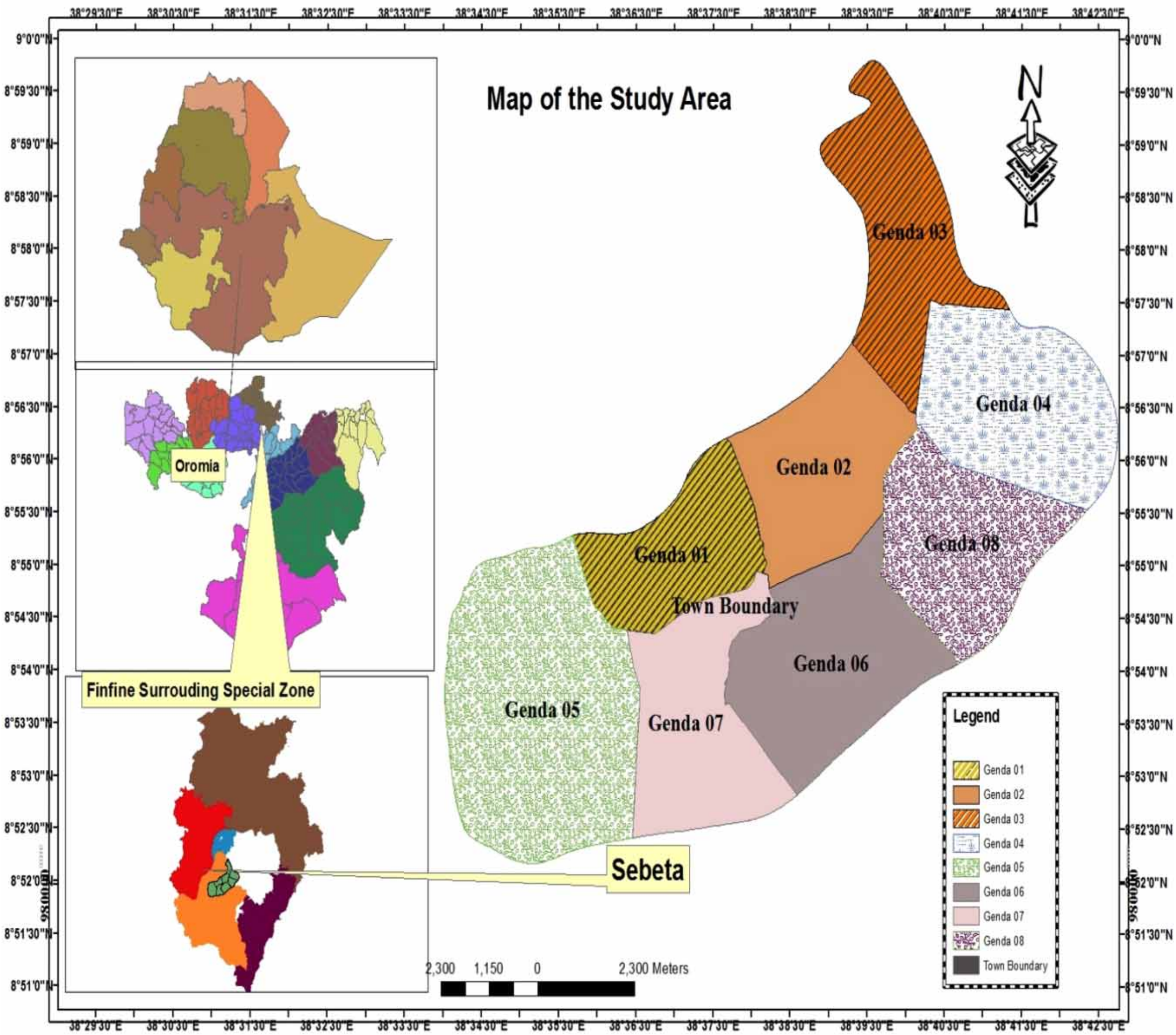

Figure 1 | A map of Sebeta as per town administration office.

24 km southwest of the Addis Ababa along Jimma road and located within an approximate geographical coordinate of 8°53′N, 8°59′N latitude and 38°35′E, 38°39′E longitude. It shares common boundaries with Addis Ababa in the North, Northeast, and East, Burayu town in the North, and rural villages of Sebeta Awas district to the South and West. The present Sebeta town consists of 10 Kebeles: Sebeta, Alemgana, Walate, Furii, Dimma, Dalati, Sebeta-Atebela, Furi-Kerabu, Furi Gerabollo, and Caffe Hora.

Based on the information from the Administrative unit, the current population of the town is 352,505 with an average family size (FS) of 4.8 members. Tariku (2018) noted that water distribution by mode of services in the area was 73.7% of households received water through public tap connection, 24.8% yard connection and 1.5% household connection. The report further disclosed that the average domestic water supply was 20 l/capita/day, which was below the minimum requirement of 80 l/capita/day for towns under category 2 according to GTP-2 (MoWIE 2015; Temesgen 2019). Therefore, the water board intends to supplement the existing water supply system of the town, providing safe water, easily accessible, in quantities adequate for drinking, food preparation, personal hygiene, and livestock, at a cost in keeping with the economic level of the communities and through facilities which can be easily operated and maintained.

Procedures of data collection

The study applied various methods of data collection, including reconnaissance surveys, field observations, key informants' interviews, and household surveys. The data were collected for a period of 2 months (February to March 2020).

Reconnaissance survey

A reconnaissance survey was conducted in town for 3 weeks (3 February 2020 to 22 February 2020) from 150 households. Different households were interviewed to capture their perception of the current water supply services. These interviews were centred on asking households to comment about the drinking water services delivered by Sebeta Drinking Water Enterprises (SDWE) in terms of quality, quantity, and reliability and the number of days water is available at the tap.

Regarding the quality of water delivered at households, 52.8% of the participants ranked that quality is average, 36% good, and 11.2% poor. The study done at household taps in Sebeta by Tariku (2018) reported that the total coliform was below the World Health Organization (WHO) standards. Therefore, this may be the reason for the lowest percentage of quality contentment among the participants. The quantity of water supplied to the population, and 61.3% of the respondent ranked that the quantity of water delivered was poor due to less availability when needed. Only 2.0% said that quantity was good. It is revealed in Table 1 that 96.7% ranked the existing water services unreliable. There was dissatisfaction with the existing water services among the residents due to water unavailability. Table 2 reveals the unavailability of piped water in the community for an average period of 3.3 days in a week according to the residents.

Table 1 | Respondents' perception of quality, quantity, reliability

	Performance terms indicators	No. of respondents	Percentage
Quality	Good	54	36
	Average	79	52.8
	Poor	17	11.2
Quantity	Good	3	2.0
	Average	55	36.7
	Poor	92	61.3
Reliability	Reliable	5	3.3
	Unreliable	145	96.7

Sampling plan

The responses from the reconnaissance survey assisted in determining current water issues in the area and in formulating questionnaires for both qualitative and quantitative contingent valuation (CV) surveys. The survey was done with the help of a graduate research assistant for better data quality. Also, secondary data information obtained from the enterprise's offices and Sebeta town Administration Plan and Economic development office was used to determine the sample size and formulate the questionnaire for household data collection. More information about the town and its community was obtained through a comprehensive review of different documents such as government and international organizations' reports, internet, and journal articles.

The household questionnaire (see Supplementary Material) which was both semi-structured and structured in nature was drafted after an exploratory survey. It was pre-tested to ensure the validity and reliability of data. Firstly, the 10 administrative Kebeles in town were treated as clusters. The first five clusters (Kebeles) with the highest population were selected for this study. These Kebeles include Sebeta, Alemgana, Walate, Furii, and Dimma. The household sample size for the research was calculated from Gochran (1977) formula as seen in the following equation:

$$N = \frac{Z^2 \times P(1 - P)}{d^2} \tag{1}$$

where N is the number of households interviewed in the study and Z is the value showing the confidence level at

Table 2 | The number of days water was unavailable per week

	Number of respondents	Mean ±std error	Median	Mode	Min–Max
Days	150	3.3 ± 0.584	3	3	0–6

95% obtained from standard normal deviation, $Z = 1.96$ (Emily 2013; Hamed 2017). High heterogeneity was assumed, and therefore, $p = 0.5$ which is equal to 50% of the unknown population (Makwinja *et al.* 2019). For a better household sample size, the margin of error (d) of 0.059 was adopted to improve the confidence of the results from the interviews. 275 sample size was obtained from the formula; however, the sample size of 280 was taken to ensure precision. Therefore, 280 questionnaires were administered to 280 households in Sebeta.

The respondents were randomly selected from the five Kebeles. At first, the questionnaire was drafted in English and then translated into Amharic which is the national and official language of Ethiopia. The study depended on the willingness of the households to participate in the answering of the questionnaire. Research assistants were employed, trained to pretest, and administer the questionnaire in the community. Data collection was done for 1 month.

Field observations and key informant interviews were conducted for 1 week. For example, Barriball & While (1994) stated that interviews are most vital because they allow the interviewees to extract all relevant information and additional important points they may not be previously considered in the questionnaires. Field observations were done by visiting Kebeles in a different period of the day to observe the availability of water at the household's access point (water tap). Also, the observation about solid waste management was conducted to see the likely impact on water sources especially groundwater. Informant interviews were for SDWE staffs to find out water supply problems, the enterprise is facing.

WTP analysis

Data obtained through the questionnaire interviews were analyzed statistically using econometric models and descriptive statistics. Data collected included information such as demographic characteristics, socioeconomic characteristics, respondents' perceptions about institutions in water management, and WTP. Descriptive statistics were mean, standard error of the mean, median, mode, standard deviation, variance, range minimum, maximum, and sum. International Business Machines (IBM) Statistical Package for the Social Sciences version 2020 was used for analysis.

Econometric regression model

The binary logistic regression model was adapted in analysing the relationship between WTP (dependent variable) and a set of independent variables. The independent variables were the factors that may influence the households' WTP toward the improvement of the water supply services. Therefore, WTP was determined as a function of independent variables as per the following mathematical formula in the following equation for the regression model (Khan *et al.* 2014; Makwinja *et al.* 2019):

$$\mathrm{WTP}_i = In\left[\frac{P_i}{1-P_i}\right] = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} \cdots \beta_k X_{ni+ei} \tag{2}$$

where WTP was a dichotomous dummy variable (where 1 = WTP for the program and 0 = not WTP for the program), i refers to a household, P_i is the probability of the households' WTP for the program, β_0 is a constant coefficient, and β_1, β_2, β_3, …, β_i, are the regression coefficients of independent variables; X_1, X_2, X_3, …, X_i.

The bivariate Pearson correlation was applied to determine the correlation between the independent variables. This analysis was to find out statistically significant relationships between the variables, strength, and direction of the relationship. Hosmer and Lemeshow goodness of fit was used for the significance of the model as per the following equation (Zoran 2016):

$$H_L = \sum_{g=1}^{G} \frac{(O_g - N_g \pi_g)^2}{N_g \pi_g (1-\pi_g)} \tag{3}$$

where O_g was the total observations of subjects in the gth group, N_g is the total observations of event outcomes in the gth group, and π_g was the mean estimated probability of an event outcome for the gth group. H_L was estimated by a chi-square with the number of groups-2 degrees of freedom. The explanatory variables that were used for analysis in the model included independent variables. These were dummy, categorical, and continuous variables: demographic variables, socioeconomic variables, and other variables depending on peoples' perceptions and practices related to water use. A total of 11 variables were identified as described in Table 3.

Table 3 | Factor analysis for WTP

Variables	β	S. E	Wald	Sig
Constant	−6.170	1.641	14.147	0.000**
GH	1.166	0.410	8.074	0.004**
AG	0.120	0.029	17.040	0.000**
MS	1.740	0.518	11.277	0.001**
L	1.543	0.459	11.291	0.001**
OC	0.496	0.525	0.892	0.345^{ns}
FS	0.080	0.137	0.339	0.560^{ns}
SYH	0.039	0.018	4.623	0.032*
HO	−0.045	0.444	0.010	0.919^{ns}
AMI	0.001	0.000	7.416	0.006**
RW			0.370	0.832^{ns}
RW (1)	−0.188	0.519	0.131	0.718^{ns}
RW (2)	−0.558	1.064	0.276	0.600^{ns}
S	−0.862	0.802	1.155	0.282^{ns}

Hosmer and Lemeshow test: Chi-square = 4.89(df = 8), $P = 0.76$; Log-likelihood = 174.200; Cox and Snell $R^2 = 0.356$; Nagelkerke $R^2 = 0.524$; *Note*: **indicates significant at 1%, *indicates significant at 5% while ^{ns} shows non significance.

Statistical approach

As a result of the first question about the household's WTP toward improving the water supply services in the area, the households were asked whether they are WTP or not without stating any particular amount of money. The respondents were humbly asked to be truthful during the interviews while considering their current expenditure on items including the current water expenditure. Depending on the household's response to the first question, they were grouped as either positive or negative. Questions were made simple by the interviewer for everyone whether literate or illiterate. The household with a positive response about WTP was then asked to state the amount it can pay toward the program in a year. The mean WTP was computed by summing up households' WTP amount and dividing the sum by the total number of households WTP toward the program as per the following equation (Emily *et al.* 2013; Banda 2018):

$$\text{Mean WTP} = \frac{\sum_{i=1}^{n} \text{WTP}_i}{n} \quad (4)$$

where i stands for the amount that a household is WTP and n stands for the sample size of households whose WTP is positive.

RESULTS AND DISCUSSION

Household's demographic and socioeconomic characteristics

The research targeted a sample size of 280 respondents in Sebeta town. Nevertheless, only 250 households replied properly to the questions in the questionnaire in line with the research objectives. This represented about 89% of the response rate, slightly higher than 80% reported in the study by Makwinja *et al.* (2019). Table 4 shows the summarized information about characteristics such as variables name, variable classification, and the descriptive statistics of the variable in terms of number, percentage, mean and standard mean error, mode, and minimum and maximum value.

As observed from Table 4, data were collected from 250 households in the five different Kebeles of Sebeta. 60.4% of the respondents were female, and 39.5% were male. Similar studies in the area of water supply have reported a larger number of female participants than males. For instance, studies conducted in Ethiopia have reported the majority of the participants as female, (66.7 and 52.5%) in Dilla town and Mekelle city, respectively (Saleamlak 2013; Tamirat 2014). Previous studies done in Kenya and Uganda reported 56.3 and 51.0% female interviewees, respectively (Wright *et al.* 2014; Roy *et al.* 2015). However, a similar study by Kiprop & Sumukwo (2017) reported 56% of respondents as males. The higher number of female participants signifies that in sub-Saharan Africa females are the most primary water collectors and easily found at home than men (Graham *et al.* 2016).

The data revealed that the average age of the respondent was about 41 years old with a range of 19–70 years old. The value was slightly lower than the average age of 45 years which was reported in Addis Ababa by Anteneh *et al.* (2019), only 25 km from the study area. This can be attributed to the different minimum and maximum years obtained from the respondents. The mode of the age was

Table 4 | Demographic and socioeconomic characteristics of the households

Variables	Category	Number of respondents	Percentage	Mean ± Std error	Mode	Min–Max
Gender	Male	99	39.5			0–1
	Female	151	60.4			
Age		250		41.880 ± 0.791	30	19–70
Marital status	Married	190	76.0			0–1
	Unmarried	60	24.0			
Literacy	Literate	130	52.0			0–1
	Illiterate	120	48.0			
Home Ownership	Self	110	44.0			0–1
	Rent	140	56.0			
FS		250		4 ± 0.116	4	1–13
YSS		250		27.530 ± 0.031	30	2–65
Occupation	Formal	64	25.6			0–1
	Informal	186	74.4			
Monthly income		250		4,861 ± 134	4,000	2,000–15,000
Monthly expenditure		250		31,120 ± 91	4,550	630–9,000

Note: YSS, years stayed in Sebeta; Exp, Expenditure.

30 years which shows that the majority of the respondents were young and energetic (Kiprop & Sumukwo 2017).

According to the survey findings, 76% of the households were married, and the remaining 24% representing widowed, divorced, separated, or single. The average household size was 4 moderately lower than the average household size of 4.6 members in Ethiopia (CSA & ICF 2017). On the contrary, Zelalem & Beyene (2012) reported the average FS of 5.86 in Goro-Gutu district with a range of 1–12. In rural areas, the standards of living are cheaper than in towns.

The literacy level was 52% signifies that 48% of the participants were not able to read and write. The figure was slightly higher than the national literacy level which was reported at 51.8% (MoE 2015). In Goro-Gutu district, grade 9 was reported as the maximum in the area (Zelalem & Beyene 2012). The high education level in Sebeta could be attributed to its being an urban centre with many educational facilities.

Concerning house ownership (HO) by the respondents, 44% of the respondents owned a house and the rest were renting. The average years that respondents have stayed in Sebeta were 27.5 years with a mode 30, signifying that there has been migration of people from other areas through the years due to industrialization and longevity in the area.

From Table 4, 25.6% of the participants are employed formally, while the remaining 74.4% are informally employed. Also, the descriptive statistics were carried out basing on the gender categories. Results indicated that 30.3% of the male participants had formal employment and 69.7% informal employment, while 22.5% of the females had formal employment and 77.5% informal employment. Tadele & Kebede (2015) reported 60.1% of the formal employment in urban areas in Ethiopia, which is greater than 25.6% from the respondents. This discrepancy could be attributed to the greater number of female respondents that were used in this study because the formal employment for females in the study area was 22.5% slightly lower than 23.3% in towns (Tadele & Kebede 2015).

The monthly income from the sampled population ranged between 2,000 and 15,000 Ethiopian Birr (ETB) with an average of 4,868.80 ETB. These values are lower than reported values in a similar study in Addis Ababa (Anteneh *et al.* 2019). The average monthly expenditure of the household was 3,119.70 ETB, with minimum and maximum at 630 and 9,000 ETB, respectively. When Pearson's correlation was performed, there was a significant positive relationship between the monthly income of an individual and expenditure, r $(248) = 0.799$, $p = 0.01$. Therefore, the higher the monthly income of the household, the higher the monthly expenditure.

Analysis of current residents' expenditure on water services

Table 5 summarizes the analysis of the monthly expenditure of households based on the current water supply conditions. 245 individuals of the 250 questionnaires were able to give estimations their water monthly expenditure. The average water expenditure was 161 ETB/month and the standard error was 6 ETB, with a median of 100 ETB. Further examination of data revealed that the average monthly expenditure on the water was only 3.3% of the mean monthly income of the individuals in the community. Similarly, the study conducted in the town of Nebelet, Ethiopia reported 4% of expenditure on water from household's monthly income (Mezgebo & Ewnetu 2015). Accessibility to improved water can depend on the affordability by an individual. Therefore, 3.3% of expenditure on water from households' monthly income follows under range 3–5% as the affordability index adopted by the number of developing nations (Smets 2009) but less than 5% recommended by the World Bank as stated by Mezgebo & Ewnetu (2015).

WTP toward the program

The results from the statistical analysis of the WTP toward improving the water supply situation are indicated in Table 6. WTP in this study means the contribution of residents toward improving the current water supply conditions in the area for a period of 10 years. This is different from the current monthly bills that residents are paying for water used.

Out of the 250 respondents, 165 (66%) were WTP toward the improvement of water supply in the area as shown in Table 6. Different studies have applied the CV in different areas to determine the willingness to accept or pay for non-market goods. For instance, Bamlaku *et al.* (2019) reported that 73.4% of the households in Shashemene, in Ethiopia were WTP toward better solid waste management. 95% of the respondents in Addis Ababa inclined to pay toward the intervention program of Legedadie-Dire catchments (Anteneh *et al.* 2019). In other sub-Saharan countries, the willingness of communities to pay for water improvements has been conducted. For example, Wright *et al.* (2014) reported 92.6% readiness to pay for improved water supply in Rubona and Kigisu, in Uganda. Also, in Tanzania, Magashi (2014) reported 83.3% of WTP for domestic improved water. Therefore, there is a certain level of WTP for improved water services in many African communities.

As shown in Table 6, the study revealed that the minimum WTP amount was 50 ETB/year exclusive of the residents' monthly water bill payment. This value (50 ETB) corresponds to the WTP toward improving the existing water supply conditions in the area for the next 10 years. The highest WTP was 700 ETB. The average yearly contribution was 241 ETB and the mode payment of 200 ETB, which was the same as the median. The mode revealed that the majority of the residents were willing to pay 200 ETB/year toward the program.

Further analysis of data about WTP toward the program monthly as Table 6 suggests that individuals in Sebeta were WTP on average 20 ETB in addition to their current water bills. The monthly median was 17 ETB. Therefore, the average monthly water bill of the household totals 180 ETB inclusive of payments toward the program of improving water supply. The increment in the average monthly payment for households was about 12.41%. Therefore, there was a promising factor from the residents toward paying for the program of improving water supply services in the area.

Table 5 | Current monthly expenditure of households on water services

Variable	Number of respondents	Mean ± Std error (ETB)	Median (ETB)	Mode (ETB)	Min–Max (ETB)
Payment/month	245	161 ± 6	100	100	50–500

Note: ETB = Ethiopian Birr, (1 ETB = 0.026 USD as per October 2020).

Table 6 | WTP analysis

Variable	Number of respondents	Mean ± Std error (ETB)	Median (ETB)	Mode (ETB)	Min–Max (ETB)
Payment/year	165	241 ± 9	200	200	50–700

Note: ETB, Ethiopian Birr (1 ETB = 0.026 USD as per October 2020).

Analysis of variables in the binary logistic regression model

The data for the binary regression model were tested for multicollinearity. The correlation matrix of the explanatory variables revealed that data had no problem with multicollinearity. According to coefficients as shown in Table 7, the correlation between the variables was not strong. All correlation coefficients between variables were below ±0.5 which is accepted by many researchers (Patrick *et al.* 2018). Therefore, the explanatory variables were appropriate to be applied in the binary logistic regression model.

Analysis of influencing factors about WTP

The logistic regression coefficients (β), standard error correlated with coefficients, Wald, and the significance of the variable are shown in Table 3.

The probability of the households' WTP for the program of improving water supply services in Sebeta is indicated in Table 3. The values of R^2 are severely restricted in the range between 0 and 100%. The R^2 values measure the fitness of data in the regression line statistically. The econometrics principles are based on these values to know the suitability of the model. A higher percentage or value implies a better appropriate model (Barnnett *et al.* 1998; Makwinja *et al.* 2019). For this study, the analysis revealed the Cox and Snell R^2 value of 0.356 and Nagelkerke R^2 value of 0.524. This shows that between 35.6 and 52.4% of the variance in the dependent variable is explained by the model. The goodness-of-fit test was determined by the Hosmer and Lemeshow test, where the model fitness depends on the insignificant value at $p > 0.05$. In this study, results from the test were 4.89 chi-square value and $p = 0.769$ indicating the fitness of the logistic regression model since the p-value was insignificant ($p > 0.05$).

The different coefficient and significance values of independent variables are shown in Table 3. The variable denoted with RW which is about responsibility for water supply services in the area was categorical and coded as in Table 8. The independent variables such as HO, responsibility for water supply services (RW, all categories), and satisfaction with the existing water supply services (S) had coefficients of regression negative. And it was noted that the p-values of HO, RW, and S were statistically insignificant at $p > 0.01$ and $p > 0.05$. On the other hand, variables, occupation type, OC (formal or informal employment), and FS had positive coefficients but they were also statistically insignificant at $p > 0.01$ and $p > 0.05$. Therefore, the insignificance values of these variables (HO, RW, S, OC, and FS) revealed that they do not have control over households' decisions to pay for water supply improvement programs in the area.

The relationship between the dependent variable (WTP) and the gender of the household was statistically significant at $p < 0.01$, with a positive correlation regression coefficient

Table 7 | Correlation matrix table of the variables

	GH	AG	MS	L	OC	HS	LHS	HO	AMI	RW	S
GH	1										
AG	0.060	1									
MS	−0.009	−0.098	1								
L	−0.017	0.024	−0.309	1							
OC	0.106	−0.375	−0.046	−0.037	1						
FS	0.100	−0.056	0.481	−0.387	−0.025	1					
LHS	0.008	0.105	0.433	−0.137	−0.136	0.282	1				
HO	−0.098	−0.130	0.117	−0.076	−0.036	0.030	0.221	1			
AMI	−0.075	−0.365	0.184	−0.105	−0.278	0.128	0.018	0.207	1		
RW	−0.091	0.038	0.061	0.103	−0.017	−0.092	−0.005	0.001	−0.046	1	
S	−0.091	0.017	0.144	−0.328	−0.027	0.116	−0.025	0.029	0.051	0.094	1

Table 8 | Independent variable description for factor analysis

Variable symbols	Description of variables
GH	The dummy variable for gender of respondents (1 = male; 0 = female)
AG	Continuous variable for the age of the respondents in the study area
MS	Dummy variable for the marital status of participants in the study (1 = married; 0 = single)
L	Variable for the literacy level of the respondents, dummy variable (1 = literate; 0 = illiterate)
OC	Dummy variable for the occupation of the respondents, (1 = formal employment; 0 = informal employment)
FS	Continuous variable for a FS of respondents, the total number of people staying in the household
SYH	The continuous variable in years that respondents have stayed in Sebeta town
HO	Dummy variable for the ownership of the house in which the respondent is staying (1 = self; 0 = landlord/landlady)
AMI	Continuous variable for the average monthly income of the household
RW	Categorical variable, respondents' opinion for who should be responsible for water supply (0 = government; 1 = community; 2 = non-government organizations (NGOs), 3 = private companies)
S	Dummy variable for the satisfaction of respondents with the existing water supply service (1 = no; 0 = yes)

of 1.166 and Wald of 8.074. The males in Sebeta are more likely to pay for the water supply improvement program than females. The findings were related to a study by Chelangat *et al.* (2018) in Kenya where gender influenced the respondent's decision to pay toward proper management of water projects. Although Mezgebo & Ewnetu (2015) had similar results of the relationship between WTP and gender, the females were more WTP than males. However, all the above findings contradicted those of Shemelis & Lamessa (2016) who reported that sex of the respondent was not an influencing factor for WTP for improved water supply in Jigjiga town, Ethiopia.

The age of the respondents was a continuous variable. The correlation regression coefficient of age was positively influencing WTP for improving water supply services. It was statistically significant at a 1% significance level. This implies that WTP increases as the respondents grow older. Kiprop & Sumukwo (2017) reported similar results in their study conducted in Marakwet county, in Kenya. This could be that most young people have little interest in knowing how government projects are run.

Similarly, the relationship between the dependent variable (WTP) and the marital status of the respondents was positive, with the coefficient of regression analysis of 1.740 and Wald of 11.277. The results from the model revealed that the relationship was significant at a 1% significance level. This explains that married respondents were more willing to pay than single respondents because they are obliged to pay for all expenditures at home. These findings of the study were similar to those of Brouwer (2009) and Chelangat *et al.* (2018).

The number of years a respondent had stayed in the area was statistically significant at a 5% significance level, with the WTP for improving water supply in the area. The coefficient was positive indicating the more years the respondent has stayed, the more WTP. Overstaying in place enables an individual to understand the different challenges of the community.

The expectations for the relationship between average monthly income and WTP were true. The coefficient value was positive and statistically significant at the 1% significance level. This implied that households with high-income value are more likely to pay for improving water supply services than low-income earners. The results were in line with the findings of several studies, where households' incomes positively impacted on the WTP decision (Mezgebo & Ewnetu 2015; Tolulope *et al.* 2018; Galgalo & Aga 2019). However, Emily *et al.* (2013) found that the relationship between income and WTP was statistically insignificant with $p > 0.05$.

As anticipated, the WTP to improve water supply services was positive to the literacy level of the respondents. The literacy level variable was significant at 1%. It is believed that a person is more informed about different key sectors of the community and the world at large when he/she is educated (Galgalo & Aga 2019). Therefore, the literate community in Sebeta town was more WTP than the illiterate. Previous studies have reported similar results that education has a high impact on the decision of the WTP for services (Dauda *et al.* 2015; Makwinja *et al.* 2019).

The independent variables of gender, age, marital status, literacy level, occupation, FS, years lived in the area, and monthly income will each have an impact on WTP if other variables are held constant. Therefore, variables gender, age, marital status, education level, years in Sebeta, and average monthly income were significantly influencing household's WTP at $p = 0.01$ and 0.05.

CONCLUSIONS AND RECOMMENDATION

The study was conducted in Sebeta town, Ethiopia. The CV results indicated a fairly good overall response rate of 66% of WTP toward improving water supply services in the town. The results further indicated that households are willing to pay an average of 20 ETB/month on top of their average current monthly water bill of 161 ETB. The mean additional WTP the amount of 20 ETB/month corresponds to 0.41% of the mean household income of 4,869 ETB. It is likely that the improvement of service provision expected by the interviewed households comes at a much higher cost than the additional WTP.

Results from the binary logistic model statistically demonstrated that independent variables of gender, age, marital status, education level, years in Sebeta, and average monthly income are significantly influencing household's WTP at $p = 0.01$ and 0.05. Although 66% of the households were willing to pay toward improving the water supply services, it is recommended that the policymakers consider the influencing factors toward WTP before setting final charges for the program.

Limitations

The study was conducted in only the five Kebeles of Sebeta with the highest population. All Kebeles in the town were not considered by this study.

AUTHOR CONTRIBUTIONS

H. M. E. designed the research, data collection, data analysis, and wrote the manuscript. I. Y. and E. A. were greatly involved in every stage of the manuscript writing and study tools development. M. K. helped in revising the manuscript. The authors acknowledge that this paper was partly based on a MSc research by Hosea Mutanda Eridadi under the supervision of Esayas Alemayehu and Inagaki Yoshihiko.

FUNDING

This research received funding through the MSc. The scholarship was awarded to the first author by the African Center of Excellence for Water Management, Addis Ababa University.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the Africa Centre of Excellence for Water Management for making this research possible through the provision of funds. Similarly, we are grateful to the research assistants and communities of Sebeta for their participation in data collection.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest concerning the publication of this paper.

DATA AVAILABILITY STATEMENT

All relevant data are included in the paper or its Supplementary Information.

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First received 6 October 2020; accepted in revised form 4 January 2021. Available online 9 February 2021