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Households' willingness to pay for improved water service in Bonga town, Kaffa zone, Southwestern Ethiopia

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A B S T R A C T

This study was initiated to estimate households' willingness to pay for improved water services and identify its determinants by using the contingent valuation method in Bonga town of Kaffa zone, Southwestern Ethiopia. A cross-sectional data from a total of 212 sampled households' from two randomly selected kebeles of Bonga town. Contingent valuation survey responses were analyzed through descriptive and econometric analysis using Probit and Bivariate probit model. Double bounded dichotomous choice with open-ended follow-up format was used to elicit the household's willingness to pay. The descriptive analysis showed that out of the total 205 valid responses indicated that most households' have perceived the problem of existing water services and were willing to pay for its improvement. Results from the study showed that about 80.98% of the sampled households were willing to pay the initial bid offered for an improvement in their water services scheme. The Probit model regression result shows that the age, daily water use, satisfaction level, fetching time, initial bid, ownership of the house, quality, family size, stay in town, and income were important factors that influenced WTP for improved water service. The study also shows that the maximum willingness to pay for improved water service was calculated to be 57.62 Birr and 30.11 Birr per month from double bounded and open-ended format respectively. The study also reveals that the aggregate welfare gains from the improvement of water supply in the study area were calculated to be 1,176,531 and 614,810 ETB per month from double bounded dichotomous choice and open-ended format respectively. Therefore, the policymakers, as well as project implementers who design solutions to address the problem of water service in the study area, should take account of these factors into their decision.

Keywords: Bivariate probit model, Bonga town, Water scheme, Willingness to pay

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Introduction

The water of satisfactory quality is the fundamental indicator of the health and well-being of a society and hence, is crucial for the socio-economic development of a given country. According to Okun (1988), as cited by (Dlamini, 2015), improved access to a clean and safe water supply is closely linked to improved economic wellbeing. Access to safe water is a prerequisite for the realization of many human rights, including those relating to people's survival, education, and standard of living (Saleamlak, 2013). 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 (Hosea *et al.,* 2021). 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).

Unfortunately, for our planet, water supplies are now running dry at an alarming rate. The world's population continues to soar but that rise in numbers has not been matched by an accompanying increase in supplies of fresh water. Less than 1% of the available water on the planet is freshwater that is used for drinking and other activities (David, 2005). According to WHO

(2017), about 844 million people globally lack access to clean water supply while 2.5 billion people have no access to adequate sanitation. In addition to that, many people especially in developing countries do not have access to safe and adequate water services, which affects their life in various ways (Mazvimavi and Mmopelwa, 2006). Due to the absence of improved water and sanitation facilities, the rural and urban areas of residents' are mainly faced with poverty. It was also estimated that 319 million people are without access to improved water supply in sub-Saharan Africa (Akeju *et al*., 2018). Many urban water supplies provided by public utilities are facing an acute shortage in many low-income countries.

Even if Ethiopia is frequently said to be the 'water tower of North-East Africa' there is a pervasive problem of safe and clean water. According to MoWR (2003) for all the water development activities achieved so far, the average access to a safe water supply is 33.7% of the total population of Ethiopia. About 93.0% of the urban populations of Ethiopia 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 (Hosea *et al.,* 2021).

Kaffa zone especially Bonga town has long been suffering from deep-rooted safe drinking water problems and sanitation services. Not only water availability is scarce in existing piped water but also supplied piped water is much damaged and cannot be used for drinking rather than washing clothes and other uses. It is also supplied only twice a week to the connected households and the water is generally unsafe. Over time, the quantity of water supplied to the town daily is grossly inadequate and could not solve the problem of water shortage in the study area. For this reason, most of the households still depend on other water sources such as; water tankers, water vendors, hand-dug wells, ponds, streams, boreholes, and well for water supply (Tezera, 2008; BTWSSO, 2020).

Its quality deterioration, unreliability, and water scarcity problems of existing water service in private piped as well public tap water supply system that households in the town are facing. This is creating many challenges in health as well as socio-economic development in the town. Due to the intricacy, households in the town are compelled to construct boreholes and hand-dugs by sacrificing their huge capital to get water of doubtful quality and the active labor force is wasting its significant time by fetching water from unimproved sources which have a negative implication in the production sector and the quality of water from those sources is also deteriorating (Hundie and Abdisa, 2016).

To perk up this extremely low level of water supply service and satisfy the rapidly growing population of town; water need as well as the required quantity and quality for the existing population; the rehabilitation of old boreholes, replacement of pipelines, Watershed improvement, substantial resource commitment, the primary target of government policies, and sustainability of existing water projects must be maintained. As indicated by Medhin (2006) since the piped water supply is not a natural system as it is a manmade infrastructure, it needs a huge amount of money and effort to make it quite accessible in both quantity and quality.

Thus to improve the water supply situation of the town demand-side information is highly required, because this demand-side approach asserts that the water utility bodies need to understand actual household use behavior and observed ability and willingness to pay for improved water services and thus enables policymakers to design appropriate water tariff that is consistent with government policy and enhance the long term viability of the service (Yibeltal, 2011; Saleamlak, 2013). This research, therefore, endeavors to estimate the Willingness to Pay (WTP) of households for better-quality water service provision and determine its influencing factors by using the Contingent Valuation Method in Bonga town, Kaffa zone, southwestern Ethiopia.

Research Methodology

Data type, sources, survey design, and administration

Bonga town is found in Kaffa zone, Southern nation nationality state, Ethiopia about 105km and 449 km far South West of Jima and Adis Ababa, respectively. Geographically, the town is situated at 7^{o} 16'-7^{o} 267' N and 36^{o} 14'-36^{o} 23' E with an elevation of 1714 m.a.s.l and meteorological station records show that average annual temperature varies from 11.8-27.1°c while annual rainfall varies between a range of 125-250 mm (KZWMED, 2020). The main source of water for the Bonga town inhabitants is coming from groundwater mainly from the Dincha and Sheta watershed well fields. Water coming from the two areas is distributed to the consumers through 2555 connections and 15 Public taps. Based on the census conducted by the CSA (2007), a total population of 127,842 out of which 61,965 were male and 65,877 female with an average population growth of the town is 4.6% and the total number of households living in the town is 23,516.

This study used cross-sectional data, by employing both qualitative and quantitative types from both primary and secondary data sources. The primary data were collected from sampled households in the study area through a structured questionnaire. In addition, the primary data were also collected through focus group discussions (FGD) and key informant interviews (KII). During the FGD and KII, the bid values for improvement of water services were determined and cross-checked with previous studies, before fixing. Secondary data were collected from different offices like Kaffa zone water, mining, and energy department, Bonga town water supply, and sewerage office, different published and unpublished sources, and relevant journal articles and websites. During the interview, a double bounded dichotomous choice elicitation method was used because of its advantages over controlling biases that arise during the CV study. It also minimizes non-responses and avoids outliers, and is more efficient. This format of elicitation makes a clear bound on WTP for answer sequences yes-no or no-yes, and no-no and yes-yes responses. Indeed, it has efficiency gains because additional questions even when they do not bound WTP completely further constrain the part of distribution where respondent's WTP lies (Haab and McConnel, 2002). The study followed a multistage sampling procedure to select the sample households' since it allows researchers to make clusters and sub-clusters until the researcher reaches the desired size or type of group. At the first stage, the study district (town) was selected purposively based on the problem of access to water service. At the second stage, out of three broad urban kebeles in the town two kebeles, namely 01 and 03 were selected randomly. At the third stage, the number of sample respondents from each kebele was selected proportionally to the total number of households in kebele, thus, probability proportional to size (PPS) was applied. Finally, each sample household was selected by using systematic simple random sampling.

For this study, the sample size was determined from out of 17300 households of two kebeles in the town based on the following formula of Yamane developed by Israel (2012) at a 7% level of precision:

$$n = \frac{N}{1+N(e)2} - - - - - - - - - - - (1)$$

Where, n is the sample size; N is total households and e is the level of precision with 7%. Before implementing the final survey, pre-testing was conducted with a random sample of 16 residents from each kebele to determine potential bid level. By a series, FGD, and pre-testing of draft questioners the starting point prices that have been identified for WTP were 8, 25, 33, and 45 Birr per month added on the water bill. Using these initial bids, sets of bids will be determined for follow-up questions based on whether the response is "no" or "yes" for the initial bid. If the respondents were willing to take the offered initial bid, the follow-up bid was 13, 30, 40, and 54. In case of a "no" response to the initial bid, the follow-up bid were 5, 20, 30, and 40 Birr respectively. Given this, the actual survey was undertaken by separating the total sampled households randomly into four groups and there were 53 randomly assigned households per Bid level.

Empirical model specification and analysis

A bivariate probit model was employed to estimate WTP for an improved water scheme because the bivariate normal density function is appealing in the sense that it allows for non-zero correlation, while the logistic distribution does not (Jeanty *et al*., 2007). For estimation of WTP, the bivariate probit model was employed. The double-bound dichotomous choice model is depicted in the following form (Haab and McConnel, 2002).

The j^{th} contribution to the Likelihood function is given as

$$L_j(\mu/t) = Pr(\mu_1 + \varepsilon_{1j} \geq t^1, \mu_2 + \varepsilon_{2j} < t^2)^{YN} * Pr(\mu_1 + \varepsilon_{1j} \geq t^1, \mu_2 + \varepsilon_{2j} \geq t^2)^{YY} * Pr(\mu_1 + \varepsilon_{1j} < t^1, \mu_2 + \varepsilon_{2j} < t^2)^{NN} * Pr(\mu_1 + \varepsilon_{1j} < t^1, \mu_2 + \varepsilon_{2j} \geq t^2)^{NY} \ldots\ldots (2)$$

Where: μ = mean value for willingness to pay , YY = yes-yes answer, NY = no-yes answer, YN = yes-no, NN = no-no answer.

And the j^{th} contribution to the bivariate probit likelihood function becomes,

$$L_j(\mu/t) = \Phi_{\varepsilon_1\varepsilon_2}(d_{1j}((t^1 - \mu_1)/\sigma_1, d_{2j}(t^1 - \mu_1)/\sigma_1, d_{1j} d_{2j}, \rho) \ldots\ldots (3)$$

Where: $\Phi\varepsilon1\varepsilon2$= Standardized bivariate normal distribution function with zero means $Y1j=1$ if the response to the first question is yes, and 0 otherwise $Y2j=1$ if the response to the second question is yes, 0 otherwise

$d1j = 2y\,1j-1$, and $d\,2j= 2y2j-1$
ρ = correlation coefficient
σ = standard deviation of the errors.

After running a regression of the dependent variable (yes/no indicator), on the constant independent variable consisting of bid values, the mean WTP is determined as follows depending on the normality assumption of WTP distribution (Haab and McConnel, 2002).

$$MWTP = -\alpha/\beta \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where, MWTP is the mean willingness to pay for improved water service, α = is the intercept of the model, β is a slope coefficient of bid values. The independent variables used to compute MWTP are the initial (bid1) and follow-up willingness to pay values (bid2). After that, from two regression outputs, the average value was calculated to estimate the mean willingness to pay.

Results and Discussion

Descriptive statistics

A total of 212 sample households were interviewed in the survey. Out of surveyed households, 2 and 5 were reported as incomplete responses and protest bidders respectively, and are excluded from the discussion. Only 205 sample households are taken for the analysis of this study.

From the sampled households, the mean age of households was found to be 44.19 years with the maximum and minimum years being 70 and 24, respectively. In terms of willingness to pay, the mean age was 51.31 and 42.57 for non-willing and willing respectively. Results from a t-test revealed statistical differences between the mean ages of the two groups, willing and non-willing respondents, as shown in Table 1. The result shows households with relatively young age were more willing to pay, this is because they may have a long horizon plan and vice versa.

The results further revealed that the sampled households had a total of 1890 family members. This constituted a mean of 4.97 members per household where the minimum size was 1 member and the maximum was 8 members. Households willing to pay the initially specified bid had a mean household size of 5.10 members, while those not willing had a mean of 4.41. This implies that a household with a large family size needs more water that is enough for their family from the improved water service. The result from the t-statistic shows that there is a statistical difference between the means of the two groups as shown by the t-value -2.39 in Table 1.

As indicated in Table 1, the mean monthly income of respondents is 2960.88 birr with the minimum and maximum incomes at 500 and 8000 Birr, respectively. Concerning willing and non-willing, willing respondents have on average greater income than non-willing respondents. From the non-willing households, the mean income was 1826.41 birr while for those willing, the mean income was 3227.41 birr. This shows the greater income, the more willing to pay for the proposed improvement water scheme. In addition, Table 1 underpins, there is a strong relationship between income and willingness to take an initial bid.

The education level of the household head was computed as the number of grades in school. A result showed that the average grade in school by the respondents of the sampled households to be at 6.83 grades with willing and non-willing the average grade is 7.58 and 3.64 respectively. This implies more educated were relatively willing to take an initial bid for improved water services and there is a strong relationship between education and willingness to pay. This result indicates that WTP tends to increase with increases in years of education.

Furthermore, the time taken to fetch water from the existing source was another important variable used in the analysis. On average, the average time to the main water source was found to be at 51.78 minutes, with a minimum of 5 minutes while a maximum of 90 minutes. The average time to fetch water for willing and non-willing households was 60.66 minutes and 13.97 minutes, respectively. The mean difference between the two groups was statistically significant at less than 1% probability level as shown by the t-value -9.26 in Table 1.

Table 1. Summary of descriptive statistics for continuous explanatory variables (n=205).

Variable	Non willing		Willing		t-test	Mean
	Mean	Std. error	Mean	Std. error		
Age (year)	51.31	1.59	42.52	0.84	4.66***	44.19
Family size (number)	4.41	0.26	5.10	0.13	-2.39**	4.97
Education (year)	3.64	0.53	7.58	0.39	-4.68***	6.83
Live in town (year)	27.15	2.15	26.25	1.24	0.33	26.42
Monthly income (birr)	1826.40	195.87	3227.40	133.45	-4.80***	2960.88
Time fetching (min)	13.97	2.12	60.66	2,38	-9.26***	51.78
Average daily water use	63.69	4.12	59.38	1.80	1.02	60.20
Initial bid (birr)	37.77	1.64	25.28	1.02	5.56***	27.60

*Source: Own Survey, 2020. *** & ** Significant at less than 1% and 5% respectively.*

Households in the study area also reported their perception regarding the quality of water they are currently using. From total sampled households, 163 were responded the quality of existing water service is poor were as 42 of respondents responded the quality of water is good. From the respondent that responded poor quality, 22.7% were non-willing to take the initial bid and 77.3%

were willing to take an initial bid for improved water service. From respondents that responded existing water service in town good were saying, 4.8% were non-willing and 95.2% were willing to take an initial bid for improved water services. In further questioning the households about water quality, the Dincha water scheme was highly contaminated with the iron rusting due to very old pipelines, and the color of water deteriorated. Based on chi-squared test analysis, Table 2 shows that there is also a strong relationship between quality of water service and willingness to take offered initial bids.

Concerning employment status, 128 were the households that informally employed skilled laborer, unemployed and others were as 77 formally employed Professional. Out of respondents who have a formal employee in the town, 92.2% were willing to take offered initial bids for proposed improvement of water scheme and 7.8% were not. This implies households hired in the formal sector have knowledge and information about the effects of water doubtful quality and appropriateness of improved water resource management. Based on chi-squared test analysis, there is also a strong relationship between employment status and willingness to pay for the proposed improvement of the water scheme.

Households in the study area also reported their awareness regarding the satisfaction of water they are currently using. Out of the total sampled households, 53 were satisfied with the existing water service in the town and 152 respondents were not satisfied. From unsatisfied households 25% were not willing to take offered initial bid and 75% were willing were as from households that were satisfied with existing water service, 2% was non-willing and 98% were also willing to take an initial bid for improved water service. Chi-squared test analysis, Table 2 shows that there is also a strong relationship between the level of satisfaction and willingness to take offered initial bids.

Table 2. Summary of descriptive statistics for discrete explanatory variables (n=205).

Variable	Responses	No willing		Willing		Total		χ^2
		No	%	No	%	No	%	
Own house	Yes	27	69	131	79	158	77	1.676
	No	12	31	35	21	47	23	
	Total	39	100	166	100	205	100	
Employment status	Employed	6	15	71	43	77	36	20.60***
	Unemployed	33	85	95	57	128	64	
	Total	39	100	166	100	205	100	
Level of satisfaction	Yes	1	2.6	52	31	53	26	13.63***
	No	38	97.4	114	69	152	74	
	Total	39	100	166	100	205	100	
Gender	Male	17	43.6	72	43.4	89	43.4	0.0006
	Female	22	56.4	94	56.6	116	56.6	
	Total	39	100	166	100	205	100	
Marital status	Married	34	87	136	82	170	83	0.615
	Unmarried	5	13	30	18	35	17	
	Total	39	100	166	100	205	100	
Quality	Good	2	5	40	24	42	20	6.975***
	Poor	37	95	126	76	163	80	
	Total	39	100	166	100	205	100	

Source: Computed from own survey, 2020

Household's willingness to pay for Improved Water Services

According to UNICEF/WHO (2017) on the human right to water, people are not expected to pay more than 3% of their household income; this does not mean that the person should not pay for water at all. In this wise, water cost should be on relative terms rather than the actual cost of producing and transporting water to households. This however opens room for debates and diverse interpretations of the meaning of the human right to water (Omole and Ndambuki, 2014). With the current situation of water supply in the study area are deteriorated, unreliable, and inaccessible, respondents were asked how comfortable they were concerning their WTP for improved water supply services. Analysis in Table 3 shows that 80.98% of the sampled respondents were willing to take initial bids to improve water supply service, while 19.02% of the respondents were not willing to pay for the service. This implies that most of the respondents were still willing to pay for improved water supply in the study area.

Table 3. Distribution of amount of initial bids.

Bid1	Frequency	Percentage	Willingness responses	
			No (%)	Yes (%)
8	52	25.37	3.85	96.15
25	51	24.88	9.80	90.20
33	51	24.88	17.65	82.35
45	51	24.88	45.10	54.90
Total	205	100	19.02	80.98

Source: Own survey, 2020

The above table also indicated that four initial bids provided for respondents 8 (25.37%), 25 (24.88%), 33 (24.88%) and 45 (24.88%) were distributed among 205 respondents. In terms of willingness to take the initial bid, households' probability to say yes for offered bid percentage decreases as the bid amount increases that consistent with the law of demand.

Estimation of Mean WTP without Covariates

One of the aims of this study is to estimate the amount of willingness to pay. The bivariate probit model was estimated by using response dummy variables for two responses and with their respective bid amounts. Table 4 shows the bivariate probit model result of two responses of willingness to pay questions.

Table 4. Mean willingness to pay for double bounded dichotomous responses.

		Coeff.	St.Err	Z	p>|Z|
Response1	Bid1	-0.0529281	0.0099345	-5.33	0.000***
	Cons	2.514826	0.356784	7.05	0.000***
Response 2	Bid2	-0.0202711	0.0081788	-2.48	0.013 **
	Cons	1.373244	0.2835177	4.84	0.000***
	/Anthrho	0.6836918	0.1846157	3.70	0.000
	Rho	0.5939142	0.1194955		
Log likelihood = -187.59587 Number of obs = 205 Prob > chi² = 0.0000 Wald chi² (2) = 29.55					
LR test of Rho = 0: chi²(1) = 17.5228 Prob>chi² = 0.000					

Source: Own survey, 2020

In the above bi-variate probit model output, rho is positively and significantly different from zero at less than a 1% probability level; implying there is a positive correlation between the two responses. In addition to this, the correlation coefficient of the error term is less than one implies the random component of WTP for the first question is not perfectly correlated with the random component of follow-up questions. According to the formula of Haab and McConnell (2002) in equation (4), the estimated willingness to pay is 57.62 ETB per month for improved water service in the town. This double bounded WTP ranges from 47.51 to 67.74 ETB per month. This result is different from the open-ended question, which has a mean WTP is 30.11 which ranges from 0 to 55 ETB per month.

Welfare measure and aggregation of willingness to pay

Aggregation of willingness to pay for improved water quality service is of great importance in the CV study. Before aggregation, protest zero bidders should be excluded from further estimation. Random sampling technique with face-to-face interviews was used in this study and protest zero responses were excluded from the estimation of aggregate benefit for improvement of water service in the town.

Table 5. Average and aggregate WTP of households for improving water service in town.

Total HHs in town	Number of samples	Number of HHs with protest zero	Proportion of protest zero	Expected protest	HHs with valid responses	Mean WTP	Total WTP/month
25,216	205	7	0.034	856	20,419	57.62	1,176,531

Source: Own survey, 2020

Table 5 reveals aggregate willingness to pay for improved water service. This was calculated by multiplying the mean willingness to pay from dichotomous choice responses result by the total number of households with valid responses within a town is 20,419 numbers of the household. Accordingly, the total willingness to pay is 1,176,531 ETB per month whereas, from the open-ended format, the total willingness to pay is 614,810 birr per month. This implies the result from dichotomous choice is greater than the open-ended format. Therefore, by implementing an improved water scheme the town's water supply enterprise not only avoids the water supply problem and increases households' welfare but also increases town water utility management and sustainability of the service.

Determinants of Households' WTP for improved water service

One of the main aims of the study was to identify determinants of WTP. A probit model was used in the analysis where the dependent variable (WTP) was binary taking values of 1 for "willing" and 0 for "not willing". Before the probit model, a Linear Probability Model (LPM) was run using OLS regressors. Variance Inflation Factor (VIF) and contingency coefficients were computed to check the existence of serious multicollinearity problems among continuous and discrete explanatory variables, respectively. The results indicated that there is no serious multicollinearity problem among explanatory variables and hence all the hypothesized variables were included in the analysis.

In Table 6 below, fourteen explanatory variables were used in the probit model to identify determinants of WTP based on the hypothesis made. The result of the model shows that the probability of chi-squared distribution (147.72) with 14 degrees of freedom. Generally, this result from the probit model showed that the variables used in the model, fit the model very well and Pseudo R^2 shows the high explanatory power of covariates.

Table 6. Probit and marginal effect results for willingness to pay.

Variables	Coef.	Std. Err.	Z	P>|z|	Marginal Effects
Ownership of the house	0.9620*	0.5790	1.66	0.097	0.0066
Time taken to fetch water	-0.8070**	0.3540	-2.28	0.022	-0.0019
Quality	1.2780***	0.4580	2.79	0.005	0.0080
Level of satisfaction	-3.1880***	0.8009	-3.98	0.000	-0.0408
Average daily water use	-0.0330***	0.0120	-2.76	0.006	-0.00008
Sex of respondent	-0.2160	0.4640	-0.47	0.642	-0.0005
Age of respondent	-0.1030***	0.0370	-2.76	0.006	-0.0002
Family size	0.2610*	0.1390	1.89	0.059	0.0006
Marital Status	-0.6460	0.5980	-1.08	0.280	-0.0009
Education	0.0995	0.0750	1.32	0.187	0.00023
Stay in town	0.0469***	0.0170	2.77	0.006	0.00011
Monthly income	0.0006***	0.0002	2.98	0.003	1.43e-06
Employment status	0.1610	0.9580	0.17	0.867	0.00033
Bid1	-0.1088***	0.0348	-3.12	0.002	-0.00026
_cons	11.5500	3.7170	3.11	0.002	
Number of ob = 205			Prob > chi^2 = 0.0000		
LR chi^2 (14) = 147.72			Pseudo R^2 = 0.7404		
Log likelihood = -25.89					

*Source: Own Survey, 2020. *, **& *** significant at less than 10%, 5% and 1%respectively.*

As indicated in the above table, ownership of the house was found to significantly affect households' WTP for improved water service at less than 10% significance level. This implies that the probability of accepting any initial bid offered is 0.66%, more for households who own the house they are currently living, than households who do not own their house, keeping the effects of other regressors constant. This positive relationship between ownership of the house and improved water service has concurred with the finding of Desalegn (2012) and Yibeltal (2011).

The age of the respondent proved to hurt households' willingness to pay for improved water service. As a result, table 6 shows, age was found to be less likely and significantly affects willingness to pay at less than 1% significance level. The descriptive analysis result also shows age has a significant relationship with the WTP for improvement of water scheme. The major reason for the negative effect of age on WTP is that the older aged households may have a shortened planning time horizon and reduce WTP for future sustainable management of improved water schemes. The marginal effect estimates also show that keeping the influences of other factors constant, a one-year increase in the age of the respondents reduces the probability of accepting the initial bid by 0.02%. This negative relationship between age and investment in improvement on water service is also consistent with the finding of Fujita *et al.* (2005); Giday and Zeleke (2015).

The regression result of the model portrays there was a positive and significant relationship between the family size of household and willingness to take offered initial bid at 10% significant level. The estimated marginal effect showed that all other factors kept constant, as the family size increased by one, the probability of households' WTP for the improved water service is increased by 0.06%. Hence, the expectation of households' effect on WTP is consistent with the study conducted by Akeju *et al.* (2018); Hundie and Abdisa (2016). Which is it is positively and significantly affect WTP for improved water services.

As expected, the dummy variable representing the quality of existing water service has a positive sign and is statistically significant at less than 1% significance level. One possible reason could be those households who perceive the poor quality and health hazards of the current water service are more likely to pay for improved water services than those households who do not perceive the problem with quality and related health hazards. The marginal effect of this variable reveals that respondents who perceived the existing water quality as poor have a 0.8% more probability of paying for quality water supply compared to respondents who did not recognize the quality of water. This is in line with the finding of Akeju *et al.* (2018) who recognized a positive relationship between WTP and the quality of existing water service in town.

The coefficient of average monthly income has a positive relationship with the households' WTP and is highly significant at a 1% level of significance. This tells us the reality that as the income of households increases their demand for potable water service increased. The regression result portrays that as income increases by a unit; the household increases the probability of accepting an offered bid by 0.00014%, by keeping other variables constant. The result is consistent with Hensher *et al.* (2005); Gossaye (2007); Zelalem and Fekadu (2012); Gidey and Zeleke (2015) who found that when income increases the probability of household saying yes to contribute for improved service increases. In addition, contrary to these findings, Adesope *et al.* (2010) found out that income had no significant effect on WTP and Chen and Chern (2004) found out that income had a significant and negative effect on WTP.

The regression result analysis showed that the households' satisfaction level with existing water service had the expected sign and was statistically significant at a 1% level of significance. The model result implied that the higher the level of satisfaction households perceives in their current water supply to be; the less he/she becomes willing to pay for the proposed improvement. The marginal effect of the variable shows that those respondents having satisfied with the existing water supply will have a 4.08% less probability of paying for improved water supply than those who are not satisfied, ceteris paribus. This agrees with Kinfe and Berhanu (2007); Giday and Zeleke (2015); Saleamlak (2013) who recognized a negative relationship between willingness to pay for improved water service and level of satisfaction.

Average daily water use is statistically significant at less than 1% to affect the probability of accepting the initial bid and is negatively associated with willingness to take offered initial bid amount. This suggests that WTP for improved water supply decreases. This is perhaps because the family whose use large water consumption is highly exposed to pay for clean water supply that makes the opportunity cost using for food and other necessities in such families. To its marginal effects, taking other factors constant, when the level of average daily water use increases by a unit, households' willingness to take offered initial bid decreases by 0.008%.

A respondent year of stay in the town is also positively and significantly associated with the likelihood of choosing improved water service at 1% level of significance. The positive and significant result showed that residents who stayed in the town for long years are more aware of the severity of the water supply problem and thus are WTP more for improved water services. The marginal effect estimates of Table 6 also show that keeping the influences of other factors constant, a one-year increase in the stay on the town of residents, increases the probability of accepting the initial bid by 0.011%. This finding also concurs with Yibeltal (2011) who found that the coefficient of stay in town has a positive relationship with the improvement of the water scheme.

The regression result analysis showed that the time taken to fetch water from the existing water source was found to be negative and significantly affects WTP at less than a 5% significant level. The negative sign shows that those sampled households who were spent less time fetching water from the source were less likely willing to pay for provisions of improved water source than high time spent. The further the households' far away from the source of water would be willing to pay more. To its marginal effect, holding all other factors constant, a minute decrease in the time spent on fetching water by households decrease the probability of WTP by 0.19 percent. This finding is also in line with Ogunniyi *et al.* (2011) who found that the coefficient of time of fetching has a negative relation with the improvement of the water scheme.

The coefficient for the variable bid was negative and was significant at less than a 1% level of significance. This implies the households' probability to say yes for offered initial bid increases with a decrease in the initial bid amount and vice versa, which is consistent with low demand. This suggests that a one percent increase in the initial bid will reduce the likelihood that respondents are paying for improved water services by 0.026%, ceteris paribus. This was in line with the studies done on improved water service (Gidey and Zeleke, 2015; Bamlaku *et al*., 2015) that showed the negative relationship between willingness to pay and initial bid.

Conclusion and Recommendation

In most sub-Saharan Africa including Ethiopia, it is common to have an unreliable and poor quality of drinking water, which is mostly provided by public utilities. At this moment, Bonga town is one of the areas, which face unreliable and inadequate supply of water as the existing water supply of the town's utility management. The descriptive result showed that out of the total 205 valid responses, 74% of them were not satisfied with the existing water service due to factors that include doubtful quality, inadequate quantity, unreliability, inefficient management of water service, high population pressure in water point and killing significant time in water point. 80.98% of valid respondents were WTP some amount of birr for the proposed improved water scheme with a mean WTP of 57.62 Birr and 30.11 Birr per monthly from the double bounded format and open-ended format respectively.

From the estimated model, the age of the household head, daily water use, satisfaction level, time of fetching, and initial bid offered was significantly and negatively affected WTP for improved water services. In addition, ownership of the house, quality, family size, stay in town and monthly income was found to be positive and significantly affect WTP for improved water service.

Indeed, the aggregate welfare gain from improved water service in the study area was estimated to be 1,176,531 and 614,810 ETB from the double bounded dichotomous choice format and open-ended format respectively per month. This shows that the value of improvement of water service from open-ended format was underestimated as compared to a double bounded format. This implies that, in the valuation of environmental resource services, using a double bounded dichotomous choice format is preferable to other elicitation methods including open-ended format.

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