Households' Willingness to Pay For The Rehabilitation of Wetlands: Evidence From Gudera Wetland, Northwest Ethiopia

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Households' willingness to pay for the rehabilitation of wetlands: evidence from Gudera wetland, Northwest Ethiopia

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Abstract

Although Gudera wetland is known for its multi-functionality, it is at the edge of collapse at this time. The study was initiated to estimate households' mean willingness to pay (WTP) for the rehabilitation of the wetland and its welfare gains from the intervention. It was also aimed to identify major determinants for the wetland rehabilitation intervention. To meet these objectives, data from 237 rural households were collected using two stage random sampling procedures. Econometric models such as, seemingly unrelated bivariate probit and double hurdle models were used to estimate mean WTP and determinants of WTP, respectively. The result shows that the mean WTP values from double bounded dichotomous choice ranges from 70.44 to 80.64 Ethiopian Birr per year per household. Therefore, the aggregated welfare gain expected from the rehabilitation intervention ranges from 2,033,180 *to 2,327,593 Ethiopian Birr per year. Factors such as farm income, participation in natural resource conservation, frequency of extension contact and trust on budget allocation have a positive and significant effect on the households' WTP. While, factors such as land size around the wetland, distance to the wetland and credit have a negative influence on households' WTP. Thus, critical consideration of such factors is pertinent to increase the level of public support towards the rehabilitation intervention.*

Keywords: Wetland rehabilitation, Willingness to pay, Hypothetical Scenario, Bivariate probit, Double hurdle

1. INTRODUCTION

Global civilizations have been associated with wetlands (Keddy *et al.* 2014). These wetlands are the earth's most productive and valuable ecosystems in the development processes of the society (Musamba *et al*. 2011; Adugna 2015). They also play a great role in maintaining healthy biodiversity hotspots and balanced food webs (Barbier *et al*. 1997; Mengistu 2003; Yilma 2003; Brander and Schuyt 2010; Olarewaju *et al*. 2014). Due to various functions they perform in the hydrological and chemical cycles, wetlands are termed as "the kidneys of the landscape" (Barbier *et al*. 1997). Nowadays, however, many of the wetlands in Ethiopia are at the edge of collapse due to unsustainable utilization (Afework 2005; Getnet *et al*. 2013).

In Ethiopia, unsustainable utilizations of wetlands such as wetland destruction and alteration through intensive irrigation, human settlements, and free grazing are considered as advanced modes of development (MEA 2005; Tamiru *et al.* 2007; Negash *et al*. 2011; Xianzhao and Shanzhong 2011). This indicates how wetlands and their values are undermined and remained little understood (Yilma 2003; Hagos *et al.* 2014; Fikirte and Mare 2015). This misconception towards wetlands puts them under a big threat and makes their existence questionable (Yilma 2003; Miheret 2011, 2015). The vanishment of Lake Haramaya is an intact evidence, where the lake continually shrunk and then totally dried-up due to unrestrained anthropogenic activities such as water withdrawal for irrigation and municipal uses (Brook 2003; Tamiru *et al.* 2007; Seifemichael *et al*. 2014).

On the other hand, because of nonexistence of market price for indirect and nonuse values, wetland utilization and management decisions in the study area are based on direct values obtained from the wetland. In fact, indirect and nonuse values from the wetlands are obviously and by far greater than the direct use values (Emerton 1998; Anderson 2010; Tietenberg and Lewis 2012). Such nonmarketable nature often creates difficulty in prioritization and allocation of the wetland resources and leads to continued degradation of the wetlands (Willy *et al*. 2013). In addition, effective and sustainable rehabilitation interventions requires due consideration of the local communities' understandings about the wetland and the value they attached to it (Abate *et al*. 2010; Juana *et al*. 2013). Therefore, estimation of the comprehensive monetary values that the local communities attached to the wetland rehabilitation intervention is one of the pressing research agenda, especially in developing countries (Bekele *et al*. 2018). Therefore, economic valuation by

estimating willingness to pay (WTP) is often considered as a panacea in monetizing non-marketed values of natural resources such as wetlands (Freeman *et al.* 2014). However, empirical studies on household's WTP for wetland rehabilitation in the study area in particular and in developing countries in general are scanty.

Most natural resource valuation studies in developing countries are concentrating on WTP for soil and water conservation, forest conservation, irrigation water use and quality water supply (e.g. Urgessa 2011; Adugna 2013; Meseret 2014; Ayana 2015; Yalfal 2015; Alemayehu 2016; Gebrelibanos 2016; Belay 2017; Tadesse 2017). In this vein, most studies neglected wetlands, which are the foundation and pillar for all forest, water and other land resources. In addition, these valuation studies have many methodological limitations in capturing biases, which usually emanate from contingent valuation methods (CVM), the constructed market scenario and the payment vehicle they used. Therefore, this study aimed to contribute to the scanty literature by estimating mean WTP and identifying determinants that affect the probability and intensity of WTP for the rehabilitation of Gudera wetland in western Ethiopia.

2. MATERIALS AND METHODS

2.1. Description of the study area

The study site is situated in Sekela district, Amhara National Regional State, Ethiopia. In this regard, Sekela district is located at a distance of 160 km from Bahir Dar and 459 km away from Addis Ababa (Muluneh 2015). The district is one of the tourist attraction site in the region, which always associated with Gish Mountain and spiritual issues. According to SWCTO (2019) the name of the capital town of the district, "Gish-Abay", has always been associated with the miraculous Holy Father "Abune Zerea-Buruk" and Gish Mountain (contributor of Blue Nile).

This district is consisting of 26 rural Kebeles and 1 urban town with a total population of 138,691 (30,151 households) and an average family size of 4.6 per household (SWARDO 2019). On the other hand, the total number of population in Asewa Tekle-Haimanot and Zegeza-Tengefa Kebeles are 2,932 and 3,199 respectively (Muluneh 2015). According to SWARDO (2019), Asewa Kebele has a total household of 705 (male 616 and female 89) whereas, Zegeza Kebele has a total household size of 627 (male 529 and female 98). The agro ecology is classified as 70% highland and 18% midland and 12% lowland (SWARDO

2019). The district's annual rainfall ranges from 1600mm to 1800mm and a mean annual temperature of 18 °C (Brehan 2017).

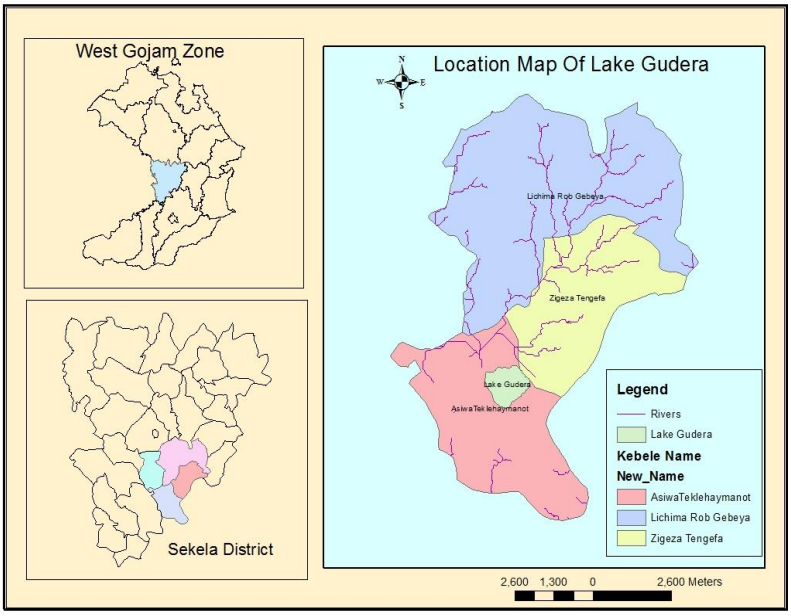

Figure 1. Location map of the study area

2.2. Data types, sources and methods of data collection

For this study, both quantitative and qualitative data types were collected using primary and secondary data sources. The primary data were collected from wetland user local households using semi-structured questionnaire, focus group discussion (FGD), and key informant interview. Secondary data were collected from research articles, books, proceedings, working papers and institutional reports.

The questionnaire tried to solicit information about different demographic, socioeconomic and institutional characteristics of the households. In addition, the questionnaire incorporated the contingent valuation (CV) scenarios and debriefing questions. Before the formal survey was conducted, the questionnaire was pretested using 22 randomly selected households from the two Kebeles. As Kuang *et al*. (2015) rightly stated the purposes of pre-testing are: (1) to check the soundness of the questionnaire; (2) to incorporate or exclude variables which are important or irrelevant for the area; and (3) to set the appropriate initial bid values for the double bounded-dichotomous choice method.

After pretesting the questionnaire, some imminent modifications were done. Most importantly, the initial bid sets were determined using mean, median and mode of the WTP

amount from the open-ended question during the pretest. Following Hanemann *et al.* (1991) and Haab and McConnell (2002), the initial bids were 50, 64 and 76 ETB per year per household and the follow-up bid sets were determined by doubling the initial bid for 'yes' response or by decreasing the initial bids by half for 'no' responses in the initial WTP question. Finally, these three initial bids were allotted to each household equally and randomly. Finally, the data from the two Kebeles were collected using 237 randomly selected wetland user local households.

In addition, 12 key informant farmers from the two Kebeles were interviewed about the major challenges observed around the wetland. Prior to the formal contingent valuation survey, these key informant households were requested to suggest possible solutions to rehabilitate the wetland. Hence, by relating the suggested solutions with the key informants and literatures, plausible rehabilitation strategies were incorporated into the CV scenario for the formal survey. Moreover, to design a plausible questionnaire and payment vehicle, two FGDs were held before and after the formal survey. As suggested by Krueger (2002) and Nyumba *et al*. (2018) the size of the participants in each Kebeles was restricted to 7 for the ease of management and smooth interaction.

2.3. Sampling techniques and sample size determination

To get representative sample rural households from the two bordering Kebeles, two-stage random sampling procedure was adopted. In the first stage, two Kebeles, which directly and/or indirectly get benefit from the wetland were purposively selected. In the second stage, households in these two Kebeles were randomly selected using simple random sampling method. For this purpose the sample size was determined by using a simplified formula developed by Yamane (1967).

$$\boldsymbol{n} = \frac{\boldsymbol{N}}{\boldsymbol{1+N\,(e)^2}} \qquad \textit{(1)}$$

Where: n = Sample size, N = Population size, e = Level of precision or the error in which the researcher will tolerate.

As the population in the study area is homogenous in many characteristics such as livelihood strategy, cultural and other socioeconomic and institutional setups, the precision

level used was 6.45%. Therefore, the sample size was determined to be 237 rural households.

$$n = \frac{30151}{1 + 30151\,(0.0645)^2} = 237$$

2.4. Constructed hypothetical market scenario

In the first part of the CV scenario, detail information about wetland degradation and its consequence were presented by relating with some evidences from Ethiopia and abroad. In addition, information that describes how the wetland would look like if intervention measures could not be undertaken were also presented in detail. After this, as Ndebele *et al*. (2014) applied, three contingent valuation scenarios were presented with color photo. The first scenario was the 'status quo scenario' and presents how the wetland currently looks like based on photos taken at the site. The second scenario was the 'future scenario 1', which tried to show how the wetland would look like if the rehabilitation program is not implemented. The final 'future scenario 2' was about how the wetland could potentially look like if the rehabilitation program implemented.

To avoid over or underestimation of WTP, households were reminded to critically consider their income level, the benefits they expect from the program, availability of substitute and other socioeconomic and institutional factors to answer the WTP questions (Arrow *et al*. 1993). In addition, to avoid protest and free-riding behavior of the households, as Ndebele *et al*. (2014) suggested, households were requested to assume that the rehabilitation program would only implemented if all the surrounding people are willing to contribute based on their ability.

2.5. Elicitation method used and initial bid sets

According to Hanemann *et al*. (1991) and Haab and McConnell (2002), using a series of questions in the DB-DC elicitation method can progressively narrow down households stated amount to their true WTP amount. For this reason, DB-DC elicitation method with follow up question was adopted to estimate mean WTP amount. The initial bids offered can be determined by using information obtained from the pretesting questionnaire using 22 randomly selected households. Therefore, initial bids that give maximum efficiency in estimating mean WTP was obtained by offering an initial bid amount closer to the true

mean WTP value (Haab and McConnell 2002) using mean, median and mode of the WTP amount from the open-ended pretest question. Hence, the initial bids that were equally and randomly allotted to each sampled households were 50, 64 and 76 ETB per year per household.

2.6. Specification of econometric models

2.6.1. Estimation of mean willingness to pay

With two binary responses (WTP1 and WTP2), it is impossible to use the conventional probit or logit model to estimate these two equations simultaneously. Thus, seemingly unrelated bivariate probit model, which simultaneously estimate the initial and follow-up bid equations, becomes appropriate. Estimation of mean WTP using such model could lead to a more statistically efficient WTP estimation (Hanemann *et al*. 1991; Cameron and Quiggin 1994; Malama 2015). A study by Signorello (1998) also confirms that, when there is interdependence between the two responses, which is manifested by the significant correlation coefficient (□<0.88), seemingly unrelated bivariate probit could be appropriate econometric model to estimate the mean WTP. Therefore, seemingly unrelated bivariate probit was employed to estimate households' mean WTP for the rehabilitation of Gudera Wetland. According to Hanemann *et al*. (1991) there are four possible outcomes in the double bounded dichotomous choice elicitation method with their probability:

$B_1 < WTP < B_2$: $\mathbf{Pr(Yes, No) = Pr(\mu_1 + \varepsilon_{1j} \square\ B_1, \mu_2 + \varepsilon_{2j} \square\ B_2)}$ (2)

$B_1 > WTP > B_2$: $\mathbf{Pr(No, Yes) = Pr(\mu_1 + \varepsilon_{1j} < B_1, \mu_2 + \varepsilon_{2j} \square\ B_2)}$ (3)

$WTP > B_2$: $\mathbf{Pr(Yes, Yes) = Pr(\mu_1 + \varepsilon_{1j} > B_1, \mu_2 + \varepsilon_{2j} \square\ B_2)}$ (4)

$WTP < B_2$: $\mathbf{Pr(No, No) = Pr(\mu_1 + \varepsilon_{1j} \square\ B_1, \mu_2 + \varepsilon_{2j} \square\ B_2)}$ (5)

where, B1, B2 and WTP are initial bid, second bid amount and WTP amount for the follow up question respectively.

According to Lemi (2015) and Belay (2017) seemingly unrelated bivariate probit model can be specified as follows:

$$\boldsymbol{Y_1^* = \alpha_1 + \beta_1 B_1 + \varepsilon_1} \quad (6)$$

$$\boldsymbol{Y_2^* = \alpha_2 + \beta_2 B_2 + \varepsilon_2}$$

(7)

$$Y_1 = \begin{cases} 1 \text{ if } Y_1^* \square B_1 \\ 0 \text{ if } Y_1^* \square B_1 \end{cases}$$

$$Y_2 = \begin{cases} 1 \text{ if } Y_2^* \square B_2 \\ 0 \text{ if } Y_2^* \square B_2 \end{cases}$$

$$Corr\ (\square 1, \square 2/B_1, B_2) = \square$$

Where, Y_1 and Y_2 are WTP responses for the first and second equations respectively, B_1 and B_2 are the bid in the first and second bid questions, α's and β's are parameters to be estimated and $\square_1$ and $\square_2$ are unobservable random components and correlation coefficient ρ, is the covariance between the errors for the two WTP function.

Therefore, the mean WTP was calculated by using the coefficients from the constant term and the bids offered. These coefficients were obtained by regressing the dependent variables (WTP1 and WTP2) on the initial and follow up bid amount holding other explanatory variables constant (Haab and McConnell 2002). Thus, mean WTP was calculated by using the formula:

$$\mathbf{MWTP = -\alpha / \beta}$$

(8)

Where, α is a coefficient for the constant term, β is a coefficient offered bids to the respondents.

2.6.2. Determinants of households' WTP amount

Literally, the WTP amount is the final amount that households are willing and able to pay for the proposed rehabilitation intervention. This variable has continuous value for those who are willing to pay and zero for those who are not. To identify the model that best fit, different methods were implemented. First, Heckman two-stage model was fitted if there is selectivity bias but the Mill's ratio or lambda was not significant. Hence, using Heckman selection model is irrelevant for the study. Hence, selection of appropriate model was made

between Tobit and double hurdle using a method called likelihood ratio (LR) test statistics. The likelihood ratio (LR) test statistics Γ can be computed (Greene 2000) as:

$$\Gamma = -2\left[\mathbf{lnL_{tobit}} - \left(\mathbf{lnL_{probit}} + \mathbf{lnL_{truncated}}\right)\right] \sim \boldsymbol{\chi}_{\mathbf{k}}^{\mathbf{2}} \quad (9)$$

Where, Γ= likelihood ratio statistic; ln= natural logarithm; L_{Tobit}, L_{Probit} and $L_{Truncated}$ are likelihood values for Tobit, Probit and Truncated regression models respectively, χ2 = Chi-square statistic and k is the number of independent variables in the equations.

Based on Equation 9, the value of likelihood ratio statistic (Γ) (32.89) was greater than the value of the chi-square statistic (25.00) at 15 degree of freedom. This indicates the superiority of the double hurdle model over the Tobit model. Hence, factors that influence the probability of households' WTP and its intensity can be determined separately in the double hurdle model. This model allows in modeling the decision process in two steps. First, households decide if they are willing to pay for the rehabilitation intervention (WTP decision) and then they decide the maximum amount they can contribute (intensity decision). Therefore, the first decision (first hurdle) was specified using probit model as follows:

$$\boldsymbol{WTP_i}^* = \square + \boldsymbol{\beta}'\boldsymbol{X_i} + \boldsymbol{u_i} \quad (10)$$

$$WTP_i = \begin{cases} 1 \; if \; WTP^* > 0 \\ 0 \; otherwise \end{cases}$$

Where WTP_i is a dummy variable that takes the value 1 if the household head is willing to pay for the rehabilitation intervention and zero otherwise; X_i is a vector of household characteristics and □ is a vector of parameters.

In the second hurdle, the decision on maximum amount of WTP were specified as follows:

$$\mathbf{MaxWTP_i}^* = \square_{\mathbf{o}} + \square'\mathbf{X_i} + \square_{\mathbf{i}} \quad (11)$$

$$MaxWTP_i = \begin{cases} 1 \; if \; MaxWTP^* > 0 \\ 0 \; otherwise \end{cases}$$

where, MaxWTP_i represents the maximum amount that the household are willing to contribute; X_i is a vector of the individual's characteristics and $\square_o, \square$ is a vector of parameters

3. RESULTS AND DISCUSSION

3.1. Descriptive statistics

From the surveyed households 82.59% of them were willing to contribute in favor of the rehabilitation intervention, whereas 17.41% of them were not willing for the proposed intervention for various reasons (Table 4). In this regard, the household's decision to accept or reject the offered bid amount is found to be a function of many demographic, socioeconomic and institutional factors. Hence, the relationship between these factors and households' WTP are presented below.

3.1.1. Demographic and socioeconomic factors of sampled households

The average distance from households' home to the wetland found to be 20.8 minutes of walk. This distance from home to the wetland also varies across willing and non-willing households. As presented in Table 1, households who were willing to contribute to the rehabilitation intervention are situated at a distance of 20 minutes of walk on average. Whereas, non-willing households are found at a distance of 24.72 minutes of walk on average. This mean difference in distance from home to the wetland is also statistically significant. This is also consistent with the finding of Kong *et al*. (2014) that non-willing households are whose who situated far from the wetland.

In the study area, crop-livestock mixed farming system are the main means of livelihood strategy (87.05%) for the households. Whereas, 12.95% of the sampled households participate in seasonal labor, petty trade, remittance and handcraft in a variety of ways. Exceptionally, willing households have lesser irrigable land (0.44 timad[1]) compared to the non-willing households (0.74 timad). This mean difference in ownership of irrigable land is also statistically significant. In consistent with the finding of Zhu *et al*. (2016) households who have more land around the buffer zone of the wetland might discern the intervention negatively due to fear of lose in their irrigable land.

[1] Timad is a local measures of land size, in which one timad is equivalent to 0.25 hectare

On the other hand, livestock rearing contributes to the rural livelihood next to crop production. In this regard, households who were willing to pay have an average TLU of 4.96 whereas; non-willing households have 3.88 TLU on average. This mean difference in TLU possession between willing and non-willing households is found to be statistically significant (Table 1). The reason is that households who have more livestock unit can made a substantial support for the rehabilitation intervention by expecting improvements in their grazing land and fodders. This finding is also consistent with the finding of Bamlaku and Yirdaw (2015).

Table 1. The relationship between continuous independent variables and WTP

Variables	Willing (n= 185)		Non-willing (n= 39)		t-value
	Mean	Std. Dev.	Mean	Std. Dev.	
Age	46.96	12.56	46.38	12.31	0.26
EDUC	1.37	2.39	1.31	2.37	0.16
Family size	6.14	2.07	6.54	2.44	1.07
Dependency Ratio	0.68	0.61	0.69	0.48	0.22
Distance	20.00	13.04	24.72	14.49	2.01**
Total land size	3.63	2.33	4.03	3.11	0.92
Irrigable Land around wetland	0.44	0.77	0.74	0.99	2.07**
TLU	4.96	2.15	3.88	1.86	2.89***
Non-farm income	1329.40	3233.29	1712.85	3409.66	0.67
On-farm income	5455.90	6162.67	2476.92	3952.24	2.89***
Extension contact	8.17	7.05	4.21	6.21	3.25***

Source: Own survey result, 2019

As presented in Table 1, there is significant difference in mean annual on-farm income from selling of livestock and produced crop between willing and non-willing households. Similar with the previous studies of Ndebele *et al*. (2014), Kuang *et al*. (2015), Bueno *et al*. (2016) and Nyongesa *et al*. (2016) willing households have a higher annual on-farm income and this could increase the financial capability of the households.

Table 2. Association between demographic and institutional variables with WTP

Variables		Willing (n= 185)		Non-willing (n= 39)		χ^2 value
		N	%	N	%	
Sex	Male	179	96.76	36	92.31	1.65
	Female	6	3.24	3	7.96	
Conservation	Yes	161	87.03	27	69.23	7.56***
	No	24	12.97	12	30.77	
Training	Yes	82	44.32	13	33.33	1.59
	No	103	55.68	26	66.67	

Credit	Yes	71	38.38	17	43.59	0.37
	No	114	61.62	22	56.41	
Trust on budget	Yes	95	51.35	10	25.64	8.55***
	No	90	48.65	29	74.36	
Source of Income	Crop-livestock	161	82.56	34	17.44	0.044**
	Petty Trade	11	84.62	2	15.38	
	Seasonal Labor	7	58.33	5	41.67	
	Remittance	3	75	1	25	

Source: own survey result, 2019

3.1.2. Institutional factors

As depicted in Table 2, significant variation in participation for natural resource conservation was observed among willing (87.03%) and non-willing (69.23%) households. This implies that willing households have better exposure for environmental conservation participation than their counterparts do. Similarly, households who were willing to contribute to the rehabilitation of Gudera wetland had more access to extension (90.81%) than non-willing households (66.67%) did. In terms of frequency of extension visit, willing households have the chance of frequent extension visit compared to the non-willing households. These findings also coincide with previous studies by Loomis and Covich (2000), Ndebele *et al*. (2014), Senayet (2014), Kaffashi *et al*. (2015) and Bueno *et al*. (2016) that awareness creation could increase the interest of local households towards the rehabilitation intervention.

The other interesting result is that 51.35% of the willing households have better trust on the proper allocation of the collected money for the proposed intervention than non-willing households (25.64%). This signifies that most of the willing households have good expectancy on the budget allocation and implementation of the rehabilitation intervention than the non-willing households at 1% significance level. This is also in agreement with the findings of Bueno *et al*. (2016) and Nyongesa *et al*. (2016).

3.2. Response patterns for the DB-DC

In the double-bounded dichotomous choice elicitation method, the response patterns inclined towards the two extremes of “Yes -Yes” and “No – No”. As Table 3 depicts, majority (30.8%) of the sampled households accept both the initial and follow-up bids. On the other hand, 29.46% of them reject both bids offered. In between these two extremes, 23.21% and 16.52% of the responses in the DB-DC elicitation method were “Yes- No” and

"No-Yes" respectively. In agreement with the Getachew (2018) such high level of acceptance of the offered bids signifies that most of the sampled households have the interest to participate in the rehabilitation of the wetland.

Table 3: Patterns of response for the two offered bids

Possible outcome	Frequency	%
Yes- Yes	69	30.80
Yes- No	52	23.21
No-Yes	37	16.52
No-No	66	29.46

Source: Own survey result, 2019

3.3. Reasons for rejecting or accepting the offered bids

Households' decision to accept or reject the offered bids is contingent on many demographic, socioeconomic and institutional factors. However, households might reject the offered bids either from their protest or from genuine behavior. In this regard, the genuine and protest behaviors were identified by using a well-designed debriefing questions. Accordingly, 20.4% of the non-willing households were protest zero bidders and the remaining were genuine zero.

For the genuine zero responses, the main reasons for rejecting the offered bids were financial constraint and satisfaction with the current state of the wetland. On the other hand, some households protest the payment for rehabilitation intervention with the reasons of "it should be the government's responsibility" and "mistrust on budget allocation during implementation".

Table 4. Reasons for rejecting the offered bids

Reasons	Frequency	%
I do not have financial capability to pay	28	57.1
Satisfied with the current status of the wetland	11	22.5
It is not fair to ask payment for common resources	2	4.1
Only users of the wetland should Pay	1	2.0
It is the government's responsibility	3	6.1
I am not confident on proper budget allocation	4	8.2

Source: Own survey result, 2019

From 224 valid responses, 82.59% of the sampled households were willing to contribute in favor of the proposed rehabilitation intervention. These willing households had different reasons or motivations to pay for the program and most of them (32.2%) were motivated to see the wetland to its former beauty. In addition, the wetland is a good source of water, thatch and different grass species locally called *kechine* and *berbenz* that used as *cheffee*[2] for cultural celebration. In this regard, the FGD and key informant interview result indicates that the harvested *cheffee* is a good source of cash income for students, landless youths and for most female-headed households. These individuals sold *cheffee* three times per week with an average of 50 ETB per trip. Besides the existing benefits, these households are motivated to support the rehabilitation intervention in order to enhance the potential future benefits including fishes after implementation of the intervention. The remaining households also support the rehabilitation intervention mainly to conserve such important wetland and bequeath for the next generation. All these magnifies how households in the study area are dedicated to the rehabilitation of Gudera wetland.

Table 5. Motivations for accepting the offered bids

Reasons for maximum WTP	Frequency	%
I want to see the Lake at its former beauty	66	35.68
Just it is our heritage	25	13.51
The benefits I derived is greater than the payment	50	27.03
For the good of the community and future generation	44	23.78

Source: Own survey result, 2019

3.4. Econometrics models estimates

3.4.1. Estimation of mean willingness to pay

As Table 6 depicts, the positive and significant sign of Rho (ρ) indicates the existence of positive relationship between the two WTP responses. On the other hand, the correlation coefficient being less than unity indicating that the random components from the first and follow-up WTP questions are not perfectly correlated. This significant, but imperfect correlation between the two error terms verifies that seemingly unrelated bivariate probit model (SUBPM) is the correct econometric model to estimate mean WTP amount. Hence, as Alberini (1995) and Cameron and Quiggin (1994) illustrated using SUBPM gives efficient and unbiased mean WTP estimation for the rehabilitation program.

[2] Cheffee is a grass species that has sprinkled on the floor to celebrate coffee and holyday or other programs

Table 6. Seemingly unrelated bivariate probit parameter estimates

Variable	Coefficient	Std. Err.	P > □Z□
Initial bids	-0.018	0.007	0.008***
Constant	1.268	0.441	0.004***
Second bids	-0.011	0.002	0.000***
Constant	0.887	0.220	0.000***
ρ (Rho)	0.882	0.159	0.000***
Number of obs		224	
Log likelihood		-297.308	
Wald chi2(2)		36.76	
Prob > chi2		0.0000	
Likelihood-ratio test of rho=0: chi2(1) = 7.344 Prob>chi2=0.0067***			
Mean WTP = 70.44 ETB (At 95% CI, 70.44 to 80.64 ETB)			
y = Pr(WTP1=1,WTP2=1) (predict, p11) = 0.4484			

Note: *** shows significant variables at 1% probability levels
Source: Own survey result, 2019

Using equation 8, the estimated mean WTP amount for the rehabilitation of Gudera wetland ranges from 70.44 to 80.64 ETB per year per household. On the other hand, the mean WTP amount from the open-ended elicitation method was about 76 ETB per year. This indicates that the mean WTP value from the open-ended elicitation format is in between the two mean WTP values of the DB-DC method. In agreement with the finding of Alem *et al.* (2013) such convergence in mean WTP values among the two elicitation methods might arise from the rightness in setting the initial bids and the plausibility of the constructed market scenario.

3.5. Determinants of households WTP decision

Distance from home to the wetland (DISTWET): As the distance from home to the wetland increase by one minute of walk, the probability of willingness to pay in favor of the rehabilitation intervention decreases by 0.4%. Thus, households who are situated far from the wetland are less likely to pay for the rehabilitation of the wetland. This attributes to the fact that those households who are situated at a distance from the wetland might perceived as they are less beneficiary from the wetland compared to the nearest. This result is also in consistent with the findings of Shang *et al*. (2012), Kong *et al*. (2014), Ndebele *et*

al. (2014), Zhu *et al*. (2016) and Tadesse (2018) that being far from the wetland has a negative influence on the WTP decision than those who situated around the wetland.

Land size around the wetland (LSIZBUFR): The interesting result is that households with more land around the wetland are less likely to accept the payment for the rehabilitation of the wetland. Hence, as households' land size around the wetland increased by one unit (*timad*), the probability of WTP in favor of the intervention decreases by 8.7%. This finding is unique in that households plough up to the edge of the Lake illegally when the water retreats every year. However, the perceived risk of loss in their irrigable land during rehabilitation intervention could negatively affect their WTP decision. Previous study by Zhu *et al*. (2016) also reported those households, who have more land around the wetland, are less likely to be willing to contribute for the rehabilitation of the wetland than those who have less.

Annual On-Farm Income (lnFARMINCO): In line with the prior expectation, annual on-farm income found to have a positive and significant influence on the willingness to pay decision. Thus, holding the effect of other variables constant, an increase in annual on-farm income by 1% increases the probability of willing to pay by 1.6%. The possible reason is that households may realize the consequence of deteriorating such wetland on their on-farm practices. In addition, households may conceive that improvement in the state of the wetland is also a way to improve their on-farm income. This finding is also consistent with previous studies by Kagunda (2003), Kong *et al*. (2014)**,** Senayet (2014), Bamlaku and Yirdaw (2015), yongesa *et al*. (2016), Wei *et al*. (2016), Lamesgin (2017) and Tadesse (2018).

Participation in environmental conservation practice (CONSERV): Households who participate in environmental conservation practices have 12.6% more probability to be willing to pay compared to those who do not participate. The rationality is that households, who participate in natural resources conservation, become well informed about the advantages of wetland conservation. This finding is also consistent with the findings of Loomis and Covich (2000), Ndebele *et al*. (2014), Kaffashi *et al*. (2015), Lamsal *et al*. (2015) and Bueno *et al*. (2016) which affirms that participation in environmental conservation practice determines WTP decision positively.

Frequency of Extension contact (EXTEN): Extension contact found to have a significant and positive effect on the probability of households' WTP. This can be interpreted as; each additional extension contact by extension agent increases the probability of household's WTP by 0.6%. The possible reason is that having more extension contact always associated with enhancement in households' awareness regarding the degradation level of the wetland and its consequence. This inspires households to conceive as rehabilitation of the wetland is pertinent to enhance the benefits obtained from it. In line with this finding, Senayet (2014), Lamesgin (2017) and Hayalneh (2018) also asserted the positive effect of frequency of extension contact on willingness to pay decision.

Table 7. Maximum likelihood estimation of the double-hurdle model

Variables	First Hurdle			Second Hurdle		
	Coef.	Std. Err.	dy/dx	Coef.	Std. Err.	dy/dx
SEX	-0.182	0.559	-0.029	7.107	32.778	7.107
AGE	0.008	0.013	0.001	-1.087*	0.610	-1.087
EDUC	0.031	0.061	0.005	2.220	2.413	2.220
DEPNDR	-0.150	0.262	-0.026	-6.678	11.353	-6.678
DISTWET	-0.020**	0.009	-0.004	-0.057	0.457	-0.057
LSIZBUFR	-0.497***	0.135	-0.087	-10.027	7.449	-10.027
TLU	0.039	0.071	0.007	9.242***	3.085	9.242
lnFARMINCO	0. 092***	0.035	0.016	1.123	1.724	1.123
lnNONFARM	-0.024	0.037	-0.004	3.535**	1.578	3.535
CONSERV	0.570*	0.298	0.126	-11.744	17.688	-11.744
EXTEN	0.035*	0.019	0.006	1.665**	0.749	1.665
TRAIN	0.072	0.263	0.013	28.211**	11.636	28.211
CREDIT	-0.586**	0.265	-0.111	5.595	11.418	5.595
TRBUGA	1.047***	0.281	0.181	12.892	10.900	12.892
BID1				-0.477	0.499	-0.477
_cons	0.089	0.984		67.642	58.199	
Observations		224		Observations		184
Log likelihood		-76.215		Log-likelihood		-959.97
LR chi2 (14)		54.70		Wald chi2(15)		45.43
Pseudo R2		0.264		Prob > chi2		0.0001
Prob > chi2		0.0000				
y = Pr(WTP) (predict) = 0.90069867				y = Linear prediction = 74.328239		

***, ** and * shows significant variables at 1%, 5% and 10% probability levels respectively

Source: Own survey result, 2019

Credit utilization (CREDIT): The exceptional result of this study was the negative relationship between credit utilization and WTP decision. This can be interpreted as: being a credit service user decreases the probability of WTP by 11.1% compared to nonusers. Surprisingly, most of the households in the study area use credit service as a means to

repay their previous year loan. The FGD result confirms that due to its higher interest rate and misallocation of the borrowed money, once the households enter into the credit system they could not repay their loan in most cases. Hence, credit user households have lower probability of WTP compared to the non-users. This finding is found to be in contrast with the findings of Ayalneh and Urgessa (2012) and Bamlaku and Yirdaw (2015).

Trust on budget allocation (TRBUGA): This variable found to have a positive and significant influence on the WTP decision as prior expectation. Therefore, having trust on the allocation of the collected budget for the rehabilitation program increases the probability of WTP by 18.1%. Similar to this finding, Petrolia *et al*. (2014), Kong *et al*. (2014)**,** Bueno *et al*. (2016), Nyongesa *et al*. (2016) and *Wei et al*. (2016) also confirm the significant contribution of having trust on budget allocation to facilitate the rehabilitation intervention.

3.6. Determinants of households WTP amount (intensity)

Age of the household head (AGE): Age has a negative influence on the WTP amount that the households could contribute to the rehabilitation program. Thus, holding the effect of other factors constant, an increase in the age of the household head by one year decreases the amount that the household could pay by 1.09 ETB. Such negative and significant relationship between age of the household head and WTP amount might be associated with lower financial capability of the old aged households compared to the young and the middle-aged households. In the study area, the households' main source of income is derived from farming (88.39%) and seasonal labor (5.36%). Hence, labor shortage and inability to engage in seasonal labor affect their WTP amount negatively.

However, previous studies showed a mixed effect of age on the WTP amount for the rehabilitation of the wetland. For instance, studies by Kagunda (2003), Mahieu *et al*. (2012), Senayet (2014), Bamlaku and Yirdaw (2015), Dameneh *et al*. (2016), Gebrelibanos (2016), and Getachew (2018) found a negative effect of age on the WTP amount. In contrary to this study, studies by Kaffashi *et al*. (2015), Lamsal *et al*. (2015), Yibeltal (2015), Petrolia D. *et al*. (2014), *Wei et al*. (2016), Berhan *et al*. (2017), Vo and Huynh (2017) and Tadesse (2018) reported that an increase in age of the household head have a positive influence on the WTP amount. However, the FGD result in this study reveals that

the only reason for the negative influence of age on the WTP amount is households' financial constraint than their reluctance.

Total Livestock Unit (TLU): In consistent with prior expectation, livestock holding measured in tropical livestock unit found to have a significant and positive influence on the households' willingness to pay amount. Thus, holding other factors constant, a one-unit increase in livestock holding in TLU increases the amount that the household could pay by 9.24 ETB at 1% significance level. The possible reason is that livestock holding is a proxy for household's wealth and serves as a main source of income next to crop production. In addition, for 74.11% of the sampled households the wetland serves as the main source of water and grass for their livestock. Therefore, more TLU holders' WTP might not only arise from their interest to rehabilitate the wetland to its former beauty. Rather, it might also be associated with the expectation of improvement in the quality/quantity of water and grass for their livestock. This study is also consistent with previous studies by Gebrelibanos (2016) and Bamlaku, and Yirdaw (2015).

Non-farm income of the household (lnNONFARM): Holding other factors constant, as the annual nonfarm income increase by 1%, the amount that the household could pay will increase by 3.54 ETB at 5% significance level. The possible reason is that having more income from non-farm practices could solve the financial constraint and encourage them to pay more money. In the study area, the wetland has more meaning than the direct benefits derived from it. Hence, more nonfarm income can be associated with more WTP amount.

Frequency of Extension contact (EXTEN): Extension visit, which is the primary source of information related to new technologies, innovations and natural resource management, found to have a positive and significant effect on the WTP amount for the rehabilitation of the wetland. Therefore, an increase in frequency of extension contact by one more visit increases the household's WTP amount by 1.67 ETB. Previous studies by Senayet (2014), Gebrelibanos (2016) and Lamesgin (2017) also emphasized that a frequent extension visit by extension agent increases the households' awareness on the roles of the wetland and this positively affects the WTP amount.

Participation in training (TRAIN): Holding other factors constant, participation in training related to natural resource (wetland) conservation increases the household's WTP amount by 28.21 ETB compared to those who do not participate in training at 5%

significance level. Hence, households who got training related to natural resource or wetland conservation tend to pay more for the rehabilitation of the wetland than their counterparts. This is because training increase households' awareness about the degradation level of the wetland and its consequences. As a result, training can be positively associated with a higher level of contribution to the proposed intervention.

3.7. Aggregated welfare-gain from the intervention

As depicted in Table 8, the mean WTP estimated from SUR bivariate probit model ranges from 70.44 to 80.64 ETB for the initial and follow-up bids respectively. After excluding expected protest bidders, about 688, 587 and 28,864 households are expected to pay for the rehabilitation intervention in Asewa, Zegeza Kebeles and the district respectively. Therefore, by using mean WTP amount from the initial bid, the expected aggregate welfare gain from the rehabilitation of the wetland is about 48,462.72, 41, 348.28 and 2,033,180 ETB per year for the households in Asewa, Zegeza Kebeles and the district respectively. Therefore, the aggregated benefit expected from the proposed intervention ranges from 2,033,180 to 2,327,593 ETB per year. However, Zegeza Kebele has more protestors compared to Asewa Kebele. This might be related to the fact that households in Zegeza Kebele are the main irrigation users and they may disagree with the rehabilitation intervention in order to plough it illegally unto the edge of the wetland.

Table 8. Aggregate Welfare gain

Kebele	Total HHs	Sampled HHs	Valid Response	% Protest zero	Expected protest bidders	Expected valid Response	Mean WTP	Aggregate WTP
Asewa	705	124	121	2.42	17	688	70.44	48462.72
Zegeza	627	110	103	6.36	40	587	70.44	41348.28
Sampled kebeles	1332	234	224	4.27	57	1275		89811
District HHs	30,151	-	30,151	4.27	1,287	28,864	70.44	2,033,180

Source: Own survey result, 2019

4. CONCLUSIONS AND RECOMMENDATIONS

Majority of the sampled households showed their support towards the rehabilitation intervention by contributing cash based on their financial capability. The mean WTP amount that each household could pay for the intervention is estimated about 70.44 and

80.64 ETB per year for the initial and follow-up bids respectively. Given this mean WTP amount, households' decision on the probability and intensity of WTP are made separately depending on different demographic, socioeconomic and institutional factors. Thus, the probability of WTP is influenced by farm income, participation in environmental conservation practices, frequency of extension visit, trust on budget allocation, land size around the wetland, distance to the wetland and credit utilization. On the other hand, the intensity of WTP is affected by nonfarm income, TLU, frequency of extension visit, training, and age. In conclusion, the probability and intensity of WTP are mainly determined by the socio-economic and institutional factors than the demographic factors. Thus, for successful rehabilitation of Gudera wetland, policymakers and other concerned parties should consider the following determinants critically.

The maximum amount of willingness to pay is negatively affected by age of the household head. Hence, devising a strategy that can improve the old aged households' annual income directly solves their budget constraint and at the same time, it increases their WTP amount significantly. In addition, households with more land size around the wetland and situated far from the wetland are less likely to pay for the rehabilitation intervention. Increasing the awareness of these households about the indirect and nonvalues they derive from this wetland and the prospects of rehabilitating the wetland changes their WTP decision positively.

In the study area, livestock rearing and fattening plays a pivotal role in generating income for the households. Therefore, livestock experts from regional to kebele level should give a continuous follow-up and support towards modernization of the livestock sector. On-farm income and Non-farm income are also found to have a positive influence on the magnitude of WTP. Therefore, government should incentivize households' involvement in non-farm practices as well as in on-farm income through technical and financial support. Extension visit and training are the proxy for information about new technology and natural resource management. An increase in frequency of extension visit and training facilitates the rehabilitation process by increasing both the probability and the maximum amount of WTP that households could contribute for the rehabilitation intervention.

On the other hand, households use the borrowed money for the unintended purpose and such utilization problem affects the probability of households' WTP negatively. Hence, Amhara Credit and Saving Institution and the borrower banks should give uninterrupted

support for credit users starting from business idea development to actual implementation. In the study area, some households have suspicion on the practicality and allocation of the collected money for the rehabilitation process. Therefore, enhancing households' trust by showing the real commitment and interest of the government and other concerned bodies towards the wetland rehabilitation is pertinent.

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Ethical approval

We all are agreed to submit the manuscript and are also responsible for its content.

Consent for publication

We all are agreed to publish our manuscript under this journal.

Availability of data and materials

The data that support the findings of this study are available from the corresponding author, [author initials], upon reasonable request.

Competing interest

We declare that we the authors have no competing interests.

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Authors' contributions

The author read and approved the final manuscript.

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