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Research article

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

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ABSTRACT

Gudera wetland is accredited as a home for innumerable goods and services that have economic value for individuals living around and outside them. However, due to the absence of rehabilitation intervention, the wetland is at the edge of collapse at this time. This paper aims to: (1) estimate households' mean willingness to pay (WTP) for the rehabilitation of the wetland, (2) investigate determinants that affect the probability and intensity of WTP, and (3) estimate aggregated welfare gains from the intervention. To address these objectives, data from 237 household heads were collected using a two-stage random sampling procedure. For the analysis, econometric models, such as bivariate probit and double hurdle, were employed to estimate the mean WTP and determinants of WTP, respectively. The result demonstrates that the mean WTP value from the double bounded dichotomous choice ranges from 70.44 to 80.64 Ethiopian Birr per year per household. Likewise, the aggregated welfare gain expected from the rehabilitation intervention ranges from 2,464,977 ($85,589) to 2,821,916 ($97,983) Ethiopian Birr per year. The double hurdle model result revealed that participation in natural resource conservation, frequency of extension contact and trust in budget allocation have a positive and significant effect on households' WTP. Whereas, factors, such as land size around the wetland, distance to the wetland and credit utilization have a negative influence on households' WTP. These findings suggest that most of the sampled households are willing to contribute for the rehabilitation intervention and this could have implications for the success of future implementation.

1. Introduction

Most of the global civilizations have been associated with wetlands (Keddy et al., 2014). These wetlands are the earth's most valuable ecosystems in the development processes of the society (Musamba et al., 2011; Adugna, 2015). They also play an irreplaceable role in maintaining biodiversity hotspots and balance of food webs (Barbier et al., 1997; Mengistu, 2003; Abebe, 2003; Brander and Schuyt, 2010; Olarewaju et al., 2014). Due to various functions they perform for the biodiversity, hydrological and chemical cycles, these wetlands are termed as "the kidneys of the landscape and biological supermarket" (Barbier et al., 1997).

Wetlands are also amongst the Earth's most productive ecosystems, providing a diverse array of ecological functions and services, such as flood control, groundwater recharge and discharge, water quality maintenance, maintenance of biological and genetic diversity, carbon sequestration, nutrient retention, micro-climate stabilization and other life-support functions (Schuyt et al., 2004; Assefa et al., 2015). Such ecological functions are not only to the population living in its periphery but also to the communities living outside the wetland area (Reyahi-khoram and Hoshmand, 2012; Schuyt, 2005). 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 utilization of wetlands, such as wetland destruction and alteration through intensive irrigation, human settlements, and free (over) grazing is 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 remain 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 future existence questionable (Abebe, 2003; Miheret, 2011, 2015). With the same notion, a previous study on Gudera wetland[1] (Mohammed, 2017) concluded that unless appropriate mitigation measures, such as rehabilitation and delineation of the wetland boundary in a way that prevents illegal

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[1] Based on Ramsar Convention, 1971, Article 1.1, the authors use the term Lake and wetland interchangeably because the depth of Lake Gudera is below six meters.

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encroachment, are taken as fast as possible, the wetland will be disappeared within the next few years (see Appendix Figure 1 and 2). The vanishment of Lake Haramaya is also 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 determined 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 non-marketable 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 require 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 monetary values that the local communities attached to the wetland is one of the pressing research agenda, especially in developing countries, like Ethiopia (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).

Several valuation studies have been conducted in developing countries like Ethiopia, but their areas of focus were 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). However, studies related to wetlands, which are the foundation and pillar for all forests, water and other natural resources, have not gained adequate emphasis. In this regard, there are very few empirical studies on household's WTP for wetland rehabilitation in Ethiopia (e.g., Gezahegne, 2015; Asmamaw et al., 2017) in particular and Kuang et al. (2015), Bueno et al. (2016), Mahieu et al. (2012), and Dameneh et al. (2016) from abroad in general. Even with these limited amounts, the studies have lots of methodological shortcomings in the constructed market scenario, the payment vehicle they used, method of capturing biases, which usually emanates from contingent valuation methods and method of analysis. Apparently, such methodological and analytical limitations could affect the reliability and validity of the findings (Hanemann et al., 1991; Haab and McConnell, 2002).

Specifically, there is no empirical study that has estimated households' WTP for wetland rehabilitation in the study area. Due to this, the value that the local community attached to the wetland and factors that ultimately affect the probability and intensity of WTP remained unidentified. Following this, there is a growing demand for quantification of the monetary value of Gudera wetland by the government for the prioritization process in future intervention. Therefore, it is imperative to fill these gaps in the literature by estimating households' mean WTP and identifying its determinants. Furthermore, this study could contribute to the field by solving the defects of the previous studies through adopting appropriate contingent valuation methods, such as acceptable elicitation method, plausible hypothetical market scenario, and suitable payment vehicle (see section 2.4 to 2.6). Thus, the study aimed to contribute to the scanty literature by (1) estimating households' mean willingness to pay (WTP) for the rehabilitation of the wetland, (2) identifying determinants that affect the probability and intensity of WTP, and (3) aggregating the total welfare gains from the rehabilitation of Gudera wetland in western Ethiopia.

2. Materials and methods

2.1. Description of the study area

Gudera wetland is situated in Sekela District, Amhara National Regional State, Ethiopia. In this regard, Sekela district is situated at a distance of 160 km from Bahir Dar, which is the capital city of Amhara National Regional State, and 459 km away from Addis Ababa, the capital city of Ethiopia, (Muluneh, 2015). The district is one of the tourist attraction site in the region, which has always been associated with Gish Mountain and spiritual issues. According to SWCTO[2](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[3] and one urban town with a total population of 168,151 (36,555 households) and an average family size of 4.6 per household (SWARDO[4] 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 (Animut, 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 agroecology is classified as 70% highland and 18% midland and 12% lowland (SWARDO, 2019). The district's annual rainfall ranges from 1600 mm to 1800 mm and has a mean annual temperature of 18 ºC (Mohammed, 2017).

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[5] using a semi-structured questionnaire, focus group discussion (FGD), and key informant interviews. On the other hand, the secondary data were collected from research articles, books, proceedings, working papers and institutional reports.

The questionnaire prepared for this study 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[6] 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 by using the 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 Ethiopian Birr (ETB[7]) 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

[2] SWCTO - Sekela Woreda Culture and Tourism Office. Here, 'Woreda' is an administrative division of Ethiopia, managed by a local government.

[3] Kebele - is the lowest administrative unit of the government system in Ethiopia. It refers to peasant associations and may contain several villages.

[4] SWARDO – Sekela Woreda Agriculture and Rural Development Office.

[5] The sample was taken from households in the two surrounding Kebeles (see Figure 1) of the wetland. These two Kebeles use this wetland as a common property and they feel as if they are the main responsible body for the management and utilization of the wetland.

[6] Some individuals may not be willing to pay for the proposed rehabilitation intervention because of their WTP amount is truly between zero and some amount lower than the offered bid amount. In this case, debriefing questions, which ask individuals' reasons for not WTP a given bid amount, are important to identify the genuine zero from the protest behavior of the household.

[7] **ETB** means "The Ethiopian Birr" is the currency of Ethiopia. **$1= 28. 80 ETB** at June 21, 2019 12:00 UTC.

equally and randomly. Finally, the data from the two Kebeles were collected from 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. The criteria to select the key informant and FGD participants were based on their knowledge about the previous and the current state of the wetland with the recommendations of local development agents. Before 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 from the key informants and different literatures, plausible rehabilitation strategies were incorporated into the contingent valuation (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 FGD participants in each Kebele was restricted to 7 for the ease of management and smooth interaction.

2.3. Sampling techniques and sample size determination

To get representative sample household heads from the two bordering Kebeles, a 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[8] 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).

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

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.

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

2.4. Constructed hypothetical market scenario

In the first part of the contingent valuation (CV) scenario[9], detailed information about wetland degradation and its consequence were presented by relating with some evidences from Ethiopia and abroad. In addition, information that describe 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 photos (online Appendix Figure 4, 5 and 6). 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 'future scenario 1' was about how the wetland could potentially look like when the rehabilitation program implemented. The final scenario was the 'future scenario 2', which tried to show how the wetland would look like if the rehabilitation program is not 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 be 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 double bounded dichotomous choice (DB-DC) elicitation method can progressively narrow down households' stated amount to their true WTP amount. For this reason, the DB-DC elicitation method with follow-up question was adopted to estimate the mean WTP amount. This method of elicitation has two rounds of questions and the amount of the second bid is contingent on the response for the first bid. This means if the first response is "yes", the second bid is some amount greater than the first bid; whereas, if the first response is "no", the second bid will be some amount smaller (Cameron and Quiggin, 1994). 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 household 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 (WTP_1 and WTP_2), it is impossible to use the conventional probit or logit model to estimate these two equations simultaneously. Thus, a seemingly unrelated bivariate probit, which simultaneously estimates the initial and follow-up bid equations, becomes an appropriate econometric model. Estimation of mean WTP using such a 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 ($\rho < 0.88$), seemingly unrelated bivariate probit could be the 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:

$$\mathrm{B}_1 < \mathrm{WTP} < \mathrm{B}_2 : \ \mathbf{Pr}(\mathbf{Yes},\ \mathbf{No}) = \mathbf{Pr}\left(\boldsymbol{\mu}_1 + \boldsymbol{\varepsilon}_{1\mathrm{j}} \geq \mathbf{B}_1,\ \boldsymbol{\mu}_2 + \boldsymbol{\varepsilon}_{2\mathrm{j}} < \mathbf{B}_2\right) \tag{2}$$

$$\mathrm{B}_1 > \mathrm{WTP} > \mathrm{B}_2 : \ \mathbf{Pr}(\mathbf{No},\ \mathbf{Yes}) = \mathbf{Pr}\left(\boldsymbol{\mu}_1 + \boldsymbol{\varepsilon}_{1\mathrm{j}} < \mathbf{B}_1,\ \boldsymbol{\mu}_2 + \boldsymbol{\varepsilon}_{2\mathrm{j}} > \mathbf{B}_2\right) \tag{3}$$

$$\mathrm{WTP} > \mathrm{B}_2 : \ \mathbf{Pr}(\mathbf{Yes},\ \mathbf{Yes}) = \mathbf{Pr}\left(\boldsymbol{\mu}_1 + \boldsymbol{\varepsilon}_{1\mathrm{j}} > \mathbf{B}_1,\ \boldsymbol{\mu}_2 + \boldsymbol{\varepsilon}_{2\mathrm{j}} \geq \mathbf{B}_2\right) \tag{4}$$

$$\mathrm{WTP} < \mathrm{B}_2 : \ \mathbf{Pr}(\mathbf{No},\ \mathbf{No}) = \mathbf{Pr}\left(\boldsymbol{\mu}_1 + \boldsymbol{\varepsilon}_{1\mathrm{j}} < \mathbf{B}_1,\ \boldsymbol{\mu}_2 + \boldsymbol{\varepsilon}_{2\mathrm{j}} < \mathbf{B}_2\right) \tag{5}$$

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:

$$\boldsymbol{Y}_1^* = \boldsymbol{\alpha}_1 + \boldsymbol{\beta}_1 \boldsymbol{B}_1 + \boldsymbol{\varepsilon}_1 \tag{6}$$

$$\boldsymbol{Y}_2^* = \boldsymbol{\alpha}_2 + \boldsymbol{\beta}_2 \boldsymbol{B}_2 + \boldsymbol{\varepsilon}_2 \tag{7}$$

[8] We used household heads as a data source and unit of analysis because decisions are made under the prime leadership of the household head. In the study area, individuals who are not head of the household are refraining from stating a payment amount because they know that whatever they say, the payment is confirmed and allowed by the household head.

[9] The actual CV scenario is presented on the online appendix section.

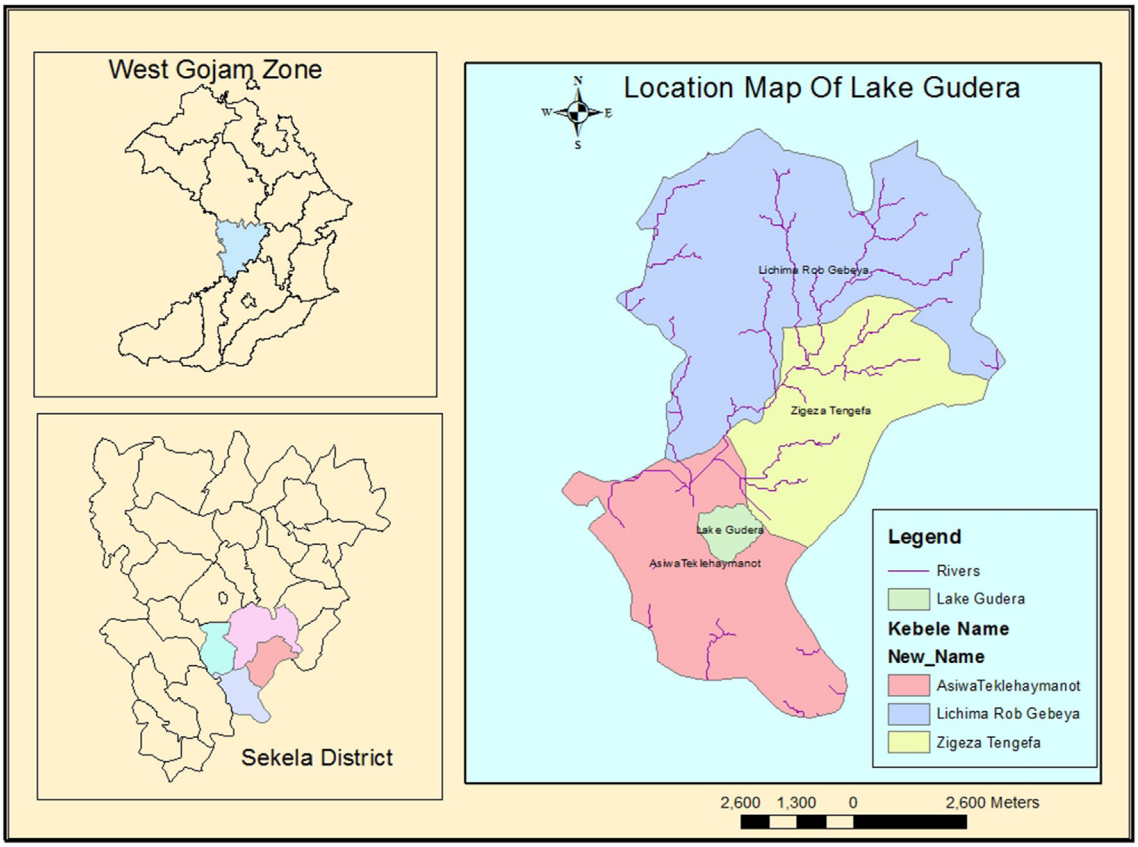

Figure 1. Location map of the study area. **Note**: The term Lake and wetland are used interchangeably because the depth is below six meters.

$$Y_1 = \begin{cases} 1 & if\ Y_1^* \geq B_1 \\ 0 & if\ Y_1^* \ B_1 \end{cases}$$

$$Y_2 = \begin{cases} 1 & if\ Y_2^* \geq B_2 \\ 0 & if\ Y_2^* \ B_2 \end{cases}$$

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

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 ε_1 and ε_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 (WTP_1 and WTP_2) 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:

$$\mathbf{MWTP} = -\boldsymbol{\alpha} / \boldsymbol{\beta} \tag{8}$$

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

2.6.2. Determinants for the probability and intensity of WTP

One of the main objectives of this study was to investigate determinants of households' WTP and its intensity. Therefore, sampled households' are expected to make two sequential decisions on WTP (binary) and then the amount of maximum WTP (continuous). In this case, the first decision (WTP) indicates the households' willingness to participate and pay for the proposed rehabilitation intervention. Whereas, the maximum WTP amount is the final amount that households are willing and able to pay for the intervention. When the dependent variable has a continuous nature, multiple regression using Ordinary Least Squares (OLS) can be used for the analysis of determinants of the maximum WTP (Lamsal et al., 2015). On the other hand, for binary dependent variable (WTP) probit and logit models allow for estimating the probability of WTP for wetland rehabilitation given some relevant demographic, economic and institutional factors (Maddala, 1992; Gujarati, 2004; Verbeek, 2004; Wooldridge, 2009).

Under the two sequential decisions, the dependent variable has continuous value for those who are willing to pay and zero for those who are not. Here, the nature of the data is a censored form i.e., some observations on the outcome variable are not observed as long as they do not pass a certain threshold (Kennedy, 2008). In this case, all values below or equal to zero were limited to zero and the only observable are the corresponding values of the independent variables. Thus, using OLS models in the case of censored data sets makes OLS estimates biased and inefficient, and Best Linear Unbiased Estimator (BLUE) does not hold (Gujarati, 2004; Greene, 2012).

In this case, Heckman two-stage, Tobit and Double hurdle models can be used for limited dependent variables but for different reasons. Thus, to identify the model that best fits, different econometric models were fitted. First, Heckman two-stage model was fitted if there is selectivity bias but the Mill's ratio or lambda was not significant. Therefore, using the Heckman selection model become irrelevant for the study. Hence, selection of appropriate model was made between Tobit and double hurdle models using a method called likelihood ratio (LR) test statistics. Using the procedure followed by Greene (2012), the likelihood ratio (LR) test statistics Γ was computed as:

$$\Gamma = -2\left[\mathbf{lnL_{tobit}} - \left(\mathbf{lnL_{probit}} + \mathbf{lnL_{truncated}}\right)\right] \sim \chi_k^2 \tag{9}$$

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, χ^2 = Chi-square statistic and k is the number of independent variables in the equations.

Based on Eq. (9), the value of likelihood ratio statistic (Γ) (32.89) was greater than the value of the chi-square statistic (25.00) at 15 degrees 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 on 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:

$$\boldsymbol{WTP_i}^{*} = \alpha + \boldsymbol{\beta}' \boldsymbol{X_i} + \boldsymbol{u_i} \tag{10}$$

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

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 α is a vector of parameters.

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

$$\mathbf{MaxWTP_i}^{*} = \beta_o + \gamma' \mathbf{X_i} + \varepsilon_i \tag{11}$$

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

where, $MaxWTP_i$ represents the maximum amount that households are willing to contribute; X_i is a vector of the individual's characteristics and β_o, γ is a vector of parameters.

The probability and intensity of WTP for the rehabilitation intervention are contingent on the household-specific variables. For instance, variables like age, education level, distance from the wetland, contribution of the wetland to a given household, income source, family size, credit, frequency of extension contact, trust on budget allocation, etc., can influence the households' WTP decision and its payment intensity. Thus, the independent variables for this study were those factors, which were hypothesized to have an association with the WTP and its intensity. In this study, demographic, socioeconomic and institutional factors are selected based on empirical reviews, prevailing theoretical explanations and prior knowledge about the households in the study area (see online appendix Table 1).

2.7. Ethical approval

This work was approved by the ethical committee of Haramaya University i.e., the chairman of Department of Graduate Committee (DGC), research thematic area leader and Dean of School of Graduate Studies (SGS). In addition, the informed consent was obtained from all the respondents during the pretest of the questionnaire.

3. Results and discussion

From the surveyed households, 52 of them were not willing to pay the offered bid sets. From these, the 39 responses were legitimate zero and recorded as a true zero in the data set for further analysis. Whereas, the 10 responses were protest zero bidders[10] and the remaining three responses were incomplete so that, these 13 responses were excluded from the data set. Hence, 224 valid responses were used for further analysis.

Table 1. The relationship between continuous independent variables and WTP decision.

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
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

3.1. Descriptive statistics on the households' characteristics

From the surveyed (valid responses) 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 2). 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 in the two subsections below.

3.1.1. Demographic and socioeconomic characteristics of sampled households

The average distance from households' home to the wetland was found to be 20.8 min[11] of walk. However, this distance from home to the wetland significantly varies across willing and non-willing households. As Table 1 summarizes, households who were willing to pay for the rehabilitation intervention are situated at a distance of 20 min of walk on average. Whereas, non-willing households are situated at a distance of 24.72 min of walk on average. This finding is consistent with the finding of Kong et al. (2014) that non-willing households are those who are situated far from the wetland.

In the study area, the crop-livestock mixed farming system is 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 land (0.44 timad[12]) around the buffer zone of the wetland compared to the non-willing households (0.74 timad). This mean difference in ownership of land around the wetland 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

[10] Protest zero bidder: Households' response (zero WTP) could be motivated by protesting behavior and these values do not show the real information about individuals' economically rational preferences on the proposed intervention.

[11] Many respondents in rural areas are more comfortable with reporting using familiar "local" or "non-standard" units instead of standard units. However, forcing them to convert into standard units during an interview is a type of cognitive burden and leads to sizable measurement errors. Thus, allowing respondents to directly report in local units, who use them in their daily activities will ultimately result in more accurate reporting (Oseni et al., 2017). Hence, distance is measured using a commonly known measurement unit called minutes of walk.

[12] Timad is a local measure of land size, in which one timad is equivalent to 0.25 ha.

Table 2. 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 for 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

wetland might discern the intervention negatively due to fear of loss in their irrigable land.

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 tropical livestock unit (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). This implies that households who have more livestock units can make substantial support for the rehabilitation intervention by expecting improvements in their grazing ground and fodders around the wetland and its catchment areas. This finding is also consistent with the finding of Bamlaku and Yirdaw (2015).

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

3.1.2. Households' exposure to institutional variables

As depicted in Table 3, significant variation in participation at natural resource conservation campaigns was observed among willing (87.03%) and non-willing (69.23%) households. This implies that willing households have better exposure to natural resource conservation participation than their counterparts do. Similarly, households who were willing to contribute to the rehabilitation intervention had more access to extension service (90.81%) than non-willing households (66.67%). In terms of frequency of extension visits, willing households have the chance of frequent extension visits compared to non-willing households. These findings also coincide with the previous studies of 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.

Table 3. Association between demographic and institutional variables (dummy) 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

Table 4. Patterns of WTP 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

Notes: "Yes-Yes" and "No –No" are if respondents accept or reject all the offered bids, respectively. The others are if the respondents accept either the first or the second bid, which is mostly the lower, and reject the other (the higher).

The other interesting result is that 51.35% of the willing households have better trust in the proper allocation of the money that will be collected 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 finding is also in agreement with the claims of Bueno et al. (2016) and Nyongesa et al. (2016) that the willingness and amount of payment for a given community-based intervention are contingent on the households' trust in its implementation ability.

3.2. Response patterns of the double bounded dichotomous choice

In the double-bounded dichotomous choice (DB-DC) elicitation method, the response patterns inclined towards the two extremes of "Yes -Yes" and "No – No". As Table 4 depicts, majority (30.8%) of the sampled households accepted both the initial and follow-up bids. On the other hand, 29.46% of them rejected both bids offered. In between these 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 finding of Getachew (2018), such a high level of acceptance of the offered bids signifies that most of the sampled households have an interest to participate in the rehabilitation of the wetland.

3.3. Reasons for rejecting or accepting the offered bids

Households' decision to accept or reject the offered bids is contingent on different demographic, socioeconomic and institutional factors. However, households might reject the offered bids either from their protest or from genuine behavior (see footnote 9). Accordingly, 20.4% of the non-willing households were protest zero bidders and the remaining were genuine zero. For the genuine zero responses, their main reasons for rejecting the offered bids were their 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 in the future.

As summarized in Table 5, 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*[13] for cultural celebration. In this regard, the FGD and

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

Table 5. Motivations for accepting the offered bids.

Reasons for maximum WTP	Frequency	%
I want to see the wetland 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

key informant interview results indicate 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 fish 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 magnify how households in the study area are dedicated to the rehabilitation of Gudera wetland.

3.4. Application of econometric models and its 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. In addition, the correlation coefficient (ρ) being less than unity indicates that the random components from the first and follow-up WTP equations 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 the mean WTP amount. In a good agreement with this claim, Alberini (1995) and Cameron and Quiggin (1994) also illustrate that using SUBPM gives efficient and unbiased mean WTP estimation for the rehabilitation program (see Table 7).

Using Eq. (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 Mezgebo et al. (2013), such convergence in mean WTP values among the two elicitation methods could arise from the rightness in setting the initial bids and the plausibility of the constructed market scenario.

Table 6. Seemingly unrelated bivariate probit model 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: chi^2 (1) = 7.344 Prob > chi^2 = 0.0067***			
Mean WTP = 70.44 ETB (At 95% CI, 70.44 to 80.64 ETB)			

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

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% significance levels, respectively.
Source: Own survey result, 2019.
Note: In nonlinear econometric models, such as logit, probit and double hurdle, the coefficients have no meaningful and direct interpretation. Thus, the marginal effect is used for the interpretation. However, for the second hurdle (in the double hurdle model), which is a truncated regression, running the marginal effect is optional because the first coefficient and the marginal effect have identical values.

3.4.2. Determinants of household's WTP decision

Distance from home to the wetland (DISTWET): In line with the prior hypothesis, as the distance from home to the wetland increases by one minute of walk, the probability of willingness to pay in favor of the rehabilitation intervention decreases by 0.4%. This infers that households who are situated far from the wetland are less likely to pay for the rehabilitation of the wetland. This is due to the fact that those households who are situated at a distance from the wetland might perceive as they are less beneficiary from the wetland compared to the nearest. It might also be associated with freeriding behavior and poor understanding of the ecological and hydrological functions of the wetland. This finding appeared to be well substantiated by 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): Contrary to the hypothesized association, households with more land around the buffer zone of the wetland were less likely to accept the payment for the rehabilitation of the wetland. Hence, as households' land size around the wetland increases by one unit (*timad*), the probability of WTP in favor of the intervention decreases by 8.7%. The possible reason is that this land is mostly possessed illegally and ploughed up to the edge of the Lake when the water retreats every year (presented at online Appendix Figure 2). This might force them to perceive that the rehabilitation intervention could deprive them from using that encroached land. Thus, such illegal land use practice and misperception on the role of the intervention could affect their WTP decision negatively. In line with this finding, 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 agreement with the prior expectation, annual on-farm income was found to have a positive and significant influence on the willingness to pay decisions. Thus, holding the effect of other variables constant, an increase in annual on-farm income by 1% increases the probability of willingness 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 future on-farm income. This finding is also consistent with previous studies by Kagunda (2003), Kong et al. (2014), Senayet (2014), Bamlaku and Yirdaw (2015), Nyongesa et al. (2016), Wei et al. (2016), Lamesgin (2017) and Tadesse (2018).

Participation in natural resource conservation practices (CONSERV): Households who participate in natural resource 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 environmental and ecological benefits 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 natural resource conservation practice determines the WTP decision positively.

Frequency of Extension contact (EXTEN): Extension contact was 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 households' WTP by 0.6%. This finding agrees with the existing evidence that having more extension contact is always associated with an enhancement in households' awareness regarding the degradation level of the wetland and its imminent consequences. 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.

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 (mostly from Amhara Credit and Saving Institution - ACSI) decreases the probability of WTP by 11.1% compared to non-users. Surprisingly, most of the households in the study area use credit service as a means to repay their previous year's loan and this adds another financial burden for the coming years. The FGD result confirms that due to its higher interest rate and mainly misallocation[14] of the borrowed money, once the households enter into the credit system they could not simply repay their loan in most cases. Hence, this study provides a new insight that credit user households have a lower probability of WTP compared to non-users. This finding contradicts with the findings of Ayalneh and Urgessa (2012) and Bamlaku and Yirdaw (2015) that credit utilization increases the financial capability of the households and this positively relates with the probability of WTP.

Trust in budget allocation (TRBUGA): As prior expectation, trust in budget allocation was found to have a positive and significant influence on the WTP decision. Therefore, having trust in the allocation of the collected money for the intended 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.

3.4.3. Determinants of households WTP amount (intensity)

Age of the household head (AGE): In contradiction with the prior hypothesis, age was found to have a negative and significant influence on the WTP amount that the households could contribute to the rehabilitation program at 10% significance levels. 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 unexpected relationship might be associated with the lower financial capability of the old-aged households compared to the young and the middle-aged households. In the study area, the households' income is mainly derived from farming (88.39%) and seasonal labor (5.36%). In this regard, old-aged households are expected to face labor shortage for farm practices and inability to engage in seasonal labor (for supplementary income) compared to the economically active aged households. Hence, such problems can directly and negatively affect the old aged households' income and their WTP amount as well.

However, various studies have reported inconsistencies on 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 relationship between age of the household and WTP amount. In contrary to this finding, studies by Kaffashi et al. (2015), Lamsal et al. (2015), Walle (2015), Petrolia et al. (2014), Wei et al. (2016), Asmamaw et al. (2017), Vo and Huynh (2017) and Tadesse (2018) reported that an increase in age of the household head has a positive influence on the WTP amount. Their point of argument is that being old aged compared to the younger households, directly associated with more knowledge on the previous feature of the wetland. In addition, by using their adaptive experience, households may easily predict the consequence of deteriorating this wetland. Consequently, they can pay more for the rehabilitation intervention without hesitation. During our FGD, households' (especially, the old aged) eagerness[15] for the rehabilitation intervention was astonishing and this supports the above authors' argument. Therefore, the study confirms that such negative relationship between age of the household head and the WTP amount is mainly associated with the deep rooted financial constraint that old aged households faced.

Tropical 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' WTP 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 households' 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 (see online Appendix Figure 3). 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).

[14] According to the discussants, because of improper allocation of the borrowed money, it is harrowing for most of the credit users to repay their loan. In the study area, some credit users requested the lending institutions as if they aimed to borrow for animal fattening or other business. In practice, however, they used that money for weddings, health expenditures, for purchasing agricultural inputs, and to repay previously borrowed money from either formal or informal lending institutions.

[15] In the FGD, households from both age groups (from 25 to 82 years) were included. During this discussion, the old aged households were highly regretted with the current status of the wetland by comparing it with the previous one. They also expressed their worry about the future fate of their heritage (Gudera wetland).

Table 8. Aggregated welfare gains from the rehabilitation intervention of Gudera wetland.

Kebele/District	Total HHs	Sampled HHs	Valid responses	% Protest zero[3]	Expected protest bidders[4]	Expected valid response[5]	Mean WTP[6]	Aggregated WTP[7]
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	36,555	-	-	4.27	1,561	34,994	70.44	2,464,977

Source: Own survey result, 2019

Notes: HHs is the abbreviated form of 'household heads' and the population data for the study area was taken from Sekela Woreda Agriculture and Rural Development Office. Valid responses are responses after the incomplete and protest zero bidders are excluded from the dataset. The number of protest zero bidders was calculated by subtracting valid responses (2) from the respective sampled households (1).

[3] Percentage of protest zero = Number of protest zero bidders divided by the respective sampled HHs.

[4] Expected protest bidders = %protest zero (3) multiplied by Total HHs.

[5] Expected valid Response = Total HHs minus Expected protest bidders (4).

[6] Mean WTP (measured in Ethiopian birr) is the estimated mean WTP amount from the initial bid using bivariate probit model (Table 6).

[7] Aggregated WTP = Expected valid Responses (5) multiplied by Mean WTP amount (6). These aggregated welfare gains were measured in Ethiopian Birr ($1 = 28. 80 ETB at June 21, 2019).

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 also increase by 3.54 ETB at 5% significance level. This implies that having more income from non-farm practices could solve the financial constraint and encourage them to contribute more to the proposed intervention. The motive here is, the wetland has more meaning for the surrounding community besides the direct benefits derived from it. Hence, more nonfarm income can be associated with more WTP amount.

Frequency of Extension contact (EXTEN): In line with the prior hypothesis, extension visit, which is the primary source of information related to new technologies, innovations and natural resource management, was found to have a positive and significant effect on the WTP amount. This implies that an increase in frequency of extension contact by one more visit increases the household's WTP amount by 1.67 ETB. This result coincides with the existing empirical evidence of Senayet (2014), Gebrelibanos (2016) and Lamesgin (2017) that a frequent extension visit by extension agent increases the households' awareness on the roles of the wetland a6nd 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 at 5% significance level. Hence, households who got training related to natural resource 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 and strongly associated with a higher level of contribution to the proposed intervention.

3.5. Aggregated welfare-gain from the rehabilitation intervention

In this study, the proposed intervention is to rehabilitate the wetland, which is a quantity and quality improvement in goods and services emanating from the wetland. Here, the welfare gain indicates the level of utility or satisfaction that the household derived from the proposed intervention (Flores, 2017). In this case, the aggregated welfare-gain is the sum of individual's WTP amount for the welfare gain through quantity increase and quality improvement in the state of the wetland (Haab and McConnell, 2002; Flores, 2017).

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 (see footnote 9), about 688, 587 and 34,994 households are expected to pay for the rehabilitation intervention in Asewa, Zegeza Kebeles and the district, respectively. Therefore, by using the mean WTP amount of the initial bid, the expected aggregate welfare gains from the rehabilitation of the wetland were 48,462.72, 41, 348.28 and 2,464,977 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 2,464,977 ($85,589) to 2,821,916 ($97,983) ETB per year. However, Zegeza Kebele has more protest zero bidders compared to Asewa Kebele. This might be related to the fact that households in Zegeza Kebele [16]are the main irrigation users around the wetland (presented at online Appendix Figure 2) and they may disagree with the rehabilitation intervention in order to plough it illegally unto the edge of the wetland.

4. Conclusions and recommendations

Due to various anthropogenic activities, the magnificent hydrological, sociocultural, and economic benefits derived from the wetland are drastically deteriorating year after year. In addition, the wetland serves as a common ground for livestock grazing and other resources, and these lead to the "tragedy of the commons". Given these concerns, rehabilitation interventions and other related attempts that could reverse these problems have not yet been executed. There was also a broader lesson that studies related to wetland valuation are still untouched in the study area and the country as well.

By considering the current state of the wetland, majority (82.59%) of the sampled households showed their interest and support towards the rehabilitation intervention. The study also confirms that households' decision on the probability and intensity of WTP are dependent on different demographic, socioeconomic and institutional factors. Specifically, the probability of WTP was influenced by farm income, participation in natural resource conservation practices, frequency of extension visits, trust in budget allocation, land size around the wetland, distance to the wetland and credit utilization. On the other hand, the intensity of WTP was affected by nonfarm income, TLU, frequency of extension visits, training, and age. These findings demonstrate that the probability and intensity of WTP are mainly determined by socio-economic and institutional factors than demographic factors. Besides, the estimated total monetary value expected from the rehabilitation of the wetland ranges from 2,464,977 ($85,589) to 2,821,916 ($97,983) ETB per a year. All the aforementioned results provide evidence of how households in the study

[16] In the study area, there is no clear demarcation between the wetland (Lake) and the surrounding farm land owners. As a result of this, farmers around the wetland claim as they are the owner of the Lake Shore when the water retreats year after year. Starting from December, farmers from Zegeza Kebele always plough up to the edge of the Lake to produce potato and maize (recessional agriculture). However, farmers from Asewa Kebele have not practiced such recessional agriculture due to topographic disadvantage.

area are willing to collaborate and support the successful implementation of future rehabilitation intervention.

The willingness to pay is negatively affected by land size owned around the wetland and the distance to the wetland. This land is mostly possessed when the water retreats and this forces them to fear that intervention. In addition, households that are situated far from the wetland are less willing to contribute to the proposed rehabilitation intervention. This is also associated with freeriding behavior and a poor understanding of the ecological and hydrological functions of the wetland. Therefore, increasing the awareness of these households about the indirect and non-use values derived from this wetland and the prospects from rehabilitating the wetland could change their perception about the multidimensional role of the wetland.

In the study area, livestock rearing and fattening play a pivotal role in generating income for the households. Therefore, livestock experts from regional to Kebelle level should give continuous follow-up and support towards modernization of the livestock sector. On-farm income and non-farm income were also found to have a positive influence on the magnitude of WTP. Therefore, the government should incentivize households' involvement in non-farm practices as well as in on-farm income sources through technical and financial support. All these efforts could increase households' income and such increment in income could positively increase their WTP for the intervention. Extension visits and training are the proxies for information about natural resource management. Therefore, extension services and training should be provided in a way that could increase the involvement of the surrounding community in the rehabilitation process.

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

The district and local level officials should promote and facilitate an integrated upper catchment treatment and conservation-sensitive cultivation practices than conversion of the wetland for agriculture purposes. In addition, free grazing should be restricted mostly during the rainy season, which is the recovery season of the wetland. Moreover, using a 'cut and carry system' to avoid the problem of animal trampling and overgrazing could be a 'win-win' solution. The district's environmental protection office should establish a genuine task force that could facilitate rehabilitation intervention of the wetland and its catchments. Lake Tana and other water bodies protection and development agency and the district's rural land administration and land use planning office should also provide uninterrupted technical and financial support for the conservation of the wetland. After effective management of the wetland, fish species suitable for the Lake should be re/stocked.

Due to hydrological connectivity and other ecological functions, the roles of this wetland are wide-ranging. In addition, these functions are not only useful to the local community living on the outskirts of the wetland, but also to the communities living outside of the wetland areas. However, the focus of this study was only on the local direct and indirect users of the wetland from the two adjoining Kebeles of the wetland, and the findings from this study must be viewed in the light of such scope or area coverage. Thus, further study should be carried out on the total economic value of the wetland by incorporating the downstream users. It is also further recommended to estimate the value of each attribute of the wetland using other appropriate environmental valuation techniques, such as choice experiment.

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 in this journal.

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Declarations

Author contribution statement

Erkie Asmarea: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Ketema Bekeleb & Saleamlak Fentaw: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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