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Analysis of Economic Value of Lake Ziway: An Application of Contingent Valuation Method

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Abstract
Lake Ziway provides numerous environmental services. However, despite these importance's because the Lake has public goods characteristics it faces numerous threats. Therefore, conservation of Lake Ziway becomes very essential otherwise the Lake will disappear in the near future. To design appropriate policy intervention for its conservation it is important to know its economic value through valuation methods. For this reason this study analyzed the economic value of Lake Ziway using contingent valuation method. Contingent valuation method used estimate household's WTP for the conservation of the Lake in money contribution; to do this a face-to-face interview were done with 261 randomly selected households. Seemingly Unrelated Bivariate Probit Model was used to analyze the determinants of household's WTP and to calculate the mean WTP which obtained from Double Bounded Dichotomous. Accordingly, the result from Seemingly Unrelated Bivariate Probit Model shown that the two bid levels, income, satisfaction within the current condition of the Lake, dependency ratio, house ownership, environmental awareness and job in the Lake are significant factors that affects household's WTP. The mean WTP estimated from the Double Bounded Dichotomous Choose found to be birr 50.99 and the total willingness to pay for the conservation of Lake Ziway was found to be 608,055.75 birr annually. Generally, the study found that households are highly willing to pay for the proposed Lake conservation plan. So, the city administration should introduce management and conservation program for efficient and sustainable utilization of the Lake.
Keywords: Willingness to pay, Contingent valuation method, Lake Valuation

1. INTRODACTION

Ethiopia has various Lakes, most of those Lakes are naturally created and only limited numbers are man-made Lakes. Most of these naturally created Lakes are located at Rift Valley or low land part of the country. For example, Lake Awassa, Lake Tana, Lake Ziway and others are naturally created Lakes in Ethiopia. The basins of these Lakes and their surroundings are home for flora and fauna (Girma, 2006). Ethiopian Rift Valley Lakes experience a wide range of climate, which determined by the annual north-south movements of inter- and sub-tropical frontal zones across the country. And almost all these Rift Valley Lakes and their feeder rivers are utilized for irrigation, soda abstraction, commercial fish farming and recreation. They also support a wide variety of endemic birds and animals (Ayenew, 2004).

Ethiopian Lakes have a great significance to the economy. Even though those Lakes are essential to the survival of the local people, they are under threat of extinction. Some of the Ethiopian Lakes are shrinking while some others (for example Lake Haromeya) have completely dried up due to overexploitation, pollution, environmental degradation, climate change ,soil erosion and sedimentation (Brook, 2003). The extinction of those Lakes is alarming and has detrimental effect on the surrounding biological, physical, hydrological and infra-structural environment (Eleni, 2009; Mulugeta et al., 2015).

Specifically, the Rift Valley Lakes are sensitive to changes in` the water use system and most Lakes have experienced a critical level changes since the 1970s due to excessive abstraction of water, land degradation, deforestation and over irrigation (Ayenew, 2002; Lijalem et al., 2007; Kassaye, 2015). Generally, Ethiopian Rift Valley Lakes are characterized by different Lake level fluctuation patterns. Most of the Lake levels show a declining trend, few of them have rising trends, while others are still in a steady condition (Eleni, 2009; Mulugeta et al., 2015).

Lake Ziway is the largest fresh water in the area holds the intrinsic value and aesthetic quality of a wetland, including its functions like shelter for a diversity of plants, aquatic birds and fish and ecological functions like filtering pollutants and sediments, protecting against wind and storm etc. (Petra et al., 2009). And provides a wide range of benefits to the society, such as source of drinking water supply for the people and livestock and it is the resource base for many livelihoods and ecosystems.

Generally, Lake Ziway has been used for a variety of developmental activities such as fisheries, irrigated agriculture (commercial farming), domestic animals watering, vehicle washing, human sanitation place of recreation and tourism attractions such as bird watching, fishing, boating, and churches on the island (Girma, 2006; Tigisti, 2009), and most recently, floriculture farming (Getachew & Seyoum,2009). In addition to this direct use value like many other Lakes, Lake Ziway helps the earth to control the chemical balance of the atmosphere. By regulating gases, it provides a clean, breathable air and keeps the general maintenance of a habitable sphere (Marbek, 2010).

However, despite these importance's because the Lake have public goods characteristics it faces numerous

threats overuse of resources such as; deforestation in the upper watersheds, Lake shore farming and damage of wetlands adjoining the Lake. And other critical threats including siltation/sedimentation, water abstraction; overfishing and discharge of pollutants into the Lake system and increasing use of agrochemicals threaten the environment, (EWNHS, 2010 ; Huib et al., 2008). To the extreme according to the projection of Habtamu (2015), water abstraction for irrigation reduces 0.4m water level of the Lake annually. This much rate of Lake level reduction (0.4m/year) may lead to the disappearance of the Lake after 27.5 years. So, Because of its higher importance, the Lake should be protected and conserved urgently; otherwise the Lake may face the destiny of Lake Alemaya in Haragae in the near future which is nearly dried up (Amare, 2005).

Besides Lake Ziway needs more attention because it has an outflow through Bulbula River which drains into Lake Abijata, which is the major feeder river of this Lake. Any decrements in the flow of the River due to Lake Ziway have a direct impact on the Lake Abijata and its surrounding ecosystem (Tenalem, 2002; Kassaye, 2015). Similarly, other unregulated utilization of the water resource in this Lake (discharge of pollutants etc.) consequently will have a negative effect on the hydrology of Lake Abiyata (Tenalem, 2002). Whenever the level of Lake Ziway falls below the controlling sill, Bulbulla River will dries up. And any abstraction of water in the Lake Ziway catchment results in a greater reduction in the level of Abiyata than in that of Ziway (Habtamu, 2015). For this reason, conservation of Lake Ziway becomes very essential and necessary even to the existence of Lake Abiyata. In general since this Lake is a multipurpose Lake, effect will disrupt the whole ecosystem unless it is conserved and protected soon.

To do this estimating monetary value of Environmental resources of ecosystem function is a critical method, it helps to understand the importance investment in order to conservation or improvement or restoration of the lake (Amirnejad et al., 2011). However despite the importance, the application of environmental valuation is not developed in Ethiopia like other developing countries and much work has not been done (Andualem, 2011). Similarly to the best knowledge of the researcher no previous works of this kind have been conducted before in this study area. While the researcher assessing the studies done on Lake Ziway almost all studies focused only on the fish management and fish related activities (Petra et.al, 2009; Endebu et al., 2015) and hydrology of the Lake (Getachew& Seyoum,2009; Habtamu,2015; Lijalem et al., 2007). For this reason, this study analyzed the economic value of the Lake.

2. METHODOLOGY

The data in this paper is collected from both primary and secondary data. Primary data collected from sample respondents via face to face interview. Specifically, the primary data was collected from three kebelles of Ziway city. From these Kebeles 261 households were selected using simple random sampling method the households who live around the Lake using an interview, by assuming that those households are more concern about conservation of the Lake because they are relatively the most beneficiary of the nonuse value of the Lake.

The design of the contingent valuation questionnaire that used to elicit willingness to pay of households was done following the recommendations of NOAA panel for CVM survey. Such as; the interview should be done in person, the willingness to pay format should be used instead of willingness to accept, and the hypothetical facts provided to the respondents must be clear-cut, understandable and constant across all the sample respondents of the survey (Haab and McConnell ,2002)..

This study employs a dichotomous choice elicitation format because the other three methods(i.e open-ended, bidding game, payment card) have been shown to suffer from incentive compatibility problems in which survey respondents can influence potential results by revealing values other than their true willingness to pay (Haab and McConnell, 2002). This dichotomous choice elicitation format includes both single bounded and double bounded formats. The single bounded dichotomous choice format is the simple for respondents to make willingness to pay decisions than open-ended questions. However, the double-bounded dichotomous choice format where respondents are presented with a "follow up" question in addition to the "yes-no" option of the SBDC is useful to correct the strategic bias and increase statistical efficiency over single-bounded. For this reason, this study used a double bounded elicitation format to elicit the household's willingness to pay for the proposed scenario that is for the conservation of the Lake.

Following Haab and McConnell (2002), in the double-bounded dichotomous format, individuals were asked two respective questions that has 'Yes' or 'No' responses, where the second question involves another bid depending on the first answer. That is if the individual answers yes to the first question then he is asked about his WTP for a higher amount. If he answers no to the first question then a lower amount is presented. To be clear let's assume the unobserved willingness to pay of the respondent j (WTP_{jo}) in the first question is between the lowest value (WTP_{jL}) and the highest value (WTP_{jH}) and if an individual is asked whether he/she is willing to pay B_q amount for the conservation of Lake or not. Where q=1, B_q refers the first bid amount and if q=2 refers to the second bid. So, we have four possible responses of individual j from his/her responses of 'Yes' or 'No'.

1. YES-YES, if the individuals response is 'Yes' for both the first and the second bids, $B_2 > B_1$. That is the highest willingness to pay in the mind of the respondent will be between (WTP_{jH}) and infinity.

$$(\text{yes, yes}) = (\text{WTP}_{j1} > B_1, \text{WTP}_{j2} > B_2)$$

2. YES-NO, if the individuals response is 'Yes' for the first bidand 'No' for the second bid, $B_2 > B_1$. So, the highest willingness to pay will be between (WTP_{jL}) and (WTP_{jH}).

$$(\text{yes, no}) = (\text{WTP}_{j1} > B_1, \text{WTP}_{j2} < B_2)$$

3. No-No, if the individual responses is 'No' for both first bid and second bid, $B_2 < B_1$. So, the individuals highest willingness to pay will be between 0 and (WTP_{jL}).

$$(\text{no, no}) = (\text{WTP}_{j1} < B_1, \text{WTP}_{j2} < B_2)$$

4. NO-YES, if the individual response is 'No' for the first bid and 'Yes' for the second bid, $B_2 < B_1$. So, the highest willingness to pay will be between (WTP_{jL}) and (WTP_{jo}).

$$(\text{no, yes}) = (\text{WTP}_{j1} < B_1, \text{WTP}_{j2} > B_2)$$

The most general econometric model for the double-bounded data comes from the formulation

$$WTP_{jq} = \mu_q + \varepsilon_{jq} \quad \text{..... .... 1}$$

Where μ1 and μ2 are the means for the first and the second willingness to pay answers respectively, (WTP_{jq}) is the jth respondent's willingness to pay and ε_{jq} are error terms which are normally distributed with mean 0 and respective variances of σ_1^2 and σ_2^2 . Therefore, to construct the likelihood function, we first derive the probability of observing each of the possible two-bid response sequences (yes-no, yes-yes, no-yes, no-no).

For illustration, the probability that respondent j answers 'yes' to the first bid and 'no' to the second bid is given by

$$\Pr(yes, no) = pr(WTP_{j1} > B_1, WTP_{j2} < B_2)$$

$$\Pr(yes, no) = \Pr(\mu_q + Ujq > \beta_1, \mu_q + Ujq < \beta_2)$$

The probability that respondent j answers 'yes' to the first and to the second bids;

$$\Pr(yes, yes) = pr(WTP_{j1} > B_1, WTP_{j2} > B_2)$$

$$\Pr(yes, yes) = \Pr(\mu_q + Ujq > \beta_1, \mu_q + Ujq > \beta_2)$$

The probability that respondent j answers 'no' to the first bid and to the second bids;

$$\Pr(no, no) = pr(WTP_{j1} < B_1, WTP_{j2} < B_2)$$

$$\Pr(no, no) = \Pr(\mu_q + Ujq < \beta_1, \mu_q + Ujq < \beta_2)$$

The probability that respondent j answers 'no' to the first bid and 'yes' to the second

$$\Pr(no, yes) = pr(WTP_{j1} < B_1, WTP_{j2} > B_2)$$

$$\Pr(no, yes) = pr(\mu_q + Ujq < \beta_1, \mu_q + Ujq > \beta_2)$$

The Jth contribution to the likelihood function becomes

$$\begin{aligned} Lj\left(\frac{\mu}{\beta}\right) = {} & [pr(\mu_1 + U_{j1} > \beta_1, \mu_2 + U_{j2} > \beta_2)YY] \\ & * [pr(\mu 1 + Uj1 < \beta 1, \mu 2 + Uj2 < \beta 2)NN] \\ & * [pr(\mu 1 + Uj1 > \beta 1, \mu 2 + Uj2 < \beta 2)YN] \\ & * [pr(\mu 1 + Uj1 < \beta 1, \mu 2 + Uj2 > \beta 2)NY] \end{aligned} \quad \text{..... .... .2}$$

Where

YY = 1 for a yes-yes answer, 0 otherwise,
NY = 1 for a no-yes answer,0 otherwise,
YN=1 for a yes no answer, 0 otherwise,
NN=1 for a no-no answer, 0otherwise, this formulation is referred to as the bivariate discrete choice model.

The functional form for Seemingly Unrelated Bivariate Probit Regression model (SUBPRM) was as follow:

$$WTP_1 = f(BID_1, X_i)$$

$$WTP_2 = f(BID_2, X_i)$$

$$WTP_1 = \beta_0 + \beta_1 BID_1 + \beta_2 GNE + \beta_3 AG + \beta_4 MRS + \beta_5 HFS + \beta_6 EDU + \beta_7 EMC + \beta_8 INC + \beta_9 DDR +$$

$$\beta_{10}PENA+\beta_{11}JOP+\beta_{12}LASTA+\beta_{13}HOW+\varepsilon_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

$$WTP_2=\beta_0+\beta_1BID_2+\beta_2GNE+\beta_3AG+\beta_4MRS+\beta_5HFS+\beta_6EDU+\beta_7EMC+\beta_8INC+\beta_9DDR+$$
$$\beta_{10}PENA+\beta_{11}JOP+\beta_{12}LASTA+\beta_{13}HOW+\varepsilon_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4$$

Where;
WTP1= respondent's WTP answer for the first bid price as dummy variable (1= 'yes" for the first bid price, 0= if says 'no')
WTP2= respondent's WTP answer for the second bid price as dummy variable (1= "yes" for the second bid price, 0= if say "no" for the bid price)
BID1= the amount of initial bid presented in birr.
BID2= the amount of second bid presented in birr.
GEN= gender of respondents
AG= age of respondents in years
EDU= respondents education level in number years of schooling
HFS= Respondents family sizes in numbers
MRS= Marital status of respondents
HOW= House ownership
INC= monthly income of the households in birr
LSAT=Respondents level of satisfaction with the existing condition
EMC= Employment Characteristics
DDR =Dependency Ratio
JOP= job opportunity in the Lake
PENA= Participation in environmental awareness creation
$\beta_0,\beta_1,\beta_2,\beta_3,\beta_4,\beta_5,\beta_6,\beta_7,\beta_8$, $\beta_9,\beta_{10},\beta_{11} and \beta_{12}$ are the parameters and ε i = error term.

3. RESULTS AND DISCUSSIONS

Table 3.1. Distribution of respondents' demographic characteristics

Variable	description of variables	Mean	Std. Dev.	Min	Max
GEN	gender (male=1, 0=female)	**0. 61**	**0.49**	**0**	**1**
AG	age of household	**43.2**	**10.13**	**21**	**66**
MRS	marital status (married=1, 0=otherwise)	**0 .89**	**0.31**	**0**	**1**
HFS	family size	**5.75**	**1.75**	**2**	**9**
EDU	education level	**7.8**	**5.8**	**0**	**17**
DDR	dependency ratio	**1.15**	**0.79**	**0**	**3.5**
EMC	employment c (gov't employee=1, 0=otherwise)	**0.42**	**0.49**	**0**	**1**
INC	monthly income	**5493**	**2956.5**	**1200**	**16000**
LASTA	level of satisfaction with status quo of the Lake (Satisfied=1, 0=unsatisfied)	**0.25**	**0.430**	**0**	**1**
JOP	job opportunity on the Lake (1=yes, 0=no)	**0.13**	**0.3**	**0**	**1**
HOW	house ownership (1=yes, 0=otherwise)	**0.83**	**0.38**	**0**	**1**
PENA	participation in environmental awareness (1=yes, 0=no)	**0.10**	**0.30**	**0**	**1**

Source: own survey, 2017
**Note that the mean estimates of dummy variables should be interpreted as percentage. For example the mean of the respondent's gender is 0.609. This means 61% of the respondents are male.

3.2. Main Problems of the Lake faces and their courses

Currently the Lake faces many problems; the above table 3.2 summarizes the main problems the Lake faces and the main causes for the problem from the households' point of view. Accordingly, the main problem currently the Lake faces is reducing in water quality (40%), followed by reducing the number of fishes (22%) and reducing water quantity (16%). For the question what is the cause for the above problems; 53% of the respondents say discharge of pollutants (chemical) into the Lake (especially from flower factories) followed by over fishing (19%) and water abstraction for irrigation (14%).

Table 3.2.: Main Problems of the Lake faces and their causes

Problems	Number of respondents	Percentage (%)	Rank
Reducing water quality	105	40	1
Reducing water quantity	42	16	3
Reducing the number of fish	58	22	2
Reducing the number of birds	36	14	4
Chang in the color of the Lake	6	2	6
Other	14	5	5
Causes of the above problems			
deforestation in the upper watersheds	24	9	4
discharge of pollutants (chemical) into the Lake	138	53	1
water abstraction for irrigation	36	14	3
Over fishing	51	19	2
Other	12	5	5
Total	261	100	

Source: own survey, 2017

3.3. Descriptive Statistics of WTP Responses and bid design

This section discusses the WTP stated by the respondents. The analysis uses the dichotomous choice CVM, in the dichotomous choice CVM all household is asked whether they would be willing to pay for the conservation of Lake Ziway, where the respondents were asked two sequential questions in such a way that the second question is depending on the response of initial bid. In particular, if a respondent accepts the initial bid, he/she would be asked about willingness to pay for twice the initial bid (2b). If a respondent rejects the initial bid offered, half of the initial bid (0.5b) was proposed.

Four starting bid prices for the proposed scenario corresponding valuation question were given. To identify these initial bids pilot study were conducted on 25 randomly selected households through open ended questions. The result showed that, the WTP response range between 0 and 150.To fit the obtained data points to underlying probability distribution; nonparametric kernel density estimation was used. The bandwidth for the estimated epanechnikov kernel is determined at 7.0093. The result show that for WTP greater than 60 and less than 30 the bid values are associated with a probability density value that is close to zero. Accordingly 30,40,50,60 initial bids were selected and distributed randomly equally among the 261 questioners, which is one initial bid was written randomly in 65(25%) questionnaires except to one which is 66. Accordingly, the second bid becomes 15, 20, 25, 30, 60, 80, 100 and 120 birr.

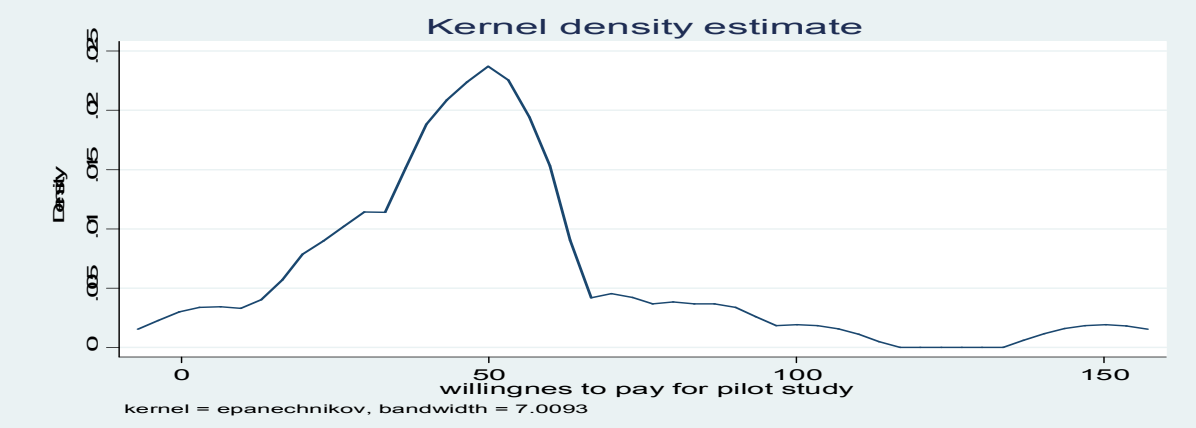

Figure 3.3.: Kernel Density Estimates of Stated WTP from the Pilot Study

Table 3.3 shows households WTP answers for the two bid prices. Out of the 261 household respondents, 69 respondents agreed to pay for the designed both bid prices (i.e. Yes-Yes), while 83 respondents disagreed to pay for both bid prices (i.e. No-No). Conversely, 64 respondents agree to the first bid price and denied to the second bid price (i.e. Yes-No) and 45 respondents disagree to the first bid price and agree to the second bid price (i.e. No-Yes). In total, 133(51%) households were willing to pay for the first bid price and 114(44%) of respondents were willing to pay for the second bid prices. And 128(49%) and 147(56%) households were unwilling to pay for the first bid price and for the second bid prices respectively.

Table 3.3: Descriptive Statistics of WTP Responses

Who is responsible	Number of respondents	Parentage (%)
Yes-yes	69	60.53
Yes-no	64	43.54
Total	133	100
No-yes	45	39.47
No-no	83	56.45
Total	128	100
Total	261	100

Source: own survey, 2017

3.4. Econometric analysis for CVM

In this section the data obtained from the households CV survey were analyzed and discussed to identify the determinants of household's willingness to pay and to calculate the mean WTP for the conservation of the Lake using seemingly unrelated bivariate probit model.

To select the appropriate model, first the study checked the significance level of rho (ρ), which shows the value of the correlation coefficient between random errors. In the Seemingly Unrelated Bivariate Probit Estimates Rho (ρ), coefficient of correlation of error terms is positive (0.5431665) and statistically significant at 5% level of significance because test for row ($\chi 2$=4.2813) suggests that the two disturbances are significantly correlated. This basically shows that there is positive linear relationship between the random components of the responses to the initial bid and the second bid.

The fact that Rho (ρ) is less than unity indicates that the correlation between the random components of the responses to the initial bid and the second bid is not perfect. Therefore, the probability in which the null hypothesis of no correlation is rejected, i.e. the first and second bid answers can be estimated simultaneously. So, the two equations may be analyzed by Seemingly Unrelated Bivariate Probit model or Bivariate Probit model rather than interval model because interval data model could be applied if the rho(ρ) coefficients were found to be insignificantly different from zero Hanemann and Kanninen (1999).

And because this study assumes that bid two (B_2) doesn't affect to answer one (WTP_1) and similarly bid one (B_1) doesn't affect answer two (WTP_2) .For this reason Seemingly Unrelated Bivariate Probit model used to estimate the mean WTP of the respondent from the double bounded format rather than bivaretprobit model. This due to the reason that Seemingly Unrelated Bivariate Probit model applicable when the two dependent variables may not depend on the same list of independent variables, but are still correlated but bivariate prrobit model is applicable if the two dependent variables depend on the same list of independent variables, but are still correlated (Joseph N., 1996).

3.4.1 The robust Seemingly Unrelated Bivariate Probit Model regression result

Table 3.4.1: Results for Seemingly Unrelated Bivariate Probit Model (Robust standard error)

Variable	Equation I		Equation II		Marginal effect	
	Coefficient	**P-value**	**Coefficient**	**P-value**	**Coefficient**	**p-value**
WTP1	-.425122 (.0110366)	0.000***			-.0062547	0.001***
WTP2			-.0215602 (.0044303)	0.000***	-.0055274	0.000***
GEN	.1526511 (.2385301)	0.522	.1752628 (.2051733)	0.348	.0668354	0.328
AG	-.017566 (.014312)	0.220	-.0167226 (.0143088)	0.243	-.0068702	0.116
MRS	-.469994 (.3082447)	0.127	.1398501 (.25543)	0.584	-.0134952	0.873
HFS	0.0312564 (.0811945)	0.700	-.123403 (.0801593)	0.124	-.0270383	0.280
EDU	.0107353 (.0254844)	0.674	..0284434 (.0201172)	0.157	.0088715	0.221
EMC	.383646 (.2750154)	0.163	-.00161965 (.2321306)	0.944	.0504588	0.536
INC	.0003598 (.0000563)	0.000***	.0002852 (.0000468)	0.000***	..000126	0.000***
DDR	-.0649134 (.1319145)	0.623	-.2255255 (.114533)	0.049**	-.0673687	0.088*
PENA	1.226843 (.4632056)	0.008***	-.4396657 (.336513)	0.191	-..2624745	0.026**
JOP	1.059858 (.2395802)	0.001***	.0853147 (2983838)	0.775	.1316791	0.220
LASTA	-.4719552 (.2395802)	0.049**	-.3434561 (.1992586)	0.0851*	-.1508544	0.016**
HOW	1.024721 (.3390638)	0.003***	.4757424 (.2451392)	0.052 **	0.25026	0.000***
Cons	-.0693359 (.6337823)	0.913	.393540 (.508114)			
Rho	0.5467 (0.20793)					

Wald test of rho=0: chi2(1) = 5.45825 Prob> chi2 = 0.0385
Log likelihood = -238.67 Restricted likelihood= -355.951
No of obs. = 261 Wald chi2 (26) = 157.42
Prob> chi2 = 0.0000
***, **, * indicates significance level at 1%, 5% and 10% respectively
Numbers in parenthesis are standard errors

Source; own survey, 2017

3.4.2 Determinants of Willingness to Pay for the conservation of the Lake

Table 3.4.2 shows the sign and the magnitude effects of different explanatory variables on the households' willingness to pay for the conservation of the Lake. The interpretation of the marginal effects of the seemingly bivariate probit model shows the change in the probability of an event due to a unit change in the continuous explanatory variables for the continuous variables and the change of dummy variables from 0 to 1 for discrete variables. Accordingly the variables are interpreted as follow;

The coefficient of initial bid amount have the negative sign and highly significant at 1% level of significance, indicating that the higher the amount the smaller the probability of accepting the offered amount which is consistent with the economic theory (law of demand). The result shows that other things remain constant a one birr increase in the initial bid decreases the probability of household's willingness to pay for the conservation of Lake Ziway by 0.622%.

Similarly the coefficient of the second bid amount have the negative sign and highly significant at 1% level of significance, indicating that the higher the amount the smaller the probability of accepting the offered amount which is consistent with the economic theory (law of demand). This shows that other things remain constant a one birr increase in the second bid will decreases the probability of household's willingness to pay for the conservation of Lake Ziway by approximately 0.55% .

Income of households found that highly significant in both equation at 1% significant level. This indicates that other things remain constant a one birr increase in the income of the respondents increases the probability of positive response for offered bid by 0.0126%, i.e. that those households with higher income are more willing to pay more for conservation of the Lake.

The dependency ratio it is only significant to the second willingness to pay answer at 5% level of significance. The result shows that other things remain constant a one unit increase in the dependency ratio of the households decreases the probability of positive response for offered bid by 6.73%, i.e. that those households with lower dependency ratio are more willing to pay for conservation of the Lake.

A dummy variable coefficient represents to households participation in environmental awareness creation was expected to have a positive relationship with households willingness to pay answer. As expected the result from this study shows the expected sign in both equations. But only equation 1 is significant at 1% level of significance. This implies that other things remain constant households who participated in environmental awareness creation program have 26.24% more probability to accept the offered bid than households who did not participated.

A dummy variable coefficient represents to households job in the Lake was expected to have a positive relationship with households willingness to pay answer. As expected the result from this study shows the expected sign in both equations. But only equation 1 is significant at 1% level of significance. The result shows that , other things remain constant households who have at list one family member works on the Lake related activity have 13.16% more probability to accept any bid offered than households who did not work on the Lake related activities.

The coefficient of the dummy variable representing the level of satisfaction with the existing condition of the Lake was expected to have a negative relation with willingness to pay answer. As expected the result from our study showed the expected sign in both equations and significant at 5% and 10% level of significance respectively. This indicates that those who are satisfied with the status quo of the Lake condition are less willing to accept the increase bid amount as compering to those unsatisfied. The marginal effect of this variable implies that other things remain constant households who satisfied with the status quo of the Lake have 15.08% less probability to accept the offered bid than the households who are not satisfied.

A dummy variable coefficient represents household ownership; house was expected to have a positive relationship with the household's willingness to pay answer. As expected the result from these study shows the expected sign in both equations and significant at 1% and 10% level of significance respectively. The result implies that other things remain constant households who have own house have 25.02% more probability to accept the offered bid price than the households who don't have own house.

The variables which represent the household's gender, marital status, family size and education has the expected sign but they are insignificant to the willingness to pay of the lake. Conversely, the variables of age and character of employment has unexpected sign and they are also insignificant to affect the dependent variable.

3.2.3 Estimation of the Mean WTP

To achieve one of the objectives of this it is necessary to estimate the mean and maximum willingness to pay. The mean WTP value of the sample households for the protection of the Lake can be calculated using $\frac{\beta_0}{\beta_1}$ from equation (1) specified in in the seemingly unrelated biprobit function. Where β_0 (intercept) and β_1 (slope of bids) are the coefficients estimated from SUBP model. However, it is better to compute the WTP using the using the krinsky and Robb Procedure because this shows the significance level for the estimating mean WTP then the above which doesn't consider that. This Krinsky Robb method uses random draws from assumed multivariate normal distribution to generate new parameter vectors. The mean WTP evaluated using the krinsky and Robb are presented here under table 3.2.3 for both answer one and answer two.

Table 3.2.3 Estimated mean willingness to pay for the conservation of the Lake using Krinsky Robb method (95 %) Confidence Interval

MEASURE	WTP	LB	UB	ASL*	CI/MEAN
Mean/Median for equation one	50.99	46.11	59.04	0.0000	0.25
Mean/Median for equation two	50.01	39.07	57.64	0.0002	0.37

*: Achieved Significance Level for testing H0: WTP<=0 vs. H1: WTP>0

Where LB: Lower bound; UB: Upper bound

As shown in table 3.2.3, the mean WTP for equation one is 50.99 birr per annum and highly significant at 1% significance level with p value 0.000. It is bounded between 46.11 birr and 59.04 birr with low variation of 8.98. Conversely the mean WTP for equation two is 50.01 birr per annum and significant at 1% significance level with p value 0.0002 which is bounded between 39.07 birr and 57.64 birr with high variation of 18.57. The above result indicates that both the mean WTP are highly significant.

However, because in the model two sets mean WTP are available the researcher must decide which estimates

to use to calculate the conservation value of the Lake (Haab and McConnell 2002). For this reason, the researcher decides to use mean willingness obtained from equation one for two reasons; first because it is highly significant and have lower variation relative to the mean WTP obtained from equation two. Secondly, the parameter of equation two are expected to contain more noise in terms of anchoring bias, where the respondent is assumed to take the cue from the first bid while making his WTP decision for the second bid (Bogale and Urgessa,2012). Therefore; the mean WTP for one household per year for conservation of Lake Ziway is 50.99 birr and when multiplied with the total number households in the city we can arrive at aggregate WTP. According to the 2008 report from Ziway (batu) finance office the number of households in the city is 11,925; this can be taken as the desired population. Therefore, the total estimation result of 11925 x 50.99 birr gives 608,055.75 birr. So, the total household willingness to pay for the conservation of Lake Ziway is 608,055.75 birr annually.

4. CONCLUSION AND POLICY IMPLICATIONS

The result of descriptive statistics indicated that the main problem the Lake faces is reducing in water quality followed by reducing in number of fishes are the main problems the lake faces and a discharge of pollutants (chemical) into the Lake identified as the major cause for those problems.

The econometric result from the seemingly bivariate Probit model revealed that seven variables were achieved the expected sign and significant in deferent level of significances in determining willingness to pay for the conservation of the Lake. These are the two bid levels, and income, satisfaction with the current condition of the Lake, dependency ratio, and participation in environmental awareness creation, house ownership and job in the Lake. Explanatory variables such as sex, education family size and marital status achieved the expected sign but they are insignificant. Conversely the variable age and employment type has unexpected sign and insignificant.

The mean willingness to pay from the dichotomous choice questions were computed using the Krinsky Robb method. Accordingly, the mean WTP for one household per year for conservation of Lake Ziway was 50.99 birr per year and the total household in the city willingness to pay for the conservation of Lake Ziway was 608,055.75 birr annually.

Based on the conclusion drown on the above the visible recommendations are forwarded here under.

The Lake Ziway provides many environmental services to society, especially as source of food and recreation to the households. So, for sustainable utilization of the Lake resource sound management system (such as; control over utilization of the lake and clean up the surrounding environment of the Lake) should be undertaken.

The study found that households are highly willing to pay for the proposed Lake conservation plan. So, the city administration should introduce management and conservation program for efficient and sustainable utilization of the Lake.

As the result of the study shows, there are different socio-economic variables that affect the household's willingness to pay for the proposed Lake conservation plan. So, the project planners should consider those significant variables that affect respondents WTP responses.

According to the information from household's respondents, currently the Lake faces different problems specially reducing in water quality followed by reducing in number of fishes are the main problems the lake faces and a discharge of pollutants (chemical) into the Lake identified as the major cause for those problems. So, the city administration should implement policies and rules that hinder pollution of the Lake urgently since this is highly damaging the biodiversity of the Lake.

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Seemingly unrelated bivariate probit — Number of obs = 261
Wald chi2(26) = 157.42
Log pseudolikelihood = -238.4866 — Prob > chi2 = 0.0000

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
WTP1						
bid1	-.0425122	.0110366	-3.85	0.000	-.0641435	-.020881
GEN	.1526511	.2385301	0.64	0.522	-.3148594	.6201615
AG	-.0175566	.014312	-1.23	0.220	-.0456076	.0104944
MRS	-.469994	.3082447	-1.52	0.127	-1.074142	.1341545
HFS	.0312564	.0811945	0.38	0.700	-.1278819	.1903947
EDU	.0107353	.0254844	0.42	0.674	-.0392131	.0606838
EMC	.383646	.2750154	1.39	0.163	-.1553742	.9226663
INC	.0003598	.0000563	6.39	0.000	.0002494	.0004701
DDR	-.0649134	.1319145	-0.49	0.623	-.3234611	.1936343
PENA	1.226843	.4632506	2.65	0.008	.3188884	2.134797
JOP	1.059858	.3058577	3.47	0.001	.4603877	1.659328
LASTA	-.4719552	.2395802	-1.97	0.049	-.9415238	-.0023867
HOW	1.024721	.3390638	3.02	0.003	.360168	1.689274
_cons	-.0693359	.6337823	-0.11	0.913	-1.311527	1.172855
WTP2						
bid2	-.0215602	.0044303	-4.87	0.000	-.0302435	-.012877
GEN	.1752628	.2057133	0.85	0.394	-.2279279	.5784535
AG	-.0167226	.0143088	-1.17	0.243	-.0447674	.0113222
MRS	.1398501	.25543	0.55	0.584	-.3607835	.6404837
HFS	-.123403	.0801593	-1.54	0.124	-.2805123	.0337063
EDU	.0284434	.0201172	1.41	0.157	-.0109855	.0678723
EMC	-.0161965	.2321306	-0.07	0.944	-.4711641	.4387712
INC	.0002852	.0000468	6.10	0.000	.0001935	.0003769
DDR	-.2255255	.114533	-1.97	0.049	-.450006	-.0010451
PENA	.4396657	.336513	1.31	0.191	-.2198876	1.099219
JOP	.0853147	.2983838	0.29	0.775	-.4995068	.6701362
LASTA	-.3434561	.1992586	-1.72	0.085	-.7339957	.0470835
HOW	.4757424	.2451392	1.94	0.052	-.0047216	.9562064
_cons	.3935405	.5081143	0.77	0.439	-.6023453	1.389426
/athrho	.6136654	.2965788	2.07	0.039	.0323817	1.194949
rho	.5467021	.2079363			.0323704	.8321075

Wald test of rho=0: chi2(1) = 4.28137 Prob > chi2 = 0.0385

Marginal effects after biprobit
y = Pr(WTP1=1,WTP2=1) (predict)
= .359308

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
bid1	-.0062547	.00195	-3.20	0.001	-.010082	-.002428	45.0575
GEN*	.0668354	.06832	0.98	0.328	-.067075	.200746	.609195
AG	-.0068702	.00437	-1.57	0.116	-.015434	.001694	43.1992
MRS*	-.0134952	.08453	-0.16	0.873	-.179176	.152186	.888889
HFS	-.0270383	.02505	-1.08	0.280	-.076142	.022065	5.74713
EDU	.0088715	.00726	1.22	0.221	-.00535	.023093	7.81226
EMC*	.0504588	.08151	0.62	0.536	-.109304	.210221	.421456
INC	.000126	.00002	7.12	0.000	.000091	.000161	5493.7
DDR	-.0673687	.03945	-1.71	0.088	-.144686	.009948	1.15498
PENA*	.2624745	.11829	2.22	0.026	.030623	.494326	.103448
JOP*	.1316791	.10727	1.23	0.220	-.078564	.341922	.130268
LASTA*	-.1508544	.0624	-2.42	0.016	-.273159	-.028549	.252874
HOW*	.2502624	.06517	3.84	0.000	.122522	.378003	.827586
bid2	-.0055274	.00137	-4.04	0.000	-.00821	-.002845	55.4023

(*) dy/dx is for discrete change of dummy variable from 0 to 1

. wtpcikr bid sex fs ed incomr ddp1 emp455loyment lasta hpep ag how_01 marst_01 la,eq (answer1)

Krinsky and Robb (95 %) Confidence Interval for WTP measures (Nb of reps: 5000 and Equation: answer1)

MEASURE	WTP	LB	UB	ASL*	CI/MEAN
MEAN/MEDIAN	50.99	46.11	59.04	0.0000	0.25

*: Achieved Significance Level for testing H0: WTP<=0 vs. H1: WTP>0
LB: Lower bound; UB: Upper bound

. wtpcikr bid2 sex fs ed incomr ddp1 emp455loyment lasta hpep ag how_01 marst_01 la,eq (answer2)

Krinsky and Robb (95 %) Confidence Interval for WTP measures (Nb of reps: 5000 and Equation: answer2)

MEASURE	WTP	LB	UB	ASL*	CI/MEAN
MEAN/MEDIAN	50.01	39.07	57.64	0.0002	0.37

*: Achieved Significance Level for testing H0: WTP<=0 vs. H1: WTP>0
LB: Lower bound; UB: Upper bound