Smallholder Households' Willingness to Pay for Conservation of Ecosystem Services of Alitash National Park, Ethiopia

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SMALLHOLDER HOUSEHOLDS' WILLINGNESS TO PAY FOR CONSERVATION OF ECOSYSTEM SERVICES OF ALITASH NATIONAL PARK, ETHIOPIA

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Abstract

Background: Despite exceptional ecosystem services are provided by Altash National Park, anthropogenic activities exert immense pressures on the parks' natural resources from the surrounding community which is eventually degrading the productivity of ecosystem services. Therefore, the aim of this study was economic valuation of ecosystem services of Altash National Park of Ethiopia. Using systematic random sampling 196 sample respondents were selected. Double bounded dichotomous choice followed by open ended format of contingent valuation method was used to state households' willingness to pay (WTP) and their maximum WTP for conservation of ecosystem services of the park. Seemingly unrelated bivariate probit model was employed to analyse the data.

Results: First and second offered bid values, Sex of respondent, Years of living in Kebele, Education status, Distance from home to park, Benefit of preservation, Distance from farm to park, Training on park conservation were found to have statistically significant influence on households' WTP for improving conservation of ecosystem services of the park. The expected aggregate WTP from double bounded dichotomous choice and open ended format was estimated 1,511,172.96 and 1,526,194.56 birr, respectively.

Conclusions: Based on the findings, since all respondents were willing to pay for the conservation of ecosystem services of the park, for every decision and formulation of policies and strategies, participation of local communities should be considered. Finally, regular training and workshop should be delivered for local communities to enhance awareness about the environmental and economic values of the park and to develop sense of ownership.

Key Words: Alitash National Park; Contingent valuation method; Economic valuation; Ecosystem services; Seemingly unrelated bivariate probit; Willingness to pay

1. INTRODUCTION

1.1. Background of the Study

In all parts of Africa and globe, national parks are the most extensive form of protected areas which comprise approximately 23% of the global protected areas. According to Assefa et al., (2017) more than 1,812 national parks were built before 2013 in Africa. National parks are crucial for conservation and preservation of biodiversity and provision of other benefits associated with the maintenance of ecological integrity (Bhat, 2016; Bhat & Sinha, 2016). Environmental resources provide significant contribution for human beings, plants and animals day to day activities (Endalew et al., 2018). Most of the ecosystem service values of national park are non -market values. As a result, there is no market clearing prices for goods and services derived from the natural ecosystem, due to this, it is impossible to estimate the full value of protecting vibrant ecosystem services (Haefele & Loomis, 2016).

Ecosystem services are the benefits that people and societies derive from the natural processes that sustain ecosystems (Daily, 1997 cited in Zhu *et al.*, 2010 and Millennium Ecosystem Assessment, 2005); and they can be generally cataloged into four broad areas as summarized by (Millennium Ecosystem Assessment, 2005; Zhu *et al* 2010; Gebre *et al.*, 2016; PAN UK, 2017 and Sahle Tesfaye, 2019), the ecosystem provides us different services: - provisioning services (like fiber, food supply, fresh water supply, biomass fuel, genetic resources, natural medicines, etc.), regulating services (like, air quality, climate change stabilization by carbon sequestration, water erosion, water purification and waste treatment; pest and regulation services, etc.), and supportive services (like, soil formation, pollination, nutrient cycling, primary production, water cycling, habitat etc.) are provided to the dwellers of the ecosystem. Furthermore, the cultural services are education, recreation/aesthetic, eco-tourism, spiritual, etc. The decision associated with this ecosystem services are expansion of social and physical infrastructures which negatively harm the ecosystem practices of services and reforestation and afforestation practices of the decision enhances the ecosystem service.

Ethiopia as a country is gifted with several cultural and natural fascinations from the tops of the rugged Simien Mountains to the depths of the Danakil Depression, at 120 meters below sea level with high appealing value.

Protected areas for wildlife and forest conservation covers about 14% of the total land area of the country. However, the country is one of the least beneficiaries of the growing tourism industry in Africa. The summation of use value and non-use value that people attach to environmental goods and services is the total economic value (TEV). The benefit that human beings get by making actual use of the good currently or in the future refers to use value while the non-instrumental values which are in the real nature of the resource but unassociated with either actual use, or the option to use in the future is referred to as non-use value (Mossie et al., 2019; Shamsudin, et al., 2009).

Ethiopia established different National Parks and protected areas at different level which play crucial role for biodiversity conservation and ecotourism expansion which can have significant economic impact specifically for the society living in the vicinity of the park and the national income in general (Sherif, 2019; Walle, 2015). Altash National park is a newly established National Park of the country and it is the home of endemic bird and animal species, and wood lands. Despite exceptional ecosystem services provided by the park, anthropogenic activities exert immense pressures on the parks' natural resources from the surrounding community which is eventually degrading the productivity of ecosystem services. Currently the park faced several problems like, extensive overgrazing, increasing demand for fuel wood and charcoal as a source of income, farm land expansion, uncontrolled fire and hunting, cutting of tree for house construction and fence. Therefore, protecting and conserving the park is essential mainly for three purposes: First, since the park is an ideal for recreational site, it increases revenue for the community and the government. Second, it maintains the ecological balance of the area since the park is covered by dense forest. Lastly, the endemic animal and bird species will be protected. According to the literature review, so far there is no study conducted on economic valuation of ecosystem services of Altash National Park. Therefore, the aim of this study was: (1) To elicit households' willingness to pay for conservation of ecosystem services of Altash National Park; (2) To examine determinant factors that influence variation in households' WTP for conservation of ecosystem services of the park; (3) To estimate households' mean and aggregate WTP for conservation of ecosystem services of Altash National Park of Ethiopia.

2. RESEARCH METHDOLOGY

2.1. Description of Study Area

This study was conducted in QuaraWoreda, West Gondar Zone of Amhara National Regional State of Ethiopia. Particularly the study focused on Alitash National Park which is located in the South Western part of Quara Woreda, West Gondar Zone (Figure 1). Alitash National Park is a newly established national park. It is established on 20th February 2006. It has an area of 2,665.7 km^2 lying between 11° 47'5.4" to 12° 31'3.6" N latitude and 35° 15' 48" to 35° 48' 51" E longitude in north western flat plain part of Ethiopia. Alitash National Park is bordered with Sudan (Dinder National Park) in the West, in the South Benshangul Gumuz National Regional State with Ayma river, Bambaho and Gelgu in the East and in the North direction it is bordered by Mehadid, Brermel, Gumz Wuha and Mosabadema peasant association of Quara District (Bekele, A & Mengesha,G 2008).

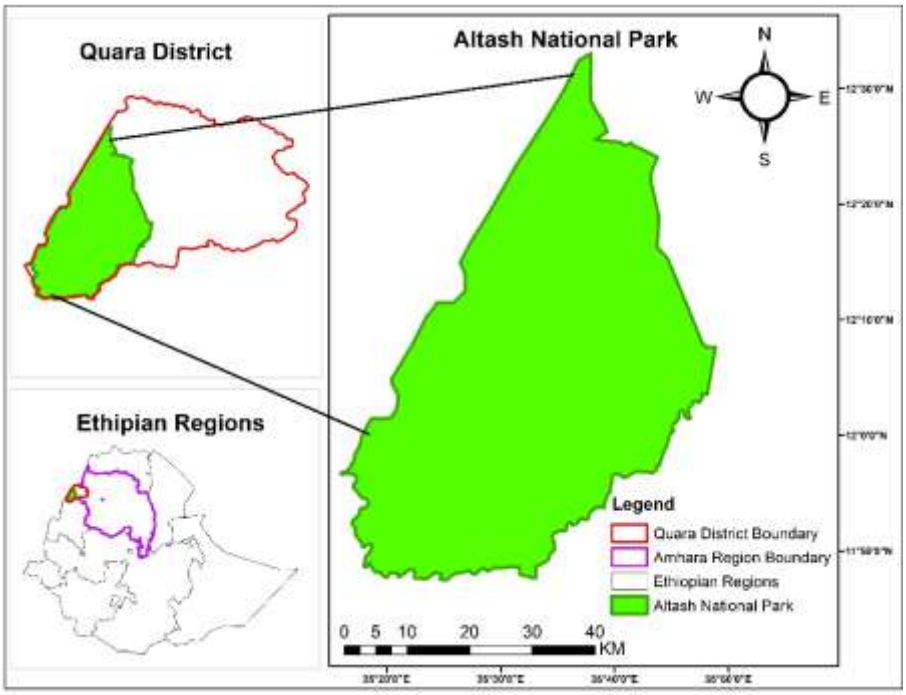

Figure 1: Map of study area.

2.2. Sample Size and Sampling Method

To select sample respondents multi-stage sampling technique were used. In the first stage, Quara District was selected purposively because Altash National Park is found within this district. In the second stage six kebelles were being randomly selected.

In the third stage a total of 196 sample respondents were being selected by using systematic random sampling method taking in to account the proportion of households in each kebelle. To obtain a representative sample size, for cross-sectional household survey the study was employ the sample size determination formula developed by Kothari (2004) as follows:

$$n = \frac{Z^2 pq}{e^2} \qquad = \frac{1.96^2 \times 0.5 \times 0.5}{0.07^2} = 196$$

Where; n = Sample size; Z= confidence level (α = 0.05, hence, Z = 1.96); p = proportion of the population containing the major interest, q = 1-p and e = allowable error.

2.3. Methods of Data Collection

The socio-economic primary data was collected through personal and face-to-face interview using semi-structured and pre-tested interview schedule that was filled up by recruited and trained enumerators under the close supervision of the researchers. Moreover, focus group discussion and key informant interview and also direct personal observation was carried out to triangulate the data obtained from survey. To address economic valuation of the park, a stated preference approach of which contingent valuation method was employed to elicit households' WTP for conservation of the park. There are different elicitation methods used to estimate willingness to pay from a sample of households in contingent valuation surveys. The most commonly and widely used elicitation formats are open ended, bidding game, payment card, single bounded dichotomous choice, and double bounded dichotomous choice formats. Among them especially dichotomous choice (DC) format is the most widely used (Ahmed and Gotoh, 2006). The other three methods have been shown to suffer from incentive compatibility problems in which survey respondents can influence potential outcomes by revealing values other than their true willingness to pay. Therefore, in this study double bounded dichotomous choice format was carried out. Moreover, to increase the precision of the estimate with dichotomous choice question, open ended follow up questions were also used. Secondary data were being obtained from various sources such as reports of bureau of Tourism and Agriculture at different levels, NGOs, district administrative office, relevant previous published and unpublished research findings.

2.4. Methods of Data Analysis

To analyse the two binary response variables which vary jointly in double bounded dichotomous choice format of contingent valuation method, seemingly unrelated bivariate probit model was used. In double bounded dichotomous choice format, respondents were asked whether they would to pay for conservation of the park using two follow-up bid value questions in which the second question is based on respondents' response on the first question. Sets of bid values are determined in double bounded dichotomous choice format by making twice the first bid value if the respondent response is "yes" for the first offered bid value and if the respondent protest against the first offered bid value, half of the first bid value was proposed (Cameron and Quiggin 1994). In this study, for the corresponding scenario valuation question four starting bid values were used. Pilot survey was undertaken on 25 randomly selected households through open ended format to set these starting bid values. In order to avoid bias, responses of these households were not included in the final analysis. Consequently, the most frequently stated bid values in the pilot survey was taken as initial bids for the double bounded dichotomous choice format. Therefore, 60, 70, 80, and 90 birr were taken for the initial bid values. These initial bid values were randomly and evenly distributed to 196 sample household questionnaire and respondents were asked questions about their willingness to pay for conservation of the park with any one of the four pre-determined first bid value and the corresponding second bid determined based on respondents response on the first question. Therefore, the sets of bid values in this study were (60,30,120),(70,35,140),(80,40,160),(90,45,180).

The significance level of rho (ρ), which shows the value of the correlation coefficient between random errors of the two equations was checked to select whether univariate or bivariate probit model is fitted for analysis. Accordingly, in the estimates of seemingly unrelated bivariate probit model (Table 2), Rho (ρ), coefficient of correlation of error terms is (0.9480595) which is positive and statistically significant at 1% level of significance. The positive sign implies the two equations error terms have positive relationship. Moreover, since the values of Rho (ρ) is less than one, there is no perfect relationship between the random components of the responses in the initial bid and the second bid. Therefore, the two equations are interdependent and can be estimated simultaneously because the probability in which the null hypothesis that willingness to pay decisions for the first bid and second bid are independent is rejected at 1% significance level. So,

instead of univariate probit model, the two equations can be analyzed either using Seemingly Unrelated Bivariate Probit model or Bivariate Probit model. However, in this study since the explanatory variables are not the same for both equations but still they are strongly correlated, seemingly unrelated bivariate probit regression estimation was employed. If the two equations dependent variables depend on the same independent variable, bivariate probit model could be applicable (Joseph N., 1996).

, a seemingly unrelated (SUR) bivariate probit model for an individual *i* can be specified as follows to identify the factors simultaneously determining the two WTP equation dependent variables (Equation 1 and 2) based on (Haab and McConnell, 2002; Cameron and Trivedi, 2010) :

$$WTP_{1i} = Xi\beta_{1i} + \varepsilon_{1i} \ldots\ldots (1)$$

$$WTP_{2i} = X_{2i}\beta_{2i} + \varepsilon_{2i} \ldots\ldots (2)$$

Where i = ith respondent's willingness to pay

$\beta_{1i} and \beta_{2i}$ = are unknown parameters to be estimated in the first and second equation respectively

X is a vector of explanatory variables that can affect amounts of offered bid values for improved irrigation water supply

WTP1 and WTP2 = unobservable random components in the first and second equations respectively

ε_1 and ε_2 , are error terms normally distributed with mean zero and respective variances σ_1 and σ_2 , and have a bivariate normal distribution with correlation coefficient ρ**.** Where**,** $\rho \neq 0$

There four joint responses probabilities for the offered initial and follow up bids are: (Yes, Yes), (Yes, No), (No, Yes) and (No, No) (Equation 3, 4, 5, 6). The probability of responses of respondent i to the first and the second offered bid valuses is given by (Haab and McConnell, 2002):

$$pr(no, no) = pr(WTP_{1i} < t^1, WTP_{2i} < t^2)$$

$$= pr(\ x_i\beta_{1i} + \varepsilon_{1i} \ \ < t^1, x_i\beta_{2i} + \varepsilon_{2i} < t^2) \ldots\ldots (3)$$

$$pr(no, yes) = pr(WTP_{1i} < t^1, WTP_{2i} \geq t^2)$$

$$= pr(x_i\beta_{1i} + \varepsilon_{1i} < t^1, x_i\beta_{2i} + \varepsilon_{2i} \geq t^2) \ldots\ldots (4)$$

$$pr(yes, no) = pr(WTP_{1i} \geq t^1, WTP_{2i} < t^2)$$

$$= pr(x_i\beta_{1i} + \varepsilon_{1i} \geq t^1, x_i\beta_{2i} + \varepsilon_{2i} < t^2) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

$$pr(yes, yes) = pr(WTP_{1i} \geq t^1, WTP_{2i} \geq t^2$$

$$= \Pr(X_i\beta_{1i} + \varepsilon_{1i} \geq t^1, X_i\beta_{2i} + \varepsilon_{2i} \geq t^2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Where t^1 = amount of the first bid (Bid 1) and t^2 = amount of the second bid (Bid 2)

2.5. Estimation of the Mean Willingness to Pay

Mean WTP can be estimated from double bounded dichotomous choice format using seemingly unrelated bivariate probit model and open ended format of contingent valuation survey undertaken in this study. Accordingly, the mean WTP of respondents from open ended format is simply average of respondents maximum WTP (Equation 7).

$$Mean\ WTP = \frac{1}{n}\sum_{i=1}^{n} yi \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Where n is the numbers of respondents and "y_i" is the amount of respondents maximum WTP.

Furthermore, the mean WTP for improving conservation of the park from double bounded dichotomous choice format using seemingly unrelated bivariate probit model can be estimated using the following formula as Habb and McConnell (2002).

$$MWTP = \frac{\alpha}{\beta}$$

Where,

Where: MWTP = Mean willingness to pay,

α□are constants/intercepts for the first and second equations

□□are the coefficients of the first and second bid values in Seemingly Unrelated Bivariate Probit model

2.6. Description of Variables and Their Measurement

2.6.1. Dependent Variables

The dependent variables are **WTP1 and WTP2** for seemingly unrelated bivariate probit analysis which has a dichotomous nature (**Yes=1 and 0=No**) measuring whether the households are willingness to pay or non-willingness to pay for the bid offered to improve conservation of Altash National park. The independent socio-economic variables which affects households' willingness to pay is described in Table 1.

Table 1: Description of Explanatory Variables and their Measurement

Variable description	Variable type	Measurement
Sex of respondent	Dummy	1= Male headed, 0= Female headed
Age of respondent	Continuous	Year
Years of living in kebele	Continuous	Year
Livestock holding	Continuous	Tropical livestock unit
Total land holding size	Continuous	Hectare
Distance from home to park	Continuous	Kilometer
Family size in adult equivalent	Continuous	Number
Education status	Dummy	1= literate, 0= Illiterate
Access to extension	Dummy	1= having access; 0= Otherwise
Benefit of preservation	Dummy	1= have benefit ; 0= Otherwise
Distance from farm to park	Continuous	Kilometer
Training/workshop on park conservation	Dummy	1= participated, 0= otherwise
Off/non-farm income	Dummy	1= participate ; 0= otherwise
Amount of first bid price (Bid1)	Continuous	Birr
Amount of second bid price (Bid2)	Continuous	Birr

3. Results and Discussion

3.1. Socio-Economic Characteristics of Respondents

Sample households were composed of both male and female headed. Of the total sample size of the study 84.69% were male headed while 15.31% were female headed households. The mean age of the respondent was 41.43 years with a minimum of 23 and a maximum of 75 years. 34.69 % of respondents were illiterate, they cannot read and write and 65.31% were literate in which they can read and write. The maximum years of the respondent living in their current area was 50 years while the minimum was 2 years with average of 19.59 years. The average family size of the respondents was 3.07 with a minimum of 1 and maximum of 8.5 in adult equivalent. 78.06% of respondents have taken training on conservation of the park while the remaining 21.94% have not taken the training. The mean land holding size of the respondents was 4.75ha with 0.3 and 15 hectare of minimum and maximum respectively.

3.2. Households' WTP for Improving Conservation of the Park

All of the respondents were willing to pay for improving conservation of the park. Double bounded dichotomous choice followed by open ended format of contingent valuation method was employed in this study. Accordingly, responses of respondent households for the initial and follow up bid values is shown in Table 1 thus, 73.47% of respondents accept both initial and follow up bid values (Yes, Yes), 8.67% of respondents accept the initial offered bid value but reject the follow up bid value (Yes, No), 11.23% of respondents reject the initial offered bid value but they accept the second offered bid value (No, Yes); 6.63% of respondents reject both offered initial and follow up bid values (No, No).

Table 2: Summary of responses for the offered initial and follow up bids

Joint responses	Frequency	Percentage
Yes-Yes	144	73.47
Yes-No	17	8.67
No-Yes	22	11.23
No-No	13	6.63
Total	196	100

Source: Own computation from field survey data, 2021

Respondent households' were also asked in which payment modality they prefer to pay the amount they would like to pay. Hence 76.02% of respondents prefer to pay through annual donation and the remaining 23.98% of respondents were preferred to pay through rural land use fee.

3.3. Households' WTP Variation for Improvement of the Park conservation

Table 3 shows results of seemingly unrelated bivariate probit model and marginal effects after seemingly unrelated bivariate probit model for households' WTP for the park conservation improvement. The marginal effect in the way that changes in WTP due to a unit change in the significant continuous explanatory variables and change from 0 to 1 for significant discrete variables was used to interpret the seemingly unrelated bivariate probit model estimates. Of fifteen explanatory variables nine variables were found to have statistically significant influence on respondents' WTP for conservation of the park. The probability of households' willingness to accept both the first and the second offered bid value (Yes, Yes) was 80.52%, the probability of accepting the first offered bid value and rejecting the second bid (Yes, No) was 6.35%. Moreover, the probability of households' rejecting the first offered bid and accepting the second bid was 1.15%, the probability of households' protesting against both the first and the follow up bid was 11.98%. Each statistically significant explanatory variables are also interpreted as follow:

The variable Years of living in kebelle is the number of years since the respondent households' living in that kebelles was found to be positively and statistically significant at 1% level of significance. The positive relationship implies that as households living more years in that particular kebelles have more awareness and feel sense of ownership for the park and willing to improve the conservation. The district was one of the area which the regional government selects for settlement and there are new settlers in the district. The marginal effect of this variable indicates that as the living of respondents in that kebelles increases by one year, the respondents' probability of willingness to pay for the conservation of the park increased by 87% keeping all other factors constant.

The dummy variable education status have positive and statistically significant influence on households' probability of willingness to pay for the park conservation improvement at 5% level

of significance. The positive effect implies literate household heads have more awareness about environmental values and they are willing to pay for improvement. The study result reveals literate households' have 1.53% more probability to accept the offered bid values for the park conservation improvement compared to illiterate respondents keeping other factors constant. This finding is consistent with the findings of (Adams et al., 2008; Bhat & Sinha, 2016).

Distance from home to park is found to have negative but statistically significant effect on households' willingness to pay for conservation of the park at 5% level of significance. The negative relationship implies that households who are far from the park are less depend on the services from the park compared to households living in the vicinity of the park, as a result they are less willing to pay for the conservation of the park. The marginal effect of this variable shows that as the distance from households' home to the park increase by one kilometer, the probability of households' willingness to pay for the conservation of the park decreases by 0.09% keeping all other factors constant. This result is consistent with the findings of (Sherif, 2019b).

Benefit of preservation is a dummy variable which have positive and statistically significant relationship with the households' willingness to pay for park conservation improvement at 10% significance level. The marginal effect result of this variable implies that households who perceive conservation of the park will have benefit have 48.22% more probability to accept the offered bid values for the park conservation improvement compared to their counter parts i.e. households' who perceive conservation of the park will not have significant benefit.

Distance from farm to park was found to have positive and statistically significant influence on households' probability of accepting the offered bid values for the conservation of the park at 1% level of significance. The negative relationship shows households' who have farm land in the vicinity of the park are not interested if conservation of the park is improved because they want to expand their farm land through encroaching, they need the park for grazing of their animals and generally their dependency on the park is very high compared to households who have farm land far from the park. The result of the marginal effect indicates as the distance from farm to park increase by one kilometer, the probability of households' willingness to pay for improvement of the park conservation increases by 12.41% keeping other factors constant at their mean value.

Sex of the household head was found to have positive and statistically significant effect on households' willingness to accept the offered bid values for conservation of the park at 5% level

of significance. The positive relationship implies that male headed households have more awareness about values of environmental resources and willing to pay for improvement compared to their counter parts. The result of the study reveals male headed households have 6.34 % more likely willing to pay for conservation of the park keeping other factors constant at their mean value. This finding is consistent with the findings of (Assefa et al., 2017; Kamri, 2013).

The dummy variable training and/or workshop participation on the conservation of the park resources was found to have positive and highly significant effect on households' willingness to pay for conservation of the park at 1% level of significance. As the result of the study indicates households who took training on park conservation have 78.56% more willing to accept the offered bid values for conservation of the park. This result is contradicted with the findings of (Sherif, 2019b) but consistent with the findings of (Assefa et al., 2017b).

The coefficient of the first bid amount was found to have negative and statistically significant effect on households' probability of accepting the first offered bid amount for conservation of the park at 5% level of significance. The negative relationship implies as the bid amount increases willingness to accept that bid amount decreases. This is consistent with the economic theory of law of demand. The marginal effect of this variable implies that as the initial offered bid amount increase by one Ethiopian birr, the probability of households' accepting the bid value decreases by 0.15% keeping other factors constant.

The coefficient of the second bid amount was also have negative but highly significant influence on households' probability of willingness to pay for conservation of the park at 1% level of significance, which is also consistent with the law of demand of economic theory. The marginal effect result shows as a one Ethiopian birr increase in the second bid amount, the probability of accepting the second bid decreases by 0.73% while keeping other variables constant at their mean value.

Table 3**:** Estimated Marginal Effects for Seemingly Unrelated Bivariate Probit Model

Variable	Coefficient (Equation 1)	P>Z	Coefficient (Equation 2)	P>Z	Marginal effect	P>Z
Sex	.0632951 (.0234)	0.008	.0330608 (.020)	0.100	.06337 (.025)	0.015**
Age	-.004167 (.0132)	0.752	-.0090097 (.012)	0.472	-.0021791 (.003)	0.502
Years of living in Kebele	.005655 (.003)	0.025	.0268322 (.018)	0.154	.869968 (.277)	0.002***
Family size	-.0034322 (.039)	0.931	.0794469 (.065)	0.225	.0165745 (.014)	0.268
Education status	.2259177 (.277)	0.415	.5414024 (.260)	0.037	.015314 (.007)	0.044**
Distance from home to park	-.0063141 (.002)	0.003	-.0024827 (.001)	0.146	-.00094 (.001)	0.044**
Off/non farm income	-.5887437 (.266)	0.027	-.1684432 (.239)	0.483	-.0938228 (.069)	0.179
Access to extension	-1.2563 (.426)	0.003	-.4778451 (.502)	0.341	-.1195915 (.077)	0.122
Benefit of preservation	.6703079 (.275)	0.015	.1412918 (.085)	0.1000	.4822271 (.275)	0.080*
Distance from farm to park	.006451 (.002)	0.010	.0073108 (.001)	0.000	.1241328 (.029)	0.000***
Livestock holding	-.1378332 (.291)	0.637	.6690606 (.275)	0.015	.0253789 (.076)	0.739
Landholding size	-.0024691 (.053)	0.963	.0137045 (.050)	0.784	.0027357 (.013)	0.837
Training on park conservation	.7748295 (.299)	0.010	.001234 (.001)	0.073	.7856248 (.286)	0.006***
Bid1	-.0169694 (.007)	0.031			-.001475 (.001)	0.034**

Bid2			-.006975 (.001)	0.000	-.0072767 (.001)	0.000***
Constant	2.156747 (.957)	0.024	2.200793 (.687)	0.001		
/athrho	1.812246 (.635)	0.004				
Rho	.9480595					
Log pseudolikelihood = -149.1154						
Number of obs = 196 Wald chi2(28) = 85.54 , Prob > chi2 = 0.0000						
Wald test of rho=0: chi2(1) = 8.12547 Prob > chi2 = 0.0044						
Probability of (Yes, Yes) = 80.52% Probability of (Yes, No) = 6.35%						
Probability of (No, Yes) = 1.15% Probability of (No, No) = 11.98%						

Source: Own computation from field survey data, 2021

Note: ***, ** and * represents significance level at 1%, 5% and 10%, respectively

Numbers in parenthesis are robust standard Errors

3.4. Households' Mean WTP for Improving Conservation of the Park

3.4.1. Estimation of Mean WTP from Double Bounded Dichotomous Choice Format (Bivariate probit model)

The coefficient of the first bid and the follow up bid in seemingly unrelated bivariate probit model was used to estimate the mean willingness to pay of respondent households for double bounded dichotomous choice format of contingent valuation method. As it is shown in table 2 the coefficient of both the first bid and second bid amount were negatively and statistically significant. The negative sign indicates there is inverse relationship between households' willingness to pay for conservation of the park and amount of bid values. As it is described in the methodology section, the mean WTP for conservation of the park from double bounded dichotomous choice format using seemingly unrelated bivariate probit model is estimated using the following formula as Habb and McConnell (2002).

$$Mean\ WTP = \frac{-\alpha}{\beta}$$

Where,

Where: WTP = Willingness to pay,

α□are constants/intercepts for the first and second equations

□□are the coefficients of the first and second bid values in seemingly unrelated bivariate probit model

Therefore, the mean willingness to pay for the first and the second equation is 127.1 and 315.53 birr respectively. On average the mean willingness to pay from double bounded dichotomous choice format is 221.32 birr by taking average of the mean WTP for equation one and equation two as follows (Lamesgin, 2017).

$$Mean\ WTP = \frac{\frac{-\alpha 1}{\beta 1}+\frac{-\alpha 2}{\beta 2}}{2} = \frac{\frac{-2.156747}{0.0169694}+\frac{-2.200793}{-0.006975}}{2} = 221.32\ birr$$

3.4.2. Estimation of Mean WTP from Open Ended Format

The households' mean willingness to pay for conservation of the park also estimated from the open ended survey of contingent valuation method employed in this study. Therefore the mean willingness to pay of households' from the open ended format is 223.52 birr per household per year which is only marginally higher than the mean willingness to pay for households from double bounded dichotomous choice format which is 221.32 birr per household per year since households have a tendency to state their maximum WTP in open ended format close vicinity to their highest offered accepted second bid value of the double bounded dichotomous choice format.

3.5. Households' Aggregate WTP for Conservation of the Park

The expected aggregate willingness to pay was estimated from both the double bounded dichotomous choice format and open ended format of the contingent valuation method employed in this study. The aggregate WTP was computed by multiplying the mean WTP by the total number of households living in the six vicinity kebelles of the park. Based on the information obtained from Quara district Agricultural office (2020), the total number of households in the six kebelles which are vicinity of the park was 6828. Therefore, the expected aggregate WTP was estimated 1,511,172.96 and 1,526,194.56 birr from the double bounded dichotomous choice and open ended format respectively.

3.6. Conclusions and Policy Implication

In this study, contingent valuation method in double bounded dichotomous choice format followed by open ended format was used to state households' willingness to pay for conservation of the Altash National park. Seemingly unrelated bivariate probit model was used to analyse determinants of households' WTP variation for conservation of the park. Accordingly, Sex of respondent, Years of living in Kebelle, Education status, Distance from home to park, Benefit of preservation, Distance from farm to park, Training on park conservation, and the first and second offered bid values were found to have statistically significant effect on households' WTP variation. Respondents' mean WTP for conservation of the park was estimated 221.32 and 223.52 birr per year from double bounded dichotomous choice and open ended format respectively. 1,511,172.96 and1,526,194.56 birr was the calculated expected aggregate WTP from double bounded dichotomous choice and open ended format. Based on the findings all respondents were willing to pay for improvement of the park conservation, therefore, participation of the community should be considered for formulation of policies and strategies and in any decision making process related with conservation of the park. Furthermore, regular training should be given for the community particularly for the new settlers in order to enhance their awareness about the value of the park and develop sense of ownership.

DECLARATIONS

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and materials

All authors declare that the datasets used in this manuscript are fully available upon request from the corresponding author.

Competing interests

The authors declare that they have no any competing interests in this manuscript.

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Authors' contributions

All authors has been actively involved in making a crucial contribution to the design and completion of this research, interpretation of data and conclusions, assisted in drafting and revising the manuscript, read and approved the final submitted manuscript.

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