Turkish Journal of Agriculture - Food Science and Technology, 10(12): 2477-2483, 2022
DOI: https://doi.org/10.24925/turjaf.v10i12.2477-2483.5315

Turkish Journal of Agriculture - Food Science and Technology

Available online, ISSN: 2148-127X | www.agrifoodscience.com | Turkish Science and Technology Publishing (TURSTEP)

Estimating and Identifying Factors Influencing Households' Willingness to Pay for Conservation of Washera Sheep Breed in Selected Areas of West Gojjam Zone, Ethiopia

Kebebew Hundie[1a,*], Awoke Melak[1,b], Tesfalem Aseged[1,c], Tadesse Hunduma[1,d], Abebe Hailu[1,e], Tesfu Fekensa[1,f]

[1]*Ethiopian Biodiversity Institute, Animal Biodiversity Directorate, PO Box 30726, Addis Ababa, Ethiopia*
[*]*Corresponding author*

ARTICLE INFO

Research Article

Received : 08/06/2022
Accepted : 24/12/2022

Keywords:
Bivariate Probit
Dichotomous Choice
Total economic
Washera-sheep
Willingness to pay

ABSTRACT

The purpose of this study was to estimate and identify factors affecting the willingness of households to pay for conservation of Washera sheep in West Gojam, Ethiopia. This study used both primary and secondary data. A three-stage sampling method was used to collect data from 240 respondents. Data were analyzed using descriptive statistics and econometric models. The two-dimensional test model used a method to determine the choice of the imputation method using double limited dichotomies. The study showed that education level, livestock size, extension contacts and credit source positively affected the maximum household's willingness to pay for conservation of Washera sheep. On the other hand, age, sex, land size, and the distance of the home from the household's market have negatively affected the maximum household's willingness to pay for conservation of Washera sheep. Meanwhile, the total number of valid answers corresponds to 122,168 households. Therefore, the mean willingness to pay for Washera sheep conservation was US$ 3.75 per year and the total economic benefit gain from Washera sheep conservation were equivalent to US$1,069,647.23. The study recommends that households be willing to contribute to the conservation of Washera sheep breed by providing the cash. This ensures community participation in all decision making and formulation of plans and policies related to the conservation of Washera sheep breeds.

[a] *kiya.kebeb@gmail.com* *https://orcid.org/0000-0002-3335-4732*
[b] *awoke.melak@yahoo.co.uk* *https://orcid.org/0000-0002-3644-7504*
[c] *tesfalemaseged@gmail.com* *https://orcid.org/0000-0002-2392-5394*
[d] *yhundumab@gmail.com* *https://orcid.org/0000-0003-1244-2343*
[e] *abebehailu3@gmail.com* *https://orcid.org/0000-0001-9862-2972*
[f] *t.tujuba@studenti.unimol.it* *https://orcid.org/0000-0003-4912-7056*

Introduction

The loss of diversity and the conservation of the genetic resources of agricultural animals has become an issue in the past few decades. Accordingly, tremendous efforts have been made worldwide to study the genetic diversity of livestock species to meet both the development needs and the conservation of animal genetic resources in various parts of the world. Livestock is an important component of Ethiopia's agriculture and is reported to be the country's largest livestock resource than any other African country. It is recognized that Ethiopia has one of the most diverse livestock populations in Africa. The number of small cattle owned by the country is estimated at 58.5 million small cattle (CSA. 2016). There are about 30 million sheep heads in Ethiopia, of which almost 72 percent are females and 28 percent are males. Of the total sheep, 99.7 percent are local, while the remainders are exotic and hybrid (CSA.2017). The existing sheep breeds in Ethiopia are adapted to the country's environment, i.e., to feed shortages and diseases (Solomon et al., 2008). In Ethiopia, the demand for animal products (small cattle), especially meat, is increasing in domestic and export markets (SPS-LMM, 2010).

Small-scale gums account for 40 percent of farm household monetary income, 19 percent of total food value from all livestock products, and 25 percent of total domestic meat consumption (Adane and Girma, 2008). Small-scale sheep farming is the main source of food security, with various functions, including monetary income, wealth conservation, organic fertilizers, socio-cultural functions, and fiber production. The productivity of local sheep is currently too low to meet this demand (Amha, 2008). Improving sheep productivity creates wealth, improves the standard of living of small farmers,

and is necessary to meet society's high demand for meat (Mesfine et al., 2014). However, a flock of sheep is less productive (average weight gain) because traditional large-scale systems manage it with little or minimal input and unimproved technology (Hayes et al., 2009). The age of the dam influences the growth capacity of sheep, the weight before mating the dam, the type of birth, the sex, the breed, and the season of birth (Solomon et al., 2011). Sheep growth capacity is an important characteristic that determines the overall productivity of sheep and the economic benefits of sheep producers for meat production. Increasing the economic benefits of sheep, production requires the market weight of lambs to be improved for market age (Mengiste et al., 2010).

However, livestock farming is becoming one of the most important value-added agricultural systems in Western Gojjam. Most of the population is engaged in basic occupations and 84 percent of small farmers are in livestock farming (Mushir and Mulugeta, 2012). Washera sheep are described as shorthaired, large builders, mostly browns, with males and females. The breed is common in the areas of Western Gojjam, Eastern Gojjam, and Awi of the Amhara National Regional State (Solomon et al., 2010). The growth rate after recovery is better than that of most local species, comparable to some breeds, such as Horro and Bonga, which are recognized in Ethiopia as large sheep breeds. Various literature mentions that species have a good potential to produce ovine products for local and export markets. Washera sheep is also known for its relatively high twinning rate (Solomon et al., 2013).

However, due to its importance, the system for managing these breeds is decreasing from time to time. Therefore, attention should be given to keeping sheep and increasing their production and productivity, and it is very important to identify the factors that affect the desire of households to keep the breeds. Therefore, this study aimed to estimate and identify the factors influencing the household's willingness to pay the costs of conserving breeds of sheep in the Gonji-Kolela, Sekela, and Yilmana Densa districts in West Gojam, Ethiopia.

Methodology

Description of the Study Area

The study was conducted in the Gonji kolela, Sekela, and Yilmana Densa districts in Ethiopia's West Gojjam Zone. The West Gojjam Zone is one of 10 Amhara National Regional State Zones, located between 36° 30' to 37^0 5' longitudes East and 10°16' to 11°54' latitudes North (Habtamu et al., 2016). The total population is estimated at 2,106,596, with more than 91% of the population living in rural areas (CSA, 2007). Agriculture is the main source of livelihood for the community. West Gojjam is divided into 13 rural districts and 5 town governments (Senedu et al., 2016). The West Gojjam district has a total land area of 13,280 square kilometers and varies in elevation between 1500-3500 m.a.s.l. The ambient temperature range is 15-20°C for most of the region (75%), and 20-27°C for the rest (Tilahun and Zeleke, 2013). However, livestock farming is emerging as one of the most important value-added agricultural systems in the West Gojjam Zone. Most of the population has full-time jobs and 84% of small farmers engage in animal husbandry (Mushir and Mulugeta, 2012).

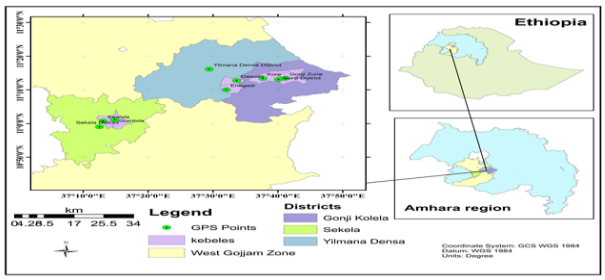

Figure 1. Map of the study area Source: GIS (2021)

Sampling Techniques and Sample Size Determination

A three-stage sampling method was adopted to select the sampled households. In the first stage, 3 out of 13 districts were purposely selected. In the second stage, 6 *kebeles* were randomly selected from the 3 selected districts (2 *kebeles* from each district). In the third stage, 240 sample respondents were selected using a simple random sampling technique based on a probability proportional to the size of the selected 6 *kebeles* populations. The sample size was determined based on (Yamane, 1967) formula. The simplified formula to calculate the sample size was;

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

Where:

n =sample size,

N = total number of farmers Washera sheep reared in the districts,

e = level of precision which is 5% (since the rears have homogeneity characteristics) Yamane's formula was used because of its homogenous type of population in the study area and 8% of the precision level was applied to manage all samples in terms of the available resource that the researchers have including cost, time, etc.

The formula used to calculate the number of sample farmers in i^{th} selected *kebele*:

$$ni = \frac{Ni \times n}{N} \quad (2)$$

Where

ni= number of the selected farmer head selected from the i^{th} *kebele*

N_i= total number of farmers head in i^{th} *kebele*

N= total number of farmers head in the six selected *kebeles*

n = sample size

Types, Sources, and Data Collection Methods

The study used both primary and secondary data sources. Primary data were collected from surrounding sample households using a structured questionnaire to find out their willingness to pay to conserve the Washera sheep breed. In addition, secondary data were collected from zonal, district, and *Kebeles* agricultural departments. The method of direct interviewing was used to conduct the survey. A self-developed questionnaire was used to interview households. Six data collectors have been hired who are district staff trained to collect data.

Methods of Data Analysis

Descriptive Results

Descriptive statistics such as mean, minimum, maximum, standard deviation, percentage, frequency, and inference statistics tests were used to compare and contrast the variables' categories of sample units.

Bivariate Probit Model Results

The basic model for analyzing double bounded dichotomy and contingent valuation questions was a random utility model. The purpose of estimating the parametric model was to determine the willingness to pay for the service described. In addition, the parametric model allows respondent characteristics to be included in the willingness to pay function. By understanding how willingness to pay reacts to individual characteristics, researchers can obtain information about the effectiveness and reliability of contingent valuation methods and estimate sample reaction to a more general population. This study was analyzed by a bivariate probit model developed by (Haab and McConnell, 2002).

$$y_{1=\alpha_{1+\beta_1 T_1}+\sum_{i=1}^{n}\beta_i X_i+\varepsilon_1} \quad (3)$$

$$y_2 = \alpha_{2+\beta_2 T_2} + \sum_{j=1}^{m}\beta_j X_j + \varepsilon_2 \quad (4)$$

$$\mathrm{corr}[\varepsilon_1, \varepsilon_2] = p$$

Where;

Y_1 and Y_2 are the binary responses to the willingness to pay questions; T_1 and T_2 were the bids in the first and second bid questions; Xi represents explanatory variables,α's the coefficients estimated.

The two-correlated willingness to pay equations (eq. (3) and (4)) above with jointly distributed normal error terms were simultaneously modeled as a double bounded dichotomous choice. This model provides information on what variables are crucial for each response to the willingness to pay question. They further state that estimating of the mean willingness to pay is feasible using the bivariate probit contingent valuation model since bivariate normal probability density functions allow for a zero and non-zero correlation. (Haab and McConnell, 2002) put that the essence of a double bounded model was as follows. Respondents were presented with initial bid prices. Following their initial responses, they were given new prices, lower if their initial responses were no, and higher if the responses were yes. Double-bounded models substantially increase the complexity of the analysis, because now the second question may depend in some way on the first question. There was potential for changes in the incentive compatibility of the model or at least some differences in the way respondents treated the first and second questions. In this study, the explanatory variables of both models were the same (Let T1 be the first bid price and T2 be the second bid price. The bounds on willingness to pay were: Xi= Xj).

I. $T_1 \leq WTP > T_2$ for the yes-no responses
II. $T_1 > WTP \geq T_{2s}$ for the no-yes responses;
III. $WTP \geq T_2$ for the yes-yes responses;
IV. $WTP < T_2$ for the no-no responses.

Following Haab and McConnell, the most general econometric model for the double-bonded data was given as:

$$WTP_{ij} = \mu_{ij} + \varepsilon_{ij} \quad (5)$$

Where WTP_{ij} represents the jth respondent's willingness to pay, and i=1, 2… represents the first and second answers. The μ1 and μ2 were the means for the first and second responses. ε_{ij} was an unobservable random component. Setting μij=xij βi allows the mean to be dependent upon the characteristics of the respondents (demographic and socio-economic variables). To construct the likelihood function, we first derive the probability of observing each possible two-bid response sequences (yes-yes, yes-no, no-yes, no-no). To design the probability that respondent j^{th} answers yes to the first bid and no to the second was given by;

Pr (yes, no) = pr ($WTP_1j \geq T_1$, $WTP_2j < T_2$)
Pr ($\mu_{ij}+\varepsilon_{1j} \geq T_1\mu_2+\varepsilon_{2j} < T_2$

The willingness to pay for conservation depends on preliminary survey and previous researchers such as (Etensa, 2014; Nigus, 2014; Berhan et al., 2016 and Kebebew et al., 2021). Accordingly, the most important determinants are age, family size, sex, education level, experience, total land size, total livestock size, extension frequency, source of credit, wealth status, and distance of home from the main market of respondents. These determinants include respondents' socioeconomic, demographic, and attitude indicators as explanatory variables. It could be specified as follow:

$$WTP = \alpha + \beta_1 AGER + \beta_2 SEXR + \beta_3 EDLR + \beta_4 FMSR + \beta_5 LSR + \beta_6 TLU + \beta_7 EXTcR + \beta_9 DHMR + \beta_{10} EXP + \beta_{11} WSR + \varepsilon_i \quad (6)$$

Where WTP was the willingness to pay for the offered bid; AGER was the Age of respondents', SEXR was the sex of respondents', FMSR was the family size of respondents', LSR was the land size of respondents', EXP was an experience of respondents', EDLR was education level of respondents', EXTcR was extension contact, DHMR was the distance of home from the market, CR was a credit source and ε_i was an error term.

Results

Descriptive Results

Respondents' demographic and socio-economic characteristics were calculated using a minimum, maximum, average, standard deviation, percent, frequency distribution, and logical statistical tests. Thus, 240 respondents from the districts of Gonji Kolela, Sekela, and Yilman Densa were interviewed and gave a full response. The average age of respondents is 44 years with a minimum and a maximum age of 20 and 80 years, respectively. The minimum, maximum and average market distance from the respondent's home is 0.1, 27 and 0.998 km, respectively, which is statistically significant for t-value 2.48. The average family size of respondents was 5

with a minimum of 1 and a maximum of 11. The average land ownership of respondents is 0.85 hectares, a minimum of 0 hectares, and a maximum of 3 hectares, which is statistically significant for a t-value of 1.97. The average level of education of respondents is 1 with a minimum of 0 and a maximum of 12 years of schooling. Respondents' yearly experience in rearing Washera sheep was 0, 58, and 13 on average, minimum and maximum, respectively.

Of all respondents, 60% were male and the remaining 40% were female. Of all respondents, 55.4% had a source of credit and 44.6% had no source of credit. The study showed that 4.6%, 73.8%, and 21.6% of the respondents were rich, middle, and poor, respectively.

Of the 240 respondents, 192 (80%) were interested in contributing to the conservation of Washera sheep breeds, and 48 (20%) were not. The main reasons were not interested in the breed conservation of Washera sheep were that I was poor (cannot pay) (43, 89.6%) and satisfied with the current situation (5, 10.4%). Of the 192 respondents interested in contributing to the conservation of Washera sheep breeds, (112, 58.3%) preferred to be collected through association payments and (74, 38.5%) paid directly. Hope, the rest (6, 3.1%) preferred through the chair of *kebeles*.

Econometric

Bivariate Probit Model Results

It was used to estimate the coefficients of the independent variables in a doubly restricted dichotomous choice. Bivariate probit regression model estimates also showed that among the eleven variables, eight (age, sex, education level, land size, livestock size, extension contacts, distance from home to market, and source of respondents' credit) were statistically significantly affected by respondents' willingness to pay for conservation breeds of Washera sheep (Table 4). The estimated average willingness to pay for the conservation of the Washera sheep breed in the West Gojjama zone using a bivariate probit model was US$3.75 per year (Table 5). In addition, the aggregate economic benefit from the targeted 285,239 households was US$1,069,647.23 (Table 6).

Table 1. Descriptive Statistics of continuous variables

Name variables	N	Min.	Max.	Mean	t-test for Equality of Means		
					t-value	Mean diff.	Std. dff.
Age of respondents (AGER)	240	20	80	43.79	.19	.34	1.82
Education level of respondents (EDLR)	240	0	12	1.06	-3.73***	-.83	.22
Total numbers of families FMSR)	240	1	11	4.90	-1.61	-.42	.26
Total land size of respondents in hectare (LSR)	240	.00	3.00	.85	-.03	-.01	.07
Total livestock (TLU)	240	1	32	9.41	-5.82***	-3.17	.54
Extension frequency (EXTcR)	240	0	8	2.36	-4.36***	-.71	.16
Distance (DHMR)	240	.1	27.0	5.998	2.48*	1.60	.64
Experience in the year (EXP)	240	0	58	13.48	-1.40	-2.31	1.65

Source: Own computation (2021)

Table 2. Descriptive statics of dummy and categorical variables

Variables	Unity	No.	%	Chi-Square Tests (X^2)
Sex (SEXR)	Female	96	40.0	0.156
	Male	144	60.0	
	Total	240	100.0	
Source of credit (SourCR)	No.	133	44.6	13.698^{***}
	Yes	107	55.4	
	Total	240	100.0	
Wealth status (WSR)	Rich	11	4.6	6.615^{**}
	Medium	177	73.8	
	Poor	52	21.6	
	Total	240	100.0	

Source: Own computation (2021)

Table 3. Descriptive statics of categorical variables

Variables	Unity	No.	%
Do you have the interest to contribute money for Washera sheep conservation	No.	48	20.0
	Yes	192	80.0
	Total	240	100.0
Reasons for no interest to contribute for Washera sheep conservation	I am poor and I cannot pay	43	89.6
	Other reasons	5	10.4
	Total	48	100.0
System of money collection	Direct payment	74	38.5
	With association payment like ikub, and idir	112	58.3
	Kebeles chairmen	6	3.1
	Total	192	100.0

Source: Own computation (2021)

Table 4. Estimated coefficients of Bivariate probit model

Variables	Coef.	Robust Std. Err.	z	P>z	[95% Conf. Interval]		dy/dx
Const.	1.131	0.808	1.400	0.161	-0.452	2.715	
AGER	-0.020*	0.012	-1.680	0.093	-0.043	0.003	-0.003
SEXR	-0.372*	0.226	-1.650	0.099	-0.815	0.070	-0.060
EDLR	0.171*	0.095	1.790	0.073	-0.016	0.358	0.029
FMSR	-0.049	0.082	-0.600	0.550	-0.210	0.112	-0.008
LSR	-0.477*	0.265	-1.800	0.072	-0.997	0.042	-0.080
TLU	0.118***	0.032	3.730	0.000	0.056	0.180	0.020
EXTcR	0.231**	0.112	2.070	0.039	0.012	0.450	0.039
DHMR	-0.137***	0.028	-5.000	0.000	-0.191	-0.084	-0.023
EXP	0.022	0.014	1.630	0.103	-0.004	0.049	0.004
SourCR	1.203***	0.250	4.810	0.000	0.713	1.694	0.195
WSR	0.033	0.221	0.150	0.880	-0.399	0.466	0.006
Number of observation = 240; Wald chi2 (11) =83.92; Prob > chi2 = 0.0000; Log pseudo likelihood = -87.422043 Pseudo R2 =0.272							

Note: ***, ** and *, significant at 1%, 5% and 10% level of significance, respectively. Source: Model result (2021)

Table 5. Mean Willingness to Pay of seemingly unrelated bivariate probit model results

Variables	Coef.	Robust Std. Err.	Z	P>z	95% Conf. Interval	
BID1	0.1332***	0.0033	40.72	0.000	0.1268	0.1396
Constant	0.5485	0.1915	2.86	0.004	0.9240	0.1731
BID2	0.1271***	0.0033	38.14	0.000	0.1206	0.1337
Constant	0.4307	0.1875	2.3	0.022	0.7983	0.0632
/athrho	4.3742	0.6630	6.6	0.000	3.0748	5.6736
Rho	0.9997	0.0004			0.9957	1.0000

Note: *** significant at 1% level of significance, Source: Model result (2021)

Table 6. Aggregate Economic Benefit

S.no	Districts	TF(1)	ED	EF	EFR	M	AB
1	Gonji kolela	20,758	6.5	1349	19,409	US$3.75	US$72,782.74
2	Sekela	152,832	6	9,170	143,662	US$3.75	US$538,732.80
3	Yilmana Densa	132,074	7.5	9,906	122,168	US$3.75	US$458,131.69
	Mean					US$3.75	US$1,069,647.23

TF: Total Farmers; ED: % of zero in each district (2); EF: Expected farmers to have zero (3)=(1)×(2)/100); EFR: Expected farmers with valid responses (4)=(1)-(3); M: Mean (WTP) (5); AB: Aggregate benefit (money) (6)=(4)×(5); Source: Own computation (2021)

Discussions

Descriptive Analysis

82.5% of respondents expressed interest in donating to Washera sheep breed conservation due to the following issues: - Decreased Washera sheep breeds in the region and inadequate management of Washera sheep and participants were unwilling to contribute money for conservation 17.5. The main reasons for respondents' unwillingness to contribute money for the conservation of Washera sheep breeds are: (a) proper management is the responsibility of the government, (b) lack of money to pay (poverty), (c) complacency with the present situation.

Econometric Analysis

Factors affecting willingness to pay for Washera sheep breeds conservation

Age: For sheep of the Washera breed, the age of the sample respondent has a negative sign and was significant at the 10% level. The marginal effect results also show that reducing the respondent's age by one year will increase the likelihood of farmers' willingness to pay to keep the Washera sheep breed by 0.003, holding other factors constant. The conclusion of the present study is consistent with what would have been reported by Salomon, where age had a negative and significant impact on respondents' willingness to pay for its restoration. Similarly, willingness to pay was reported to be negatively affected by respondent age (Gebrelibanos and Endriss, 2012; Belay et al., 2020 and Berhan et al., 2021).

Distance to the main market: This variable is found to have the expected negative effect and is significant at the 1% level. The marginal effect size shows that in the ceteris paribus, the probability that those households are willing to pay for the conservation of the Washera sheep breed decreases by 0.023. The results are consistent with (Kebebew et al., 2021).

Land Size: The outcome of the model showed that total land ownership negatively influenced respondents' willingness to pay to conserve the Washera sheep breed with a significance level of 10%. The marginal effect of these variables shows that a 0.08 reduction in the household land area increases the likelihood of being willing to pay to conserve the Washera sheep breed, other factors held constant. This result is consistent with the results of and (Belay et al., 2020 and kebebew et al., 2021).

Livestock Size: It was found that keeping livestock in TLU positively influences respondents' willingness to pay with a significance level of 1%. The marginal effect of these variables indicates that for each additional TLU

increment, the probability of being willing to pay to conserve the Washera sheep breed increases by about 0.02, keeping other variables constant at their mean. This result is consistent with the studies by (Belay et al., 2020).

Extension Contact: This variable had a significant and positive effect on the treatment plant in the conserve of Washera sheep breeds, and it was significant at a level of significance of 5%. The value of the marginal effect shows that the probability of willingness to pay to conserve the Washer sheep for farmers who have contact with extension agents increases by 0.039, ceteris paribus the results a lined with result of (Belay et al., 2020).

Sex: As a dummy variable, the sex of the respondent has a negative sign, although this is not expected a priori. This shows that women's households are willing to pay more than men, which is statistically significant at the 5% level. The marginal effect indicates that the probability of male-headed households' willingness to pay to keep the Washera sheep decreased by 0.06, all else equal.

Educational level: The education level of the head of household is statistically significant, and the positive sign is expected to be at the 10% significant level. The coefficient of this variable has a positive sign, indicating that the level of the WTP's coefficient of education is consistent with established theory and evidence that education is positively associated with people's WTP protection, meaning that highly educated people can perceive more the need to conserve and manage resources well. The marginal effect of this variable shows that other things being equal; a one-step increase in household education increases the probability of being willing to pay for Washera sheep breed conservation by 0.029. This result is consistent with the findings of (Gebrelibanos and Edriss, 2012 and Tilahun and Zeleke, 2013).

Source of credit: As expected, this variable was found to have a positive effect, and was significant at the 1% significance level for preserving Washera sheep breeds. Marginal utility values show that farmers with access to credits are willing to pay 0.195 more for the protection of Washera sheep breeds, ceteris paribus.

Conclusion

The study's goal was to estimate the households' desire to pay for the conservation of the Washera sheep breed in the Zone west of Gojam using the contingent valuation method, where both descriptive methods and standard economics were used to analyze the data. In this study, the average desire to pay was calculated monthly to conserve the Washera sheep breed of open questions and double-dichotomous choice questions were computed. The result of the variable Bivariate Probit model revealed that the level of education of families, the size of livestock, extension contact, and the source of credit have a positive and significant impact on the desire of the maximum households to pay for the conservation of the Washera sheep breed. On the other hand, age, sex, land size, and household distance from the head of the household market have a negative impact on the household's maximum desire to pay for the conservation of Washera sheep breeds. Therefore, the average willingness to pay for open-ended questions is $3.75 per year. In the study, out of a total of 240 sample households, only 48 (20%) protested zero or invalid responses and 192 (80%) had valid responses. Based on this information, the total number of protest zeros is expected to equal 9,906 households, which were excluded from further analysis. On the other hand, the total number of valid responses is equal to 122,168 households. Based on this information, the total economic benefit of the double dichotomous choice model is equal to US$1,069,647.23 from Washera sheep.

Recommendations

Based on the survey results, it can be suggested that households are willing to participate in Washera sheep breed conservation through cash contributions. Therefore, community participation in every conservation decision and policy and strategy development should be ensured.

Acknowledgments

The authors would like to thank the Ethiopian Biodiversity Institute (EBI), the Animal Biodiversity Directorate for their financial and logistical support, and all respondents who actively participated in the study. In addition, government officials and civil servants at all levels who directly or indirectly participated in this research are highly appreciated, especially for their assistance during data collection.

References

Adane H, Girma A. 2008. Economic significance of sheep and goats. In: Yami, A., Merkel, R.C. (Eds), sheep and goat production handbook for Ethiopia. Ethiopia Sheep and Goat Productivity Improvement Program (ESGPIP), Pp: 1- 4. file:///C:/Users/Afe/Downloads/Documents/Chapter%201_%20EconSignificance%20of%20Sheep%20and%20Goats_0.pdf

Amha SS. 2008. Sheep and goat meat characteristics and quality. In: Alemu Yami and R.C.Merkel (Eds). Sheep and goat production handbook for Ethiopia. Ethiopian sheep and goats' productivity improvement program (ESGPIP), Addis Ababa Ethiopia. Pp 323-328.

Belay G, Ketema M, Hasen M. 2020. Households' willingness to pay for soil conservation on communal lands: application of the contingent valuation method in northeastern Ethiopia. Journal of Environmental Planning and Management, 63(12), 227-2245. https://doi.org/10.1080/09640568.2020.1717933.

Berhan A, Birhanu B, Misikire T, Afework K, Biniam G, Abraham A. 2016. Estimating Willingness to Pay for Labeobarbus Fish Species Conservation in Lake Tana, Ethiopia: A Contingent Valuation Study. *International Journal of Natural Resource Ecology and Management.* Vol. 1, (4), pp. 155-161. DOI: 10.11648/j.ijnrem.20160104.12

CSA. 2007. Livestock Sample Survey 2006-2007 (1997 Ethiopian Calendar) (AgLVS2006), Version 1.1. Addis Ababa, Ethiopia. https://catalog.ihsn.org/catalog/1072/variable/F5/V132?name=fa

CSA. 2016. Report on livestock and livestock characteristics (private peasant holdings). Central Statistical Agency (CSA): Addis Ababa, Ethiopia.

CSA. 2017. Federal Democratic Republic of Ethiopia Central Statistics Agency, Agricultural Sample Survey 2016/17 (2009 E.C.) Volume II Report on Livestock and Livestock Characteristics (Private Peasant Holdings) statistical bulletin 583 Addis Ababa, Ethiopia.

Etensa T. 2014. Economic Valuation of Conservational Benefits of Natural Wetland Ecosystem Values. LAP LAMBERT Academic Publishing. https://www.libreriauniversitaria.it/economic-valuation-conservational-benefits-etland/book/9783659586712

Gebrelibanos H, Edriss W. 2012. Valuation of Soil Conservation Practices in Adwa Woreda, Ethiopia, Journal of Economics and Sustainable Development, Vol.3, (13). file:///C:/Users/Afe/Downloads/Valuation_of_Soil_Conservation_Practices.pdf

Haab T, McConnell K. 2002. Valuing Environmental and Natural Resources. https://www.elgaronline.com/view/9781840647044.xml

Habtamu E, Wondie T, Aweke S, Tadesse Z, Zerihun M, Zewudie Z, Kello AB, Roberts CH, Emerson PM, Bailey RL, Mabey DC, Rajak SN, Callahan K, Weiss HA, Burton MJ. 2016. Posterior lamellar versus bilamellar tarsal rotation surgery for trachomatous trichiasis in Ethiopia: a randomized controlled trial. The Lancet Global health, 4 (3). http://researchonline.lshtm.ac.uk/2537674/ DOI: 10.1016/S2214-109X (15)00299-5

Hayes BJ, Bowman PJ, Chamberlain AJ, Goddard ME. 2009. Invited review: Genomic selection in dairy cattle: progress and challenges. Journal of Dairy Science 92: 433–43. DOI: 10.3168/jds.2008-1646

Kebebew H, Lemessa B, Tekele Sh, Berhan A, Tesfu F. 2021. Evaluating Household's Willingness to Pay for Catfish Species Conservation in Lake Hawassa, Sidama National Region State, Ethiopia. *International Journal Oceanography Aquaculture*, 5(1): 000204. DOI: 10.23880/ijoac-16000204

Mengistie T, Girma A, Solomon G, Sisay L, Abebe M, Markos T. 2010. Growth performances of Washera sheep under smallholder management systems in Yilmana Densa and Quarit districts, Ethiopia. Tropical Animal Health and Production 42(4): 659-667. DOI: 10.1007/s11250-009-9473-x.

Mesfine L, Mussie H, Getenet M. 2014. Evaluation of growth performance of local and Dorper× local crossbred sheep in eastern Amhara region, Ethiopia. Iranian Journal of Applied Animal Science 4(4): 787-794. file:///C:/Users/Afe/Downloads/1034220140414.pdf

Mushir A, Mulugeta N. 2012. Livestock Husbandry and Economic-Sustainability of Small Farmers in Peri-Urban Areas: A Case Study from West Gojjam Region, Ethiopia, Ethiopian Journal of Environmental Studies and Management EJESM Vol. 5 No. 2. DOI: 10.4314/ejesm.v5i2.13

Nigus HY. 2014. Households Willingness to Pay for Camel Milk in Aba'ala Woreda, Afar Regional State. Master Thesis, Mekelle University. https://opendocs.ids.ac.uk/opendocs/bitstream/handle/20.500.12413/4482/Households%20Willingness%20to%20Pay%20for%20Camel%20Milk%20in%20Aba'ala%20Woreda.pdf;jsessionid=C420C3F6B770788544734D3CCC5BFAF5?sequence=1

Senedu B, Gebreegziabher Solomon A, Yime Bjune GA. 2016. Tuberculosis Case Noti cation and treatment Outcomes in West Gojjam Zone, Northwest Ethiopia: A Five-Year Retrospective Study. Amhara Regional State Health Bureau, Bahir Dar, Ethiopia. Journal of Tuberculosis Research (4):23-33.

Solomon G, Azage T, Berhanu G, Dirk H. 2010. Sheep and goat production and marketing systems in Ethiopia: Characteristics and strategies for improvement. Improving Productivity and Market Success of Ethiopian Farmers Project Working Paper 23. International Livestock Research Institute, Nairobi, Kenya. Pp 58. https://hdl.handle.net/10568/2238

Solomon G, Komen H, Hanotte O, van Arendonk JAM. 2008. Indigenous sheep resources of Ethiopia: Types, production systems, and farmers' preferences. Animal Genetic Resources Information 43:25–40. DOI: https://doi.org/10.1017/S1014233900002704

Solomon G, Solomon A, Rischkowsky B, Haile A, Okeyo AM, Dessie T. 2013. Review of sheep research and development projects in Ethiopia. ILRI (aka ILCA and ILRAD). https://core.ac.uk/download/pdf/132647353.pdf.

Solomon G, Yani A, Kassahun A. 2011. A practical guide on village-based cooperative sheep breeding schemes. Ethiopian sheep and goat productivity improvement program (EGSPIP) Technical Bulletin No. 40. Addis Ababa: EGSPIP.

SPS- LMM. 2010. Ethiopia Sanitary and Phytosanitary Standards and Livestock, Meat Marketing Program. Focus on Ethiopia's meat and live animal export. Trade Bulletin 2, September 2010. file:///C:/Users/Afe/Downloads/Documents/PA00T597.pdf.

Tilahun G, Zeleke M. 2013. Diagnosis and intervention plans for West Gojjam Zone, Amhara Region. Livestock and Irrigation Value Chains for Ethiopian Smallholder. Central Statistics Authority of Ethiopia. Summary and Statistical Report of the 2007 Population and Housing Census, Central Statistic Authority of Ethiopia, Addis Ababa, Ethiopia.

Yamane T. 1967. Statistics: An Introductory Analysis, 2nd Ed., New York: Harper and Row.https://www.amazon.com/ Statistics-Introductory-Analysis-Taro Yamane/dp/B0000CNPXC