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Smallholder Farmer's Willingness to Pay for Improved Soil and Water Conservation Practice: A Contingent Valuation Study in Abaro- Toga Watershed Ethiopia

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Abstract

This paper estimates the mean willingness to pay of smallholder farmers for improved soil and water conservation practices using a contingent valuation method with a Double Bounded Dichotomous Choice technique followed by open-ended questions were applied. Seemingly unrelated Bivariate probit and Probit regression models were applied to determine the mean and factors affecting willingness to pay for soil and water conservation practice, respectively. Data were collected from 150 randomly selected smallholder farm households through a structured questionnaire and focus group discussions using face-to-face interviews. The study shows that the majority of the sample households has been affected by erosion problems because of deforestation, high intensity of rainfall, the slope of the land and the watershed shares common catchment with Abro Mountain. The econometric result shows that the mean and total willingness to pay from double bound elicitation method was computed 36.08 Birr/year and 1,336,873 Birr/year (1 US$=20.8 Birr) for five years respectively, while the mean and total willingness to pay from open ended elicitation method was computed at 26.39 Birr/year and 974,097.08 Birr per year. The mean annual willingness to pay for soil and water conservation from double bound elicitation method was greater than from open ended elicitation method. Hence, policy makers should target double bounded elicitation method than open ended elicitation method to eliciting the willingness to pay for soil and water conservation activity. This study empirically proved that households' age, household size, education, income, total livestock unit, slop of land, perception and initial bids, are the key determinants of soil and water conservation activities.

Keywords

Contingent Valuation Method, Willingness to Pay, Soil and Water Conservation, Double Bounded, Dichotomous Choice

1. Introduction

The economic development of Ethiopia is highly dependent on the performance of its agricultural sector. Agriculture contributes 53% of the country's Gross Domestic Product (GDP), 85% of all exports (coffee, livestock and livestock product and oil seeds) and provides employment for 85% of the population [26]. Agriculture provides raw material for 70% of industries in the country [41]. In spite of its remarkable potential, the performance of Ethiopian agriculture has been sluggish in the last decades. However the population grows at an average rate of 2.52% per annum [55; 26]. That means, food production lagged far behind population growth leading to food shortage and thereby resulted in national poverty of 44.2% of the population [26]. The dominant economic activity is undertaken by smallholder farm household which are subsistent oriented. Low agricultural productivity due to land degradation mainly accelerated soil erosion is a critical problem throughout

Africa [25].

Several studies in Ethiopia have revealed that soil erosion has become an alarming problem [53; 3; 19; 32; 38] and it is the major factor affecting the sustainability of agricultural production. The loss of soil and essential nutrients due to unsustainable agricultural practices is costing $139 million or 3-4% of its agricultural GDP [16]. Similarly, [36] estimated, soil loss due to water erosion is about 1493 million Mg per annum. On croplands, average soil loss rates reach 42 t/ha/year or 4 mm of soil depth per annum in the country as a whole. In individual fields however, the rate may reach up to 300 t/ha/year, which is by all measures exceeds the rate of soil formation.

Although estimates of the extent and rate of soil erosion lack consistency, the results of various studies highlight the severity of the problem [7]. However, policy makers largely neglected land conservation until 1970s [45], and the problem attracted policy attention only after the devastating famine problem in 1973/1974 [44]. Since then, several SWC and land reclamation projects were initiated with the support of donor agencies and efforts have been put in place in order to rehabilitate degraded areas. For these purpose various SWC measures were introduced [24; 6]. The SWC works include planting trees on hillsides and catchments areas, water harvesting in drier areas, stream development, construction of earth dams, pond, gully plugging, traces, diversion of drains, and check dam [10].

According to [54], among the various forms of land degradation, soil erosion is the most important and an ominous threat to the food security and development prospects of Ethiopia and many other developing countries. In the study area Abaro Toga watershed is faced by intensive soil erosion problem because, it shares a common catchment with Abro Mountain that runs a long distance. Due to such distant setting flow of water it exhibits high runoff velocity that results in damaging fertile top soil resources. As perceived by local people year to year the productivity of crop production is decline. Hence, to grapple with the problem of soil erosion massive reforestation and soil and water conservation practices were launched since the 1970 and 1980s by mobilizing farmers in the country as well as in the study area [20; 38].

However, reports indicate that these conservation structures have not been as successful as they could be, because the farmers were not enthusiastic enough in accepting widely and maintaining the soil and water conservation practices [17; 56]. [15] the failure of conservation practices partly emerge from the fact that planners and implementing agencies ignore or fail to consider socio-cultural factors as key determinants of the success or failure of conservation programs.

2. Objectives of the Study

The general objective of the study was to estimate Smallholder farmers' willingness to pay (WTP) participation on soil and water conservation (SWC) practices and to find the major factors influencing farmer's WTP in the case of Abaro Toga watershed, Ethiopia.

The specific objectives of this study are:

- To elicit and determining households' willingness to pay for soil and water practice using Contingent Valuation **(**CVM)
- To identify factors that determine farmers' willingness to participate in soil and water conservation practice;

3. Materials and Methods

3.1. Description of the Study Area

Abaro Toga watershed is located at Shashemene district, West Arsi Zone, Oromia Regional State, Ethiopia. This watershed is situated at 259 km from capital city of Ethiopia to the south direction of Shashemene town. The watershed is bordered by Kofele district from the east, by Wondo district from the south direction, by Shashemene town from the north and by Bulchana Danaba peasant association from the west direction. According to Woreda agricultural office the total land area of the watershed is 7,126 km^2. The watershed comprise of six peasant association kebeles[1] such as Abaro, Ebicha, Idola Burka, AlacheHarabate, Waransa and Toga.

3.2. Sample Size and Data Collection Methods

A two-stage simple technique was used when selecting respondents. In the first stage four kebeles (Abaro, Ebicha, Woransa and Toga) were purposively selected out of the six kebeles. Abaro and Ebicha were upper catchment highland area where soil erosion begins whereas, Woransa and Toga from lower catchment which is perceived by intensive soil erosion problem. These numbers of kebeles were considered to be sufficiently large for drawing valid statistical inferences and were also manageable to be surveyed with the available resources of finance and time. In the second stage, total of 156 households were selected using random sampling techniques. Both secondary and primary data were used for this study. The primary data were collected from sample respondents through a structured questionnaire via face to face interview with the heads or working members of households. CVM method in the form of double-bounded dichotomous choice elicitation method with open ended follow up question was also employed to elicit households' WTP for soil and water conservation practice. The double-bounded dichotomous choice format (yes-no, no-yes responses) makes clear bounds on unobservable true WTP. Besides, the yes-yes, no-no response sharpens the true WTP [31]. Finally, the double-bounded dichotomous choice format help to elicited more information about respondent's WTP than single bounded format [33; 9].

3.3. Preliminary Survey and Bids

Before the final survey was conducted a pre-test was done

1Kebele is the lowest administrative unit and equivalent to Peasant association in rural areas

using 45 randomly selected households. Then based on the pilot results the starting point prices identified for WTP in Birr were 40, 68 and 120 Birr per year. Therefore, the total sampled households were divided randomly into three equal groups (about 52 households). The field survey was successfully completed with relatively small number of protest zeros (about 3.2%). These protesters provided wrong value and after checked for sample selection bias they excluded from the data set. The criteria for selecting protest zero was based on the report of the NOAA Panel on contingent valuation by [9]. [9] suggested that a respondent actually willing to pay the stated amount might answer in the negative, if the respondent believes the proposed scenarios distributed the burden unfairly, doubt on the feasibility of the proposed action and refusal to accept the hypothetical choice problem.

3.4. Analytical Methods

The qualitative and quantitative data obtained through data collected were analyzed using descriptive statistics and Econometric model. Descriptive statistics such as mean, standard deviation and percentage were used along with the econometric model to analyze the collected data. In this study we used the probit and bivariate probit models. The probit model is used to identify factors affecting the WTP of households for soil and water conservation practice. The model takes the following form [21].

$$Y_i = X_i\beta + \varepsilon_i \quad (1)$$

I=1 if $y_i \geq t_i$ I=0 if $y_i \leq t_i$

where: Let y_i = i^{th} respondents true unobserved point valuation for the environmental resource in question.

β = a coefficient for X

t_i = the offered threshold, assigned arbitrarily to the i^{th} respondent

I = discrete response of a respondent for the WTP question (1=yes, 0= no)

ε_i= unobservable random component distributed N(0, σ)

X_i = observable attributes of the respondent

The probit model is applicable to CV studies with one dichotomous-choice question but by introducing a follow-up dichotomous-choice question, the statistical efficiency improves by the application of a bivariate probit model [21]. For estimation of WTP, the BivarateProbit Model is used i.e. double bound Dichotomous choice model takes the following form [31].

The j^{th} contribution to the Likelihood function is given as

$$L\ (\mu / t)=\Pr(\mu+\varepsilon \geq t, \mu+\varepsilon < t) * \Pr(\mu+\varepsilon > t, \mu+\varepsilon \geq t)^{YY*} \Pr(\mu+\varepsilon < t, \mu+\varepsilon < t) * \Pr(\mu+\varepsilon < t, \mu+\varepsilon \geq t)^{NY} \quad (2)$$

This formulation is referred to as the bivariate discrete choice model

Where μ = mean value for willingness to pay

YY = 1 for a yes-yes answer, 0 otherwise, NY =1 for a no-yes answer, 0 otherwise, etc.

And the j^{th} contribution to the bivariate probit Likelihood function becomes.

$$L\ (j_\mu / t) = \Phi_1\ (d\ ((t-\mu)/\sigma), d\ ((t-\mu)/\sigma), d\ d\ \rho). \quad (3)$$

Where

$\Phi_{1\varepsilon}$ ε2 =Standardized bivariate normal distribution function with zero means

Y_{1j}=1 if the response to the first question is yes, and 0 otherwise

Y_{2j}=1 if the response to the second question is yes, 0 otherwise

$d_{1j} = 2y_{1j}^{-1}$, and $d_{2j}= 2y_{2j}^{-1}$

ρ = correlation coefficient

σ = standard deviation of the errors

This general model is estimated using the standard bivarate probit algorithms. Finally, the mean willingness to pay (MWTP) from bivariate probit model were calculated using the formula specified by [31].

$$MWTP(\mu) = -\frac{\alpha}{\beta} \quad (4)$$

Where α = coefficient for the constant term

ß= coefficient offered bids to the respondent

But, before the probit model (Equation 1) was applied to analysis the effect of explanatory variables on WTP, variance inflation factor (VIF) was applied to test the collinearity between continuous explanatory variables. It was computed as: $VIF(Xi) = \frac{1}{1 - Ri^2}$; Where R^2 is the coefficient ofdetermination in the regression of one explanatory variable (X) on the other explanatory variables (Xj). If there is no collinearity between regressors, the value VIF is 1. A VIF value of a variable exceeds 10, which happened when R2i exceeds 0.90, and that variable is said to be highly collinear [30]. Contingency coefficients also estimated to see the degree of association between the dummy explanatory variables. A value of 0.75 or more indicates a stronger relationship between the variables [35]. The contingency coefficients(C) were computed as: $CC = \sqrt{\frac{x^2}{N + x^2}}$ Where C= coefficient of contingency, Φ^2= Chi-square test and N= total sample size. The pseudo-R square and the chi-square were used to measure the goodness of fit of the model and the significance of the model used.

4. Results and Discussion

4.1. Descriptive Statistics

4.1.1. Households Characteristics

Sex: The majority of the respondents 124 (82.7%) were male. Since males have decision making power in the family, the proportion of male was slightly higher. The share of male in the willing respondents is higher 64.5% than the share of female 35.48% from the non-willing respondents. The reason may be

males have decision-making power, more educated, more aware and involvement in environmental activity like SWC practice than female. In addition to this, SWC activities were more labor intensive which are difficult to be performed by female, except material transportation that used for construction of soil and water conservation structures.This finding is analogous with [43] study in Nairobi city, Kenya and [34]. The chi-square statistics test revealed that there is significant association between sex and WTP decisions for SWC practice (P≤ 1). The marital status figure reveals that 96 (76.6%) of the respondents were married. Share of willing to pay of married respondents 63.4% was higher. The proportion of willing and non-willing respondents did vary significantly with marital status. The access of credit figure reveals that 52.66% of the respondents were access to credit. Share of credit user in the willing respondents is higher 64.66% than the non-willing. The proportion of willing and non-willing respondents did not vary significantly with credit user respondents.

Table 1. *Descriptive statistics of some socio-economic characteristics for willing and non-willing to pay respondents.*

Variables	Willing (N=97)	Non willing (N=53)	Total (N=150)	X^2
Sex	80	44	124	1.00
	17	9	26	
Marital status	27	11	38	0.433
	70	42	112	
Credit access	54	25	79	0.393
	43	28	71	

Note: Variables in which willing respondents have significant differences from non-willing respondents: *** = at 0.01 levels of significance.

Age: The data on age revealed a wide range of responses starting from 22 to 84 years where the average was found to be 43 years. The mean age of non-willing respondents is higher than mean age of willing respondents, but it is not statistically significant.

Education: The education figures reveal that about 57.3% were found literates/ have attended formal education. With the consideration of all respondents, average years of schooling is estimated at apparently 6 years, to range from a minimum of 0 years of schooling to a maximum of 15 (12+3) years of schooling. The estimated average years of education of the willing respondents is higher than the non-willing respondents and estimated to 7 years of education and 4 years of education/schooling respectively. The respective independent t-test result showed that, the difference in mean years of education between the willing respondents and the non-willing ones is statistically significant at p<0.01 (Table 2). This might be because as years of education increases respondents will become more concerned of environmental degradation and aware of the benefits of SWC practice. In addition, more educational attainment has a positive impact on ability to pay which in turn increases their probability of willing to pay.

Income: The surveyed households on the average earn was Birr 28,886 annually income. The main sources of income are crop production, livestock selling, laboring and off farm activities. The income level ranges from a minimum of Birr 11,050 to a maximum of Birr 41000 per year. Taking the average family size of 11, the average per capita income was Birr 2,626 per year. Willing households earn Birr 29,792.78 mean income per year which is significantly higher (p<0.01) than Birr 27,227.55 mean yearly income of the non-willing households. This shows that as annually income of the household increases their probability of willingness to pay also increases. This might because higher income earners are more flexible to invest for a good/service which secures them a higher level of utility.

Table 2. *Descriptive statistics of some socio-economic characteristics for total willing and non-willing to pay respondents (Mean, Std. Dev, and t-value).*

Variables	WTP	Min	Mean	Max	Std. Dev.	μ diff	t-
Age	WTP	22	42.13	82	14.6		
	NWTP	22	44.43	84	17.13	2.29	.864
Total		22	42.95	84	15.56		
Income	WTP	17000	29793	41000	6178		
	NWTP	11050	27228	41000	8412	-2565	-2.13
Total		11050	28886	41000	7128		
livestock	WTP	2	4.18	9	1.27		
	NWTP	1	4.30	9	1.58	.126	.532
Total		1	4.22	9	1.39		
HH size	WTP	2	11.28	9	8.43		
	NWTP	4	10.19	38	5.66	-1.08	-.842
Total		9	10.89	38	7.57		
Distance to farm area	WTP	0	370.46	2750	518.3		
	NWTP	0	450.9	2500	5378	80.4	.897
Total		0	398.9	2750	524.9		
Land Size	WTP	1	2.06	6	1.36		
	NWTP	0.5	1.83	6	1.15	-0.22	-1.01
Total		1	1.98	6	1.292		
Education	WTP	0	7.422	15.00	4.53		
	NWTP	0	4.641	10	4.14	-2.66	-3.49
Total		0	6.48	15	4.63		

Note:

- Variables in which willing respondents have significant differences from non-willing respondents: *** = at 0.01 level of significance
- mean diff = mean (non wiling)-mean (willing), H0: mean diff=0 and HA: mean diff >< = 0

Livestock unit: The average livestock number of sampled respondent was 4 with a minimum of 1 livestock and a maximum of 9. In Ethiopia, livestock are important source of cash income, food, household energy and manure. hence the chi-square statics reveled that there is significant association between number willing and non willing respondents. Households with higher total live stock unit are more willing to pay and prefer to have improved availability of soil and water conservation practice.

Household Size: The average household size of sampled respondents was 11 with a minimum of 1 household member and a maximum of 38 household members. The average family size was is higher but closer to the rural average of 10.9 persons per household of [22] report of population statistics. The average household size was about 11.28 and 10.19 for willing and non-willing households, respectively. The mean difference is significantly varied between households in the two groups.

Distance to the farm area and land Size: Table 2 shows summary of distance from home and land of the sampled households. Data with regard to distance showed that the households' farm is located from very near (0 m) to 2750 m with an average of 398.9 m away from the home. Distance is also an important factor of access. Soils and water can be managed more easily when farmland is located at close proximity to the household. However, the chi- square taste indicates that there is no significant association betweendistance to the farm area of willing and non willing respondents. The total size of the total land holdings of the sampled households was also estimated at 1.98 ha. That is, the land holdings of the households' ranges from 0.5 ha to 6 ha with average cultivated farm size per household of 1.98 ha.

Specifically, about 69.3% of the surveyed household controlled less than 0.5 ha of farm land. About 30.7% of the sampled respondents owned a farm size from 1.98 ha to 6 ha. The independent t-test square statics revealed that there is significant association between willing and non willing respondents. This indicates that households with higher land often rich and have access to more resources, and they are more willing to pay than households with small land size. This indicated that the average farm size of the study area is similar than the national average of ≤ 1ha [27] (FDRE, 2010). In addition the physical soil and water conservation structures occupy much land surfaces in fragmented and small plots which cause reduction of production and productivity of the cultivable land that could not be compensated by the benefits of conservation [53; 23]. The survey result indicated that area of land had significant influence on the use of improved physical SWC practices.

4.1.2. Farmers' Awareness About the Causes and Indicators of Soil Erosion Problems

To corroborate the presence of soil erosion in the study area sampled households were asked the indicator of soil erosion problem on their own farm plots, 75.3% of farmers reported that the presence of gullies and rills as a major indicator on their cultivated plot and communal grazing land. The rest, 17.3% and 7.4%, of farmers also reported that the decline of agricultural productivity of their farm plots and the change of soil color were the indicators of soil erosion, respectively. This observation of the farmers is most closely associated with the scientific finding of most researchers.

According to the survey result, soil erosion was severe on farm plots and communal grazing lands at rainy or summer season. This shows that the major causes of soil erosion in the study area is water erosion. Hence, this is a call for community awareness about the problem and causes of soil erosion as well as its consequences will help to motivate farmers to use soil conservation practices.

4.1.3. Soil Conservation Practice Implemented by Farmers in the Study Area

According to the finding of the survey, most of household farmers agreed that soil and water conservation practices are important to minimize the rate of soil erosion on farm plots and communal lands. This indicates that households had good perception and participation towards the importance of soil and water conservation methods on farm plots and communal lands. All sampled farmers stated that they use both traditional and introduced soil and water conservation methods on their own farm plots to prevent soil erosion and enhance soil fertility.

According to the survey results there are various soil and water conservation practices applied by farmers on their own farm plots and communal lands erosion control methods used in the study area include, plantation of trees (especially *kulkual*), contour plowing, check dams, soil and stone bunds, diversion ditches (cut of drain) locally called *"feses"*, crop rotation and terracing, application of manure. Terracing, soil and stand protection, Tree planting are the three top practices appreciated by the respondents, on the other hand, the check dam, intercropping and diversion of ditches are also less appreciated SWC methods (fig 1).

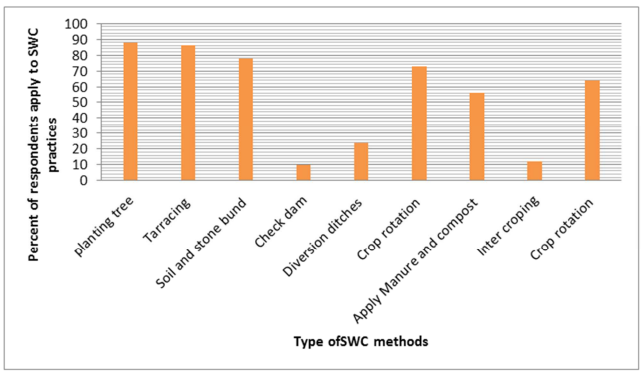

Figure 1. *Farmers' response regard to the major soil conservation methods they implemented.*

4.2. Households WTP for SWC Practices

Using double bounded dichotomous choice format the mean WTP from responses of both the first and the second bids were estimated. The analysis was conducted using seemingly unrelated bivariate probit model. The result revealed that the correlation coefficient of the error term is less than one implying that the random component of WTP for the first question is not perfect correlation with the random component from the follow-up question.

Table 3. *Parameter estimates of bivariate probit model.*

Variable	Coeff	Std. Err	Z
Initial bid	-0.0326	0.00612	- 6.61
Constant	1.2001	0.18267	2.80
Second bid	-0.0105	0.00482	- 6.77
Constant	0.4122	0.24078	4.57
/athrho	0.20745	0.21222	0.98
Rho	0.20453	0.20334	

Prob> chi2 = 0.0000Wald chi2(2) = 77.17 Log likelihood =92.6309
Likelihood-ratio test of rho=0: chi2(1) = .959754 Prob> chi2 = 0.3272

The annual mean WTP (equation 4)was computed at 38.03 Birr per year per household for five years.At 95% confidence interval the WTP for SWC practicebetween 36.81 to 39.25Birr per year perhouseholds for five years (See Table 3). The mean WTP of the respondents from open ended elicitation methodalso computed at 26.39 Birr per household per year for five years with the minimum 0 and maximum 120 Birr.The result shows that the mean WTP from open ended response was less than the mean WTP from the doublebound format. This may indicate the respondents' wants or free service from the government or free riding in theopen ended questions. This result is consistent with the findings of [37; 11; 5]. The willing respondents were also asked to point out their reasons for maximum WTP in Birr. The respondents provided different reason for their maximum WTP. About 42.26% of the respondents reported that they could not afford more than what they stated because of inadequate income. While, the rest 57.73% reported that the amount they decided to pay was satisfactory (See Table 4).

Table 4. *Reason for their maximum WTP in Birr.*

Reason	Frequency	%
Inadequate income to provided more	41	42.26
It is adequate	56	57.73
Total	97	100

However, about 59 (37.8%) of the sample respondents' were not willing to pay for SWC practice. Specifically, of the 37.8% unwilling sampled respondents about 8.471% of the households were categorized as genuine zero bidders. Whereas, about 91.52% of the respondents stated protest zero1[2] (See Table 5).

2The criteria for selecting protest zero was based on the discussion on NOAA panel guide on Arrow *et al* (1993)

Table 5. *Reason for not Willing to Pay.*

Respondents reasons for zero bid	Frequency	%
We do not believe that the money we pay will actually be used for the proposed change	16	27.11
We believed that the proposed project is unnecessary	38	64.40
Total protest answers	54	91.52
Lack of money	5	8.471
Total non-protest answers	59	100

4.3. Households' WTP for Soil and Water Conservation Practice

Before running the econometric model, the independent variables were tested for the presence of multicollinearity (table 6). The result showed that there were no multicollinearity problems between the variables. The value for Contingency Coefficient(CC^3) for the dummy variables were less than 0.75 and the value of Variance Inflation Factor (VIF^4) for the continuous variables were less than 10; which are obviously the indicators for the absence of multicollinearity.

The chi-square ($\chi 2$) distribution is used as the measure of overall significance of a model in probit model estimation. The result of the probit model shows that, the probability of the chi-square distributions was 45.678 with 15 degree of freedom less than the tabulated counter factual is 0.0000, which is less than 1%. So, this shows that, the variables included explaining willingness to pay fits the probit model at less than 1% probability level. The estimated result on factors affecting the households' WTP for SWC practice is presented in Table 7 and it shows both the significant and insignificant variables. However, only the significant variables are discussed.

Age of the household head (AGE): Age of the household head had negative and significant effect on households WTP at less than 1% level of significant. This may be older age may shorten planning time horizon and reduce the WTP. On the other hand, young farmers may have a longer planning horizon and, hence, may be more likely to be willing for conservation. Besides, an older aged household heads are more likely to have a money shortage and reduce willingness to pay for SWC practices. That is holding other things constant, a one year increase in household head age leads to decrease the probability of accepting the first bid by 1.41%. The negative relationship between WTP and age is inconsistent with the finding of [39; 11; 48; 5; 46].

Family size of the household (FSIZE): The total family size of households, is negative and significant at 1% level of significant. The estimated marginal effect showed that all other factors kept constant, as the family size increase by

3 $VIF = \frac{1}{1 + R_i^2}$ Where, Ri 2 is the coefficient of determination in the regression of one explanatory variable (X) on the other explanatory variables (Xj).

4 $CC = \sqrt{\frac{X^2}{N + X^2}}$ where, CC= coefficient of contingency, $\chi 2$= Chi-square test and N= total sample size

one, the probability of accepting the first bid is decreased by 5.73%. This result is consistent with the findings of [11; 5]. In contrary with these finding of [28].

Table 6. *Contingency coefficient and Variance inflating factor of variables used in regression.*

Contingency coefficients for dummy explanatory variables								
	sex		**Marital status**	**credit**	**Land use**	**fertility**	**slop**	**Perception**
Sex	1.000							
Marital status	0.421		1.000					
credit	0.059		-0.245	1.000				
Land use type	0.331		0.2327	0.109	1.0000			
fertility	0.113		-0.0761	0.561	0.1372	1.0000		
slop	-0.113		0.1086	0.027	-0.0753	0.2148	1.00	
Perception	0.0481		0.1346	0.072	0.3185	0.1445	0.00	1.0000
Variance Inflating Factor for Continues variable								
Variables	Age	Income	Education	HHsize	Livestock unit	Farm size	Distance	Bid
VIF	1.37	1.51	1.55	1.31	1.60	2.49	3.44	3.2

Table 7. *The probit model estimation results of households' WTP.*

WTP	**Coef.**	**Std.error**	**Z**	**P/z/**	**Dy/dx**
Age	-0.703	0.598	-1.67	0.002	-.014146
HH_hsize	-0.33	0.586	-0.43	0.005	-.0573104
Educ.	3.288	1.670	3.12	0.597	.0319589
Marital st.*	0.384	0.637	0.79	0.215	.1024763
Income	0.000	0.000	2.34	0.008	.0193
Sex*	3.463	1.447	0.43	0.597	.0573104
Farm size	-1.063	1.330	0.28	0.418	-.00493
Distance	-1.865	0.631	-0.95	0.103	-.0000839
Fertility*	-0.017	0.048	-0.06	0.724	-.0091789
Slop*	2.651	0.631	3.13	0.003	.3793325
Land use type*	2.298	0.651	0.07	0.647	.0094057
Credit*	1.30	0.644	1.21	0.021	.0697178
Livestock	1.145	0.177	1.65	0.041	.0102943
Percep*	1.069	0.039	0.12	0.009	.0129797
BID	-0.986	0.289	-1.36	0.001	.01839
constant	0.063	1.512	0.677	0.583	

No. of observation= 150, -2 Log likelihood=-84.03, prob>chi=0.03, R Square= 0.137,LR chi2 (15)=26.78; (*) dy/dx is for discrete change of dummy variable from 0 to 1

Education level:The education level of the respondents is positively and significantly related to WTP. That is, respondents with more years of schooling are WTP for SWC practice. This might be due to the fact that educated household heads perceive and are willing to pay more than less educated households. The result also revealed that holding other things constant, a unit increase in years of schooling of the respondent increases the probability of accepting the first bid by about 31.95%. This clearly calls the importance of human capital development for implementation of soil conservation practices. This is consistent with the findings of [29; 48; 50; 37; 49; 11; 42]. In contrary with these finding of [8].

Annual income: Annual income of the respondent is positive and significant relationship with the households' WTP.One possible reason could be that literate individuals are more concerned about soil and water conservation than illiterate ones.Keeping the influence of other factors constant, when annual income of a household increases by one Birr, households' willingness to pay for soil conservation increases by 1.93%. A study by [4; 29; 50; 47; 52; 37] recognizes significant association between households income and willingness to pay.

Slop of farm landof the respondents had positive effect on households' WTP for SWC practice 5% level of significant. The implication is that the farmer who has a land with steep slope is more likely to understand soil erosion problem and apply conservation structures than the farmer who has flat sloped land. That is, keeping other things constant, changing the dummy from 0 to 1 will increase probability of accepting the initial bid by about 34%. This is consistent with [12; 53; 18].

Total Livestock Unit (TLU) has been found to relate to the probability of WTP for SWC practices positively and significantly at 5%. TLU could be a proxy for wealth under Ethiopian farmers condition. When the wealth of a household increases, the WTP will also increase. the marginal effect analysis shows that keeping other things constant a one unit increase in the livestock the probability of accepting the first bid increases by10.29%. This is consistent with the findings of [28].

Perception of farmers' about the existence of soil erosion problem has been positive and significant at less than 5% probability level. Holding other things constant, changing the dummy from 0 to 1 will increasethe probability of a households WTP for SWC practice by 1.29% for perceived farmers than the other counter factual respectively. The implication is that a farmer who feels that his/her farmlands are prone to soil erosion is more likely to continuously use SWC measures than those who do not perceive the problem of soil erosion. This is consistent with the result of [1].

The initial bid offered (BID1) has a negative and significant effect on the WTP for SWC practices at less than 1% level of significance. The marginal analysis indicated that as the starting bid price increases by one unit, the probability of household's WTP for SWC by 0.01839.

4.4. Mean WTP and Estimation of Consumer Surplus of Soil Conservation Practices

According to [40] there are four important issues to be considered regarding sample design and execution in order to have a valid aggregation of benefits: population choice bias, sampling frame bias, sample none response bias and sample selection bias. Random sampling method was used in this study using a list of household. Protest zero responses were not excluded from the analysis and a face to face interview method is used. Hence, none of the above biases was expected in the analysis.

If the probit model is estimated on a dichotomous choice CV question with a follow up and the parameter shows that either the mean, or variance or both differ between the initial bid price and the follow up, the researcher must decide which estimates to use to calculate the WTP measure [31]. Hence, in order to choose the appropriate WTP among the two probit estimates, we looked into the data and the total amount for the YY and NN responses accounted for about 74.6% of the total responses. This means that the 2nd bid amount was closer to the unobserved true value of the individual. For example, let the first random bid for the individual be 40 Birr per year and let the respondent accept the first bid. Then the 2nd bid becomes 68Birr per year, again, let the respondent accept the second bid. This means that the respondents' true WTP is greater than or equal to 68Birr per year so, the 2nd bid will be a better estimate than the 1st one. The same is true for NN answer. Even for the rest 25.34% of the NY and YN responses, both the first and the second bid amounts will have equal chances to be closer estimates of the true value. Hence, using the second estimate of the double boundedbivarateprobit model result the mean willingness to pay for SWC is 36.81Birr per year.

As it is indicated in Table 8, the aggregate WTP was calculated by multiplying the mean WTP by the total number of households who are expected to have a valid response in the study area. Following this, in this study the aggregate WTP for soil and water conservation practices was computed at 1,336,873Birr per.

Table 8. *Householdes aggregate willingness to pay.*

Total HHs Y	Expected HHs to have a protest zero (A^5)	Expected HHs' with Valid Responses (B^6)	Mean WTP (C^7)	Aggregate Benefit (D^8)
38,277	1,224.864	37,052	36.081	1,336,873

5 6(3.2 %) of our 156 sampled households were protest zeros. We excluded those protest zeros from further analysis after we have tested for sample selection bias. So A is the expected number of households which are expected to protest for the proposed project. It is calculated by multiplying the percentage of sampled protest zeros (3.2 %) with the total population 38277 (A).

6 Is Y-A which is the total households in the study area which are expected to have a valid response

7 The mean WTP calculated from the maximum amount of Birr that a household could pay for SWC

8 Is mean multiplied by the number of total households which are expected to have valid response (B*Mean WTP)

5. Conclusions and Recommendations

The paper has estimated the total WTP for SWC practices and assessed the determinants of WTP practices in Abaro - Toga watershed, Ethiopia. The value elicitation method used is a double bounded dichotomous choice with an open ended follow-up question, which is closer to the market scenario respondents are familiar with in Ethiopia. Evidence from the study support that, age, household size, education, income, slop of farm land, perception of soil erosion, total livestock units, are significant factors that explain households' WTP. The mean WTP is found to be 36.08Birr per year with an aggregate benefit of 1,336,873Birr per year. Therefore, actions to be made towards these socio-economic aspects that significantly influenced households WTP is a first step conserving soil and water to sustain SWC practice to enhance Agricultural production. Policy thrust should focus on enhancing land tenure security through land certification among others.

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References

[1] AberaBirhanu (2003). Factors influencing the adoption of soil conservation practices in north-western Ethiopia. M.Sc. Thesis, Institute of Rural development, University of Göttingen, Germany.

[2] Adepoju and Omonona (2009). Determinants Of Willingness to Pay for Improved Water Supply in Osogbo Metropolis, Osun State, Nigeria". *Research Journal of Social Sciences*, 4: 1-6.

[3] Admasu Amare (2005). Study of sediment yield from the Watershed of Angereb reservoir. M. Scthesis, Department of Agricultural Engineering, Alemaya University, Ethiopia. 98 p.

[4] Adugnaw Birhanu and Desalew Meseret, (2013). Structural Soil and Water Conservation Practices in Farta District, North Western Ethiopia: An Investigation on Factors Influencing Continued Use. Journal of Science, Technology and Arts Research 2(4): 114-121.

[5] AlemMezgebu, ZbeneAsfaw, workuTessema, (2013). Economic value of irrigation water in Wondo Genet District, Ethiopia: An Application of Contingent valuation method.*Journal of Economics and Sustainable Development 4(2): 23-36.*

[6] Amsalu, A. (2006). *Caring for the Land Best Practices in Soil and Water conservation in Beressa Watershed, Highland of Ethiopia*. Tropical Resource Management Paper No.76: Wageningen University.

[7] Amsalu, A., De Graaff, J. (2007). Determinants of adoption and continued use of stone terraces for soil and water conservation in an Ethiopian highland watershed. *Ecological Economics*, 61, 294–302.

[8] Angella, N., Dick, S., Fred, B. (2014) "Willingness to pay for irrigation water and its determinants among rice farmers at Doho Rice Irrigation Scheme (DRIS) in Uganda. Journal of Development and Agricultural Economics, Vol 6(8) pp 345-355.

[9] Arrow, K., R., Solow, P.R., Portney, E. E., Leamer, R., Radner, H., Schuman (1993). Report of the NOAA Panel on Contingent Valuation. Federal Register. V. 58: 4601- 4614.

[10] Asrat P, Kassa, B. and Hamito, D. (2004). Determinants of farmers' willing to pay for soil conservation practices in the southern highlands of Ethiopia: Land degradation and development, 15, 423-438.

[11] BamlakuAyenew, YemiruTesfaye, Abrham Belay (2015). Economic Value of Wondo Genet Catchment Forest in Domestic Water Supply Services, Southern Ethiopia.*Journal of Economics and Sustainable Development* ISSN 2222-1700 (Paper) ISSN 2222-2855.

[12] Bekele Shiferaw (1998). Peasant Agriculture and Sustainable land use in Ethiopia. Economic Analysis of Constraints and Incentives for Soil Conservation. Agricultural University of Norway. Dissertation no: 1998:1.

[13] Bekele Shiferaw and Holden, S.T. (1998). Resource degradation and adoption of land conservation technologies in the Ethiopian Highlands: A case study in AnditTid, North Shewa. *Agricultural Economics* 18(3): 233-47.

[14] Bekele, W., Drake, L. (2003). Soil and water conservation decision behavior of subsistence farmer s in the Eastern Highlands of Ethiopia: a case study of the Hunde-Lafto area. Econ. 46(3), 437–451.

[15] Belay, T., 1992. Farmers' perception of erosion hazards and attitude towards soil conservation in Gununo, Welayita. Ethiopia Journal of Development Research, 14(2), 32 P.

[16] Berry, L. (2009). *Land Degradation in Ethiopia: Its Extent and Impact*. Global Mechanism and World Bank.

[17] Betru, N. (2002). Soil and Water conservation program in Amhara National Regional State. Paper presented at a Conference on Natural Resources Degradation and Environmental Protection in the Amhara National Regional State held from July 24-26, 2002, Bahir Dar, Ethiopia.

[18] Bett, C., 2004. Farm Adoption Decisions of Soil and Water Management Techniques in Semi-Arid Eastern Kenya. A Paper Presented at the 48th Annual Conference of the Australian Agricultural and resource Economics Society. Melbourne, 11th-13th February, 2004, Australia, pp: 45-52.

[19] Bewket W, Teferi E (2009). Assessment of soil erosion hazard and prioritization for treatment at the watershed level: case study in the Chemoga watershed, Blue Nile basin, Ethiopia. Land Degrad Dev 20: 609–622.

[20] Bewket, W., (2007). soil and water conservation intervantion with conventional technologies in northwestern highland of Ethiopia: Acceptance and adoption by farmers. Land use policy, 24: 404-416.

[21] Cameron, T. A. and Quiggin, J. (1994). Estimation Using Contingent Valuation Data from A 'Dichotomous Choice with Follow-Up' Questionnaire. *Journal ofEnvironmental Economics and Management*. 27(3):218-34.

[22] Central Statistical Agency (CSA). 2010. Summary and statistical report on the 2007 population and housing census of Ethiopia: Results for Amhara region. Federal Democratic Republic of Ethiopia, Population Census Commission, CSA, Addis Ababa, Ethiopia.

[23] Chilot, Y (2007). The Dynamics of Soil Degradation and Incentives for Optimal Management in Central Highlands of Ethiopia. PhD. Dissertation, University of Pretoria.

[24] Dejene, A. (2003). Integrated national resources management to enhance food security: The case of community based approaches in Ethiopia. Rome.

[25] FAO (Food and Agriculture Organization). New Partnership for Africa's Development: Comprehensive Africa Agriculture Development Program: FAO, Rome. 2002.

[26] FAO (Food and Agriculture Organization). Statistical database for Ethiopia, 2007 available at www.FOASTAT.FAO.ORG

[27] FDRE. (2010). The Federal Democratic Republic of Ethiopia: Poverty Reduction Strategy Paper: Growth and Transformation Plan 2010/11–2014/15 – Volume I

[28] Gebrelibanos Gebremedhin, (2012). Households' willingness to pay for soil conservation practices in adwaworeda, ethiopia: a contingent valuation study.

[29] Genanew, B. (1999). Analysis of Determinants of Households' Willingness to Pay and Demand for Improved Water Services: A Contingent Valuation Study in Harar Town (Ethiopia). Unpublished MSc. Thesis Economics Department, AAU.

[30] Gujarati DN (2005). Basic Econometrics TATA McGRAW-HILL Publishing Co Limited. New Delhi, India, p.b4.

[31] Haab, T.C. and K. E. McConnell (2002). Valuing Environmental and Natural Resources, the Econometrics of Non Market Valuation. Edward Elgar, Cheltenham U.K.

[32] Haile GW, Fetene M (2012) Assessment of soil erosion hazard in kilie catchment, east shoa, Ethiopia. Land Degrad Dev 23:293–306.

[33] Hanemann, M., Loomis, J. and Kaninen, B.(1991). Statistical Efficiency of Double Bounded Dichotomous Choice Contingent Valuation. American Journal of Agricultural Economics, Vol. 73, No. 4. (Nov., 1991), pp. 1255-1263.

[34] HassenBeshir, (2014). Conomicsof Soil And Water Conservation: The Case of Smallholder Farmers In North Eastern Highlands Of Ethiopia. The Experiment, 2014, Vol. 23 (3)1611-1627.

[35] Healy, F.J. (1984). Statistics: A Tool for Social Research. Wadsworth Publishing Company, California.

[36] Hurni, H. (1993). *Land degradation, famine, and land resource scenarios in Ethiopia: World Soil Erosion and Conservation, Cambridge Studies in Applied Ecology and Resource Management* (Pimentel, D. ed., pp. 27- 62), UK: Cambridge University Press.

[37] Jonse, B. (2005). Valuing Non-Agricultural Uses of Irrigation Water: Empirical Evidences from the Abay River-Basin of the Amhara Regional State, Ethiopia. School of Graduate Studies, Addis Abeba University.

[38] Kebede Wolka, Habitamu Tadesse, Efrem Garedew and Fantaw Yimer (2014). Soil erosion risk assessment in the Chaleleka wetland watershed, Central Rift Valley of Ethiopia. Environmental Systems Research (2015) 4:5 DOI 10.1186/s40068-015-0030-5.

[39] Mallios Z. and Latinopoulos P. (2001) Willingness to pay for irrigation water: a case study in Chalkidiki, Greece, In: Lekkas, T.D. (Eds), Proceedings 7th International Conference on Environmental Science and Technology, Ermoupolis, Greece.

[40] Mitchell R., and Carson, R. (1989). Using Surveys to Value Public Goods: The Contingent Valuation Method. Resources for the Future. Washington DC, 436 pp.

[41] MoFED (Ministry of Finance and Economic Development), Ethiopia: Building on Progress a Plan for Accelerated and Sustained Development to End Poverty (PASDEP) (2005/06-2009/10). Volume I:Main text, Ministry of Finance and Economic Development (MoFED), September, 2006, Addis Ababa, 2006.

[42] OgunniyiLT,Sanusi WA, Ezekiel AA (2011). Determinant of rural household willingnes to pay safe water in Kwara State, Nigeria Aquaculture. Aquarium, conservation and Legislation. Int. J. Bio flux 4(5):660-669.

[43] Pro-poor Reward for Environmental Services in Africa/World Agroforestry Centre (PRESA/ICRAF), (2011). The Willingness to pay (WTP) of water users for increased and reliable water supply via catchment management in Sasumua: Results from a contingent valuation survey in Nairobi city, Kenya.

[44] Shiferaw, B., Holden, S. (1998). Resource degradation and adoption of land conservation techno logies in the Ethiopian highlands: a case study in AnditTid, North Shewa. *Agric. Econ.* 18, 233–247.

[45] Shiferw, B., Holden ST. (1999). Soil and small holders' conservation decision in the high lands of Ethiopia. *World Development, 27*(4), 739-752.

[46] Solomon Jabessa. (2004). Contingent Valuation of Multi-Purpose Tree Resource. The Case of Arsi Zone, Ethiopia. Thesis submitted to the School of Graduate Studies of Addis Ababa University.

[47] Sustainable Agriculture & Natural Resource Management Collaborative Research Support Program (SANREM CRSP). 2003. Water Resources Management and Willingness to Pay: The Case of Cotacachi, Ecuador. SANREM CRSP Research Brief, No. 15.

[48] Tegegne G/Egziabher (1999). Willingness to Pay for Environmental Protection: An Application of Contingent Valuation Method (CVM) in Sekota District, Northern Ethiopia. *Ethiopian JournalofAgricultural Economics*, V.3 No.1

[49] Tesfaye G., Zerihun M., Menfese T., S.C., Narayana 2013. Adoption of Structural Soil and Water Conservation Technologies by Small holder farmers in AdamaWereda, East Shewa, Ethiopia. *International Journal of Advanced Structures and Geotechnical Engineering,* ISSN 2319-5347, Vol. 02, No. 02, pp 58-68.

[50] Tsegabrihan G. (1999). Estimating Willingness to Pay for Irrigation Water: A Contingent Valuation Case Study on Small Scale Irrigation Schemes in Tigray Ethiopia. Unpublished MSc. Thesis Department of Economics, AAU.

[51] Ulimwengu, J. and PrabuddhaSanyal, P. 2011. Joint estimation of farmers' stated willingness to pay for agricultural services, IFPRI Discussion Paper 01070 Internatinal Food Policy Research Institute.

[52] W/Giorgis, T. (2004). Estimating Willingness to Pay for Irrigation Water: A Contingent Valuation Case Study on Small Scale Irrigation Schemes, paper submitted to the Second International Conference on the Ethiopian Economy organized by the Ethiopian Economic Association.

[53] Wagayehu B, Lars D (2003) Soil and Water Conservation Decision ofSubsistence Farmers in the Eastern Highlands of Ethiopia: a case study ofthe Hunde-Lafto area. Ecological Economics, 2003, 46: 437-451.

[54] Wegayehu, B. (2003). Economics of soil and water conservation: Theory and Empirical Application to Subsistence Farming in the Eastern Ethiopia highlands. PhD Dissertation, Swedish University of Agricultural Sciences, Uppsala.

[55] World Bank, Africa Data Base. CD on Africa data base extracted for Ethiopia. 2004.

[56] Yeraswork, A., 2000. Twenty years to nowhere: Property rights, and conservation in Ethiopia, Red Sea Press, Lawrenceville, NJ.