Labor as a Payment Vehicle for Valuing Soil and Water Conservation Practice: An Application of Contingent Valuation Method in Abaro- Toga Watershed, Southern Ethiopia

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Abstract
This paper examines the determinants of farmers' willingness to pay (WTP) for soil and water conservation (SWC) practices applied Contingent Valuation Method in terms of labor contribution in Abaro-Toga Watershed. The paper is based on analysis of data collected from 150 randomly selected households through face to face interview. Descriptive statistics and econometrics logit models were applied. Results of the study showed that most respondents were WTP for SWC practices because of severity of soil erosion problem. Response to the hypothetical scenario revealed that sampled households expressed their mean WTP to be 36.01 labor days per year with an aggregate benefit of 1334247 labor days per year which is equivalent to 23349329.8 Birr. While, from the open ended elicitation methods total WTP was computed at mean of 32.21 labor days per year with an aggregate benefit of 1193449.3 labor days per year which is equivalent to 20885362.76 birr (1 US$=20.8 birr). This indicated that the total WTP from double bound elicitation format is greater than the WTP from open ended question. Hence, policy makers should target double bounded elicitation method than open ended elicitation method to eliciting the WTP for SWC practice. The results of logistic regression analysis also show that farmers' decisions to participate in SWC practices are influenced by a host of factors (Age, HH size, education, income, sex, slop of land, number of livestock holding, perception, labor shortage, and bid value). The implication is that taking these factors into account while planning SWC measures enables policy makers to come up with projects that win acceptance by the local people.

Keywords: Determinants, Soil and water conservation, Logit, Contingent valuation, willingness to pay

1. Background
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 (FAO, 2007). Agriculture provides raw material for 70% of industries in the country (MOFED, 2006). 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 (World Bank, 2004; FAO 2007). 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 (FAO, 2007). 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 (FAO, 2002).

Several studies in Ethiopia have revealed that soil erosion has become an alarming problem (Wagayehu and Drake (2003); Admasu (2005); Bewket and Teferi (2009); Haile and Fetene (2012); Wolka et al, 2015) 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 (Berry, 2009). Similarly, Hurni (1993) 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 (Amsalu & De Graaff, 2007). However, policy makers largely neglected land conservation until 1970s (Shiferaw & Holden, 1999), and the problem attracted policy attention only after the devastating famine problem in 1973/1974 (Shiferaw & Holden, 1998). 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 (Dejene, 2003; Amsalu, 2006). 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 (Asrat et al., 2004).

According to Wegayehu (2003), 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 (Bewket, 2007; kebede, 2014).

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 (Fisum, et al, 2002; Betru, 2002; Yeraswork, 2000). Belay (1992) 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. According to Amarasekara et al. (2009), and Ulimwengu and Sanyal (2011), willingness to invest in soil and water conservation measures increases with farm income, level of awareness and ownership security of land. Thus, this study assess determinants of farmers’ willingness to pay (participate) in soil and water conservation practices so as to solve existing problem in the area using CVM. This study, therefore, attempts to explore the following research objectives:

- To identify factors that determine farmers’ willingness to participate in soil and water conservation practice;
- To measure the relative importance of the hypothesized explanatory variables in the farmers’ willingness to pay (participate) in soil and water conservation practices;
- To provide information on the farmers willingness to participate in soil and water conservation practice;

2. Materials and Methods

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 km². The watershed comprise of six peasant association kebele such as Abaro, Ebicha, Idola Burka, Alache Harabate, Waransa and Toga.

Sample Size and Data Collection Methods

A two-stage simple technique was used when selecting respondents. In the first stage, four kebeles were randomly selected out of the 6 kebeles found in the watershed. 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 in terms of labor contribution/persons per day/. 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 (Haab and McConnell 2002). Finally, the double-bounded dichotomous choice format help to elicited more information about respondent’s WTP than single bounded format (Hanemann et al. 1991; Arrow et al. 1993).

Preliminary Survey and Bids

Before the final survey was conducted a pre-test was done using 45 randomly selected households. Then based on the pilot results three starting point price were introduced in terms of labor days was 31, 35 and 48 labor days per year for five years. 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 Arrow et al. (1993). Arrow et al. (1993) 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.

Empirical Model Specification

Logit and probit models are popular statistical techniques in which the probability of a dichotomous outcome
(such as continued use or non-continued use) is related to a set of explanatory variables that are hypothesized to influence the outcome (Neupane et al., 2002). However, Pindyck and Rubinfeld (1981) acknowledged logistic probability function as computationally easier to use than the other types. That is why logistic regression model was used for this study. The logit model based on the cumulative probability function was adopted to determine the mean willingness to pay SWC practice by households and factors influencing households’ willingness to pay because of its ability to deal with a dichotomous dependent variable. The logistic regression analysis is a uni/multivariate technique which allows for estimating the probability that an event will occur or not, through prediction of a binary dependent outcome from a set of independent variables Roopa, (2000). The Logit model was adopted for this study as used by Hanemann (1989), Whittington, et al, (1990), Branka and Kelly (2001), Yusuf et al, (2007), Adepoju and Omonona (2009). To identify the factors that determine the willingness to pay SWC practice by households, the households responses to the willingness to pay questions were regressed against the prices the households are willing to pay and other socioeconomic characteristics of the household. The regression logit model is specified as:

\[
P_i = \frac{1}{1 + e^{-\beta_0 + \beta_1 x_1 + \ldots + \beta_k x_k}}
\]

Where \(Y = \text{response of household to willingness to pay question which is either 1 if Yes or 0 if No}
\)
\(\beta_0 = \text{constant}, \beta_1 = \text{coefficient of the bid price that the households are willing to pay for SWC practice}, \ x_1 = \text{the bid price that the household was willing to pay for SWC practice.}
\)

\[
Y = \frac{1}{1 + \exp(-\beta_0 + \beta_1 x_1 + \ldots + \beta_k x_k)}
\]

Where \(Y = \text{responses of household WTP which is either 1 for Yes and 0 for No}
\)
\(Z = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots \ldots + \beta_k x_k
\)

\(\text{X}_i, X_2, X_3 = \text{Explanatory variables and } \beta_0, \beta_1, \beta_2 = \text{coefficient of explanatory variable}
\)

The Mean willingness to pay for SWC practice with no covariates i.e. WTP checked against the offered amount by households was calculated using the formula adopted by Yusuf et.al given as:

\[
\text{MeanWTP} = \frac{1}{\beta \ln(1 + \exp \alpha)}
\]

Where \(\alpha = \text{coefficient for the constant term, and } \beta = \text{coefficient for offered bids to the respondents.}
\)

3. Results and Discussion

Awareness of Farmers’ about the Causes and Indicators of Soil Erosion Problems in the Study Area

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.

Major 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

Households WTP for Soil and Water Conservation

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 logistic model without covariates i.e. WTP\(^1\) checked against the offered amount 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.

The annual open ended response mean WTP was computed at 32.21 labor days per year per household for five year (see table 1). At 95% confidence interval the WTP for SWC practice varies between 53.64 to 36.01 labor per households for the initial bid and second bid amount respectively (See Table 2). The result shows that the mean WTP from logit was greater than the mean value from the open ended response.

Table 1: Households’ WTP from Open-Ended Questions

<table>
<thead>
<tr>
<th>WTP in person days</th>
<th>Number of HHs</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>19</td>
<td>12.67</td>
</tr>
<tr>
<td>20-30</td>
<td>58</td>
<td>38.67</td>
</tr>
<tr>
<td>40.5-50.5</td>
<td>45</td>
<td>30.00</td>
</tr>
<tr>
<td>60-70.5</td>
<td>22</td>
<td>14.67</td>
</tr>
<tr>
<td>80.5-90.5</td>
<td>6</td>
<td>4.00</td>
</tr>
</tbody>
</table>

This may indicate free riding and lack of base for answering question in the open ended questions. This result is consistent with the findings of Jonse, (2005), Bamlaku et al 2015, Alem et al 2013.

Table 2: Reason for not Willing to Pay

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>Standard error</th>
<th>Wald</th>
<th>df</th>
<th>sig</th>
<th>Exp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial bid</td>
<td>-0.018</td>
<td>0.0201</td>
<td>1.148</td>
<td>1</td>
<td>0.002*</td>
<td>1.040</td>
</tr>
<tr>
<td>Constant</td>
<td>1.755</td>
<td>0.7538</td>
<td>0.113</td>
<td>1</td>
<td>0.005*</td>
<td>1.584</td>
</tr>
<tr>
<td>second bid</td>
<td>-0.1978</td>
<td>0.0234</td>
<td>7.095</td>
<td>1</td>
<td>0.008</td>
<td>1.000</td>
</tr>
<tr>
<td>Constant</td>
<td>7.1223</td>
<td>0.8024</td>
<td>8.731</td>
<td>1</td>
<td>0.003*</td>
<td>0.155</td>
</tr>
</tbody>
</table>

Chi-squared 55.57 and 38.6, df 1, Pseudo R-squared 0.5294, & 0.251, Log likelihood-23.364264 & -112.707

The willing respondents were also asked to point out their reasons for maximum WTP in labor contribution. The respondents provided different reason for their maximum WTP. About 66.41% of the respondents reported that they could not provide more because of labor shortage. While, the rest 33.59% reported that the amount they decided to pay is enough (See Table 3).

\(\text{MeanWTP} = \frac{1}{\beta} \ln(1 + \exp \alpha)\) \(\alpha\) is a coefficient for the constant term, and \(\beta\) is a coefficient for offered bids to the respondents

\(^1\) The mean WTP from logit model was computed using the formula specified by (Yusuf et.al.,2007)
Table 3: Reason for their Maximum WTP in labor days

<table>
<thead>
<tr>
<th>Reason</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>I could not provided more because of labor shortage</td>
<td>87</td>
<td>66.41</td>
</tr>
<tr>
<td>That amount is enough</td>
<td>44</td>
<td>33.59</td>
</tr>
<tr>
<td>Total</td>
<td>131</td>
<td>100</td>
</tr>
</tbody>
</table>

However, about 12.66% of the sample respondents’ were not willing to pay for SWC practice. Specifically, of the unwilling sampled respondents about 89.14% of the households were categorized as genuine zero bidders. Whereas, about 10.86% of the respondents stated protest\(^1\) zero (See Table 4).

Table 4: Reason for not Willing to Pay

<table>
<thead>
<tr>
<th>Respondents reasons for zero bid</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>We do not believe that the labor days we pay will actually be used for the proposed change</td>
<td>16</td>
<td>27.11</td>
</tr>
<tr>
<td>Lack of money and shortage of labor</td>
<td>38</td>
<td>64.40</td>
</tr>
<tr>
<td>We believed that the proposed project is unnecessary</td>
<td>5</td>
<td>10.86</td>
</tr>
<tr>
<td>Total</td>
<td>59</td>
<td>100</td>
</tr>
</tbody>
</table>

Determinants of Households’ WTP for soil and water conservation practice

Before running the econometric model, the independent variables were tested for the presence of multicollinearity (table 5). The result showed that there were no multicollinearity problems between the variables. The value for Contingency Coefficient (CC\(^2\)) for the dummy variables were less than 0.75 and the value of Variance Inflation Factor (VIF\(^3\)) 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 logistic model estimation. The result of the logistic model shows that, the probability of the chi-square distributions was 45.678 with 16 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 logistic model at less than 1% probability level.

Table 4: Contingency coefficient and Variance inflating factor of variables used in regression.

<table>
<thead>
<tr>
<th>Contingency coefficients for dummy explanatory variables</th>
<th>sex</th>
<th>Marital status</th>
<th>credit</th>
<th>Land use</th>
<th>fertility</th>
<th>slop</th>
<th>Perception</th>
<th>Labor shortage</th>
</tr>
</thead>
<tbody>
<tr>
<td>sex</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marital status</td>
<td>0.42</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>credit</td>
<td>0.059</td>
<td>-0.245</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land use type</td>
<td>0.331</td>
<td>0.2327</td>
<td>0.109</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fertility</td>
<td>0.113</td>
<td>-0.0761</td>
<td>0.561</td>
<td>0.1372</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>slop</td>
<td>-0.113</td>
<td>0.1086</td>
<td>0.027</td>
<td>-0.0753</td>
<td>0.2148</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perception</td>
<td>0.0481</td>
<td>0.1346</td>
<td>0.072</td>
<td>0.3185</td>
<td>0.1445</td>
<td>0.00</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>Labor shortage</td>
<td>0.0107</td>
<td>0.01270</td>
<td>0.323</td>
<td>0.0235</td>
<td>0.0549</td>
<td>0.10</td>
<td>0.0415</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

Variance Inflating Factor for Continues variable

<table>
<thead>
<tr>
<th>Variables</th>
<th>Age</th>
<th>Income</th>
<th>Education</th>
<th>HHsize</th>
<th>Livestock unit</th>
<th>Farm size</th>
<th>Distance</th>
<th>Bid</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIF</td>
<td>1.37</td>
<td>1.51</td>
<td>1.55</td>
<td>1.31</td>
<td>1.60</td>
<td>2.49</td>
<td>3.44</td>
<td>3.29</td>
</tr>
</tbody>
</table>

The estimated result on factors affecting the households’ WTP for SWC practice is presented in Table 6 and it shows both the significant and insignificant variables. However, only the significant variables are

\(^1\) The criteria for selecting protest zero was based on the discussion on NOAA panel guide on Arrow et al. (1993)

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

\(^3\) \(CC = \sqrt{\frac{\chi^2}{N + \chi^2}}\) where, \(CC=\) coefficient of contingency, \(\chi^2=\) Chi-square test and \(N=\) total sample size
discussed.

Table 14: The Logistic model estimation results of households’ WTP

<table>
<thead>
<tr>
<th>Variables</th>
<th>β</th>
<th>Std.error</th>
<th>Wald</th>
<th>Sig</th>
<th>Exp(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-0.069</td>
<td>0.051</td>
<td>1.854</td>
<td>0.017</td>
<td>0.933</td>
</tr>
<tr>
<td>HH_hsize</td>
<td>0.975</td>
<td>1.149</td>
<td>0.720</td>
<td>0.013</td>
<td>0.377</td>
</tr>
<tr>
<td>Educ.</td>
<td>0.431</td>
<td>0.876</td>
<td>0.242</td>
<td>1.623</td>
<td>1.539</td>
</tr>
<tr>
<td>Marital st.</td>
<td>-0.923</td>
<td>1.88</td>
<td>0.061</td>
<td>1.730</td>
<td>0.923</td>
</tr>
<tr>
<td>Income</td>
<td>0.123</td>
<td>0.047</td>
<td>6.781</td>
<td>0.070</td>
<td>1.131</td>
</tr>
<tr>
<td>Sex</td>
<td>-0.309</td>
<td>0.644</td>
<td>0.230</td>
<td>0.062</td>
<td>0.734</td>
</tr>
<tr>
<td>Farm_size</td>
<td>0.110</td>
<td>0.454</td>
<td>0.058</td>
<td>1.809</td>
<td>1.116</td>
</tr>
<tr>
<td>Distance</td>
<td>0.000</td>
<td>0.001</td>
<td>0.006</td>
<td>0.939</td>
<td>1.000</td>
</tr>
<tr>
<td>Fertility</td>
<td>1.340</td>
<td>1.052</td>
<td>1.622</td>
<td>1.203</td>
<td>0.262</td>
</tr>
<tr>
<td>Slop</td>
<td>0.629</td>
<td>0.739</td>
<td>0.726</td>
<td>0.023</td>
<td>1.876</td>
</tr>
<tr>
<td>Land_use</td>
<td>1.968</td>
<td>1.300</td>
<td>2.293</td>
<td>0.130</td>
<td>1.040</td>
</tr>
<tr>
<td>Credit</td>
<td>2.611</td>
<td>2.572</td>
<td>1.031</td>
<td>0.131</td>
<td>13.619</td>
</tr>
<tr>
<td>Livestock</td>
<td>-0.304</td>
<td>0.312</td>
<td>0.951</td>
<td>0.029</td>
<td>0.738</td>
</tr>
<tr>
<td>Percep</td>
<td>1.612</td>
<td>1.966</td>
<td>0.672</td>
<td>0.041</td>
<td>5.014</td>
</tr>
<tr>
<td>Labour shortage</td>
<td>.051</td>
<td>0.040</td>
<td>1.601</td>
<td>0.016</td>
<td>1.052</td>
</tr>
<tr>
<td>BID</td>
<td>-2.410</td>
<td>1.237</td>
<td>3.795</td>
<td>0.001</td>
<td>11.134</td>
</tr>
<tr>
<td>constant</td>
<td>2.410</td>
<td>1.237</td>
<td>3.791</td>
<td>0.51</td>
<td>9.654</td>
</tr>
</tbody>
</table>

No. of observation 150  
-2 Log likelihood=151.1  \( X^2 = 45.678 \)  
R Square= 0.104

Age of the household head (AGE): Age of the household head had negative and significant effect on households’ WTP in labor days contribution 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 labor shortage and reduce willingness to pay for soil and water conservation practices. Keeping the influence of other factors constant, an increase in household head age by one year the probability of willingness to pay in labor days reduces by 1.071 times. The negative relationship between WTP and age is inconsistent with the finding of Mallios and Latinopoulos (2005), Bamlaku et al, 2015, Tegegne (1999), Alem et al, 2013, Solomon (2004).

Family size of the household (FSIZE): The estimated coefficient of the total family size, which is one of the most crucial explanatory variables of probability of WTP, was found to be statistically significant with the expected positive sign (p<0.05). This indicates that the probability of WTP to support the proposed soil conservation practices increases as the total household size increases under the hypothetical market scenario. Keeping the influence of other factors constant, an increase in household size by one member increases the probability of willingness to pay by 2.65. This could be explained by the fact that, soil conservation practices are labor intensive; hence, households with large labor supply are willing to invest more in soil conservation practices. This result is consistent with the findings of (Gebrebilanos, 2012). In contrary with these finding of Bamlaku et al., 2015 and Alem et al., 2013.

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. This clearly calls the importance of human capital development for implementation of soil conservation practices. This is consistent with the findings of Tiwari (1998), Whittington et al. (1990), Genanew (1999), Tegegne (1999), Tsegabrihan (1999) and Jonse (2005) Tesfaye et al, 2013, Bamlaku et al 2015, Ogguniyyi et al 2011. In contrary with these finding of Angella et al 2014.

Annual income of the respondent shows expected positive and significant relationship with the households’ WTP. Keeping the influence of other factors constant, when farm income of a household increases by one birr, households’ willingness to pay for soil conservation increases by 0.64 labor days. A study by Adugnaw and Desalew, 2013 Genanew (1999), Tsegabrihan (1999), SANREM CRSP (2003), W/Giorgis (2004) and Jonse (2005), recognizes significant association between households income and willingness to pay.

Slop of farm land: of the respondents had positive effect on households’ WTP for SWC practice 5% level of significant. The implication is that the farmer who has a plot with steep slope is more likely to understand soil erosion problem and apply conservation structures than the farmer who has flat sloped plot. This is consistent with Bekele, 1998; Wagayehu, and Lars, 2003; and Bett, 2004.

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.
the wealth of a household increases, the WTP will also increase. The odds ratio show that for each additional increment of TLU, the probability of the willingness of the household to pay for the conservation practices will 1.35 times increase keeping the other explanatory variables. This is consistent with the findings of Alem et al., 2013, Gebrelibanos et al., 2012.

**Perception** about the existence of problem of soil erosion positive and significant at less than 5% probability level. Holding other things constant, the probability of a household WTP for SWC practice increases by 0.199 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. Which is consistent with the result of Abera (2003).

Labor shortage: labor shortage is positively and significantly related to WTP at 5% significant level. This indicates that SWC practices are labor intensive; hence, households with low labor shortage are willing to invest less in soil conservation practices.

Consistent with the earlier expectation and economic theory, 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 odds ratio indicates that a one labor days increase for the contribution of the proposed project reduces the probability of being willing to pay by 0.089.

**Mean WTP and Estimation of Consumer Surplus of Soil Conservation Practices**

According to Mitchell and Carson (1989) 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 logit 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 (Haab and McConnell, 2002). Hence, in order to choose the appropriate WTP among the two logit estimates, we looked into the data and 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 bounded logit model the mean willingness to pay for SWC is 36.01 labor days per year.

As it is indicated in Table 7, 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 1334247 labor days per year which is equivalent to 23349329.8Birr.

<table>
<thead>
<tr>
<th>Total HHs</th>
<th>Expected HHs to have a protest zero</th>
<th>Expected HHs’ with Valid Responses</th>
<th>Mean WTP3</th>
<th>Aggregate Benefit (Labor)</th>
<th>Aggregate Benefit (in Money)</th>
</tr>
</thead>
<tbody>
<tr>
<td>38277</td>
<td>1224.864</td>
<td>37052</td>
<td>36.01</td>
<td>1334247</td>
<td>23349329.8</td>
</tr>
</tbody>
</table>

**Conclusions**

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

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1. 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).
2. Is A-B which is the total households in the study area which are expected to have a valid response
3. The mean WTP calculated from the maximum amount of labor that a household could pay for SWC
4. Is mean multiplied by the number of total households which are expected to have valid response (C*Mean WTP) measured in labor
5. Is the total aggregate benefit in monetary equivalent in Ethiopian local Currency (Birr), which is calculated by multiplying the total labor of the households with the minimum wage rate in the study area (17.50 birr) at the time of data collection.
Ethiopia. Evidence from the study support that, age, household size, education, income, slope, perception of soil erosion, total livestock units, labor shortage for farm practices, are significant factors that explain households’ WTP. The mean WTP is found to be 36.01 labor days per year with an aggregate benefit of 1334247 labor days per year which is equivalent to 23349329.8 Birr. Policy thrust should focus on enhancing land tenure security through land certification among others.

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