

Valuation of Soil Conservation Practices in Adwa Woreda, Ethiopia: A Contingent Valuation Study

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Abstract

Soil degradation is one of the most serious environmental problems in the highlands of Ethiopia. The prevalence of traditional agricultural land use and the absence of appropriate resource management often result in the degradation of natural soil fertility in the country. Thus, in this study we have attempted to investigate the value that the farmers have attached to soil conservation practices and the determinants of willingness to pay for it using a Contingent Valuation Method. In the CVM survey, Double Bounded Dichotomous Choice format with an open ended follow up was used to elicit the households' willingness to pay. Based on data collected from 218 respondents, probit model was employed to assess the determinants of willingness to pay. The model shows that age, sex, education level, family size, perception, tenure, Total Livestock Units and initial bid were the important variables in determining willingness to pay for soil conservation practices in the study area. Our study also shows that the mean willingness to pay (WTP) estimated from the Double Bounded Dichotomous Choice format was computed at 56.65 person days per household per annum. The respective total aggregate value of soil conservation in the study area (Adwa Woreda) was computed to be 1 373 592 person days per annum, which is equivalent to 16 483 104 Ethiopian Birr. Therefore, if new intervention program for soil conservation is to be implemented, policy makers should consider those factors for better results. In Our study, we found very few protest zeros only (1.8%) which shows CVM is suitable method for valuing non marketed goods in less developing countries like Ethiopia.

Keywords: Contingent Valuation Method, Willingness to Pay, Soil Conservation, Double Bounded Dichotomous Choice

1. Introduction

Soil is the second most important for life next to water. Abundant growth of life is found in areas with good soils. From the record of past achievements, history tells us that civilization and fertility of soils are closely interlinked. However, the loss of soil through land degradation and soil erosion has been a great threat for this valuable resource in most developing countries like Ethiopia. The declination of the fertility of soil has been occurred due to accelerated erosion caused by human interference. Today soil erosion is almost universally recognized as a serious threat to human wellbeing.

Soil erosion is one of the most serious environmental problems in the highlands of Ethiopia. The prevalence of traditional agricultural land use and the absence of appropriate resource management often result in the degradation of natural soil fertility. This has important implications for soil productivity, household food security, and poverty in those areas of the country (Teklewold and Kohlin, 2011). Serious soil erosion is estimated to have affected 25% of the area of the highlands and now seriously eroded that they will not be economically productive again in the foreseeable future (Hans-Joachim et al., 1996 as it is cited in Yitayal, 2004). The average annual rate of soil loss in the country is estimated to be 42 tons/hectare/year which results to 1 to 2% of crop loss (Hurni, 1993), and it can be even higher on steep slopes and on places where the vegetation cover is low.

Natural and environmental resources conservation in Ethiopia, specifically soil, is therefore not only closely related to the improvement and conservation of ecological environment, but also to the sustainable development of its agricultural sector and its economy at large. To this end, in Ethiopia, efforts towards soil conservation were started since the 1970s and 1980s. Since then a huge amount of money has been invested in an attempt to introduce soil and water conservation measures particularly in the areas where the problem of soil erosion is threatening and food deficit is widespread. The conservation measures were in most cases physical measures and undertaken through campaign using Food-for-Work (FFW) or Cash-for-Work (CFW) as an instrument to motivate farmers to putting up the conservation structures both on communal holdings as well as on their own plots (Habtamu, 2009; Hurni, 1988).

Nevertheless, the achievements have fallen far below expectations. The country still loses a tremendous amount of fertile topsoil, and the threat of land degradation is broadening alarmingly (Teklu and Gezahegn, 2003). This is mainly because farmers' perception of their environment has been misunderstood partly in the country. It is misunderstood partly because outsiders, both scholars and policy makers, who write about farmers and formulate polices, often have limited understanding about the farmers' attitude towards environment (Paulos, 2002). Furthermore, the farmers' view of the environment is often ignored without due consideration of the condition he/she faces between survival and environmental exploitation (Alemneh, 1990). So far, conservation practices were mainly undertaken in a campaign often without the involvement of the land user (Shiferaw and Holden, 1998).

Does such an experience mean that there is no hope for soil conservation in Ethiopia? Absolutely not, the problem would have been rather, the campaigns that have been undertaken in Ethiopia for soil conservation practices have failed to consider local peoples' willingness to pay for such projects from the very initiation of conservation measures. This motivates that, there is a need to study on willingness to pay and design of polices and strategies that promote resource conserving land use with active participation of local people.

Hence, the main objective of this paper is therefore to assess the value households attach to soil conservation practices and determinants of willingness to pay to stop or reduce the negative effects of soil erosion in the study area (Adwa Woreda). In this paper we use the contingent valuation method (CVM), which is mostly applied to value non marketed and public goods. Double Bounded dichotomous choice format with an Open- ended follow up were used to elicit the willingness to pay of rural households.

The reminder of the paper is organized as follows. In section 2, we have reviewed the theory of welfare economics. The CVM survey is reviewed in section 3. In section 4, we have developed the empirical models. Section 5 discuses the model output. In section 6, conclusion and policy recommendations are presented.

2. Theory of Welfare Economics

The basic concept of welfare economics is based on the fact that economic activity is to increase the wellbeing of the responding individual or economic agent. In our case, the basic assumption is that, individuals would do decisions to participate in soil conservation practices to maximize their utility based on how well the household is given situations and constraints. From this, it follows that the basis for deriving measures of values is based on the effect of the hypothesized project on household's wellbeing.

The best way of explaining welfare is based on the Pareto criterion, which stated that policy changes which make at least one person better off without making any one worse off are desirable. According to Haab and McConnell (2002), the idea of a potential Pareto improvement provides the rationale of public intervention to increase the efficiency of resource allocation. If the sum of the benefits from a public action, to whomever they may occur, exceeds the costs of the action, it is deemed worthwhile by this criterion. The sum of the benefits entails two kind of information: knowledge of the individual benefits and a means of expanding the benefits to the relevant population. Econometric practice is typically applied to obtain individual benefits. Knowledge of individuals, who benefit, while not necessarily inferred from econometric work, is nevertheless an essential ingredient in determining the benefits. The applied side of modern welfare economics and/or benefit-cost analysis works a variant of the Pareto criterion by trying to find ways to place a dollar value on the gains and losses to those affected by a change in the level of provision of a public good. This allows the calculation of net gain or loss from a policy change, and determination of whether the change is potentially Pareto improving. Changes in environmental quality can affect individual's welfare through changes in prices they pay for marketed goods, changes in prices they receive for their factors of production, changes in the risks they face and changes in the quantities or qualities of non-marketed goods or public goods such as improvement in soil conservation, in our case.

Conventional economic tools for cost benefit analysis can be used for decision making when some public projects leads only to income and price changes of market goods. In such cases, prices are taken as an expression of the willingness to pay for the good, which is the total value the buyer, has for the good. However, if the project involves changes in non marketed good or public goods (e.g. reduction of soil erosion problem through integrated soil conservation practices), those methods are not sufficient (Weldesilassie et al. 2009). Therefore, to measure the value people attach to goods, which do not have a perfect market, or any market at all, direct valuation methods' such as the contingent valuation have been used in the existing literature. A typical measure of such benefits is referred to as Hicksian compensating surplus which holds utility constant at the initial level.
Suppose, in our case, Adwa Woreda[1] is considering an improvement in soil conservation and desires a measure

[1] Is an administrative unit in Ethiopia, which is almost similar to District

of WTP, in other words, a Hicksian compensated surplus, were a household is asked to respond by giving the difference of two expenditure functions:

$$CV_{01}^{h} = e(P, EU_{1}, K_{1}) - e(P, EU_{0}, K_{1}) \quad (1)$$

Where $e(P, EU, K, Z)$ is a household's expenditure function given price vector P is vector of prices, EU is expected utility level and K is the soil conservation quality being changed. The subscripts 0 and 1 represents to the situations before and after implementation of the project respectively. Thus, in the case of a utility-increasing project, the compensating variation equals the maximum amount of person days that could be extracted from the household after the project implementation to leave the household just as well off as without the project. Consequently, in this case, the compensating variation stands for the household's willingness to pay (WTP) for the project. If prices and incomes remain constant, equation (1) can be expressed as:

$$CV_{01}^{h} = e(P, EU_{0}, K_{0}) - e(P, EU_{0}, K_{1}) \quad (2)$$

Which is also known as the compensating surplus for the environmental change resulting from the project (Fremann, 2003). Equation (2) then can be expressed as the integral of the household's shadow price function of the environmental good:

$$CV_{01}^{h} = \int_{k_0}^{k_1} \pi_h(P, K, EU_0)\,dk \quad (3)$$

Where the shadow price function $\pi_h(P, K, EU) = -\partial e(P, K, EU) / \partial K$ is, of course, not observable. In practice, therefore, the utility change resulting from a change in the level of the public good is assessed by asking respondents in CVM interviews their WTP for the proposed public project leading to this change (Weldesilassie et al. 2009).

3. The Empirical CVM Survey

3.1 Data Source and Method of Data Collection

The study area, Adwa Woreda of the central zone of Tigray regional state of Ethiopia was selected for this study because; it is one of the erosion prone areas in the region, as well as, in the country. Time and money limits our study from expanding to include more Woredas (districts) for investigation. However, the study randomly selected 5 rural Kebeles (peasant associations) from the 18 peasant associations of the Wereda (district). Further, farm households were selected using the probability proportional to size (number of farm households) of the peasant associations from the five peasant associations using simple random sampling technique. The sampling list was obtained from the Woreda and respective peasant association administrations. A total of 225 households were randomly selected and 218 households were used for the analysis. Three of the seven respondents were excluded because they had insufficient information in their questionnaire. Four of the seven respondents were excluded because they had protest zeros[2]. But, before we decided to exclude them from further analysis, a sample selection bias test was undertaken whether excluding the protest zeros would create a sample selection bias. The two sample (Valid responses and protest zeros) mean were not statistically different in almost all the covariates. This revels excluding the protest zeros wouldn't insert sample selection bias. Thus, the final analysis was undertaken based on the respondents (218) who had valid responses. The primary data were collected from sample respondents through a structured questionnaire, via face to face interview.

A CVM method was also employed to elicit households WTP for soil conservation practices. In CVM surveys, there are about four major elicitation methods, namely Open ended format, Bidding game, Payment cards and Dichotomous or Discrete choice. The dichotomous choice approach has become quite widely adopted, despite criticisms and doubts, in parts because it appears to be incentive compatible in theory. When respondents do not give a direct estimate of their willingness to pay, they have diminished ability to influence the aggregate outcome. However, this advantage of compatibility has a limitation. Estimates of willingness to pay are not revealed by respondents (Haab and McConnell, 2002). To improve the precision of the WTP estimates, in recent year's researchers have introduced a follow up question to the dichotomous question (Alberini and Cooper, 2000).

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

The single bounded dichotomous choice format is easier for respondents to make willingness to pay decisions than open-ended questions (Bennett and Carter, 1993). However, the double-bounded dichotomous choice format is useful to correct the strategic bias and improve statistical efficiency over single-bounded in at least three ways. First, it is similar to the current market situation in Ethiopia, where sellers state an initial price and a chance is given to the buyers to negotiate. Second, the yes-yes, no-no response in the double bound dichotomous choice format sharpens the true and makes clear bounds on unobservable true WTP hence; there is efficiency gain (Haab and McConnell, 2002). Finally, the double-bounded dichotomous choice format is more efficient than single bounded dichotomous choice as more information is elicited about each respondent's WTP and a parametric mean could be elicited (Hanemann et al. 1991; Haab and McConnell, 2002; Arrow et al., 1993). Hence, in this paper we employ the double-bounded dichotomous choice format to elicit respondents' WTP.

3.2 Field Work Procedure and Questionnaire Design

The survey questionnaire of this study has three parts. The first part of the survey questionnaire includes about perception of respondents on soil erosion and soil conservation practices. The second part of the questionnaire present the valuation scenario in question and the different willingness to pay questions. The valuation scenario section of the questioner has tried to give as much information as possible about detailed description of the hypothetical market of soil conservation practices to be undertaken. Specifically, the valuation scenario includes descriptions of the good (what is going to be valued), the constructed market (how the good will be provided) and the method of payment (how could be paid for the good). In the Double-bounded dichotomous choice elicitation format a respondent was asked about his/her WTP of a pre-specified amount of initial bid during pilot survey for the proposed soil conservation practices. The questionnaire contains questions on the number of person days that households could be willing to pay for soil conservation practices per year. Only person days payment vehicles was taken based on the results of the pilot survey i.e. the respondents were not willing to pay any amount of cash for the proposed soil conservation practices. This can be justified by the fact that several rural people are experienced cash constraints and have cheap labour (see Paulos, 2002; Anemut, 2006; Alemu, 2000). Finally, the questionnaire was designed to collect the socio economic characteristics of the sampled respondents.

An important issue in the implementation of the CV survey and especially the Dichotomous choice is the choice of initial and follow up bid values. Bid design is important from the point of view of the efficiency of the estimators because they determine the variance-covariance matrix when they are the only repressors. That is why before the final survey was implemented, we had to do a pilot survey and focus group discussions to come up with starting bids with a randomly selected 30 households. The main objective of the pilot survey was to elicit the payment vehicles and to set up the starting point prices which finally were distributed randomly to the questionnaires. The pilot survey was undertaken via the open ended questionnaire format. The results of the pilot survey revealed that households willingness to pay ranges from 0 to 110 person days per annum. In view of this, three starting bids 22, 40 and 65 person days per year were randomly allocated to the 225 randomly selected respondents in the final survey. If the respondents were willing to take the offered initial bid, the follow up bid is doubled and in case of a "no" response to the initial bid, the follow up bid is half of the initial bid. For example, when offered a bid of 22 a follow up bid of 44 is offered if the answer was "yes" and in case of a "no" response a bid of 11 is given to the household. Thus, the range of bid vectors in the follow up were 11, 20, 32, 44, 80 and 130 person days per year.

4. Empirical Model Specifications

4.1 Estimation of Factors Affecting Willingness to Pay Model

The objective is to quantify the relationship between the individual characteristics and the probability of household WTP for a randomly offered initial bid values. For a given specified amount of labor that has to be subtracted from a given households' labor endowment for the proposed project soil conservation practices, farmers have the choice either to accept the pre specified bid or not to accept for the dichotomous choice question of the CVM survey. The decision process of the farmer can be modeled in a simple utility framework following Hanemann (1984). Let the utility or satisfaction of a given farmer is given by:

$$U_i = U_i(L, Z, q) \qquad (4)$$

Where U_i is the utility of the household i, L is total labour endowment of the household in a year, Z are socio economic characteristics of the household, whereas q is soil conservation quality as perceived by the farmer. Furthermore, let us assume that there are two states of the world corresponding to different levels of soil conservation quality: q* as the quality after the soil conservation practice is undertaken and q as the quality before the soil conservation practices is undertaken or if the practice is not pursued. Since the total labour endowment of the particular household is a principal or most limiting asset of the household, it is assumed that the individual will be willing to pay the suggested reduction from its total labour endowment so as to maximize his or her utility under the following condition or reject it otherwise;

$$U_i^{1}(L - BID, Z, q^*) + e_1 \geq U_i^{0}(L, Z, q) + e_0 \quad \text{......(5)}$$

Where U_i, L, Z, q and q* are as defined above, BID is the initial labor payment requirement per year for the soil conservation practices e_1 and e_0 are the error terms which are assumed to be normally distributed with mean zero and constant variance. Therefore, the probability that a household will decide to pay for the soil conservation is the probability that the conditional indirect utility function for the proposed intervention is greater than the conditional indirect utility function for the status quo.

It is worth mentioning that the utility functions are usually unobservable. The Utility function of the i[th] household which is assumed to be a function of observable household characteristics; resource endowment and environmental quality, $X_{ti,}$ and a disturbance term e_{ti} can be specified as;

$$U_i^t = f(X_{ti}) + e_{ti}, t = 0,1 i = 1,2,......n \quad \text{......(6)}$$

The focus in this model is on the factors that determine the probability of accepting the initial bid. The i[th] farm household will be willing to accept the initial bid when $U_i^1 \geq U_i^0$ .Therefore, the choice problem can be modeled as binary response variable Y, Where,

$$Y_i = \begin{cases} 1, if U_i^{1}(R_e - BID, Z, q^*) + e_1 \geq U_i^{0}(R_e, Z, q) + e_0 \\ 0, otherwise \end{cases} \quad \text{......(7)}$$

The probability that a given household is willing to pay for the soil and water conservation is given by;

$$\Pr ob(Y_i = 1) = \Pr ob(U_i^1 > U_i^0) \quad \text{......(8)}$$

If we substitute equation 8 to 6

$$\Pr ob(Y = 1) = \Pr ob(\alpha_1^{'} X_i + \varepsilon_{1i} > \alpha_0^{'} X_i + \varepsilon_{0i}) \quad \text{......(9)}$$

By rearranging Equation (9), we get,

$$\Pr ob(Y = 1) = \Pr ob\left[(\varepsilon_{1i} - \varepsilon_{0i}) > X_i(\alpha_0^{'} - \alpha_1^{'})\right] \quad \text{......(10)}$$

If we assume $u_i = \varepsilon_{1i} - \varepsilon_{0i}$ and $\beta = \alpha_0^{'} - \alpha_1^{'}$, we have,

$$\Pr ob(Y = 1) = \Pr ob(u_i > X_i \beta) = F(X_i \beta) \quad \text{......(11)}$$

Where, F is the cumulative distribution function (cdf). This provides an underlying structural model for estimating the probability and it can be estimated either using a probit or logit model, depending on the assumption on the distribution of the error term (ε) and computational convenience (Green, 2002). Assuming a normal distribution of the error terms the probit model can be specified.

Following Hanemann (1984), the probit model can be specified as;

$$Y_i^* = \beta' X_i + \varepsilon_i \quad \text{......(12)}$$

$Y_i = 1$ if $Yi^* \geq t^*$

$Y_i = 0$ if $Y_i^* < t^*$

Where:

β= is vector of unknown parameters of the model

x_i = is vector of explanatory variables

y_i *= Unobservable households' actual WTP for soil conservation. y_i * is simply a latent variable.

y_i = Discrete response of the respondents for the WTP

t_i* = the offered initial bids assigned arbitrarily to the i[th] respondent

ε_i = Unobservable random component distributed N $(0,\sigma^2)$

The respondents know their own maximum willingness to pay, y_i *, but to the researcher it is a random variable with a given cumulative distribution function (cdf) denoted by *F* (y_i *; ***β***) where ***β*** represents the parameters of this distribution, which are to be estimated on the basis of the responses to the CVM survey.

4.2 Estimation of the Mean Willingness to Pay and Aggregate Benefits

The bivariate probit model was also used to estimate the mean WTP from the double bounded dichotomous choice format of the contingent valuation survey. Let $\mathbf{t^1}$ be the first bid price and $\mathbf{t^2}$ be the second. The take-it-or-leave-it with follow up format starts with an initial bid, $\mathbf{t^1}$. The level of the second bid depends on the response to the first bid. That is, if the respondent answers ''yes'' for the initial bids, she/he receives an upper follow-up bid **t2**; if she/he answers ''no'' for the initial bid, she/he receives a lower follow-up bid t^2. In general, there are four possible outcomes: both answers "yes"; both answers "no"; "yes" followed by a "no"; and "no" followed by a "yes". The bounds on WTP are:

1. $t^1 \le WTP < t^2$ for the yes-no responses;
2. $t^1 > WTP \ge t^2$ for the no-yes responses;……………………..……..(13)
3. $WTP \ge t^2$ for the yes-yes responses;
4. $WTP < t^2$ for the no-no responses;

Following Haab and MacConnell, (2002) the probability of of observing each of the possible two-bid response sequences (yes-yes, yes-no, no-yes, no-no) can be represented as follows.

$$\Pr(yes,no) = \Pr(WTP_{1i} \ge t^1, WTP_{2i} < t^2) = \Pr(u_1 + \varepsilon_{1i} \ge t^1, u_2 + \varepsilon_{2i} < t^2)$$
$$\Pr(yes,yes) = \Pr(WTP_{1i} \ge t^1, WTP_{2i} \ge t^2) = \Pr(u_1 + \varepsilon_{1i} \ge t^1, u_2 + \varepsilon_{2i} \ge t^2)$$
$$\Pr(no,yes) = \Pr(WTP_{1i} < t^1, WTP_{2i} \ge t^2) = \Pr(u_1 + \varepsilon_{1i} < t^1, u_2 + \varepsilon_{2i} \ge t^2) \ldots\ldots\ldots\ldots(14)$$
$$\Pr(no,no) = \Pr(WTP_{1i} < t^1, WTP_{2i} < t^2) = \Pr(u_1 + \varepsilon_{1i} < t^1, u_2 + \varepsilon_{2i} < t^2)$$

Each individual respondent (i[th]) contribution to the likelihood function becomes

$$L_i(u/t) = \Pr(u_1 + \varepsilon_{1i} \ge t^1, u_2 + \varepsilon_{2i} < t^2)^{YN} X \Pr(u_1 + \varepsilon_{1i} \ge t^1, u_2 + \varepsilon_{2i} \ge t^2)^{YY}$$
$$X \Pr(u_1 + \varepsilon_{1i} < t^1, u_2 + \varepsilon_{2i} < t^2)^{NN} X \Pr(u_1 + \varepsilon_{1i} < t^1, u_2 + \varepsilon_{2i} \ge t^2)^{NY} \ldots\ldots\ldots\ldots(15)$$

Where YY=1 for a yes-yes answer, 0 otherwise, NY=1 for a no-yes answer, 0 otherwise, NN=1 for a no-no answer, 0 otherwise and YN=1 for a yes-no answer, 0 otherwise. Assuming the error terms are normally distributed with means 0 and respective variances of σ_1^2 and σ_1^2, then WTP_{1i} and WTP_{2i} have a bivariate normal distribution with mean u_1 and u_2, variances σ_1^2 and σ_1^2 and correlation coefficient ρ, which is the covariance between the errors for the two WTP function.

But, when the estimated correlation co-efficient of the error terms in bivairate probit model are assumed to follow normal distributions with zero mean and distinguishable from zero the system of equations could be estimated as Seemingly Unrelated Bivariate Probit (SUBVP) model (Cameron and Quiggin, 1994). Hence, in this study a SUBVP was used to estimate the mean WTP of the respondents from the double bounded format.

Finally, the mean willingness to pay (MWTP) from bivariate probit model (Equation 16) was calculated using the formula specified by Haab and Mconnell, (2002).

$$MWTP = \frac{-\alpha}{\beta} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(16)$$

Where α = a coefficient for the constant term

β = a coefficient offered bids to the respondents

5. Results and Discussion

5.1 Determinants of Willingness to Pay for Soil Conservation

In this section, estimation results of the probit model are reported based on theoretical model that has already been developed in section four. The model was used to examine whether WTP for soil conservation of surveyed households are related to the explanatory variables or not. A total of 16 explanatory variables were considered in the econometric model out of which only 8 variables were found to significantly influence the probability of willingness to pay among the farm households at least at 5% probability level.

The chi-square ($\chi2$) distribution is used as the measure of overall significance of a model in probit model estimation. The result of our probit model shows that, the probability of the chi-square distributions (-147.8) with 16 degree of freedom less than the tabulated counterfactual 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% level of significance. This implies that the joint null hypothesis of coefficients of all explanatory variables included in the model were zero should be rejected. In general, it shows that, our data fits the model very well (Table 1).

As indicated in Table 1, eight of the sixteen variables were found to be statistically significant affecting WTP. Sex of the household head (SEX), Education level of the household head (EDUCATION), Perception of soil erosion problem (PERCEPTION), Family size of the household (FSIZE), land tenure (TENURE) and Total livestock units (TLU), had a positive and significant effect in accepting the offered initial bid. On the other hand, Age of the household head (AGE), Initial bid offered (BID1) were found to be significant to affect willingness to pay negatively.

Age of the household head (AGE**)** had negative effect on the willingness to pay of households for soil conservation practices. The negative and significant correlation between age and willingness to pay for soil conservation practices might be perhaps because of two reasons. Older age may shorten planning time horizon and reduce WTP. Thus, older households are less likely willing to pay for soil conservation practices as they expect they would benefit less from the investment relative to young household heads, given that the benefits are generally longer term in nature. Besides, an older aged household are more likely to have a labour shortage and reduces willingness to pay for soil conservation practices. The marginal effect estimates of Table 1 also shows, that keeping the influences of other factors constant at their mean value, a one year increase in the age of the household head reduces the probability of accepting the first bid by about 1.2% and was happened to be significant at less than 1% probability level.

The result of probit model revealed that male headed household heads were found to be willing to pay for soil conservation practices than female headed households. The sign of sex turned out to be consistent with the prior expectation and it was positively and significantly related with the dependent variable at less than 5% level of significance. Alemu, (2000) and Animut, (2006) reported the same result. Education level of the household head was also significant at 1 percent probability level to say “yes” to the offered initial bid. It had a positive and strong relationship with the dependent variable showing that as the education level of the household head increases, willingness to pay for conservation practices increases. The marginal effect result show that for each additional increment of education, the probability of willingness of a household to pay for the soil conservation practices will increase by 9.1%, ceteris paribus at less than 1% probability level. One possible reason could be that more educated individuals are concerned about environmental goods including soil in our case. This could be possibly because education increases environmental awareness and value for environmental goods such as soil Tegegne, (1999) reported a similar result.

Family size of the house hold and perception of soil erosion was also found to be significant to affect the probability of accepting the initial bid as expected. The marginal effect estimates shows that all things keeping the influence of other factors constant, a 1 person increase in the total family size increases the probability of willingness to pay by 7%. Similarly, holding other things constant, the probability of a household WTP for conservation increases by 81.9% for perceived farmers than the other counter factual.

Initial bid offered has been found to be negative and significantly related at 1% significance level with willingness to pay for conservation practices. This implies, the probability of a yes response to the initial bid increases with decrease in the offered initial bid which is consistent with the economic theory. Tenure security of land and total livestock holdings were also responsible for accepting the initial bid as expected.

5.2 Estimation of Mean Willingness to Pay and Aggregate Benefit

As it is discussed in the methodology part, the main objective of the double bounded dichotomous choice format was to estimate the mean WTP from responses of both the first and the second bids offered. The result revealed that the initial bid and the second bid have the negative signs and statistically significant as expected at less than 1% probability level (Tables 2). This implies that higher initial bid and second bid lead to lower probability of accepting the bid offered.

In the Seemingly Unrelated Bivariate Probit Estimates (SUBPE) Rho (ρ) is positively and significantly different from zero at less than 1% probability level; implying that there is positive correlation between the two responses. Besides, the correlation coefficient of the error term is less than one implies that the random component of WTP for the first question is not perfectly correlation with the random component from the follow-up question. The estimation results of the model are reported in Table 2.

Using these coefficients in Table 2, the mean willingness to pay for soil conservation practices from the double bounded probit estimate was estimated using the formula by Habb and McConnell, (2002) (see equation 16) to be 56.65 person days per year per household. At 95% confidence interval the WTP varies between 51.01 to 62.29 person days per year.

An important issue related to the measurement of welfare using WTP is aggregation of benefit (Alemu, 2000). 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. A face to face interview method is used and Protest zero responses were excluded from the analysis and expected Protest zeros was accounted in the estimation of the total aggregate benefit of soil conservation in this paper. Hence, none of the above biases was expected in our analysis.

Mean was used as a measure of aggregate value of soil conservation in this study. The mean is perhaps better than the median since the good dealt with is not a pure public good (Alemu, 2000) as there are purely private benefits from soil erosion conservation measures. As it is indicated in Table 3, 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 conservation practices was computed at 1 373 592 person days per year which is equivalent to 16 483 104 Birr.

6. Conclusion and Policy Recommendation

In this study we used double bounded followed by an open ended format contingent valuation technique to elicit farmers' willingness to contribute labor for soil conservation practices in Adwa Woreda, Ethiopia. The survey was administered via face to face interview through trained enumerators. Data from 218 households were used in the final analysis. A bivariate probit model was used to calculate the mean willingness to contribute labor of households for the proposed soil conservation practices. Besides, a probit model was employed to determine the effect of different explanatory variables on farmers' willingness to participate in soil conservation practices.

Based on the double bounded dichotomous choice format, the mean willingness to pay was calculated to be 56.65 person days per annum per household. The total aggregate value of soil conservation is calculated to be 1 373 592 person days per year which is equivalent to 16 483 104 Ethiopian Birr. This shows that farmers of the study area have perceived the problem of soil erosion and are willing to pay for it. Our study also reveals that, there are very few protest zeros only (1.8%) which shows CVM is suitable for use in less developing countries like Ethiopia.

This study underlines the importance of human capital development in increasing the probability of willingness to pay. The results of the study also show that those farmers who have perceived soil erosion as a serious problem were willing to participate in soil conservation practices than those who do not perceived. This implies that unless planners first increase farmers' recognition of soil erosion hazard, it would be very difficult to implement effective sustainable soil conservation practices. Our study also shows land tenure security is an important determinant of WTP Therefore, increasing security of land tenure through land certification would enhance the probability of the WTP of the households for the conservation practices. Furthermore, the results of the study also reveal that wealth indicators such as total livestock holdings have a positive effect to WTP for soil conservation practices in the study area. This implies that for successful management of natural resources such as soil wealth improving programs should target the poor so that they would be able to pay. Attention and help from the government must be also given to female headed households as their WTP is less than male headed households. Finally, policy and program intervention designed to address soil erosion problems in the area have needed to take in to account these important factors for effectiveness.

7. References

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Table 1: Probit Estimates of Willingness to Pay for Soil Conservation Practices

	Probit			Marginal Effects		
VARIABLES	Coefficients	Stad. Err	Z-Value	dy/dx	Stan .Err	Z-value
AGE	-0.0396***	-0.0129	-3.07	-0.012***	-0.004	-2.84
SEX	0.712**	-0.3480	2.05	0.229	-0.118	1.94
EDUCATION	0.309***	-0.0956	3.23	0.091***	-0.024	3.78
SPOSITION	1.730	-0.9230	1.88	0.279***	-0.076	3.67
DISTANCE	0.000704	-0.0032	0.22	0.0002	-0.0009	0.22
FSIZE	0.238**	-0.0941	2.53	0.07**	-0.028	2.47
FASIZE	0.384	-0.6370	0.6	0.113	-0.186	0.6
PERCEPTION	4.674***	-1.5710	2.97	0.819***	-0.062	13.21
FEROSION	-0.365	-0.4840	-0.75	-0.107	-0.142	-0.76
BID1	-0.0458***	-0.0100	-4.58	-0.0135***	-0.003	-4.68
LSHORTAGE	-0.681	-0.4110	-1.66	-0.224	-0.151	-1.48
EXTFREQUENCY	0.0113	-0.0227	0.5	0.003	-0.007	0.49
TENURE	2.074**	-0.8220	2.52	0.609**	-0.282	2.16
INCOME	7.87E-05	-0.0001	1.37	0.00002	-0.00002	1.41
TLU	0.245***	-0.0910	2.69	0.072***	-0.027	2.62
AMCREDIT	-5.98E-05	-0.0001	-1.1	-0.00002	-0.00002	-1.14
CONSTANT	-5.784***	-2.0230	-2.86			
Observations	218			LR chi2 (16)	192.9	
Log likelihood	-48.37			Pseudo R2	0.666	
				Prob>Chi2	0.0000	

*** &** Significance at 1% and 5% respectively
Source: Owen Survey, 2012

Table 2: Parameter Estimates of the Double Bounded Dichotomous Choice Format

Variable	Coeff	Std. Err	Z
Initial bid	-0.0277***	-0.00446	-6.21
Constant	1.413***	-0.211	6.7
Second bid	-0.0158***	-0.00275	-5.73
Constant	0.984***	-0.171	5.75
Athrho	1.116***	0.365	3.06
ρ	0.806	-0.128	

Log- likelihood= -272.5
Number of Observations = 218
Wald chi2(2)= 56.54
Prob> chi2=0.0000

Likelihood-ratio test of rho=0: chi2(1) =19.43 Prob > chi2 = 0.0000

Source: Own Survey, 2012 *** significance at 1% probability level

Table 3: Estimation of Total Aggregate Benefits of Soil Conservation

Total Population (Y)	Expected HHs to have a protest zeros (X)[3]	Expected HHs with valid responses (Z)[4]	Mean WT[5]	Aggregate Benefit (Person Days)[6]	Aggregate benefit (money)[7]
24,692	445	24,247	56.65	1373592.55	16483110.6

Source: Own Calculation, 2012

[3] 4(1.8%) of our 222 sampled households were protest zeros. We excluded those protest zeros from further analysis after we have tested for sample selection bias. So X is the expected number of households which are expected to protest for the proposed project. It is calculated by the percentage of sampled protest zeros (1.8%) by the total population 24,692 (Y).
[4] Is Y-X which is the total households in the study area which are expected to have a valid response
[5] Is the mean willingness to pay calculated from the double bounded dichotomous choice estimation
[6] Is mean multiplied by the number of total households which are expected to have valid response (Z*Mean WTP) measured in person days
[7] Is the total aggregate benefit in monetary equivalent in Ethiopian local Currency (Birr)