HOUSEHOLDS' WILLINGNESS TO PAY FOR SOIL CONSERVATION PRACTICES IN ADWA WOREDA, ETHIOPIA: A CONTINGENT VALUATION STUDY

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DECLARATION

I, **Gebrelibanos Gebremedhin Gebremariam**, declare that this thesis is a result of my own original effort and work, and that to the best of my knowledge, the findings have never been previously presented to the University of Malawi or elsewhere for the award of any academic qualification. Where assistance was sought, it has been accordingly acknowledged.

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CERTIFICATE OF APPROVAL

We, the undersigned, certify that this thesis is a result of the authors' own work, and that to the best of our knowledge, it has not been submitted for any academic qualification within the University of Malawi or elsewhere. The thesis is acceptable in form and content, and that satisfactory knowledge of the field covered by the thesis was demonstrated by the candidate through oral examination held on 10th July, 2012.

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DEDICATION

This thesis is affectionately dedicated to my grandparents.

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ABSTRACT

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 in the country. Hence, this study assesses farm households' WTP for soil conservation practices through a CVM study. Double Bounded Dichotomous choice with an Open ended follow up format was used to elicit the households' willingness to pay. Based on data collected from 218 respondents, descriptive statistics indicated that most of the respondents have perceived the problem of soil erosion and are willing to pay for conservation practices. Probit model was employed to assess the determinants of willingness to pay. Results of the model shows that age of the household head, sex of the household head, education level of the household head, family size, perception, land tenure, Total Livestock Units and initial bid were the important variables in determining willingness to pay for soil conservation practices in the study area. The study also show that the mean willingness to pay estimated from the Double Bounded Dichotomous Choice and open ended formats was computed at 56.65 and 48.94 person days per annum, respectively. The respective total aggregate value of soil conservation in the study area (Adwa Woreda) was computed to be 1,373,592 (16,483,104 Birr) and 1,186,648.18 (14,239,778.16 Birr) per annum for five years, respectively. The results of the study have shown that socio economic characteristics of the household and other institutional factors are responsible for household's WTP for soil conservation practices. Therefore, policy and program intervention designed to address soil erosion problems in the study area have needed to take in to account these characteristics.

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GLOSSARY OF ETHIOPIAN TERMS

Birr	Is the local currency of Ethiopia
Kebele	Is the lowest administrative unit in Ethiopia.
Tsimdi	Is a measure of cultivable land (1 tsimdi = 0.25 hectare)
Woreda	Is an administrative unit in rural Ethiopia which often used interchangeably with District. It is the unit above kebele administration.
Zone	Is an administrative unit in Ethiopia, which is below the level of regional state and above Woreda.

ACRONYMS

AERC	African Economic Research Consortium
AWARDO	Adwa Woreda Agricultural and Rural Development Office
CAM	Conjoint Analysis Method
CEM	Choice Experiment Method
CFW	Cash for Work
CIM	Cost of Illness Method
CV	Compensating Variation
CVM	Contingent Valuation Method
CS	Compensating Surplus
DC	Dichotomous Choice
EC	Ethiopian Calendar
EHRS	Ethiopian Highland Reclamation Study
EV	Equivalent Variation
ES	Equivalent Surplus
FFW	Food for Work
GDP	Gross Domestic Product
Ha	Hectare

HPM	Hedonic Pricing Method
IFPRI	International Food Policy Research Institute
MOARD	Ministry of Agriculture and Rural Development
MPM	Market Price Method
NFIM	Net Factor Income Method
NGO	None Governmental Organizations
PA	Peasant Associations
PFM	Production Function Method
RCM	Replacement Cost Method
SMNP	Simen Mountains National Park
TCM	Travel Cost Method
TEV	Total Economic Value
TLU	Total Livestock Units
UN	United Nation
USD	United States Dollar
WTA	Willingness to Accept
WTP	Willingness to Pay

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

The economic development of developing countries depends on the performance of the agricultural sector, and the contribution of this sector depends on how the natural resources are managed. Unfortunately, in the majority of developing nations, the quality and quantity of natural resources are decreasing resulting in more severe droughts and floods (Fikru, 2009).

Ethiopia, being among these developing countries, has heavily relied on its environmental and agricultural resource base for the past years. In general, agriculture in the country is characterized by limited use of external inputs and continuous deterioration of the resources. According to Daniel (2002), Ethiopia for the last couple of decades has faced serious ecological imbalances because of large scale deforestation and soil erosion caused by improper farming practices, destructive forest exploitation, wild fire and uncontrolled grazing practices. This has resulted in a declining agricultural production, water depletion, disturbed hydrological conditions, and poverty and food insecurity.

Bojo and Cassells (1995), assessed land degradation and indicated that the immediate gross financial losses due to land degradation in the Ethiopian highlands were about USD 102 million per annum which was about 3 % of the country's GDP. The study also showed that virtually all of the losses were due to nutrient losses resulting from

the removal of dung and crop residues from cropland, while the remaining was mainly due to soil erosion. Other modeling work suggests that the loss of agricultural value between 2000 and 2010 to be a huge about $7 billion (Berry, 2003).

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. According to Alemneh (2003), there was no Government policy on soil conservation or natural resources management in Ethiopia prior to 1974. The 1974-1975 famine was the turning point in Ethiopian history in terms of establishing a linkage between degradation of natural resources and famine. Since then, different soil conserving technologies with a varied approach has been underway.

However, the achievements of those soil conservation attempts have been daunting. In order to combat soil degradation and to introduce sustainable use of resources, there is a need to take action. Thus, it is imperative that the local people participate in the designing and practices of conservation measures. This study was undertaken in Adwa at the Tigrian highlands of Ethiopia. At present, the study area is faced with extreme soil degradation. The principal factors responsible for the problem include steep topography, inherent erodible nature of the soils and expansion of farmland. The study was aimed at identifying the factors that determine farmers' willingness to take part in soil conservation practices.

1.2 Statement of the Problem

Soil is the second most important to life next to water. From the record of past achievements, history tells us that civilization and fertility of soils are closely interlinked. The declination of the fertility of soils had 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. This makes the issue of soil conservation not only necessary but also a vital concern if the country wants to achieve sustainable development of its agricultural sector and its economy at large.

Anemut (2006), argues that, natural resources such as soil are important natural resources as they have useful effects on ecological balances and also for they are the means for the livelihood of many local people worldwide; especially in the developing countries. However, due to lack of efficient property right, increased

population growth, lower productivity of agriculture and fast expansion of farmlands in most developing countries many environmentally important areas are highly degraded. According to the same author, the non-participatory nature of environmental policies, which gives less priority to the local communities need and priorities in the management and use of natural resources, has worsened the problem of natural resource degradation in most developing countries.

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. It induces on-site costs to individual farmers, and off-site costs to society. That coupled with poverty, fast growing population and policy failure; poses a serious threat to national and household food security.

To avert the global as well as local environmental disaster being brought by soil erosion, it is imperative to take action quickly and on a vast scale. It is therefore, very necessary to induce in every one's mind the importance of conserving soil resources. Hence, in this study, an attempt was made to estimate local peoples' willingness to pay for conservation practices.

1.3 Justification of the Study

The achievements of the soil conservation practices that have been undertaken in Ethiopia have fallen far below expectations. The country still loses a tremendous amount of fertile topsoil, and the threat of land degradation is broadening alarmingly (Tekelu and Gezeahegn, 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. 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 projects that have been undertaken in Ethiopia for soil conservation 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.

Thus, this study analyzes the value that farmers' attach to soil conservation practices, determinants of their willingness to pay for soil conservation via labour contribution and the welfare gain from such activities. Generally, understanding the factors leading to willingness to pay in soil conservation practices would help policy makers to design and implement more effective soil conservation plans.

1.4 Objective of the Study

The general objective of this study was to generate the demand side information from households who are the major victims of land degradation and soil erosion. So, the prime concern of this study is to elicit farmers' willingness to participate in soil conservation and rehabilitation practices in the study area.

The specific objectives of the study were:

- To identify the determinants that affects the willingness of households to participate for soil conservation practices.
- To estimate the mean labour contribution of households for soil conservation in the study area.
- To estimate the welfare gain of soil conservation project in the study area.

1.5 Working Hypotheses

With market imperfections, the probability or the level of farm household's WTP for soil conservation depends on various factors, such as poverty and household characteristics, than only farm characteristics. If markets (for example, credit markets) were perfect, then farm households' WTP would depend only on farm characteristics as they could address cash liquidity problems through these credit markets (Tessema and Holden, 2006). Therefore, based on this theory the hypotheses are as follows:

1. Perception of severity of soil degradation at the study area will not affect the household's WTP for soil conservation.

2. Socio economic variables such as age, sex, education level, social position of the household head and land tenure do not affect households' willingness to pay for soil conservation practices.

3. Wealth and resources endowments such as family size, total livestock holdings and income of households do not affect willingness to pay of households' for soil conservation practices.

1.6 Research Questions

The underline questions of this study were:

1. What is the value of soil conservation practices that the farmers attached to it?
2. What are the determinants of willingness to pay?

1.7 Organization of the Thesis

The forgoing Chapter has presented the introduction of the study. The rest of the thesis is organized as follows. Chapter Two will present literature review. The reviewed studies are in the area of soil and land degradation problems, natural resources valuation methods and theory of welfare economics. Chapter Three presents methodology. The Chapter starts with sample and sampling technique and methods of data collection. Later the probit and bivariate probit models are discussed. Results and discussions are presented in Chapter Four. Chapter Six concludes the study and presents policy recommendations.

CHAPTER TWO

2.0 REVIEW OF LITERATURE

This chapter is mainly concerned with the review on soil and land degradation problem in Ethiopia, natural resources valuation techniques and theory of welfare economics. The chapter further reviews the criticisms of the contingent valuation method. Finally, some studies that have been done in Ethiopia and elsewhere using the contingent valuation method are reviewed.

2.1 The Concept and Problem of Land Degradation

Land degradation can be defined as a process that lowers the current and future capacity of the land to support human life (Demeke, 1998). Land degradation and soil degradation are often used interchangeably. However, land degradation has a broader concept and refers to the degradation of soil, water, climate, and fauna and flora (Alemneh et al. 1997 cited in Behailu, 2009).

Land/soil degradation can either be as a result of natural hazards or due to unsuitable land use and inappropriate land management practices. Natural hazards include land topography and climatic factors such as steep slopes, frequent floods and tornadoes, blowing of high velocity wind, rains of high intensity, strong leaching in humid regions and drought conditions in dry regions. Deforestation of fragile land, over cutting of vegetation, shifting cultivation, overgrazing, unbalanced fertilizer use and non-adoption of soil conservation management practices, over-pumping of ground

water (in excess of capacity for recharge) are some of the factors which comes under human intervention resulting in soil erosion (Dominic, 2000).

Ethiopia is one of the Sub Saharan African countries where soil degradation has reached a severe stage. Land degradation mainly due to soil erosion and nutrient depletion, has become one of the most important environmental problems in the country. Coupled with poverty, fast growing population and policy failures, land degradation poses a serious threat to national and household food security (Shiferaw and Holden, 1999). According to Gebreegziabher et al. (2006), in Ethiopia where deforestation is a major problem, many peasants have switched from fuel wood to dung for cooking and heating purposes, thereby damaging the agricultural productivity of cropland. In Tigrai region, for example, dung rose from about 10% of total household fuel consumption in the 1980s to about 50 percent by the year 1999.

An Ethiopian Highland Reclamation Study (EHRS) conducted two decades ago revealed a frightening trend in environmental degradation where by "…27 million hectares or almost 50% of the highland area was significantly eroded, 14 million hectares seriously eroded and over 2 million hectares beyond reclamation. Erosion rates were estimated at 130 tons/ha/yr for cropland and 35 tons/ha/yr average for all land in the highlands….". Forests in general have shrunk from covering 65% of the country and 90% of the highlands to 2.2% and 5.6% respectively" With the country's population now almost double what it was then, things have, obviously, gotten much worse since (Aynalem, Undated).

2.2 Causes of Land Degradation

Land degradation is the result of complex interactions between physical, environmental, biological, socio-economical, and political issues of local, country wide or global nature. But, the major causes of land degradation are caused by the mismanagement of land by the respective local uses.

The causes of land degradation can be grouped in to proximate and underlying factors. The proximate causes of land degradation include cultivation of steep slopes and erodible soils, low vegetation cover of the soil, burning of dung and crop residues, declining fallow periods, and limited application of organic or inorganic fertilizers. The underlying causes of land degradation include such factors as population pressure; poverty; high costs or limited access of farmers to fertilizers, fuel and animal feed; insecure land tenure; limited farmer knowledge of improved integrated soil and water management measures; and limited or lack of access to credit. The proximate causes of land degradation are the symptoms of inappropriate land management practices as conditioned by the underlying factors. Hence, efforts for soil conservation need to address the underlying causes primarily, as focusing on the proximate causes would mean addressing the symptoms of the problem rather than the real causes (Gebremedhin, 2004).

According to Hurni (1988), both environmental and socio-political factors have contributed to the poor performance of Ethiopian agriculture. Environmental factors include the dissected terrain, the cultivation of steeper slopes, erratic and erosive rainfall, and so on. Socio-political factors include the top down approach adopted by bodies intervening to improve soil and water conservation. Farmers have been

minimally involved in soil conservation activities and indigenous knowledge has been undermined within planning, design, and implementation processes. As a result, soil and water conservation programs have to date proved to be highly unpopular among farmers.

In response, the government of Ethiopia attempted to combine incentives with participatory approaches to soil conservation. However, real participation of beneficiaries has not been realized in the country. Perhaps as a result, the adoption of soil conservation practices remains low. Moreover, the use of indirect economic incentives such as credit supply, extension services, reduction of land taxes, input and output price support and market development has been limited. These experiences indicates that there is a need to use both direct and indirect incentives combined with real participation of beneficiaries if effective and sustained soil conservation effort is to take place (Gebremedhin, 2004). This is due because there are no perfect markets for soil erosion prevention practices as the good is public. Therefore, the objective of this study is to determine the value that households attach to reduce soil and land degradation in the study area, as manifested in their willingness to pay.

2.3 Economic Values of Natural Resources

For market prices to represent the correct value society attaches to the good, markets need to be competitive and work freely. 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. But in reality markets are far from being perfect, and even they do not exist for some class of goods. Therefore, to measure the value people attach to

goods, which do not have a perfect market, or any market at all; we need to understand the concept of value (Aklilu, 2002).

This is at least for the following reasons. Firstly, there is a situation where markets are missing to value the natural resources. In the absence of perfect markets, values of goods and services are not properly revealed. Secondly, even if markets exist, they do not do their job well due to market distortions, for example imperfect land property rights in the study area could lead to land degradation, in this case. Thirdly, uncertainty is involved about the demand and supply of natural resources and/or it is difficult to estimate, especially in the future due to the non rival and excludability nature of such resources. This is in the sense that, most economic markets capture, at best, the current preferences of the buyers and sellers. Fourthly, governments may like to use the valuation as against the restricted, administered or operating market prices for designing natural resources conservation programmes. Fifthly, in order to arrive at natural resource accounting, for methods such as Net Present Value methods, or for cost-benefit analyses, valuation is a necessity. Finally, for most natural resources, it is essential to understand and appreciate its alternatives uses apart from its direct value of the resources such as existence and indirect values (Kadekodi, 2001).

The expression of total economic value bears as an attempt to overcome the traditional evaluation of environmental goods, exclusively based on the use value attributed to goods considering direct benefits enjoyed by final consumers. It seems that the expression “total economic value” appeared for the first time in an essay by Peterson and Sorg in 1987, “Toward the measurement of total economic value”. Then the term was more and more used by other environmental economists.

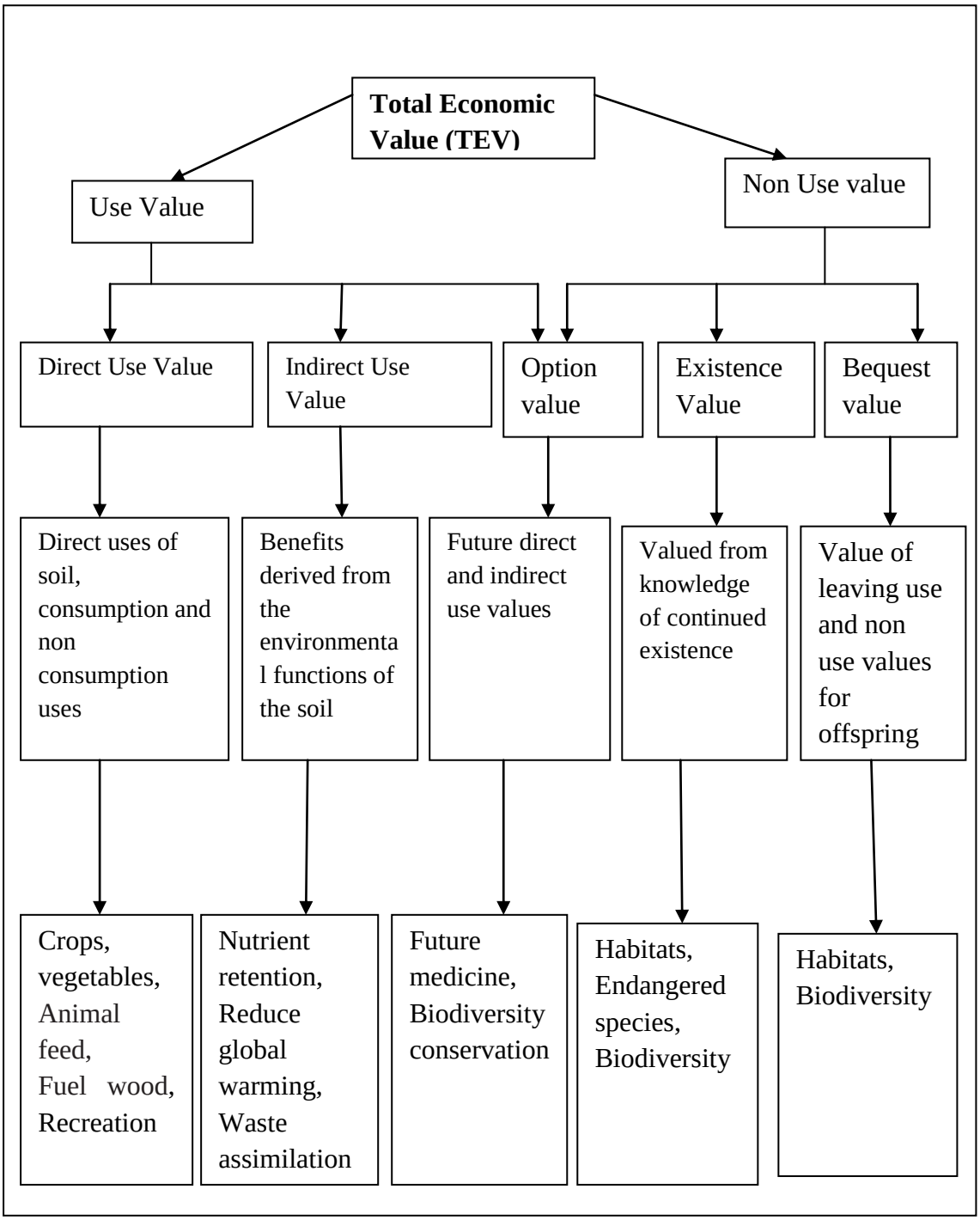
The use value derives from a concrete use of environmental goods. Every use, in any moment and by anyone is realized to create use values, which are more or less measurable since they derive from their current use. Increase in crop production can be considered as the use value of soil conservation.

But the total economic value is not only use value; it is given by the sum of use and nonuse values referring to intrinsic benefits, i.e. those deriving from the mere existence of environmental goods, in our case soil. The first economist, who identified the total economic value double feature, was Kutrilla, (1995). After Kutrilla the scholars interested in these topics have not been limited to theoretical analysis of the total economic value and of its components, but their attention is centered on an empirical analysis which allows them to identify the main features especially of non-use value and the different methods usable for their measurement.

As shown in Figure 2.1 the Total Economic Value (TEV) that people attach to an environmental good is the summation of use value and non-use value. Use value refers to the benefit people get by making actual use of the good now or in the future. Use value is divided into direct use value, indirect use value and option values. Protection from soil erosion is a direct benefit that comes from better soil management practices. By definition, use values derive from the actual use of the environment while non-use values are non-instrumental values which are in the real nature of the thing but unassociated with actual use, or the option to use the thing. Instead such values are taken to be entities that reflect people's preferences, but include concern for, sympathy with, and respect for the rights or welfare of non-human beings. Soil resources can be also valued for their potential to be available in the future. These potential future benefits constitute an option value. It may be

thought of as an insurance premium one may be willing to pay to ensure the supply of the soil resources later in time.

The theoretical framework for total economic values of soil conservation is depicted in Figure 2.1.



Source: Adopted from Hodge and Dunn 1992, cited in Marcouiller et al. (1999), with modifications

Figure 2.1: Components of TEV of Soil Resource

Non-use value is divided into existence and bequest value. Existence value is the value people attach to soil conservation service not because they want to use the soil now or in the future, but because they just want to make sure the soil exists. Bequest value is a non-use value that one expects his/her descendents to get from the soil conservation services.

2.4 Natural Resources Valuation Methods

Environmental valuation techniques help to estimate the value people attach to environmental amenity or services, i.e., how much better or worse off individuals are or would be as a result of a change in environmental quality. Since there are no existing markets for environmental goods, people's valuation for these kinds of goods could be elicited using two techniques. When a valuation technique considers related or surrogate markets in which the environmental good is implicitly traded, it is referred as a revealed preference method or indirect valuation method. Examples of this valuation method include the travel cost method (TCM), the hedonic pricing method (HPM), the production function method (PFM), the net factor income method (NFIM), the replacement cost method (RCM), the market prices method (MPM), and the cost-of-illness method (CIM). The second category of environmental resource valuation methods is known as the stated preference method or direct valuation method. These comprise survey-based methods that can be used either for those environmental goods that are not traded in any market or for assessing individuals' stated behavior in a hypothetical setting. The method includes a number of different approaches such as choice experiment method (CEM), contingent valuation method (CVM) and conjoint analysis (CAM) (Aklilu, 2002; Tietmberg, 2003; Birol et al., 2006 cited in Habtamu, 2009).

But for this study, only contingent valuation method was used to elicit the WTP of households for soil conservation practices. One reason for using CVM is its superiority over other valuation methods, which is its ability to capture, both use and non-use values. Using other valuation methods such as hedonic pricing and travel cost method would underestimate the benefits people get from soil conservation since they measure use values only (Aklilu, 2002).

The other reason for using CVM is its ease of data collection and requirement compared to other valuation methods. Further, the other methods such as TCM and HPM are based on Marshallian demand which does not hold utility constant, which is difficult to measure the change in welfare if utility does not hold constant. Therefore, CVM is the best valuation method available for measuring the total value people give for soil conservation in Adwa, Ethiopia.

2.5 Theory of Welfare Economics

The basic concept of welfare economics is that the purpose of any economic activity is to increase the wellbeing of the responding individual or economic agent. In our case, the basic assumption is that, individuals make decisions to maximize their utility based on how well he or she is given situations and constraints. From this, it follows that the basis for deriving measures of economic values is based on the effect of the hypothesized project on respondent's wellbeing.

Welfare economics, whose theory relates to the basic theory of individual preferences and demand for goods, seeks to make judgments about the desirability of having some projects undertake to generate some benefits or payments of compensation not to do

projects (Alebel, 2002). Welfare economics can be measured by a cardinal utility theory. However, a welfare measure based on the cardinal theory has drawbacks to correctly measure the welfare change of a given project in the sense that it assumes utility is measurable in a cardinal sense and comparable across individuals. According to Alebel (2002), the notion of cardinal utility had been completely rejected in favour of an ordinal definition of utility. This ordinal definition of utility enables consumers to preferentially rank alternative bundles of goods in a manner consistent with certain axioms of rational behaviour that include completeness, transitivity, convexity and non-satiation.

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. That is, 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.

This allows the calculation of net gain or loss from a policy change, and determination of whether the change is potentially Pareto improving. The gains from changes in environmental quality can be derived from the effects in 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 this case.

Benefit can be measured using either the consumer surplus, the area under the Marshalian demand curve, or one of the four which Hicks (1943) suggested; compensating variation (CV), equivalent variation (EV), compensating surplus (CS) and equivalent surplus (ES). Use of the Marshalian demand curve in stated preference methodology is problematic because utility is not kept constant. That is, in Marshalian demand analysis, the change in demand of the good to be valued due to a change in price, is the sum of the income as well as substitution effects. The income effect is the component of the total effect of a price change due to change in purchasing power. The substitution effect is the component of the total effect of a price change due to the change in the relative attractiveness of the good. This increase reflects a movement along the same indifference curve. This shows that when someone is interested to calculate the willingness to pay he has to remove the income effect, because the willingness to pay estimates should reflect the substitution effect only, where the individual utility level remains unchanged.

The limitation of the Marshalian demand of including both the income and substitution effects due to a price change to estimate the willingness to pay can be addressed by the Hicksian compensated demand. The Hicksian measures take only the substitution effect, where the individual's utility levels are kept constant along the compensated Hicksian demand curve. CV and CS are measures of the gains or loss which hold utility constant at the initial level while EV and ES are measures of welfare change which hold utility constant at some specified alternative level.

Policy interest usually lies in the potential benefits as measured from consumer's current or initial level of utility. Furthermore, if the proposed change is welfare increasing, which is the focus of this study, then the appropriate welfare measure is

the compensating surplus (Mitchell and Carson, 1989). This measure can be interpreted as the consumer's maximum willingness to pay in order to gain the quantity increase and still maintain his initial level of utility.

If one is interested to estimate the Hicksian demand curve in order to calculate the benefit of policy change, he/she must correctly estimate the demand function for the improvement of the public good. However, this task is difficult due to the fact that estimation of demand requires substantial methodological efforts as well as due to lack of accurate market data for these goods. An alternative method to this is to use a hypothetical market model, which is a contingent valuation method, where hypothetical questions on their willingness to pay for a particular effect are presented to people. This method requires the creation of a market scenario that resembles actual market situation for goods and services, which does not have efficient market or no market at all. From the survey data obtained using contingent valuation method, not only a maximum willingness to pay data can be generated, which will be used to construct the demand curves but also used to conduct valuation process of the public good without having to estimate the actual demand curve (Alebel, 2002).

The willingness to pay to improve the productivity of the land using the concept of the Hicksian compensated surplus measure can be represented as follows (Holden and Shiferaw, 2002).

$$WTP = e(P, EU_0, K_0, Z^h) - e(P, EU_0, K_1, Z^h) \quad \text{.....(1)}$$

Where WTP is Hicksian compensating surplus, P is vector of prices, EU_0 is the current expected utility level, K_0 is the old soil conservation technology, and K_1 is the

new soil conservation technology that helps to maintain productivity, and Z^h represents farm and household characteristics as well as other exogenous variables that affect the WTP. The function e(.) is an expenditure function that represents the minimum expenditure level required to attain the initial level of utility EU_0 before and after the change. The WTP is therefore the difference in the level of expenditure required to attain the initial level of utility after the change in the soil conservation.

The households will be willing to participate in soil conservation if they perceive that the use of technology K_1 (soil conservation structure) would help them to maintain the productivity of their land, which otherwise would deteriorate due to erosion and other land degradation factors. Inclusion of household characteristics is important here as we are dealing not with pure consumers but with farm households who are both producers and consumers of their produce. These are entities that operate in imperfect market conditions, and their production and consumption decisions are not separable (Tessema and Holden, 2006).

2.6 Contingent Valuation Methods (CVM)

2.6.1 Theoretical Literature

CVM is an environmental valuation method, which uses a hypothetical market to appraise consumer preferences by directly asking their willingness to pay or willingness to accept for change in the level of environmental good or services. The contingent valuation method involves directly asking people, in a survey, how much they would be willing to pay for specific environmental services. In some cases, people are asked for the amount of compensation they would be willing to accept to

give up specific environmental services. It is called "contingent" valuation, because people are asked to state their willingness to pay, contingent on a specific hypothetical scenario and description of the environmental service.

If a researcher manages to correctly apply the procedures, CVM can able to capture the total value of the good- both use and non-use values and its flexibility facilitates valuation of a wide range of non-market goods. As a result, CVM is becoming the most preferred valuation method at present (Mitchell and Carson, 1989; Whittington, 1998). Although economists were slow to adopt the general approach of CVM, the method is now ubiquitous (Haab and McConnell, 2002).

In most CVM applications, the major steps are the following

- Deciding what change you are going to value
- Deciding how you are going to implement the questionnaire
- Designing and administering the CVM survey
- Analysis of the responses
- Estimating and aggregating benefits (WTP)
- Evaluating the CVM exercise (Validation Tests)

Contingent valuation survey consists three basic parts (Mitchell and Carson, 1989). First, a hypothetical description of the condition under which the good or service is to be offered as presented to the respondent. Second, questions which elicit the respondents' willingness to pay for the goods being valued are presented. Finally, questions on socio-economic, demographic characteristics and their use of the good or service under consideration are given to the respondents.

A CVM study could be undertaken using different elicitation methods or method of asking questions. This part of the questionnaire confronts the respondent with a given monetary amount, and one way or the other induces a response. This has evolved from the simple open-ended question of early studies such as 'What is the maximum amount you would pay for…..?' through bidding games and payment cards to dichotomous choice questions Below, we have discussed the approaches of asking questions that lead directly to willingness to pay or provide information to provide preferences (Haab and McConnell, 2002).

Open Ended Format: A CVM question in which the respondent is asked to provide the interviewer with a point estimate of his or her willingness to pay (ibid).

Bidding Games: This method starts by asking respondents whether they accept a given price for the good and higher or lower prices will be offered depending on the answer given to the initial prices. The bidding stops when iterations have converged to a point estimate of willingness to pay (ibid).

Payment Cards: A CVM question format in which individuals are asked to choose a willingness to pay point estimate (or a range of estimates) from a list of values predetermined by the surveyors, and shown to the respondent on a card (ibid).

Dichotomous or Discrete Choice CVM: A CVM question format in which respondents are asked simple yes or no questions of the stylized form: Would you be willing to pay $t? (ibid)

As it is discussed earlier, a CVM study could be undertaken using one of the above methods. But the first three methods have been shown to suffer from compatibility problems in which survey respondents can influence potential outcome by revealing values other than their true willingness to pay. 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 years researchers have introduced a follow up question to the dichotomous question (Alberini and Cooper, 2000). Hence, in this study, a double bounded dichotomous question and an open ended follow up was used. This approach is similar to real life situation in Ethiopia at a market where the seller first states some bid price for a good and then negotiation starts between the seller and the buyer. Some studies (for instance, Alemu, 2000; Paulos, 2002; Anemut; 2006, Habtamu, 2009) implement an elicitation procedure, which includes an initial dichotomous choice payment question followed by another question.

2.6.2 Bias Issues in Contingent Valuation Methods

Although CVM is the best method for valuing non marketed goods, it has some limitations. One of the main limitations of a CVM study is that due to the hypothetical nature of the good which is going to be valued. This relates to the fact that, many people have little experience in making explicit value of the environmental good especially the non use values. Therefore, some people have difficulties to accept

results obtained through CVM as true willingness to pay which will be revealed if the good valued were to be supplied in reality. But many studies have shown that CVM can give a reliable result if applied correctly and carefully (Whittington, 1998; Alberini and Cooper, 2000).

The other main limitation of a CVM study is that, it looks only at the demand side of the public good. It is argued that as an expressed-preference valuation method, CVM is inherently susceptible to various types of bias. Biases can be broadly classified into: general (strategic) and instrument (starting point bias). The designer of CVM study should, therefore, take these possible biases into consideration (Paulos, 2002). Some of the biases in CVM study are discussed below.

Starting point bias: This is a bias that occurs when the respondent's willingness to pay is influenced by the initial value suggested to the respondent to take it or leave it. This problem is encountered when the elicitation format involves starting values.

Hypothetical bias- The unique future of CVM is its hypothetical nature of the good and hence could be suffered from hypothetical bias. If respondents are not familiar with the scenario presented, their response cannot be taken as their real willingness to pay. This bias can be minimized by a careful description of the good under consideration for the respondents.

Compliance bias–occurs when the interviewer is leading the respondent towards the answer he/she is expecting. Compliance bias can also come because of the sponsor of the good being valued. This bias can be reduced by carefully designing the survey,

good training of the interviewers and good supervision of the main survey (Mitchell and Carson, 1989).

Strategic bias –arises when the respondents expect something out of the result of the study and report not their real WTP/WTA but something which they think will affect the research outcome in favour of them. Respondents may tend to understate their true willingness to pay if they think they have to pay their reported willingness to pay, but their response will not affect the supply of the good. But if they think they will not pay their reported willingness to pay and if they want the good to be supplied they overstate their WTP for the good (Mitchell and Carson, 1989). To reduce this bias, giving detailed description of the good being valued and telling the respondent that the objective of the study is only for designing policy also helps.

2.7 Empirical Studies

Basarir et al. (2009), analyzed producer's willingness to pay for improved irrigation water in Turhal and Sulvova regions of Turkey. A survey technique was implemented via face to face interview with 130 randomly selected producers to elicit the willingness to pay, as well as, to collect data for the factors responsible for willingness to pay. The researchers used Tobit and Heckman sample selection model for data analysis since their data were censored at zero. The researchers finally found that, producers who are male, from Turhal region, have more vegetable land, and polluted water were willing to pay more for increasing the quality of irrigation water.

Chukwuonee and Okorji (2008), had studied determines of willingness of households in forest communities in the rainforest region of Nigeria to pay for systematic

management of community forests using the contingent-valuation method. A multistage random-sampling technique was used in selecting 180 respondent households used for the study. The value-elicitation format used was discrete choice with open-ended follow-up questions. A Tobit model with sample selection was used in estimating the bid function. The findings show that some variables such as wealth category, occupation of the household head, number of years of schooling of the household head and number of females in a household positively and significantly influence willingness to pay. Gender (male-headed households), start price of the valuation, number of males in a household and distance from home to forests negatively and significantly influence willingness to pay. Finally, the researchers recommend that incorporating these findings in initiatives to organize the local community in systematic management of community forests for non timber forest products conservation will enhance participation and hence poverty alleviation.

Alemu (2000), uses a CVM in his study on community forestry in Ethiopia. The researcher examines the determinants of peasants' willingness to pay (WTP) for community woodlots that are financed, managed and used by the communities themselves. He used a Tobit model with sample selection to test for selectivity bias that may arise from excluding (discarding) invalid responses (protest zero, missing bids and outliers) in his empirical analysis of theoretical validity of responses to the valuation question. The value elicitation method used in his paper is discrete question with open-ended follow up. A total of 480 rural household samples were used, and the survey was administered through face to face interviews. He included income, household size, age-sex composition, sex, education of household head, distance of homestead to the proposed place of plantation and other variables as explanatory

variables which can affect willingness to pay. The results of his study showed that income, household size, number of trees owned, distance of homestead to plantation and sex of household head are important variables that explain WTP for community woodlots in rural Ethiopia. The study also found that discarding invalid responses leads to sample selection bias, and suggest that community afforestation projects should consider household and site specific factors.

Anemut (2006), was the one who conducted a CVM study to analyse the determinants of farmers willingness to pay, intensity of payment and expected net loss of the Simen Mountains National Park (SNPA) in Ethiopia. A three stage random sampling technique was used to select 100 respondents. He founds that farmers were willing to contribute only labour for the park conservation and he forced to take only labour for the elicitation of WTP. He used Heckman two stage econometric estimation procedure. Results from the probit model showed that age of the household head and degradation of farm plots were negatively and significantly related to the probability of farmers' willingness to pay. On the other hand, developmental projects intervention as a result of the park, total livestock unit, total cultivable land, perception of environmental degradation and land tenure security were found to positively and significantly relate to the willingness to pay for the conservation of the SMNP. The results of second stage estimation for labor contribution intensity showed that, training related to soil and water conservation, farm plot degradation, satisfaction with conflict resolution mechanism of the park management and distance from the Woreda town was negatively and significantly related to labor contribution intensity.

However, economic benefits obtained as a result of improved technologies and total income received from touristic activities was positively and significantly related to

labor contribution intensity. Furthermore, his second stage estimation results of the expected net loss regression showed that, sex of the household head and existence of farm plots with in the park boundary are positively and significantly related to expected net loss. However, age of the household head, number of oxen, distance from the Woreda centre, dependency ratio and willingness of the households to pay were found to negatively and significantly relate to expected net loss.

Using data from the national family health survey of India which was conducted by the International Institute for Population Sciences in 1998-1999, Jalan et al. (2009), analyzed the relationship between awareness and the demand for environmental qualities. They took schooling, exposure to mass media, and other measures of awareness on home water purification. They found that, these measures of awareness have statistically significant effects on home purification and, therefore, on willingness to pay. These effects were similar in magnitude to the wealth effects. Average costs of different home purification methods were used to generate partial estimates of willingness to pay for better drinking water quality.

Speelman et al. (2010), used contingent ranking to analyse the willingness to pay (WTP) of smallholder irrigators for changes in the water rights system in South Africa. A contingent ranking is a method survey-based technique for modelling preferences for goods, where goods are described in terms of their attributes. The results indicate that smallholders are prepared to pay considerably higher water prices if these are connected to improvements in the water rights system. By segmenting the population the researchers were also shown that the importance attached to water rights dimensions varies in each segment. While lower institutional trust and lower income levels lead to a lower WTP for transferability, experiencing water shortage

increases this WTP. Finally, the researchers conclude that, such information is valuable in guiding policymakers in the future design of water rights.

Zewudu & Yemsirach (2004), on their study of people's willingness to pay for the Netchsar National Park, Ethiopia also used a CVM. The Guji and Kore communities have settled in eastern part of the park and in areas adjacent to the park. These pastoralist communities use the park for cattle grazing purposes. For this and other reasons, the park is endangered. The researchers used a dichotomous choice contingent valuation method (CVM) format to elicit the willingness to pay. The results showed that the means for WTP are Birr 28.34 and Birr 57.07 per year per household for Guji and Kore communities, respectively and its determinants were primary economic activity of the household, dependency ratio and distance from the park. The study suggested that the park management should involve the local community in its conservation endeavour and share the benefits with them.

Tessema and Holden (2006), assessed farmer's willingness to pay for soil conservation practices in southern Ethiopia. Based on data collected from 140 farm households operating 556 plots, descriptive statistics indicate that majority of the households in the study area perceive the severity of land degradation in their village and especially on their private farms, in terms of soil erosion and nutrient depletion. Contingent valuation results indicate that about 96 percent of the respondents were willing to contribute labour to conserve soil in their farms. When the payment is in cash, about 84% were willing to pay. Household random effect model was used to empirically investigate the determinants of the farm households' willingness to pay or contribute for soil conservation. The empirical result shows that WTP is affected by perception of erosion, poverty in terms of resource endowment and cash, and plot

characteristics. The study noted that the farm households are able to contribute more in terms of labour than money due to sever cash poverty. Using labour days as a payment vehicle for WTP studies in similar areas would provide a more sensible outcomes than using monetary payments.

In this chapter the problem of soil erosion has been reviewed. From the literature it was found that soil erosion is a great treat to Ethiopia which accounts a substantial loss of the GDP. This chapter also presents the economic values of natural resources and their methods of valuation. The method of contingent valuation which this study uses for valuing soil conservation practices in Adwa Woreda was also critically reviewed. The literature shows that despite its limitations, contingent valuation can be applied in less developing countries like Ethiopia to value non marketed goods. Contingent valuation studies that have been done by other researchers were also presented.

CHAPTER THREE

3.0 METHODOLOGY

This chapter presents the methodology that was employed in this study. It includes the sample and sampling technique that was used to select the sample households, data sources and methods of data collection, field work procedure and questionnaire design. Later the probit and the bivariate probit model are discussed. The chapter concludes with the definition of the variables that were used in the probit model.

3.1 Sample and Sampling Technique

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 this study from expanding to other Zones or Woredas (Districts) for investigation. However, the study randomly selected 5 rural Kebeles (Peasant Associations) from the 18 peasant associations of the Woreda (District). Further, farm households were selected using the probability proportional to the 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. The sample size was determined by the rule of thumb that every explanatory variable in the model to have at least 10 sample respondents.

Table 3.1: Summary of Surveyed Households

Name of Peasant Association	Total Households	Number of Sampled Households
Mariam-Shewito	1570	43
Gendebta	1806	49
Bet- Yehanes	1575	43
Endaba-Gerima	1651	45
Yeha	1686	46
Total	**8288**	**225**

Source: Woreda Administration office and own calculation

3.2 Data Source and Method of Data Collection

Primary data were collected from sample respondents through a structured questionnaire (Appendix I), via face to face interview. The primary data were collected on the demographic, social, institutional, economic, awareness, and willingness to pay for soil conservation practices. Four enumerators from Axum University were used to undertake the data collection. Prior to data collection training was given to the enumerators on method of data collection and interviewing techniques. Discussion with stockholders was also the sources of primary data. Continuous supervision was made by the principal researcher to correct possible errors on the spot. Secondary data were obtained from various sources such as reports of Ministry of Agriculture and Rural development (MOARD), Adwa Woreda Agriculture and Rural Development Office (AWARDO), Journal articles.

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).

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, this study employs the double-bounded dichotomous choice format to elicit respondents' WTP for soil conservation practices in the study area.

3.3 Field Work Procedure and Questionnaire Design

The survey questionnaire of this study has three parts. The first part of the survey questionnaire includes information about some socio economic variables of households, perception of respondents, 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 questionnaire 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 pre-test 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 pilot survey of the survey i.e. the respondents were not willing to pay any amount of cash for the proposed soil and water 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 resource endowment and institutional characteristics of the sampled respondents.

An important issue in the implementation of the CVM 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.

3.4 Method of Data Analysis

3.4.1 Theoretical Framework

Following Yu and Abler (2010), if the indirect utility function for a respondent is given by $V(p, q^*, l)$, given labour endowment of the household l, soil conservation quality q^* and an exogenous price vectors p. If the respondent decides not to protest

and participate in bidding, and she/he is willing to contribute some labour $t(t \geq 0)$ for improving soil conservation quality (e), the indirect utility function can be represented by $V(p, q^* + e, l - t)$. Under the market equilibrium, the indirect utility function becomes;

$$V(p, q^*, l) = V(p, q^* + e, l - t) \quad \text{.....(2)}$$

Suppose soil conservation improvement and labour changes are very small, and we can take the first order approximation of $V(p, q^* + e, l - t)$.,

$$V(p, q^* + e, l - t) \approx V(p, q^*, l) + \frac{\partial V(p, q^*, l)}{\partial q^*} e - \frac{\partial V(p, q^*, l)}{\partial l} t \quad \text{.....(3)}$$

Combining equation (1) and (2), we have

$$WTP = t = \frac{\partial V(p, q^*, l) \big/ \partial q^*}{\partial V(p, q^*, l) \big/ \partial l} e \quad \text{.....(4)}$$

Equation (3) indicates that WTP may be zero for some person when his/her marginal utility of soil conservation quality $\partial V(p, q^*, l) / \partial q^*$ is zero, or when the marginal utility of labour endowment $\partial V(p, q^*, l) / \partial l$ tends to infinity; otherwise, it will be a positive number.

3.4.2 Empirical Model Specification

3.4.2.1 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:

$$U_i = U_i(L, Z, q) \quad \text{.....(5)}$$

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;

$$U_i^1(L - BID, Z, q^*) + e_1 \geq U_i^0(L, Z, q) + e_0 \quad \text{.....(6)}$$

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 with zero means and independently distributed. 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;

$$U_i^t = f(X_{ti}) + e_{ti}, t = 0,1 i = 1,2,.....n \quad \text{.....(7)}$$

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 modelled as binary response variable Y, Where,

$$Y_i = \begin{cases} 1, if U_i^{\ 1}(R_e - BID, Z, q^*) + e_1 \geq U_i^{\ 0}(R_e, Z, q) + e_0 \\ 0, otherwise \end{cases} \quad \text{.....(8)}$$

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

$$\Pr ob(Y_i = 1) = \Pr ob(U_i^1 > U_i^0) \quad \text{.....(9)}$$

If we substitute equation 9 to 7

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

By rearranging Equation (10), we get,

$$\Pr ob(Y = 1) = \Pr ob\left[(\varepsilon_{1i} - \varepsilon_{0i}) > X_i(\alpha_0^{'} - \alpha_1^{'})\right] \quad \text{.....(11)}$$

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

$$\Pr ob(Y = 1) = \Pr ob(u_i > X_i \beta) = F(X_i \beta) \quad \text{.....(12)}$$

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;

$Y_i^* = \beta' X_i + \varepsilon_i$ .....(13)

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

$Y_i = 0$ 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, σ)

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 $F(y_i^*; \beta)$ where β represents the parameters of this distribution, which are to be estimated on the basis of the responses to the CVM survey.

3.4.3 Estimation of the Mean Willingness to Pay

The bivariate probit model was also used to estimate the mean WTP from the double bounded dichotomous choice format. The mathematical estimation of the bivariate probit model is presented below.

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 $\mathbf{t^2}$; if she/he answers ‘’no’’ for the initial bid, $\mathbf{t^1}$ she/he receives a lower follow-up bid $\boldsymbol{t^2}$. 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 (Haab and McConnell, 2002):

1. $t^1 \leq WTP < t^2$ for the yes-no responses;
2. $t^1 > WTP \geq t^2$ for the no-yes responses;…….....…..(14)
3. $WTP \geq t^2$ for the yes-yes responses;
4. $WTP < t^2$ for the no-no responses;

The most general econometric model for the double – bounded data comes from the formulation below (*ibid*).

$$WTP_{ij} = u_j + \varepsilon_{ji} \text{.....(15)}$$

Where WTP_{ij} represents the ith respondent’s willingness to pay, and j=1, 2 represents the first and second answers. u_1 and u_2 are the means for the first and second responses.

The probability of observing each of the possible two-bid response sequences (yes-yes, yes-no, no-yes, no-no) can be represented as follows.

$$\Pr(yes,no) = \Pr(WTP_{1i} \geq t^1, WTP_{2i} < t^2) = \Pr(u_1 + \varepsilon_{1i} \geq t^1, u_2 + \varepsilon_{2i} < t^2)$$
$$\Pr(yes,yes) = \Pr(WTP_{1i} \geq t^1, WTP_{2i} \geq t^2) = \Pr(u_1 + \varepsilon_{1i} \geq t^1, u_2 + \varepsilon_{2i} \geq t^2)$$
$$\Pr(no,yes) = \Pr(WTP_{1i} < t^1, WTP_{2i} \geq t^2) = \Pr(u_1 + \varepsilon_{1i} < t^1, u_2 + \varepsilon_{2i} \geq t^2) \quad \text{.....(16)}$$
$$\Pr(no,no) = \Pr(WTP_{1i} < t^1, WTP_{2i} < t^2) = \Pr(u_1 + \varepsilon_{1i} < t^1, u_2 + \varepsilon_{2i} < t^2)$$

Each individual respondent (ith) contribution to the likelihood function becomes

$$L_i(u/t) = \Pr(u_1 + \varepsilon_{1i} \geq t^1, u_2 + \varepsilon_{2i} < t^2)^{YN} X \Pr(u_1 + \varepsilon_{1i} \geq t^1, u_2 + \varepsilon_{2i} \geq t^2)^{YY}$$
$$X \Pr(u_1 + \varepsilon_{1i} < t^1, u_2 + \varepsilon_{2i} < t^2)^{NN} X \Pr(u_1 + \varepsilon_{1i} < t^1, u_2 + \varepsilon_{2i} \geq t^2)^{NY} \quad \text{.....(17)}$$

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.

Given the dichotomous choice responses to each question, the normally distributed model is referred to as the bivariate probit model. The likelihood function for the bivariate probit model can be derived as follows. The probability that $WTP_{1i} < t^1$ and $WTP_{2i} < t^2$ i.e. the probability of a no-no response is;

$$\Pr(u_1 + \varepsilon_{1i} < t^1, u_2 + \varepsilon_{2i} < t^2) = \Phi_{\varepsilon 1 \varepsilon 2}\left(\frac{t^1 - u_1}{\sigma_1}, \frac{t^2 - u_2}{\sigma_2}, \rho\right) \quad \text{.....(18)}$$

Where $\Phi_{\varepsilon 1 \varepsilon 2}(.)$ is the standard bivariate normal cumulative distribution function with zero mean, and unit variance and correlation coefficient ρ. Similarly the probability of no- yes response is;

$$\Pr(u_1 + \varepsilon_{1i} < t^1, u_2 + \varepsilon_{2i} \geq t^2) = \Phi_{\varepsilon 1 \varepsilon 2}(\frac{t^1 - u_1}{\sigma_1}, \frac{t^2 - u_2}{\sigma_2}, \rho) \quad \text{.....(19)}$$

The probability of yes – no response is;

$$\Pr(u_1 + \varepsilon_{1i} \geq t^1, u_2 + \varepsilon_{2i} < t^2) = \Phi_{\varepsilon 1 \varepsilon 2}(\frac{t^1 - u_1}{\sigma_1}, \frac{t^2 - u_2}{\sigma_2}, \rho) \quad \text{.....(20)}$$

And, the probability of yes-yes response is;

$$\Pr(u_1 + \varepsilon_{1i} \geq t^1, u_2 + \varepsilon_{2i} \geq t^2) = \Phi_{\varepsilon 1 \varepsilon 2}(\frac{t^1 - u_1}{\sigma_1}, \frac{t^2 - u_2}{\sigma_2}, \rho) \quad \text{.....(21)}$$

Defining y_{1i}=1 if the response to the first question is yes, and 0 otherwise, y_{2i}=1 if the response to the second question is yes, and 0 otherwise, $d_{1i}=2y_{1i} - 1$ and $d_{2i}=2y_{2i} - 1$, the ith contribution to the bivariate probit likelihood function becomes;

$$L_i(u/t) = \Phi_{\varepsilon 1 \varepsilon 2}\left(d_{1i}\left(\frac{t^1 - u_1}{\sigma_1} \right), d_{2i}\left(\frac{t^2 - u_2}{\sigma_2} \right), d_{1i} d_{2i} \rho \right) \quad \text{.....(22)}$$

But, when the estimated correlation co-efficient of the error terms in bivariate 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.

Following, Green, (1997), a Bivariate Probit Model can be specified as:

$$
\begin{aligned}
&y_1^* = \beta_1 X_1^{'} + \varepsilon_1; \\
&y_2^* = \beta_2 X_2^{'} + \varepsilon_2 \\
&E(\varepsilon_1 \mid X_1, X_2) = E(\varepsilon_2 \mid X_1, X_2) = 0; \qquad (23) \\
&Var(\varepsilon_1 \mid X_1, X_2) = Var(\varepsilon_2 \mid X_1, X_2) = 1; \\
&Cov(\varepsilon_1, \varepsilon_2 \mid X_1, X_2) = \rho
\end{aligned}
$$

Where: $y_1^* = i^{th}$ respondent unobservable true WTP at the time of the first bid will offered. WTP=1 if $y_1^* \geq X_1$ (initial bids), 0 otherwise.

$y_2^* = i^{th}$ respondent implicit underlying point estimate at the time of the second bid is offered.

The mean willingness to pay (MWTP) from bivariate probit model (Equation 16) can be calculated using the formula specified by Haab and McConnell (2002).

$$MWTP = \frac{-\alpha}{\beta} \qquad (24)$$

Where α = a coefficient for the constant term

β = a coefficient offered bids to the respondents

3.5 Definition of Variables

The Dependent Variable of the Model: The dependent variable is a binary choice variable and measuring the willingness of households to pay for soil conservation practices of labour contribution. The value of the dependent variable takes 1 for the "yes" to the initial bid, zero otherwise.

The Independent Variables of the Model: With market imperfection, the probability or the level of farm household's WTP for soil conservation depends on various factors such as poverty and household characteristics, than only farm characteristics (Tessema and Holden, 2006). Based on the findings of past studies on households' willingness to pay for non market goods, decisions on investment and participation, the following variables were hypothesized to determine household' willingness to participate in soil conservation practices.

Age of the house hold head (**AGE**): This is a continuous variable indicating the age of the household head in years. The age of farm household head may have either negative or positive effect on soil conservation willingness. Older age may shorten planning time horizon and reduce the WTP; or it may relate to farm experience and increase willingness to improve the soil for better productivity (Tessema and Holden, 2006). The longer farming experience, here equated with the older farmers is expected to have a positive effect on conservation decision. On the other hand, young farmers may have a longer planning horizon and, hence, may be more likely to invest in conservation. Yitayal (2004), Tessema and Holden (2006), found a negative and significant relationship, on the contrary, Demeke (2003), found a positive relationship

between age and soil conservation investment decisions. So, the effect of age of the household head to willingness to pay for soil conservation can be positive or negative.

Education level of the Household head (EDUCATION): This is the number of years that the household head had spent in a formal school. Household heads who have high level of education can better understand the problem of soil erosion, hence would be willing to contribute to the specified bid. Household heads with better education are expected to understand consequences of degradation and be willing to invest more in soil conservation (Tessema and Holden, 2006). Paulos (2002), reported a positive relationship. It had a positive and strong relationship with the dependent variable showing that literate household heads were more to recognize the advantages of soil conservation and was willing to take part in it. Similarly, Yitayal (2004), in his study in Jimma Zone found a positive relationship. So, the expected sign of Education level of the household head is positive.

Social Position (SPOSITION): Is a dummy variable which takes 1 if the household has some social position in its community; 0, otherwise. Social position of the household head is expected to affect willingness to pay positively.

Household Size (FSIZE): It is a continuous variable which refers to the number of family members of the household. This explanatory variable is included because it affects the labour supply at household level. Some soil conservation technologies are labour intensive and this may have a positive implication on whether the household can decide to participate in the soil conservation practices.

Gender of the Household Head (SEX): This is recorded as dummy variable (1=male, 0=otherwise) and is included in the model to find out the influence of Gender for soil conservation willingness to pay. Male farmers have a probability of getting more access to information than female household heads. Doss and Morries (2001), as it is cited in Behailu (2009), confirmed that women farmers tend to adopt improved technologies at a lower rate than men because of limited access to information and resource. This can be further justified that soil conservation structures need intensive labour so male headed households are expected to be more willing than female headed households. It is, therefore, hypothesized that sex of the household head will have a positive influence on the WTP.

Farm Size (FASIZE): It is a continuous variable expressed in terms of hectares of cultivable land owned and expected to have a positive effect on the willingness of farmers to pay for the soil conservation. This is because farmers who have more cultivable land are expected to be more willing to devote some land for soil conservation structure and are expected to pay for the soil conservation practices. This hypothesis is similar to the findings of Paulos (2002), where total cultivable land was found to be positively associated with willingness to pay for soil conservation.

Farmers' perception of erosion hazard (PERCEPTION): This is a dummy which takes 1 if the household perceives the problem of soil erosion, zero otherwise. The recognition of the soil erosion problem is considered to be vital for soil conservation decision. In other words, farmers who have already perceived the problem of soil erosion are more likely to be willing to participate in soil conservation activities than those who have not perceived the problem (Paulos, 2002). Thus, the perception

variable will be expected to be strongly and positively associated with farmers' willingness to pay for soil conservation.

Farm land forgone by erosion (FEROSION): This is a dummy variable which takes 1 if the farmer had abandoned a farm land because of soil erosion, zero otherwise. It is expected to have a positive influence on willingness to pay.

Distance to the nearest market (DISTANCE): This is a continuous variable which refers to the amount of time in minutes that a farmer spends to reach to the nearest market from home. The average time the farmer must travel from the residential area to the nearest market may have an effect on the willingness to pay for conservation practices. It is hypothesized that the further away the residential area of the household from the nearest market, less is expected to be willing to participate in soil conservation practices because it is expected to compete with selling of products. So, Distance to the nearest market is expected to have a negative effect on WTP.

Total livestock holding in Tropical Livestock Unit (TLU): This refers to the total number of livestock (measured in Tropical Livestock Units, TLU) the farmer owns. In Ethiopia, livestock are important source of cash income, food, household energy, manure and source of power for cultivation. It is, therefore, hypothesised that the higher the livestock holding the higher the household will be willing to pay for soil conservation practices.

Farm Income (FARMINC): This is a continuous variable which is the total income from crop production, animal selling, off farm income as well as remittance that the

household gets in a year, valued in Ethiopian birr. It is expected to have a positive relationship with WTP.

Perception to Security of Tenure (TENURE): A dummy variable, which is a proxy for security of land tenure that takes a value 1 if the peasant considered that he/ she would be able to use the plot area at least during his/her life time, zero otherwise. The incentive to land improvement decision is based on part of secured future access to land. Hence, a positive effect was expected.

Frequency of extension contact (FREQEXTENSION): This is continuous variable which is the number of days that the farmer had contact with extension agent in a year. Extension is a way of building the human capital of farmers by exposing them to information that reduces uncertainty (Feder et al. 1985). In this study this variable is expected to affect willingness for soil conservation of farmers positively. This is because extension intervention is expected to strengthen technology usage of the farmers which further improves the income status and thus resulting in increase in the willingness of the households to use soil conservation practices.

Labour Shortage (LSHORTAGE): This is a dummy variable which takes 1 if the household has a labour shortage for farm activities and had hired some labour for farm activities and 0, otherwise. We expect to have a negative relationship with willingness to pay.

Amount of Credit: This is a continuous variable which is the amount of money that the household gets in the past two year from formal and informal credit sources.

Credit might relax cash constraint and might enhance willingness to pay. Hence, it was hypothesized that there would be a positive relationship.

Initial offered Bid (BID1): This is bid price offered to the respondents. In this study the bid price was used as one of the explanatory variables in the analysis. The bid price is expected to influences negatively to the willingness to pay of the respondents'.

The purpose of this chapter was to present the methodology that was used in the study. A two stage simple random sampling was used to select the sampled households for the final study. Data were collected through face to face interview via trained enumerators. Descriptive statistics as well as econometric models were developed to analyse the collected data from the sampled households. The variables that were used in the econometric model were also defined in this chapter.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

This chapter presents, the results obtained from the sample respondents. The first section provides descriptive statistics of the survey results. The second section deals with the analysis of determinants of respondents' WTP for soil conservation practices. The last section computes mean WTP, estimation of total WTP and aggregate demand for soil conservation practices. The descriptive analysis made use of tools such as mean, percentages, standard deviation and frequency. Econometric analysis was used to identify the determinants of willingness to pay and to estimate the parametric mean of WTP. The statistical significance of the variables was tested using chi-square (χ^2) and F statistics.

4.1 Descriptive Statistics

4.1.1 Summary of Households' Characteristics

For this study, data were collected from 225 randomly selected respondents. Data from 218 respondents were utilized for the analysis. From the total sample of 218, 154 which are 70.6% of the respondents were male headed households and 64 which are 29.4% were female headed households. Out of the total sample households taken 128 (58.72%) were willing to take and contribute the pre specified initial offered bid and 90 (41.28%) of the households were not willing to pay the initially offered pre specified bid. Out of all the 90 non willing households, male headed households contribute 53.33 % while female headed households were 46.67%. On the other hand,

from the total 128 willing households, 82.81% were male headed households and 17.19% were female headed households. Table 4.1 indicates that there is strong relationship between sex of the household head and willingness status to accept the offered initial bid, which is significant at less than 1% probability level. This underlines that, sex difference is an important component in WTP decision.

Table 4.1: Sex Composition of Sample Households

SEX	Non Willing		Willing		Total		χ^2
	No.	Percentage	No.	Percentage	No.	Percentage	
Male	48	53.33	106	82.81	154	70.6	22.14***
Female	42	46.67	22	17.19	64	29.4	
Total	90	100	128	100	218	100	

*** Significant at less than 1% Non-Willing is a "No" answer for the first bid while Willing is a "Yes" answer for the first bid

Source: Own Survey, 2012

In addition, out of the 154 male headed households, 48 (31.17%) of them were not willing and the remaining 106 (68.83%) of them were willing to contribute the pre specified initial bid offered amount of labor for soil conservation practices. From the total 64 female headed households 42 (65.62%) were not willing to take the initial person days offered and the remaining 22 (34.38%) were willing to take up the initial bid of person days per year.

Table 4.2 shows the relationship of willingness to pay and marital status and social position of households in the study area. Of the total farmers surveyed, 149 (68.35%) were married, 69 (31.65%) were single (Divorced and Widowed). In addition, out of the 149 married respondents, 116 (77.6%) were willing and 33 (22.1%) were not willing. Furthermore, 59.4 percent of the single respondents were not willing and the rest 40.6 percent were willing to pay the initial bid. In addition, there is also statistically

significant relationship between willingness status and marital status of the household head showing that, marital status systematically and significantly relates with WTP status. This is mostly because married households have the capacity to accept the offered initial bid because they have more labour force (family size) than single households.

Table 4.2: Household Characteristics Marital Status and Social Position

	Non Willing		Willing		Total		
Marital status	No.	Percentage	No.	Percentage	No.	Percentage	χ^2
Married	45	50	104	81.25	149	68.35	23.85***
Single	45	50	24	18.75	69	31.65	
Total	90	100	128	100	218	100	
Social Position							
Yes	5	5.66	24	18.75	29	13.3	7.98**
No	85	94.44	104	81.25	189	86.7	
Total	90	100	128		218	100	

*** and ** significance level at less than 1% and 5% respectively

Source: Owen Survey, 2012

The sampled households had a total of 1320 family members averaging at about 6.06 with a minimum of 1 size and a maximum of 11 members in a household. The mean household sizes of the willing and non willing households were 6.89 and 4.43, respectively, and this difference is statistically significant at less than 1% probability level; showing that there was a significance difference between the willing and non-willing households in family size. This is because soil conservation practices are labour intensive activities and family size is an important resource endowment (Table 4.3).

The mean of the number of years that the household head spent on school was also computed as it is shown in Table 4.3. The result shows that, the mean of years that the

household head spent in school for the willing and no willing households are 2.39 and 0.56 years respectively. The total sample mean education level of the sampled household was 1.64 years. Similar to family size, the mean education level of the household heads of the willing and non-willing were statistically significant difference at less than 1% probability level. The significance effect of the variable indicates that the importance of education in influencing farmers to pay for soil conservation practices.

Table 4.3: Age, Family Size, Education and Distance to Market of Households

	Non Willing (N=90)		Willing (N=128)			
Variable	Mean	St.Err	Mean	St.Er	t test	Mean(N=218)
AGE	56.1	1.59	49.5	0.99	3.69***	52.22
EDUCATION	0.56	0.18	2.39	0.28	-4.92***	1.64
FSIZE	4.85	0.204	6.899	0.183	-7.36***	6.05
DISTANCE	71.678	5.5	66.21	4.33	0.788	68.47

*** Significant at less than 1% probability level
Source: Own Survey, 2012

Furthermore, the total sample age of the household heads of the respondents was 52.22 years. The willing households had a sample mean age of 49.44 years, while the counterfactuals had a sample mean of 57.65 years. The mean difference between the two groups was statistically significant at less than 1% probability level; showing that there is a strong relationship between age and willingness to pay. On the other hand, the mean amount of walking distance to the nearest market is 68.47 minutes and the value for willing household was 66.21 and that of the non-willing household was 71.678. However, there is no statistically significant difference between willing and non-willing households based on the number of minutes to walk to the nearest market.

4.1.2 Resources Ownership

The survey results showed that the households possession of cultivable land ranged from the smallest 0.125 ha (which is equivalent to half a ‘’timad’’) to the highest 2.5 ha (which is equivalent to 5 ‘’timad’’). The average size of cultivated land owned by the sample respondents was about 0.61 ha. Willing farmers owned on the average 0.66 ha of cultivated land. The corresponding figure for the non-willing farmers was 0.504 ha. The mean difference of own cultivated land for the two groups was significant at 5 % significance level (Table 4.4). This means, willingness tends to increase as farm size increases. This is probably because soil conservation practices take proportionally more space on small land holdings and the benefit from such practices on these small land holdings will not be enough to compensate for the decline in production due to the loss in area devoted to the conservation structures. On the other hand, households who have small land holdings may need to subsidize their income from off farm activities given productions are low from small land holdings and might not get time to spend on conservation practices.

Table 4.4: Farm Size, Income and TLU Ownership of Sampled Households

	Non Willingness (N=90)		Willing N(128)			
Variable	Mean	St.Err	Mean	St.Er	t test	Mean(N=218)
FASIZE	0.54	0.026	0.652	0.032	-2.57**	0.605
INCOME	4781.29	354.06	7865.98	316.4	-6.42***	6592.48
TLU	2.95	0.22	5.45	0.222	-7.81***	4.42

FASIZE= Total farm Size INCOME= Total income TLU= Total Livestock Units
*** and ** statistically significant at 1% and 5% respectively
Source: Own Survey, 2012

The mean income of the sample households was estimated to be 6592.48 Ethiopian birr[1] per annum. The main sources of income are crop production, livestock selling, laboring and off farm activities. The mean total income of the willing and non-willing was estimated to be 7865.98 Birr and 4781.29 Birr respectively. Table 4.4 shows that there is statistically significant difference between the two groups in terms of total income at less than 1% probability level. It was also tested whether or not there was a statistical difference between the willing and non willing households based on the total livestock possession (TLU). The results show that there is statistically significant difference at less than 1% probability level based on TLU among the two groups which had a mean of 2.95 for the non-willing and 5.45 for the willing. The total sample mean of TLU of the respondents was 4.42 units. This implies that resource possession indicators such as Income, TLU and Farm size gives farmers the capacity and courage to take soil conservation measures.

4.1.3 Physical Characteristics of Households Farm Land

The sample respondents were asked whether or not they have forgone farm land because of soil erosion. About 85% of the respondents reported that they have abandoned because of soil erosion while the rest 15% reported that they did not. 80 % and 88.28% of the non-wiling and willing households reported they have abandoned some proportion of their land because of soil erosion. As it is presented in the Table 4.5, there is no significant relationship between abandoned of farm land due to farm erosion and willingness status at 5% probability level. This shows both groups have abandoned some proportion of their cultivable land due to soil erosion.

[1] Birr is the local currency of Ethiopia. 1$ was equivalent to 17.23 birr in February 2012

Based on farmers understanding of slope and possibility of plots for oxen plough and hoe cultivation, farm plots were classified into four. These were; relatively flat farm plots, gently sloped farm plots, plots that have very steep slope but possible for oxen plough and plots that is very steep slope not possible for oxen plough. Out of the total sample surveyed, 2.29 % households had very steep slope lands (Table 4.5) and 50 % of the households had lands which are steep sloped, 41.28 % of the farmers have gently sloped lands. Only 6.43 % of the farmers had relatively flat plots. This shows how soil erosion is a serious problem in the study area. But, the results in Table 4.5 show that there is no statistically significant relationship.

Table 4.5: Physical Characteristics of Households Farm Land

	Non Willing		Willing		Total		
	No.	Percentage	No.	Percentage	No.	Percentage	χ^2
Farm Erosion							
Yes	72	80	113	88.28	185	84.86	2.82
No	18	20	15	11.72	33	15.14	
Total	90	100	128	100	218	100	
Farm Land Exposure to Erosion							
No risk	9	10	7	5.47	16	7.34	2.62
Medium	63	70	101	78.91	164	75.23	
High Exposure	18	20	20	15.62	38	17.43	
Total	90	100	128	100	218	100	
Average Slope of Farm Land							
Very Steep	2	2.22	3	2.34	5	2.29	5.14
Steep	48	53.33	61	47.66	109	50	
Gentle slope	31	34.45	59	46.1	90	41.28	
Flat	9	10	5	3.9	14	6.43	
Total	90	100	128	100	218	100	

Source: Own Survey, 2012

4.1.4 Perception of Soil Erosion Hazard

The level of perception of soil erosion problem is positively associated with age of the household head, the level of education of the household head and diffusion of information through extension and other channels (Shiferaw and Holden, 1998). Generally speaking, perception of soil erosion problem is an important factor for farmers to make decisions on conservation investments (Paulos, 2002). In the country (Ethiopia) in general, and in the study site in particular, soil erosion is accelerated by an alarming rate mainly because of expansion of farmland to hillsides by clearing the natural vegetation. In spite of this fact the extension advice provided to farmers regarding soil conservation and the practical actions being taken are minimal as compared to the severity of the problem (Paulos, 2002).

Table 4.6: Perception of Soil Erosion Hazard

	Non Willing		Willing		Total		
	No	Percentage	No	Percentage	No	Percentage	χ^2
Perception							
Yes	85	94.44	127	99.22	212	97.25	4.5**
No	5	5.66	1	0.78	6	2.75	
Total	90	100	128	100	218	100	

Source: Own Survey, 2012 ** Significance at 5%

More than 99% of the respondents who were willing to take the pre specified initial bid in soil conservation practices perceived soil erosion as a problem in their area. Similarly more than 94% of the non-willing households also perceive the problem of soil erosion in their area. This shows that the problem of soil erosion hazard is well perceived in the study area and there is a need to take action. Table 4.6 shows that there is statistically significant relationship between willingness status and perception

of soil erosion hazard at less than 5% probability level showing that perception of soil erosion hazard increases willingness to pay.

4.1.5 Land Tenure

Land tenure system which is the result of a complex interrelated linkage of social, cultural, economical, political and institutional system needs a special attention. In Ethiopia, government owns land and farmers have uses right and they can also rent their land (Behailu, 2009). The sampled households were also classified based on tenure security of their farm lands. 98.43 percent of the respondents who were willing to take the offered initial bid for soil conservation practices were secured that their farm land will be with them at least until their life time. Of the 90 respondents who were not willing to participate in soil conservation practices, 78.89% were secured that their farm land will be with them at least until their life time (Table 4.7). Table 4.7 shows that there is a statistically significant relationship between land tenure security and willingness to pay at less than 1% probability level showing that land tenure security is an important variable for households decision to participate in soil conservation practices. This implies that security of land at least until life time gives farmers opportunity to invest in soil conservation practices.

Table 4.7: Land Tenure Security of Sampled Households

	Non Willing		Willing		Total		
	No	Percentage	No	Percentage	No	Percentage	χ^2
Land Tenure							
Yes	71	78.89	126	98.43	197	90.37	23.2***
No	19	21.11	2	1.57	21	9.63	
Total	90	100	128	100	218	100	

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

4.1.6 Labor Availability

Any form of soil conservation activity demands labor input. In order to undertake the practice, farm households need to take some labor away from their farm activities (Paulos, 2002). Table 4.8 shows that a large number of non-willing farmers (about 38.89%) reported labor shortage as a problem as compared to the willing household which was only 13.28 percent. As can be seen in the Table 4.8, 23.85% of the total respondents had reported labor shortage as a problem, whereas labor shortage was not reported as a problem by 76.15% of the respondents and there was a statistically significant relationship between willingness status and problem of labor shortage. Showing that, labor is an important factor in determining willingness to pay for soil conservation practices.

Table 4.8: Labor Availability of Households

	Non Willing		Willing		Total		
	No	Percentage	No	Percentage	Number	Percentage	χ^2
Labour Shortage							
Yes	35	38.89	17	13.28	52	23.85	19.08***
No	55	61.11	111	86.72	166	76.15	
Total	90	100	128	100	218	100	

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

4.2 Analysis of Determinants of Households' WTP

Estimation results of the probit model are reported based on the theoretical model that has already been developed in chapter three. 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 less than 5% probability level.

Before running the econometric model, the independent (continuous) variables were tested for the presence of multicollinearity (Appendix IV). The result showed that there were no multicollinearity problems between the variables. The value for Contingency Coefficient(CC) (Appendix V) for the dummy variables were less than 0.75 and the value of Variance Inflation Factor (VIF) 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 (192.9) 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% probability level. 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, the data fits the model very well. The results are given in Table 4.9.

As indicated in Table 4.9 of the probit estimate, out of the total 16 explanatory variables hypothesized, 6 explanatory variables have positive and significant effects on probably of respondents accepting the offered initial bid, and 2 had negative and significant effect to the log likelihood of the probit model. On the other hand the rest 8 explanatory variables were found to be not significant at 5% probability level.

Table 4.9: Probit Model Estimates of WTP

Variables	Coefficients	Stad. Err	Z-Value	P-Value
AGE	-0.0396***	-0.0129	-3.07	0.0020
SEX	0.712**	-0.3480	2.05	0.0410
EDUCATION	0.309***	-0.0956	3.23	0.0010
SPOSITION	1.730	-0.9230	1.88	0.0610
DISTANCE	0.000704	-0.0032	0.22	0.8260
FSIZE	0.238**	-0.0941	2.53	0.0110
FASIZE	0.384	-0.6370	0.6	0.5470
PERCEPTION	4.674***	-1.5710	2.97	0.0030
FEROSION	-0.365	-0.4840	-0.75	0.4510
BID1	-0.0458***	-0.0100	-4.58	0.0000
LSHORTAGE	-0.681	-0.4110	-1.66	0.0980
EXTFREQUENCY	0.0113	-0.0227	0.5	0.6200
TENURE	2.074**	-0.8220	2.52	0.0120
INCOME	7.87E-05	-0.0001	1.37	0.1690
TLU	0.245***	-0.0910	2.69	0.0070
AMCREDIT	-5.98E-05	-0.0001	-1.1	0.2710
CONSTANT	-5.784***	-2.0230	-2.86	0.0040
Observations	218			
Log likelihood	-48.37			
LR chi2 (16)	192.9			
Pseudo R2	0.666			
Prob>Chi2	0.0000			

*** &** Significance at 1% and 5% respectively

Source: Own Survey, 2012

In the determinants of willingness to pay estimation of the probit model, the not significant explanatory variables were less important in explaining the variability in the willingness to pay. Thus, in this study only the significant explanatory variables were discussed below. However, it is noticed that, the non significant variables have also contributed to the log likelihood function of the probit model.

Age of the household head (AGE): Age of the household head had negative effect on the willingness to pay of households for soil conservation practices. It had negative and significant effect on households' WTP in person day's contribution at less than

1% level of significant. The descriptive statistics also shows there is a significant difference between the two mean.

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 the WTP. Thus, older 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. 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 labour shortage and reduce willingness to pay for soil conservation practices. The negative relationship between age and investment for environmental protection is consistent with the findings of Tegegne (1999), Yitayal (2004), and Solomon (2004).

Sex of the household head (SEX): Unlike age of the households, sex of the household head was found to have a positive effect to willingness to pay for soil conservation. The result of probit model revealed that male headed household heads were found to be willing to pay more 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. This is mainly because; female headed households have less resources possession endowment as well as some cultural constraints than meal headed households.

Education level of the household head (EDUCATION): This variable took the expected sign and its coefficient was significant at less than 1 percent probability level. 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. This could be possibly because, education increases environmental awareness and value for environmental goods such as soil. Tegegne (1999), and Paulos (2002), reported a similar result.

Family size of the household (FSIZE): The coefficient of this variable supports the proposed hypothesis and it was found to be significant at 5 percent probability level. Households with higher family size are expected to pay more than those who have less family size because the proposed project was by labour contribution. This is precisely because soil conservation practices are labor intensive to build and maintain, hence households with large labor may tend to pay more for conservation. The implication of the positive sign is that an increase in household family size increases the probability of a respondent to support the proposed voluntary labour contributions to soil conservation.

Perception of soil erosion (PERCEPTION): The sign of perception of soil erosion in a plot is turned out to be consistent with the a priori expectation and it was positively and strongly related with the yes answer to the first initial bid offered. That is, households that have perceived the problem of soil erosion in the study are willing to pay more than the farmers who didn't perceive the problem of soil erosion in their plot land. The coefficient of this variable was significant at 1% probability level. Paulos, (2002) also found similar result.

Initial bid offered (BID1): 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 indicates that the likelihood of accepting an offered bid amount increases as the bid amount goes down and vice versa which is consistent with the economic theory.

Land Tenure (TENURE): The coefficient of the variable land tenure appeared to be significant at 5% probability level with the expected sign. The implication of the positive sign is that a perception of security of the cultivated land at least until life time increases the probability of a farmer to support the proposed voluntary labour contributions. This result implies that it is land tenure security of farm land is an important determinant of the WTP for soil conservation practices.

Total Livestock Unit (TLU): TLU has an expected positive effect related to likelihood of saying yes to the first bid. The coefficient of this variable was significant at 1% probability level which shows TLU possession increases WTP. Livestock is considered as a measure of wealth and increased availability of capital which make WTP in soil conservation more feasible. The empirical findings by Jonse (2005), indicated that number of livestock in terms of tropical livestock unit plays an important role for willingness to pay. This is consistent with the fact that TLU is one of the wealth indicators and should have a positive contribution to willingness to pay.

In general, in the probit model farm land forgone because of erosion (FEROSION), distance to the nearest market (DISTANCE) and amount of credit received within the past two years (AMCREDIT) has the unexpected signs but statistically insignificant

with the prior expectations. Other variables such as total farm size (FASIZE), social position of the household head (SPOSITION), Labour shortage for farm activities (LSHORTAGE), frequency of extension visit in a year (EXTFREQUENCY) and total income (INCOME) has expected sign but statistically not significant at 5%.

It is clear, however, that the coefficients of the probit model do not indicate the marginal effects of explanatory variables on the variation of the dependent variable. That is, in the probit model only the signs (not the magnitudes) of the coefficients of independent variables are important. In order to analyze the effects of each explanatory variable on the probability that the respondent accepts the initial offered bid or rejects it, the partial derivatives of the dependent variable with respect to each explanatory variable must be taken (Greene, 1993). The marginal effects of the probit model estimation results are reported in the Table 4.10 below.

The interpretation of the marginal effects of the probit model indicates the change in the likelihood occurrence of an event due to the change of dummy variables from 0 to 1 and a unit change from the mean in the continuous explanatory variables at a time keeping the other variables constant at their mean.

Table 4.10: Marginal Effects of the Explanatory Variables

Variables	dy/dx	Stan .Err	Z-value	P-Value
AGE	-0.012***	-0.004	-2.84	0.0050
SEX	0.229	-0.118	1.94	0.0530
EDUCATION	0.091***	-0.024	3.78	0.0000
SPOSITION	0.279***	-0.076	3.67	0.0000
DISTANCE	0.0002	-0.0009	0.22	0.8260
FSIZE	0.07**	-0.028	2.47	0.0130
FASIZE	0.113	-0.186	0.6	0.5450
PERCEPTION	0.819***	-0.062	13.21	0.0000
FEROSION	-0.107	-0.142	-0.76	0.4490
BID1	0.0135***	-0.003	-4.68	0.0000
LSHORTAGE	-0.224	-0.151	-1.48	0.1380
EXTFREQUENCY	0.003	-0.007	0.49	0.6240
TENURE	0.609**	-0.282	2.16	0.0310
INCOME	0.00002	0.00002	1.41	0.1590
TLU	0.072***	-0.027	2.62	0.0090
AMCREDIT	-0.00002	-2E-05	-1.14	0.2540

*** &** significance at 1% and 5% respectively
Source: Own Survey, 2012

The result in Table 4.10 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% level of probability level. This indicated that older household heads are less willing to pay more for soil conservation practices in the study area.

The marginal effect estimates of the probit model showed education level of the household head (EDUCATION) has been found to relate to the probability of willingness to pay for the soil conservation practices positively and significantly. The result show that for each additional increment of education, the probability of the willingness of the household to pay for 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.

In addition, the result of the probit model showed that having social position in the study area was positively and significantly related to the probability of yes for the offered initial bid for conservation practices at less than 1 % probability level. This implies that farmers who have some social position in the study area are more willing to pay for the conservation practices. The reason might be due to the fact that having some social position increases responsibility hence willingness to pay for soil conservation practices. The estimated coefficient of 0.279 indicates having some social position increases willingness to pay by 27.9 percent.

The estimated coefficient of the total family size (FSIZE), which is one of the most crucial explanatory variables of probability of WTP, was found to be statistically significant at the 5% level with the expected positive sign. 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, a 1 person increase in the total family size increases the probability of willingness to pay by 7%. This is precisely because soil conservation practices are labor intensive to build and maintain, hence households with large labor are willing to invest more in conservation.

Perception about the existence of problem of soil erosion was happened to take the expected sign and significant at less than 1% probability level. Holding other things constant, the probability of a household willingness for conservation increases by

81.9% for perceived farmers than the other counter factual. This implies that, perception of soil erosion problem plays an important role in WTP decision.

Consistent with the earlier expectation and economic theory, the initial bid offered (BID1) has a negative and significant effect on the WTP for soil and water conservation practices at less than 1% level of significance. The marginal effect indicates that a one person days increase for the contribution of the proposed project reduces the probability of being willing to pay by nearly 1.4%.

The security of land at least until lifetime (TENURE) was positively and significantly related to the households' WTP to support the proposed conservation practices. This variable was expected and significant at less than 5% probability level. Holding other variables at their respected mean, a perception of land security at least until life time increases the household's WTP to support conservation practices by approximately 60.9 percent. This result implies that it is not only the capability of the farmers but also their perception of land security that influences the decision to participate in soil conservation practices.

Total Livestock Unit (TLU) has been found to relate to the probability of willingness to pay for soil conservation practices positively and significantly. TLU could be a proxy for wealth under Ethiopian farmers' condition. When the wealth of a household increases, the willingness to pay will also increase. The marginal effect show that for each additional increment of TLU, the probability of the willingness of the household to pay for the conservation practices will increase by 7.2%, keeping the other explanatory variables at their mean. This is consistent with the fact that TLU is one of the wealth indicators and should have a positive contribution to willingness to pay.

4.3 Households Willingness to Pay for Soil Conservation Practices

4.3.1 Descriptive Statistics of the Discrete Responses

The bid sets were randomly distributed to the questionnaire. These initial and second bids were obtained during the pilot survey and focus group discussion. For each initial bid offered (bid1), there are two possible responses. The first row for each initial bid summarizes the "no" response to that bid. The second row for each bid summarizes the "yes" responses. An initial bid of 22 person days per year resulted in 57 "yes" responses and 16 "no" responses. Of the 57 "yes" responses to BID1=22, the follow up bid (BID2=44) resulted in 41 "yes" and 16 "no" responses and out of the 16 "no" responses for the initial bid (BID1=22) the follow up bid (BID2=11) resulted in 5 and 11 "yes" and "no" responses respectively. Similarly, the second initial bid (BID1=40) man days per year resulted in 46 "yes" and 26 "no" responses. The follow up bid for the 46 "yes" responses of the second initial bid (BID1=40), which is BID2=80, resulted in 29 "yes" and 17 "no" responses, while the "no" responses to the second initial bid, which is BID2=20, resulted in 12 "yes" and 14 "no" responses. Finally, the third initial bid (BID1=65) was resulted in 25 "yes" and 48 "no" responses. The 25 "yes" responses of the third initial bid have produced 9 "yes" and 16 "no" responses for the amount of bid offered in the second question, which was 130 person days per year. On the other hand, the 48 "no" responses for the third initial bid have produced 24 each "yes" and "no" answers for the bid offered in the second question, which was 32 person days per year. In general, a total of 436 responses were obtained for the analysis from the double bounded dichotomous question.

Table 4.11: Summary of Discrete Responses to the Double- Bounded Questions

Initial Price (BID1)	Follow Up Price (BID2)	First Question		Second Question	
		No. of 'yes' responses to the initial price	No. of 'No' responses to the initial price	No. of 'yes' responses to the Follow up price	No. of 'No' responses to the Follow up price
22	11	0	16	5	11
22	44	57	0	41	16
40	20	0	26	12	14
40	80	46	0	29	17
65	32	0	48	24	24
65	130	25	0	9	16

Source: Own Survey, 2012

Households were also categorized based on their joint responses to the offered bids (initial and follow up). The results revealed that about 22.5% of the households rejected the initial offers as well as the follow up discounted bids (no-no). Of the 218 surveyed respondents, the percentage of households that did not accept the initial bid but accepted the second discounted bid was found to be 19%. The third category of households presented in Table 4.10 was those households that accepted the initial bid but rejected the higher second follow up bid. This category accounts 22.5% of the households. The fourth category represents households who had yes-yes responses for the first initial bid as well as for the higher follow up bids. Those households were 36% of the total sampled households.

The frequency Table 4.12 of the willingness to pay category showed that the highest frequency was observed in the fourth willingness to pay category of households in which, the households accepted the offered initial bids as well as the second higher bids. This was followed by the "no-no" and "yes-no" categories which constitutes 22.5% each of the sampled households. Finally, the 2nd category of households in

which their responses were “no” to the initial bids followed by “yes” to the follow up lower second bids placed on the 4th rank with a percentage of 16.

Table 4.12: Frequency of Willingness to pay

WTP Category	Frequency	Percent
No –No	49	22.5
No –Yes	41	19
Yes –No	49	22.5
Yes- Yes	79	36
Total	218	100

Source: Own Survey, 2012

4.2.2 Estimation of Mean from Double Bounded Dichotomous Choice Format

Table 4.13 presents the descriptive statistics of households’ responses to the offered bids in the double bounded dichotomous choice format. The result shows that the average initial bid was 42.34 person days per year. Whereas, the average second bid for soil and water conservation practices was 54.63 person days per year. The “yes” response for the first bid offered is about 59% while the “yes” responses for the second bid were about 55%.

Table 4.13: Descriptive Statistics of the Dichotomous Choice Format

Variable	Observation	Mean	Stan. Dev	Min	Max
BID1	218	42.34404	17.7124	22	65
BID2	218	54.63303	34.7513	11	130
VBID1	218	0.587156	0.4934784	0	1
VBID2	218	0.5504587	0.4985923	0	1

Source: Own Survey, 2012

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 4.14). This implies that higher initial bid and second bid lead to lower probability of accepting the bid offered.

Table 4.14: 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
P	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

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 implying that the random component of WTP for the first question is not perfectly correlated with the random component from the follow-up question. The estimation results of the model are reported in Table 4.14.

Using these coefficients in Table 4.14, 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 24) to be 56.65 person

days per year per household for five years. At 95% confidence interval the WTP varies between 51.01 to 62.29 person days per year. The result shows that the mean WTP from double bound format was greater than the mean value from the open ended response which was computed at 48.94 person days per year per household for five years.

4.3.1 Analysis of Results of the Open Ended Format

In the open ended question, respondents were asked to state the maximum amount they would like to pay for soil conservation practices. The amount of labour that the households would contribute to the proposed project ranges from 0 to 152 person days per year for five years. Table 4.15 presents the frequency distribution of farm households' WTP in person days per year for five years. The table shows that about 83.49 % of the farmers were willing to pay some amount of labor for soil conservation practices. In the practice of CVM, 0 bidders are presented with follow-up questions to ascertain whether they are expressing a protest bid against the valuation or they place no value on the resource (Paulos, 2002).

Table 4.15: Willingness to Pay of Households Based on the Open Ended Format

Willingness to pay of households (Open Ended Question)	Frequency	Percent
Non Willing (0)	36	16.51
Willing(>0)	182	83.49
Total	218	100

Source: Owen survey, 2012

The frequency distribution of the responses of the sampled households of the open ended responses is also presented in the Table 4.16.

Table 4.16: Frequency Distribution of the Open Ended Questionnaire Format

Number of person days	Number of farmers	Percent
0	36	17
10-25	33	15
26 – 41	33	15
42 – 57	30	14
58 – 73	31	14
74 – 89	26	12
90 – 105	20	9
106 – 121	1	0
122 – 137	4	2
138 – 153	4	2
Observations	218	
Mean	48.94	
Standard Deviation	35.72	
Maximum	150	
Minimum	0	

Source: Owen survey, 2012

Table 4.16 shows distribution of farmers' willingness to spend person days on soil conservation practices in a year. Of the 218 sample respondents 36 were not willing to contribute any labor for soil conservation practices. On the other hand, the remaining 182 were willing to contribute some amount of labor. The average number of days that farmers were willing to contribute for soil conservation practices was 48.94. Figure 4.1 shows the frequency curve of sample households' maximum willingness to contribute labor for soil conservation practices in a year. The curve shows that lower numbers of respondents recoded in the higher bids.

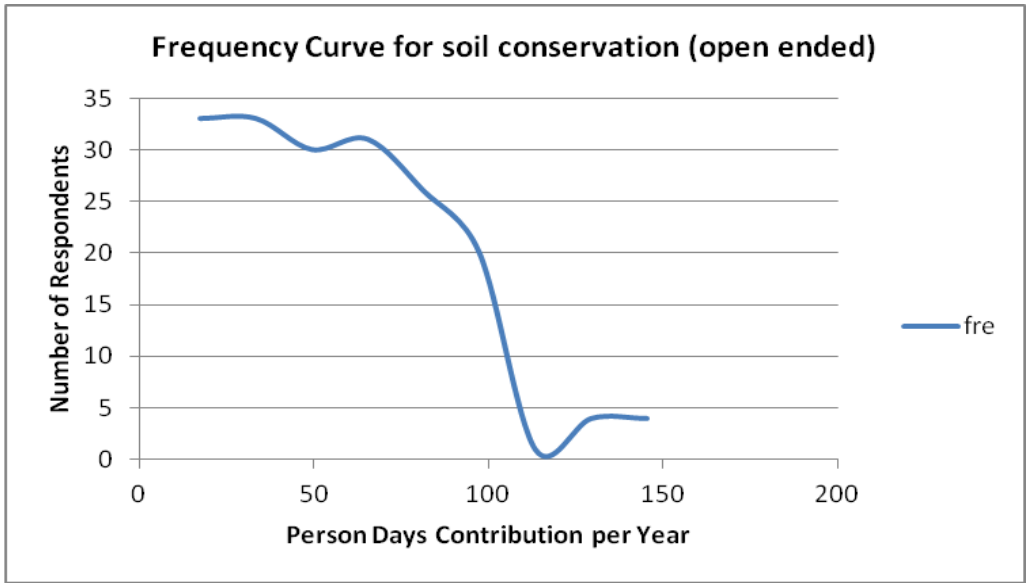


Figure 4.1: Ferequency Curve for Soil Conservation
Source: Own survey, 2012

4.3.2 Reasons for Maximum Willingness to pay

Respondents were asked to point out their major reasons for their maximum willingness to pay. Of the 218 sampled households included in the analysis 83.49% of the households state their reason for maximum willingness to pay. The rest 16.51% of the sampled households were missing because they were not willing to pay any amount of person days for the proposed project of soil conservation practices.

Table 4.17: Reasons for Maximum Willingness to Pay

Reason For maximum Willingness to Pay	Frequency	Percent	Cum.
I think it is worth that amount	101	55.19	55.19
Others should pay	22	12.02	67.21
I could not afford more	59	32.79	100
Total	182	100	

Source: Survey Result, 2012

From the 182 (83.49%) households who had a positive willingness to pay, 101 of them (55.19) of the household revealed "I think it is worth that amount" as their reason for the maximum amount they revealed in the open ended format of the CVM survey. The households with a positive willingness to pay who revealed "others should pay" were about 12%. Finally, about 33% of the households who had a positive willingness to pay revealed "I could not afford more" as their reason for their maximum willingness to pay. The possible reason for this might be income and/or labour constraint that they have.

Table 4.18: Reasons for Not Willing to Pay

Respondents reasons for not willingness for soil conservation practices	Frequency	%
I have shortage of labor	36	90
The government should pay for it	2	5
I don't observe the problem of soil erosion in my farm land	2	5
Total	**40**	**100**

Source: Owen survey, 2012

Table 4.18 reports the reasons of sample respondents' who were not willing to pay for the proposed hypothetical project. Accordingly, of the 40 of sampled respondents who were unwilling to pay either, about 90% of the households were not willing to pay because shortage of labor and they were categorized as true zero bids. Whereas, about 10% of the respondents stated protest zero[2] (Table 4.18**).** The protest zero bidders said that 'the government should pay for it'' and 'I don't observe the problem of soil erosion in my farm land.'' These respondents were excluded from further analysis.

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

However, households responded true zero (90% of the unwilling) were included in the analysis.

4.4 Welfare Measure and Aggregation

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 biases, sampling frame bias, sample none response bias and sample selection bias. Random sampling method was used in this study using a list of households. A face to face interview method is used and Protest zero responses were excluded from the analysis and possibility of Protest zeros was accounted in the estimation of the aggregate benefit. Hence, none of the above biases was expected in the analysis.

Table 4.19: Welfare Measures and Aggregate Benefits by Peasant Associations

Name of Peasant Association	Total HHs in each PA	No. of sampled HHs	No. HH with protest Zeros by PA	Proportion of Protest Zeros	Expected protest HH by PA	HHs with valid responses by PA	Mean WTP	Total WTP[3] by PA
M/ Shewito	1570	42	1	0.024	37.38	1532.62	56.65	86822.87
Gendebta	1806	48	2	0.042	75.25	1730.75	56.65	98046.99
B/Yehans	1575	47		0.000	0.00	1575	56.65	89223.75
E/ Gerima	1651	42		0.000	0.00	1651	56.65	93529.15
Yeha	1686	43	1	0.023	39.21	1646.79	56.65	93290.69
Total	**8288**	**222**	**4**		**151.84**	**8136.16**		**460913**

Source: Own Survey, 2012

[3] The figures are in person days per year at the time of survey the minimum wage rate per day was 12 Ethiopian Birr

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. In Table 4.19 above, 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 selected peasant associations. Following this, in this study the aggregate WTP for soil conservation practices was computed at 460,913 (5,530,956 Birr)[4] person days per year for five years in the selected five peasant associations based on the mean from the double bounded dichotomous choice format. Whereas, from open ended questions the total WTP for soil conservation practices was also computed at 398,183.67 (4,778,204.04 Birr) person days per year. This shows that there is high level of willingness to pay for soil conservation practices in the study area.

There are 24,692 households in the study area (Adwa Woreda). It is also possible to calculate the total aggregate value of soil conservation practices for the whole Woreda. After deducting the protest zeros (445)[5] the expected total households with valid responses are 24,247 households. The total willingness to pay in the whole study area (Adwa Woreda) is simply the multiplication of the respective means and the number of expected households to have valid responses. Hence, the aggregate value of soil conservation in the study area from the double bounded and open ended

[4] Is the monetary value of the person day estimates which was multiplied by 12 Birr, the minimum wage rate in the study area at the time of data collection

[5] Those are households' which are expected to protest against the proposed project in the entire study area, Adwa Woreda. It was calculated by the multiplication of the percentage of protest sampled households' (1.8%) by the total number of households in the study area. Hence, 1.8%*24,692 = 445. This number was deducted from the total number of households in the study area for welfare analysis.

formats are 1,373,592 (16,483,104 Birr) and 1,186,648.18 (14,239,778.16 Birr) person days per annum for five years, respectively.

The purpose of this chapter was to assess the determinants of WTP, to estimate mean WTP as well as aggregate value of soil conservation practices in Adwa Woreda. The results of the probit model showed that; Age of the household head (AGE) and Initial bid offered (BID1) were found to significantly affect WTP decision negatively. On the other hand, Education level of the household head (EDUCATION), perception of soil erosion problem (PERCEPTION), Total livestock units (TLU), Sex of the household head (SEX), Family size of the household (FSIZE) and land tenure (TENURE) were found to be significant to affect WTP positively. The mean WTP from the bivariate model estimates and open ended format were found to be 56.65 and 48.94 person days per annum per household for five years. The total aggregate value of soil conservation practices in the study area from the double bounded and open ended formats were calculated to be 1,373,592 (16,483,104 Birr) and 1,186,648.18 (14,239,778.16 Birr) person days per annum for five years, respectively.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMENDATION

5.1 Conclusion

Soil erosion is one of the most chronic environmental and economic problems of the present situation in Ethiopia, in general, and in the study area in particular. It is getting worst than it was ever before. Hillsides stripped of their protective covering of vegetation are rapidly eroding, depositing huge amount of silt into downstream reservoirs and river valleys. Floods are becoming more frequent and more sever. To avert the global as well as local environmental disaster being brought by soil erosion, it is imperative to take action quickly and on a vast scale. It is therefore, very necessary to induce in every one's mind the importance of conserving soil resources. To this end, in this study, an attempt was made to analyze local peoples' willingness to pay for soil conservation practices.

The principal objective of this study was to estimate the economic values of soil conservation measures and to identify and analyze the determinants of farmers' willingness to participate in soil conservation practices in Adwa Woreda, Ethiopia. More specifically, the study was designed to identify the variables, which determine farmers' willingness to participate in soil conservation practices and find out how each variable is related to the willingness of farmers to participate in soil conservation practices. Furthermore, the study was designed to see the possibility of cost recovery by looking at the demand side of the households' willingness to pay for soil conservation practices and to estimate the mean willingness to pay.

The study used relevant secondary data and information collected from various publications, journals and reports but the major sources of data were obtained from a contingent valuation survey of 218 sample respondents using two stage simple random sampling technique with structured questionnaire administered with trained enumerators of Axum University students. Probability proportional to size sampling technique was employed to select the farm households from five Peasant Associations, which were selected first by simple random sampling technique.

This study made use of the CVM technique to elicit farmers' willingness to contribute labor for soil conservation practices. Before the final survey was undertaken a pilot survey was conducted on 30 randomly selected respondents. The open ended format was used on the pilot survey to come up with the starting bids. A person day of 22, 40 and 65 was used as starting prices in the final survey. In the final survey, the elicitation method used was double bounded dichotomous choice format with open ended follow up question.

The chi-square ($\chi 2$) test was used to confirm the presence of difference between acceptance of the offered initial based on the dummy explanatory variables and the F-Statistics was used for the continuous explanatory variables.

Results of the study revealed that 58.71% of the sampled households were willing to take the initial offered bid while the rest 41.29% were not willing. However, 83.35% of the respondents were willing to contribute some amount of labour for the proposed soil conservation practices. These shows that majority of the households are concerned about the problem of soil erosion in the study area and there is a possibility

of voluntarily instruments such as willingness to pay for soil conservation practices in the study area.

A probit model was employed to determine the effect of the explanatory variables on farmers' willingness to participate in soil conservation practices. In addition to the probit model, descriptive statistics were also used to assess farmers' perception of soil erosion problem and to assess WTP for soil conservation practices. Results from descriptive statistics further showed that the willing and non-willing households differed significantly in some substantial explanatory variables. The marginal effects of the explanatory variables were also calculated. Before estimating the models, the problem of multicollinearity was checked by variance inflation factor (VIF) and Contingency Coefficient (CC).

Sixteen variables were used on the empirical findings of the determinants of willingness to pay for soil conservation practices. Age of the household head (AGE) and Initial bid offered (BID1) were found to significantly affect WTP decision negatively. On the other hand, Education level of the household head (EDUCATION), perception of soil erosion problem (PERCEPTION), Total livestock units (TLU), Sex of the household head (SEX), Family size of the household (FSIZE) and land tenure (TENURE) were found to be significant to affect willingness to pay positively.

Besides, a bivariate probit model was used to calculate the mean willingness to contribute labor of households for the proposed soil and water conservation practices. The results revealed that the local communities are willing to pay for the proposed project. The mean willingness to pay from the double bounded dichotomous choice

format and open ended format was calculated to be 56.65 and 48.94 person days per annum, respectively. The aggregate welfare gain from soil conservation in the study area from the double bounded dichotomous choice format and open ended format was calculated to be 1,373,592 and 1,186,648.18 person days, respectively.

The study found that the value of soil conservation from open ended format was underestimated as compared to the double bounded format. This may indicate free riding and lack of base for answering WTP questions under open ended format. Thus, in estimating the value of environmental resource like soil conservation at household level, it is important to use contingent valuation method in the form of double bounded elicitation format than other elicitation method (that is, open ended question). In general, the study founds high level of welfare gain from projects of soil conservation practices in the study area.

5.2 Recommendation

The results of the study have shown that the socio economic characteristics of the household and other institutional factors are responsible for household's willingness to pay for soil conservation practices. Therefore, policy and program intervention designed to address soil erosion problems in the study area have needed to take in to account these important characteristics for effectiveness. Based on the findings of the study, the following points need to be considered as possible policy implications in order to enhance farmers' participation in the planning and implementation of soil conservation activities.

- In order to introduce a sustainable soil management at a household level, the households should be given the right to play the major role in planning, managing, controlling and using their own resources. It is also better for the policy makers to design the participation of the households based on labor contribution than cash contribution, while designing a soil conservation project.

- The results of this study shows that sex of the household head had a positive effect on willingness to pay decision. This shows that female headed households are less willing to pay for soil conservation practices than male headed households. This is because female headed households have limited resource possessions as compared to male headed households. Hence, there is a need to enhance the capacity and resources possession of female headed households so that they can able to take their parts in soil conservation practices as they have accounted for substantial number in the rural families of the study area.

- The level of formal education of the household head was found to be an important variable affecting the probability of willingness to pay for soil conservation practices. This 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 projects.

- The results of this study also show that land tenure security is positively and significantly related to the probability of households' willingness to pay for soil conservation practices. This means as the household head thinks he/ she is secured his land at least until his life time, the probability of WTP for soil conservation increases. 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.

- Finally, this study only analyses the demand side information for soil conservation practices in the study area. It should also be noted that such studies should also be complemented by other studies such as comparing cost and benefit of soil conservation practices.

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APPENDIX I: Questionnaire

This questionnaire has been prepared to gather information about farming practices, problem of soil erosion, willingness to pay for soil conservation and socioeconomic conditions of households. The objective of this questionnaire is to collect information related to willingness to pay for soil conservation practices in this Woreda. The research is intended to develop a mechanism to help you in improving land productivity through soil conservation practices in collaboration with you. The information that you have delivered to the student will only be used for academic purposes. In answering my questions, please remember that there are no correct or wrong answers. I am Just after your opinion. Hence, we request you honest and fair responses to fill up this questionnaire.

General Information:

Name of the enumerator---------- Sign. ---------- Date----------

Name of the PA---------- Name of the Village----------

FARMER/HOUSEHOLD INFORMATION

1.1. Age_____

1.2. Gender Male = 1 Female = 0

1.3. Marital status

Married =1 Divorced =3

Single =2 Widowed =4

1.4. Education Level----------years.

1.5. When did you start farming for your own? (year)_____

1.6. Did you have some social position in the community so far? Yes=1 no=2

1.7. If yes, what is your position in the community? ----------

1.8 . Distance from home to the nearest market.....Munites?

2. Information about the sample household family

2.1 Information about family members

No.	Name	Age	Sex	Education level	Relationship	The average working hour per day		
						On-farm	Off-farm	On both
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								

NB. Code of family member relation 1=head of the household 2=Wife 3= Son/ daughter 4=servant 5= other

3. Information about sample household land use.

No	Type of land use	Area in hectare
1	Cultivated land	
2	Grazing land	
3	Forest land	
4	Fallow land	
5	Homestead	
6	Other	

4). AWARENESS TOWARDS EROSION AND EROSION HAZARDS

4.1 Do you perceive the problem of soil erosion in your area? 1.Yes 0. No

4.2 If yes, what features lead you to believe that such problem exists?

(i)----------

(ii) ----------

4.3 Is your farmland prone to erosion? 1. Yes 0. No

4.4 If yes, how much of your farmland affected by erosion in (ha)----------

4.5 How do you perceive the level of parcel's exposure to soil erosion?

1. No risk 2. Medium 3. High exposure to erosion

4.6 Has your farmland been severely affected by soil erosion before?

1. yes 0. No

4.7 If yes, severity of erosion on your farming plots since started farming ?

1. very severe 2. Severe 3. Minor

4.8. When did soil erosion problem start in your farm?

1.Prior to birth (heard from parents) 2. Since childhood

3. In recent years (before ----- years) 4. Others (specify)----------

4.9. How does the household perceive the soil depth/ fertility since starting farming as compared to the past?

1. Increasing 2. Decreasing 3. No change 4. Do not know

4.10. If answer is increasing to 9, what measures did the household take to rehabilitate the conditions?

1. Apply manure 2. Apply chemical fertilizer 3. Practice terracing

4. Planted trees or grass 5. Fallow system 6. Strip cropping along the contour 7. Bunding 8. Check dams 9. Others(specify)----

4. 11. How serious is the decline in soil fertility on the main plot since started farming with reference to normal year/ adequate rainfall?

1.Very serious 2. Serious 3.Minor 4. No problem

4. 12. Do you think soil erosion will affect your farmland in the future if situations remain unchecked?

1.yes 0. No

4.13. Slope of the land you have (as perceived by the farmer)

1. Very steep 2. Steep 3. Gentle slope 4.Flat 5. Others (specify)----------

4.14. Have you taken any of the following measures because of erosion?

1. abandoned your cultivated land 2. Expanded to marginal land

3. have taken off farm employment 4. Other (specify)---------

4.15.How is the fertility of your farmland? (As perceived by the farmer)

1. fertile 2. Moderately fertile

3. Infertile 4. Others (specify)--------.

4. 16. If non-fertile, what was the cause of non-fertility?

1. Intensive cultivation for many years 2. Erosion

3. Do not know 4. Others (specify)--------

4.17. Do you observe change in the level of crop yield on your cultivated land?

1. Yes 0. no

5. AWARENESS TO TECHNOLOGY

5.1. Do you know the existence of soil conservation practices?

1.yes 0.no

5.2 . If yes to 1, have you used any one of the following physical soil conservation practice(s)?

1. Terrace 2. Counter bunds 3. Grass strip 4. Soil and stone bund 5.Others

5.3. If the farmer did not use any soil conservation practice, mention reasons for not using.

1. lack of money 2. Labor shortage 3. Others (specify)----------

5.4. Have you participated in community conservation activities this year?

1. yes 0. No

5.5 Do you use fertilizer on your farm to maintain soil fertility?

1. yes 0. No

5.6 If yes, amount per ha in kg……..

6. WILLINGNESS TO PARTICIPATE IN SOIL CONSERVATION PRACTICES (Enumerator read the scenario)

1. Are you willing to contribute labor 22/40/65 person days in a year? (circle one)

Yes= 1 No= 0

If the answer for the above question is 'yes' go to question number 2, if the answer is no go to question number 3.

2. Are you willing to contribute 44/80/130 person days in a year?

Yes= 1 No= 0

3. Are you willing to contribute 11/20/32 person days for the conservation activities in a year ?

Yes= 1 No= 0

4. What is the maximum amount of person days you are willing to pay in a year? ----person days.

5. What is the main reason for your maximum willingness to contribute person days in number 4 above?

a. I think it is worth that amount

b. Others should pay

c. I could not afford more

d. Other reason(specify)_____

6. If you are not willing to pay, why you stated zero bids?

a. I do not trust in rehabilitation

b. I do not have enough labor/Shortage of money

c. The government should pay for it

d. I do not observe the problem of soil erosion

e. Other (specify, if any) _____

7) Information about the plot characteristics and soil conversion measures.

No	Descriptions	Plot-1	Plot-2	Plot-3	Plot-4
1	Area of the plot(tsemdi)				
2	Source of the plot 1) inherited 2) received from kebele 3)rented in				
3	Distance from home (walking minutes)				
4	Soil fertility status of the plot 1)low 2)medium 3) high				
5	Slope: 1) Flat (0-6%) 2) gentle slope (6-15%)3) Steep slope & Mountainous (> 15%)				
6	Color of the soil 1) red 2) black 3) brown				
7	Service year of the plot				
8	Degree of erosion problem on the plot1) high 2)medium 3)low				
9	Irrigated or not 1) yes 2) no				
10	Presence of at least one type of improved Conservation structures 1) yes 2)no				
11	Improved soil conservation structures built in meter				
	Stone bund				
	Soil bund				
	Cut off drain				
	Fanyajuu				
	Others, specify				
12	Estimated area covered with improved soil conservation structures				
	Stone bund				

	Soil bund				
	Cut off drain				
13	When start the construction of improved soil conservation structure on the plot?				
14	Who constructed the structures? 1)Community participation 2) Family (hired)labor 3) Financial incentives by government 4)labor exchange				
15	Status (degree) of use of improved soil conservation structures (practices)1) Removed totally 2) Partially removed3) Not removed; 4) Modified				
16	Who did the maintenance work? 1) Community participation 2) Family/hired labor 3) labor exchange				
17	Traditional soil conservation structures built (in meter)				
	Traditional stone bund				
	Traditional soil bund				
	Cut off-drain				
	Traditional ditches				
	Trash lines				
	Others, specify				

8. LABOUR AVAILABILITY

8.1. Do you have labour shortage for farm activities? Yes =1 no =0

8.2. If yes, for which kind of farm activities?

1. Crop production 2. livestock production

3. Soil conservation activities 4. other (specify)----------

8.3. If yes to 8.1, how do you solve labour shortage?

Hiring labour =1 use communal labour =2 other (specify)=3----------

8.4. If labour is hired, what type of labour do you hire?

Permanent =1 casual =2 both =3

8.5. If permanent, how much do you pay per annum?(birr)_____

8.6. If casual, how much do you pay per day?(birr)_____

8.7**.** Can you get labour to hire when you are in need?

Yes =1 no =0

8.8. Do you or your family member work on off- farm activities? 1) Yes 2) No

8.9. If the answer to question 8.8 is yes, Fill in the following table For 2003/04

No	Type of off-farm (non-farm) activity	Family members working 1)men 2)women 3)children	Total income obtained in one year (birr)
1	Pity trade		
2	Pottery		
3	Weaving		
4	Leather making		
5	selling of fire wood		
6	Labor hire out		
7	Remittance		

9. INSTITUTIONAL CONTACT AND ASSISTANCE

9.1. Frequency of visit by development workers per year? ---------- days

9. 2. Have you received extension advice on soil conservation practices so far?

1.yes 0. No

9. 3. Are there any governmental or non-governmental organizations working on soil conservation activities in your area?

1.yes 0.no

9. 4. Have you been advised by any of these organizations to undertake soil conservation practices? 1. Yes 0.no

9.5. In which kind of soil conservation programs have you been involved?

1.food for work 2. Money for work 3. Free 4. Others (Specify)----------

9.6. Have you attend any soil conservation training in the past?

1. Yes 0. No

10. TENURE OR PROPERTY RIGHT

10.1. For how long have you been with your land? ----------

10.2. Do you feel secure that the land belongs to you at least in your lifetime?

1.yes 0. No

10.3. If no, what are the reasons?----------

10.4. How would the newly married member(s) of the household get land?

1. Share the household land 2. The PA provide him/her 3.Other (Specify)

11 . INCOME SOURCE OR WEALTH INDICATORS

11.1. What are your main sources of income (in order of importance)?

crop sale =1 live stock sale =2 Off-farm income =3 others (specify) =4------

11.2. What was the estimated amount of off-farm income in birr (in 2003)?----------

11.3. If the household does not have more than one ox ask how the household plough its farm.

1. Rented ox 2. Pairing with others 3. shared out/rent out the land

4. Other (specify)----------

11.4. If the household do not have ox ask how the household plough its farm?

1. Hoe/spade 2. Coupling with others 3. Exchange labour for ox / oxen 4. Rented ox/oxen 5. shared out/rent out the land 6. fallow the land 7. Others (specify)----

A) Please indicate amount of crops produced and sold in this year (2003 EC)

Type of Crop	**Land used For rain feed agriculture in 'tsimdi' (2003)**	**Output in (kg)**	**Land irrigation farming**	**Output in (Kg)**	**For sells (kg)**	**Average selling price**
Teff						
Wheat						
Barley						
Hanfes						
Sorghum						
Maize						
Beans						
Field peas						
Faba bean						
Pea						
Linseed						
Lentil						
Noug						
Tomato						
Potato						
Garlic						
Onion						
Cabbage						
other						

B) Animal Ownership

N^{o}	Type of livestock	Number	Sold	revenue
1	Ox			
2	Cow			
3	Calve			
4	Heifer			
5	Horses			
6	Mules			
7	Donkey			
8	Goats			
9	Sheep			
10	Chicken			

12. CREDIT

12.1. Did you have formal or informal sources of credit? Yes=1 no=0

12.2. If yes, how much have you borrowed in the last two years?

Commercial Bank (birr)	Dedebit micro finance (birr)	Maret (birr)	Cooperatives (birr)	Informal money lenders (birr)	others	Total (birr)

12.3. If no, why?----------

APPENDEX II: Contingent Valuation Scenario

As you might notice it by yourself through time or heard about it, this area was very productive and comfortable for crop production as well as livestock raring in the back days. However, as you are observing through time, these valuable soil resources are being degraded over time because of intensive cultivation and other activities. With this rate of degradation, the futurity of the soil resource is endangered. To overcome this problem it is not an easy task, but possible to stop and reverse the degradation problem by conservation works. The conservation works include rehabilitation of the soil by making soil structures and planting trees where applicable to do so. Such soil conservation and rehabilitation activities need initial investment, running cost and labor. This is due because the current soil erosion of this area will be solved if integrated management could be undertaken in all the endangered plots. This will be done if and only if you as the owner and indigenous people of this area are participating. We want to know the amount of days you are willing to spend on such activities for the coming five years. We would now like you to answer the following questions on the amount of person days you are willing to spend on the activities. Please keep in mind your personal income constraints your necessary expenses and labor shortage. Given this:

APPENDIX III: Open Ended Question

Open Ended Question that was used to find the Starting Point Bids during the pre Test

After opening statement

1. What is the maximum amount of time (number of days) you would be willing to spend per year on soil conservation activities?

APPENDIX IV: VIF of Continuous Explanatory Variables

Variable	VIF	1/VIF
TLU	2.01	0.50
FARMINC	1.83	0.55
FSIZE	1.62	0.62
FASIZE	1.46	0.69
EDUCATION	1.26	0.80
EXTFREQUENCY	1.21	0.82
DISTANCE	1.15	0.87
AMCREDIT	1.14	0.88
BID1	1.03	0.97
Mean	**1.41**	

APPENDIX V: Contingency Coefficient for Discrete Variables

Variable	SEX	SPOSITION	PERCEPTION	FEROSION	LSHORTAGE	TENURE
SEX	1.00					
SPOSITION	0.10	1.00				
PERCEPTION	0.02	0.10	1.00			
FEROSION	0.11	0.08	0.40	1.00		
LSHORTAGE	0.18	-0.03	0.03	-0.08	1.00	
TENURE	0.15	0.07	0.04	0.06	-0.23	1.00