HOUSEHOLDS' WILLINGNESS TO PAY FOR SOIL CONSERVATION PRACTICES ON CULTIVATED LAND IN SOUTH ACHEFER DISTRICT, AMHARA NATIONAL REGIONAL STATE OF ETHIOPIA: A CONTINGENT VALUATION APPROACH

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As thesis research advisors, we hereby certify that we have read and evaluated this thesis prepared, under our guidance, by **Lamesgin Tebeje**, entitled "**Households' Willingness to Pay for Soil Conservation Practices on Cultivated Land in South Achefer District, Amhara National Regional State of Ethiopia"** and we recommend that it can be submitted as fulfilling the thesis requirement.

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As members of the Board of Examiners of the final MSc Thesis Open Defense Examination, we certify that we have read and evaluated the thesis prepared by **Lamesgin Tebeje Workie** and examined the candidate. We recommended that the thesis can be accepted as fulfilling the thesis requirement for the degree of Master of Science in Agricultural and applied economics.

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DEDICATION

This work is dedicated to my mother, Wubet Alemu and my father, Tebeje Workie for their courage, concern, and prayer. Without their endless support, I would have never been in my present position.

STATEMENT OF THE AUTHOR

By my signature below, I declare and affirm that this thesis is my own work. I have followed all ethical and technical principles of scholarship in the preparation, data collection, data analysis and compilation of this thesis. Any scholarship that is included in the thesis has been given recognition through citation.

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BIOGRAPHICAL SKETCH

The author was born from his mother Wubet Alemu and his father Tebeje Workie on 20th of January 1987 in Godber Medhanialem kebele, Dembecha District of West Gojjam Zone; Amhara National Regional State, Ethiopia. He attended his primary, secondary and preparatory educations at Godber Medhanialem Elementary, Dembecha Senior Secondary and Damot (Finoteselam) Preparatory schools respectively, from 1995 and 2005.

After he has successfully passed the Ethiopian Higher Education Entrance Qualification Examination, he joined Haramaya University in 2005 and obtained his BSc Degree in Agricultural Economics on July 12, 2008. Few months after his graduation, he was employed by S/Achefer District office of Agriculture and Rural Development as a "*community problem and need assessment survey expert*" for two years and two months until February 2011. Then after, he was employed as "*Community development facilitator*" at Tana and Beles Integrated Watershed Development Project and served for four years and ten months up to October 2015.

Then after, he joined the Postgraduate Program Directorate of Haramaya University in October 2015 to pursue his Masters study in Agricultural and Applied Economics under the sponsorship of African Economic Research Consortium (AERC).

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ACRONYMS AND ABBREVIATIONS

BOFED	Bureau of Finance and Economic Development
CEM	Choice Experiment Method
CV	Contingent Valuation
CVM	Contingent Valuation Method
DBDCF	Double Bounded Dichotomous Choice
FAO	Food and Agriculture Organization of the United Nation
Ha	Hectare
IFPRI	International Food Policy Research Institute
MEA	Millennium Ecosystem Assessment
MWTP	Mean Willingness to Pay
NOAA	National Oceanic Atmospheric Administration
SBDCF	Single Bounded Dichotomous Choice Format
SC	Soil Conservation
TEEB	The Economics of Ecosystems and Biodiversity
TEV	Total Economic Value
TLU	Tropical Livestock Unit
UNCCD	United Nations Convention to Combat Desertification
USDA	United States Department of Agriculture
WAO	Woreda Agriculture Office
WMO	World Meteorological Organization
WTA	Willingness to Accept
WTP	Willingness to Pay.

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ABSTRACT

When the market for a certain good is competitive enough, economic activities can be studied by the market pricing mechanism. Because this is usually not feasible in case of non-marketed environmental goods, like soil in our case, with embodied natural and cultural heritage, particular methods for economic valuation of such goods have to be applied. This research presents the economic valuation of soil through assessing the willingness to pay of households for soil conservation in South Achefer District of Amhara Region. For this purpose the method of Contingent valuation was used to conduct an econometric analysis of willingness-to-pay using both Double Bounded Dichotomous Choice and open ended elicitation format question. Both primary and secondary data were collected for analysis using structured questionnaire. By employing a bivariate probit model, this study obtained the value of willingness-to-pay and identified its determinants from a survey results of randomly selected 156 sample households' using a three stage sampling procedure. The result indicates that 48.08% of the surveyed household were willing to pay the initial cash contribution provided and the value of mean willingness to pay from both Double Bounded Dichotomous Choice and open ended question were found to be 36.46 and 27.23 Ethiopian birr per household per year respectively. The thesis used the average individual value of willingness-to-pay to calculate the aggregate willingness-to-pay and estimated the aggregate revenue of 942,928.52 and 704,243.95 Ethiopian Birr per year for the district respectively. The predicted probability estimation result of the model also shows that the probability of accepting both bid values, the initial and follow up bids is 9.24%. Similarly the probability of saying 'yes' only to the first and the follow up bid independently is 44.77 and 64.47% respectively. This study also empirically proved that, important variables determining willingness to pay of households' for possible soil conservation programs in the study area for both responses of the bivariate regression model were found to be sex of the household head, annual income of the household, perception about soil erosion, initial Bid and frequency of extension contact. Therefore policy and program intervention designed to address soil erosion problems in the study area have needed to take in to account these important significant variables for effectiveness.

Key Words: Bivariate probit model, CVM, WTP, discrete choice method.

1. INTRODUCTION

1.1. Background of the Study

In the predominantly agrarian societies of Africa, one of the most ominous threats to food supply is environmental degradation, the deterioration of croplands, grasslands and forests. Today, smallholders in developing countries are facing land scarcity and soil degradation. Small holders are still poor and food insecurity is a great problem. Soil in the highlands is now seriously eroded to the extent that it will not be economically productive again in the foreseeable future. The capacity of the farming communities to sustain production is, therefore, under serious pressure (Habtamu, 2014).

According to Alemayehu (2016), the economic development of developing countries depends on the performance of the agricultural sector, and the contribution of this sector in turn 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.

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 Gebrelibanos (2012), Ethiopia for the last two 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.

The average annual rate of soil loss in the country is estimated to be 42 tons/hectare/year which results 1 to 2% of crop loss and it can be even higher on steep slopes and on places where the vegetation cover is low (Biniyam, 2013). 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 implication for soil productivity, household food security, and poverty in the country (Teklewold and Kohlin, 2011).

Soil conservation in Ethiopia 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. Since then a huge amount of money has been invested in an attempt to introduce soil and water conservation measures particularly in the areas where the problem of soil erosion is threatening and food deficit is widespread. The conservation measures were in most cases physical measures and undertaken throughout the country by government and World Food Program (FAO, 2008). To this end, in Ethiopia, efforts towards soil conservation were started since the 1970s and 1980s (Lemi, 2015).

Soil and water conservation interventions in general have played a considerable role in maintaining and/or restoring soil fertility, crop production, restoring vegetation cover and ecological health, and in mitigating anthropogenic land degradation. However, many of the conservation structured previously done are dismantled and the interventions need improvement to maximize the benefit and balance people's current and future needs (Amsalu and De Graaff, 2007).

Nevertheless, the achievements have fallen far below expectations, and the country still loses a tremendous amount of fertile topsoil and the threat of land degradation is broadening alarmingly (Teklu and Gezahegn, 2003). This is mainly because farmers' perception of their environment has been misunderstood partly in the country. It is misunderstood partly because outsiders, both scholars and policy makers often have limited understanding about the farmers' attitude towards environment (Paulos, 2002). So far, conservation practices were mainly undertaken in a campaign often without the involvement of the land user and soil erosion problem still persists and becomes the major cause for food insecurity (Lemi, 2015).

Such an experience does not mean that there is no hope for soil conservation in Ethiopia, rather it may be the problem of the campaigns that have been undertaken in Ethiopia that soil conservation practices have failed to consider local peoples' willingness to pay for such projects from the very initiation of conservation measures (Gebrelibanos, 2012).

Like any other parts of Ethiopia, a lot has been invested for soil restoration practices in the study area, South Achefer district, started from few decades in the past till now. But soil erosion has become an alarming problem and it is the major factor affecting the sustainability of agricultural production. This might be something wrong in the approach that soil

conservation has been practiced (Shiberu, 2010). This paper will try to solve the problem through assessing the willingness of farmers to pay for soil restoration practices using contingent valuation approach.

1.2. Statement of the Problem

Soil erosion is an ominous threat to the food security and development prospects of Ethiopia (MEA, 2005). It induces on-site and off-site costs to both individual farmers, and the society at large respectively that coupled with poverty, fast growing population and policy failure; poses a serious threat to national and household food security.

In the country like Ethiopia whose people's livelihood predominantly depends on agriculture, maintaining and efficiently using soil is a prominent issue for increasing productivity and in turn income of every society. However, lack of appropriate and effective approaches for the wisely management of the natural resource is a colossal challenge facing the country in its ambition to realize both environmental protection and community's livelihood security. Poor conservation of environmental services has led to its serious degradation in the last 50–60 years (MEA, 2005).

Like other parts of Ethiopia, soil erosion in South Achefer district is severely affecting communal, private and cultivation lands at all. This shows that the past malpractices performed by land users like; unrestricted access to communal land use (free grazing), traditional land use, and lack of awareness and absence of appropriate sustainable soil conservation measures led to land degradation in the district. Meaning that the community in the study area has been severely affected by the environmental problems.

Therefore, the challenge is how to cope up with soil degradation problem that affects the livelihood of the people in South Achefer District in. Soil conservation is one of the adaptation strategies which reduce land degradation and increase the production and productivity of the agricultural sector. However, achieving sustainable pathways out of the problem of land degradation and poverty requires active participation of farmers' in conservation practices and understand how farmers value the soil conservation practices on cultivated land.

In Ethiopia, a few studies employed valuation techniques to understand the farmer's willingness to pay for soil conservation activities using CVM methods e.g. Asrat *et al*. (2004), Tessema and Holden, (2006), Belay, (2015) and Bamlaku and Yirdaw, (2016). All the aforementioned studies except Belay (2015), who investigated farmers' willingness to pay for soil conservation on communal lands, did not specify on which land types (private, communal, degraded, cultivated land) the farmers' willingness to pay was assessed. That might lead to a biased result and conclusion about the farmers' willingness to pay for soil conservation practices as farmers may have different willingness to pay for different land types they owned. This implies that, there has no empirical study on willingness to pay for soil conservation that applied valuation techniques on cultivated lands in the study area. Therefore, this kind of research is necessary to give insights and helps the government or other development agents to design intervention mechanisms and mobilize the local people for more conservation activities for different land types.

1.3. Objectives of the Study

The general objective of the study was to estimate households' willingness to pay cash for soil conservation practices on cultivated land in South Achefer district.

The specific objectives of this study were:

1. To estimate the mean cash willingness to pay of households for soil conservation practices; and
2. To identify the determinants of households' willingness to pay for soil conservation practices on cultivated land.

1.4. Research Questions

The underline questions of this study are:

1 What is the value that farmers attach to soil to perform soil conservation practices?

2 What are the determinants of willingness to pay for soil conservation activities?

3 What types of soil conservation practices were used to apply in the area?

1.5. Significance of the Study

The achievements of the soil conservation practices that have been undertaken in the study area have fallen far below expectations. The area still loses a tremendous amount of fertile topsoil, and the threat of land degradation is broadening alarmingly

Controlling the problem of soil erosion is important and conservation intervention is plainly justifiable. However, despite observing the problem of soil erosion and efforts to address the issue was started in early 1970s, the sustainability of the conservation activities on cultivated land that have been performed since then are not found on the ground as farmers either rejected totally or dismantled the structures installed (Bekele, 1998; Adugna, 2008; Merkineh, 2017). Thus, studies on willingness to pay behavior of farmers which ensures their self-initiated participation on the conservation activities have practical significance particularly for success and sustainability of the conservation activities to be done.

The success and sustainability of soil conservation intervention depends, among many things, on clear understanding of causes and extent of soil degradation, execution of the right conservation technologies and involvement of farmers on designing and implementation (Belay *et al*., 2013). Despite that, the success and sustainability of soil conservation interventions primarily depends on willingness and self-driving participation of the farmers on the activities to be undertaken. Though different studies were conducted to assess the farmers' willingness to pay for such soil conservation practices generally in different parts of the country, no study has been conducted in the study area. This study is, thus, hoped to contribute along this line and will be conducted for the dearth of information on willingness to pay behavior of farmers on cultivated lands. By investigating factors that affect farmers' decision towards their willingness to pay, this thesis will recommend for future soil conservation intervention approaches.

1.6. Scope and Limitation of the Study

Since it is not possible to cover the whole aspects of the study area with the available time and resources, it is advisable to limit the study size and scope of the problem to a manageable size. Thus the study was limited on examining the farmers' willingness to pay for soil conservation practices on cultivated lands and examining socio-economic and institutional factors that affect the amount of money farmers are willingly pay for soil conservation

practices within the confined area, South Achefer District; by using contingent valuation method and taking representative sample kebeles from the district and randomly selected respondents from each sample kebeles accordingly.

1.7. Organization of the Thesis

The aforementioned Chapter presented the introduction of the study. The rest of the thesis is organized as follows. Chapter Two presents the literature review. The reviewed studies are in the area of soil and land degradation problems, natural resources valuation methods and economic values of natural resources. Chapter three presents methodology. This Chapter starts with describing the study area sampling procedure and sample size determination, data source and methods of collection and methods of data analysis. Results and discussions are presented in Chapter Four. The last chapter presents summary, conclusions and policy recommendation of the study.

2. REVIEW OF LITERATURE

This chapter reviews the concepts and definitions of terminologies used, economic values of non-marketed natural resources, the different valuation methods, techniques of elicitation mechanisms how to value such resources and findings of empirical researches with regard to such environmental valuation mechanisms.

2.1. Basic Concepts and Terminologies

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 (Demeke, 2009; Vogt, 2011).

Land degradation: is a reduction of the biological or economic productivity of land resulting from land uses or from a process arising from human activities and habitation patterns (WMO, 2010). It is the loss of beneficial goods and services derived from terrestrial ecosystems, which include soil, vegetation, other plant and animal life, and the ecological and hydrological processes that operate within these systems which causes soil erosion, soil nutrient depletion, and salinization and loss of vegetation cover (USDA, 2003; IFPRI, 2011). It is also 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 (UNCCD, 2013; Habitamu, 2014).

Soil degradation: is the reduction in productive capacity of soil caused by overgrazing, deforestation, inappropriate agricultural practices, overexploitation of fuel wood leading to desertification and other man-induced activities (Amsalu and De Graaff, 2007).

The costs of land degradation in Ethiopia include: direct costs like, costs of nutrients lost with top soil erosion (or the replacement costs of these nutrients), lost production due to nutrient and soil loss, costs of forest removal, loss of livestock carrying capacity and indirect costs like, loss of environmental services, silting of dams and river beds, increasing irregularity of stream and rivers and reduced groundwater capacity (Akter and Gathala, 2014).

Other indirect costs relate to social and community losses due to malnutrition, poverty and migration, while poverty is compounded by the lack of economic marketing structure. Some of these costs can and have been quantified, others are more difficult (Nkonya *et al*., 2013). According to different findings causes of land degradation can be seen into two categories: proximate and underlying. Proximate causes are those that have a direct effect on the terrestrial ecosystem and related to topography, unsustainable land management practices such as, land over changes (forests woodlands and shrub land conversion to new agricultural land uses, over-cultivation, overgrazing and excessive forest conversion (IFPRI, 2011; Belay *et al*., 2014).

The underlying causes on the other hand are those that indirectly affect proximate causes. Some of the underlying causes of land degradation are population density, poverty, land tenure and lack of access to agricultural extension, infrastructure, and markets, lack of institutions to promote land conservation practices, and political instability (Abdrohman, 2010; FAO, 2007). According to the findings of many literatures overstocking and overgrazing, deforestation, cultivation of steep slopes, poor management or farming using inappropriate techniques, cultivation on river banks, inappropriate road drainage, land tenure, market, lack of institution, and poverty as the causes of land degradation.

Soil erosion is a result of the operation of the physical forces of wind and water on soil, which has become vulnerable, usually because of human interference with the natural environment. For this reason, soil erosion can be viewed as a symptom of bad land use and management (Addisu, 2011).

Soil conservation can defined as the combination of the appropriate land use and management practices that promotes the productive and sustainable use of erosion and other forms of land degradation. It also refers to the protection of fertile top soil from erosion by wind and water and the replacement of nutrient in the soil by means of investing on different soil restoration activities like cover crops, terracing, contour farming crop rotation etc.(Senders, 2004).Such measures are broadly classified into physical and biological soil conservation measures. The physical measures include bunds, terraces, moisture retention structures check dams, and Sediment storage dams, cutoff drains and waterways and the biological measures are vegetative barriers, agronomic and soil fertility improving practices which are reinforcement measures (Merkineh, 2017; Shiberu, 2010).

Willingness to Pay: is the maximum amount a person is prepared to pay, sacrifice or exchange in order to receive a good or service or to avoid a decline in service or undesired impact such as environmental pollution or degradation, soil degradation in the case of this paper (Horna et al., 2005).

Willingness to accept: is the minimum amount an individual is prepared to receive to give up a good or accept an undesirable situation such as a decline in service or environmental degradation (TEEB, 2010, Alberini and Kahn, 2009).

2.2. Economic Values of Natural Resources

The market prices of goods and services represents the correct value society attaches to the good and services on condition that markets are competitive and freely working. 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).

The definition of valuation is an attempt to put monetary values to environmental goods and services. And it is a means that economists use to obtain information on the values of environmental goods and services. The information can be used to influence decisions about wise use and conservation of the ecosystem. The basic aim of valuation is to determine households' preferences by gauging how much they are willing to pay for given benefits or certain environmental attributes (Balmford *et al*., 2011). In the economics literature, the total (economic) value people attach to an environmental good is divided into two groups - use value and non-use value (Balmford *et al*., 2011).

Use value: refers to the benefit people get by making actual use of the good now or in the future. This value is divided into direct use value, indirect use value and option value. Living in a clean environment is a direct use derived from a better waste management and prevention of some diseases, because of better waste management is the indirect use. The option value is the future (expected) benefit the individual gets from living in a clean city in the future.

Non-use or passive use values: When we come to the other category of economic values, 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 (Krutilla, 1967). These values are the manifestation of people's willingness to pay for a resource regardless of their ability to make any use of it now, or in the future. Such values may arise because of altruism towards future generations (bequest value) or because of the simple knowledge that something exists (existence value) even if individuals never plan to use it. That is why the non-use values are in turn classified in to existence value and bequest value. The existence value is emanated from vicarious consumption (For which the utility is derived from knowing that others derive from the benefit of the conserved natural resource, soil.) and stewardship (utility derived from preserving the environment for the future).

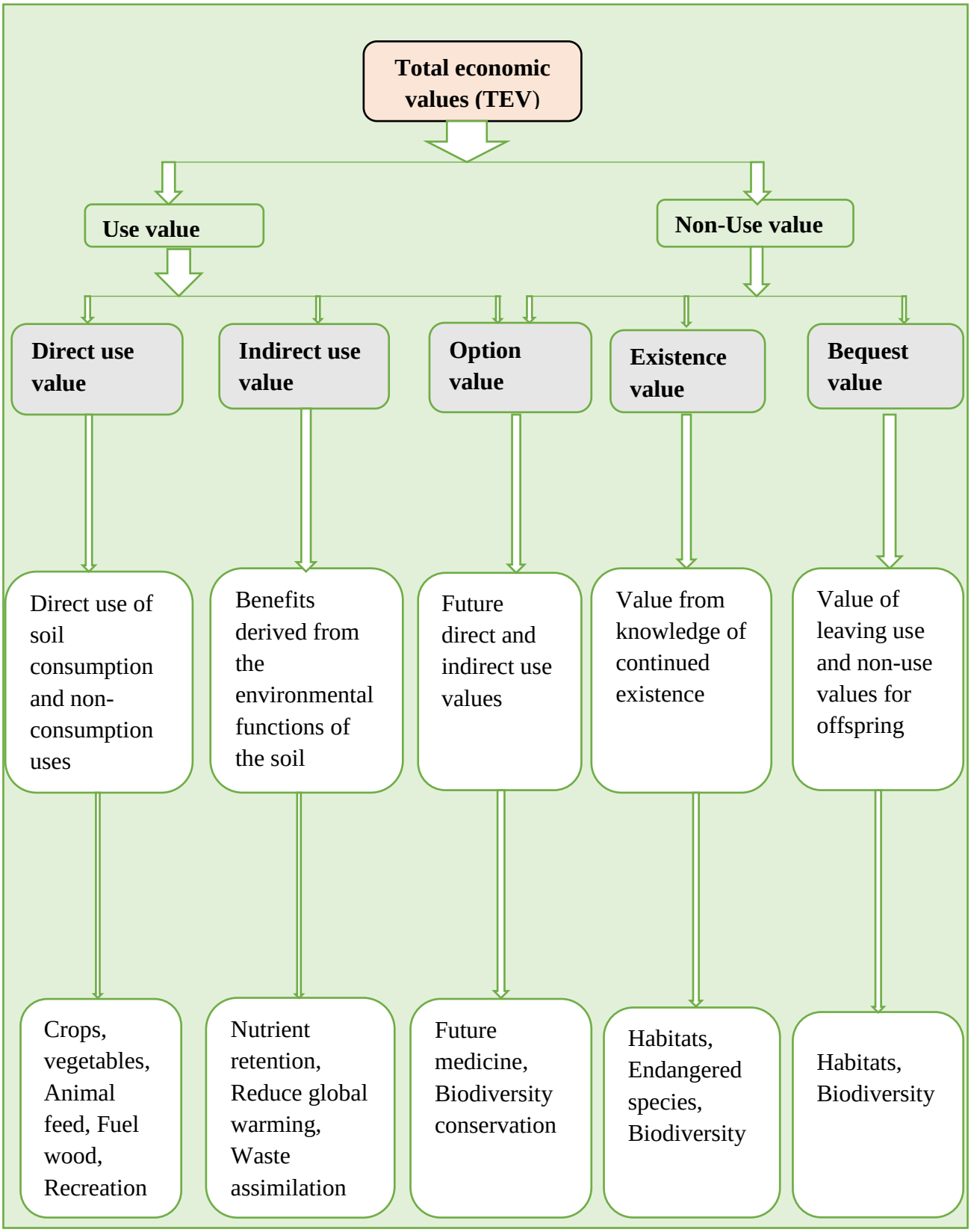


Figure 1: The theoretical framework for total economic values of soil conservation

Source: Adopted from Hodge and Dunn 1992, (cited in Gebrelibanos, 2012)

2.3. Natural Resources Valuation Methods

Environmental valuation of non-marketable goods and services is a technique employed to attach a value for the benefit obtained from the environment and natural resources. Valuation of natural resources like soil, forests, water sources and fishery; and environmental services like clean air, recreations and amenities is useful as such resources yield flows of service to people in increasing its welfare (Freeman, 1993). This is based on the notion of welfare economics that the basic concept of welfare economics is based on the fact that economic activity is to increase the wellbeing of the responding individual or economic agent. In our case, the basic assumption is that, individuals would do decisions to participate in soil conservation practices to maximize their utility based on how well the household is given situations and constraints. From this, it follows that the basis for deriving measures of values is based on the effect of the hypothesized project on household's wellbeing. Environmental valuations, soil damage valuation in this case, assess the social benefits of environmental goods and services forgone due to the change in the quality of soil or in other words, measure the contribution to the human welfare that would have been if the quality deterioration had not been occurred (Boyd, 2007).

Welfare economics, through benefit-cost analysis, seeks to reveal whether the potential change in utility resulting from a change in an environmental economic variables, such as a change in a quality of soil, water, air and the level of provision, is positive (Just Hueth and Schmidt, 1982). The welfare implications are often expressed in terms of a change in an index, usually the monetary amount or amount of labour which would need to be taken from or given to the agent to keep the agent's overall level of utility constant. At the level of an individual economic agent, these monetary measures take a particularly simple form: for a desired increase in the good, the maximum amount the agent would be WTP to obtain the improvement, and for a decrease in the good, the minimum amount the agent would be voluntarily WTA in compensation in exchange for accepting the decrease. Whether willingness to pay or willingness to accept is the appropriate measure depends upon the relevant property right to the good. A number of different proposals for how to aggregate the monetized measures obtained from agents have been advanced (Matos *et al*., 2010).

According to Freeman (2003), the widely used methods of valuation of some non-market goods and services are revealed and stated preference methods. But stated preference method

is preferred over the revealed preference method. It is so happen because revealed preference method cannot measure total economic value (TEV), (use plus non-use values of non-market goods) and secondly while RP models measure the household's WTP, one cannot be sure that the price captures all the effects.

2.3.1 Revealed preference method

Revealed preference methods are based on the actual behavior reflecting utility maximization subject to constraint. However, revealed preference models cannot measure existence value or option value. Revealed preference method is also based on the observed choices in a referendum way. Examples of this valuation methods under the category of revealed preference 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/n (MPM), and the cost-of-illness method (CIM). (Aklilu, 2002; Tietmberg, 2003; Birol *et al*., 2006; Habtamu, 2014).

2.3.2 Stated preference method

In the stated preference category, there are different approaches such as choice experiment method (CEM), contingent valuation method (CVM) and conjoint analysis method (CAM).Stated Preference Method uses a direct approach to elicit willingness to pay, this method involves asking people directly about the values they place on non-market goods and services by creating in effect, a hypothetical market (Freeman, 2003). As one of the direct stated preference techniques, contingent valuation method is used in assessing perception of respondents about their willingness to pay for a hypothetical scenario (Alberini and Kahn, 2009; Cho *et al*., 2008). This is used to estimate the use and non-use values of environmental resources (Edwaerds Jones *et al*., 2000).

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 of revealed preferences like Hedonic pricing and travel cost method underestimate the benefits people get from improved soil management since they measure use values only (Abila, 2011). The other reason for using CVM is its ease of data collection and requirement compared to other valuation methods.

2.3.2.1 Contingent valuation methods

Economic value is measurable in relation to utility functions through the concepts of willingness to pay (WTP) and willingness to accept (WTA) compensation, as well as through the related measures of consumers' surplus, compensating variation and equivalent variation Aryal et al. (2009).

One of the most widely used stated preference methods is the CVM and this method is a "generic approach" (Carson and Hanemann, 2005; Tisdell *et al*., 2008), which simulates real market settings, in order to elicit individuals' preferences about a specified environmental item (Gregory and Slovic, 2000). Therefore, CVM uses a survey to directly ask the participants how much they would be willing-to-pay (WTP) for a welfare gain (due to an increased utility), or how much they would be willing-to-accept (WTA) as compensation for a welfare loss (due to a decreased utility) that occurs because of a change in the specified environmental item (Carson and Hanemann, 2005; Bockstael and Freeman, 2005) or 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 will have to be derived from hidden or implicit markets by constructing artificial markets where people are asked to state their preferences (Hanley et al., 2003).

Conducting a CV survey implies several stages (Perman *et al.*, 2003; Chee, 2004): (i) designing the hypothetical market, (ii) carrying out the interviews (face-to-face, per telephone or mail), in order to obtain WTP/WTA amounts, (iii) calculating average and/or mean WTP/WTA, (iv) aggregation of individual WTP/WTA amounts to one figure representing the relevant population, and (v) evaluation of the CV procedure and results. For the last few decades Contingent Valuation Method has become a quintessential tool for estimating the notional demand curve of non-marketed goods.

According to Hicks (1939), the estimation of a change in consumer wellbeing can be carried out by its income variation, introducing two measures of value that support the economic valuation of environmental impacts. The measures are compensatory and equivalent variations and are linked with variations in consumers' utility and preferences.

According to Antoušková (2012), the Contingent Valuation Method (CVM) aggregates a set of techniques used in research to estimate the economic values of environmental goods and

services based on consumers' preferences. These techniques are based on individual budgetary evaluations, given an increase or decrease in the quality or amount of an environmental good or service, in a hypothetical scenario. This is the method that allows valuating the use value (UV) and non- use value (NUV) of environmental resources. Its domain of application is the valuation of natural resource damage; soil, water, valuation of wildlife, protection of habitats and measurement of the use value (UV) of leisure and recreational sites. According to Alem *et al.*, (2013), the CVM constitutes the only alternative to attain economic value estimates when there is presence of distortions in environmental goods and services, there are no effective market nor substitute markets for it. Seong H. C. *et al*. (2008), explain that the theoretical concept of CV method is consumer theory (consumer choice and consumer surplus). The individual WTP discloses, through the graduation of the marginal utility, the best estimate of its demand scale, and thus, quantifying social welfare measures. The consumer choices are based on the utility maximization premise, under budgetary restriction. The consumer surplus valuates the different degrees of individuals' preferences for various goods and services revealed when consumers go to the market and pay a specific amount for them.

The CVM uses questionnaire techniques to valuate consumers expressed preferences, and clearly describe the good to quantify. In order to the respondents declare and quantify their real preferences, this method simulates scenarios with characteristics analogous to the existing in the real world. Based on personal opinions, constructs a hypothetical market and quantify WTP (payment for a wellbeing improvement) and WTA (reimbursement for a wellbeing loss) according to variations in the availability of environmental resources.

The intended result is to reach maximum WTP for a given benefit, the minimum compensation to abdicate the benefit or WTA for environmental damage. Finally, average WTP/WTA is calculated, the populations are added and thus obtaining the estimates of the value attributed to the environmental good. Alem *et al.* (2013), point out that one of the advantages of this type of methodology consists, precisely, of producing estimates of values that could not be obtained by other ways. According to Carson and Hanemann (2005), the limitations of these methods derive from individuals apparently contradictory behaviours, according with the roles adopted in face of the environmental good. The author refer that most of the folks propose to establish extremely high values to admit the loss of a natural

resources and excessively low values in the hypothesis of having to contribute to assure its protection (Carson and Hanemann, 2005)

The CVM can bear ambiguous results due to bias, resulting from the market fictitious feature and from quality of the individuals' information. The respondents cannot reveal the real WTP or WTA due to their reduced experience, mostly for the WTA case. Moreover, the interviewer can induce answers. And, having no commitment with an effective payment, the vehicle used can affect the result.

To the same way the contingent valuation method involves directly asking people, in a survey, how much they would be willing to pay for specific environmental goods and services, improving soil quality in this case. 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.

In CVM it is obvious that there are two states or conditions for which individuals can apparently see the differences on their welfare and that becomes the possible reason to undertake the study: the status quo versus some alternative state of the world, and information is elicited about how the individual feels about the alternative relative to the status quo, and their WTP/WTA, if anything, to obtain the alternative or status-quo. It also involves providing a description of the existing situation and the possible changes to the environment which are expected to result from proposed changes in management or use a sample of the population and then directly asking about how much they are WTP or WTA to prevent the proposed change in the environment. The payment vehicle is important as respondents could register a protest bid if they object to the method by which the payment would be made (Cameron and Quiggin, 1994).

CVM became popular for valuation of infrastructure projects in developing countries after Whittington (1987) who specifically used CVM as a tool for helping to evaluate water supply projects. According to Birol *et al*. (2006), more than 5000 CVM studies have been conducted in over 100 countries to examine soil, water and other related resource issues. According to Whittington (2002), despite the criticism of its hypothetical nature and the common faults in developing countries contingent valuation implementation, that are mostly observed such as poor survey implementation, poorly crafted contingent valuation scenarios, failure to test for

the effects of variations in survey design on the results of contingent valuation studies, CVM gives the most nearly appropriate value for nonmarket environmental goods and services if it is properly and wisely implemented in a manner that will minimize the above problems during the survey (Eiji and Yasuo(2013)

2.3.2.2. Choice experiment method

In a choice experiment (CE) respondents are presented with a series of alternatives, differing in terms of attributes and levels, and asked to choose their most preferred. A baseline alternative, corresponding to the status quo or `do nothing' situation, is usually included in each choice set. This is because one of the Options must always be in the respondent's currently feasible choice set in order to be able to interpret the results in standard welfare economic terms.

Discrete choice experiments (DCE) are increasingly used to elicit preferences about health care interventions because interventions can be described by their attributes and, an individual's valuation depends on the levels of these attributes. The relative importance of attributes to individuals is usually elicited by presenting the respondent with a series of choice sets here the levels of the attributes are changed across the sets. (Mirja *et al*., 2012).

CEM is a family of survey-based methodologies for modelling preferences for goods, where goods are described in terms of their attributes and of the levels that these take. Respondents are presented with various alternative descriptions of a good, differentiated by their attributes and levels, and are asked to rank the various alternatives, to rate them or to choose their most preferred. By including price cost as one of the attributes of the good, willingness to pay can be indirectly recovered from people's rankings, ratings or choices. As with contingent valuation, CM can also measure all forms of value including non-use values (Hynes *et al*., 2011). Choice experiment method of environmental valuation is more suited for: - (a) Valuing goods with more than two alternatives or multiple choice sets and overcomes some of the problems critics asserted existed with CV, (b) That CE represented a new approach taken from marketing, (c) There was a large demand from policy makers for valuing changes in attributes (Mitchell and Carson, 1989).. But for this study the environmental good with two alternatives, soil, the status quo and another alternative states of world was valued and contingent valuation method was a quintessential approach for eliciting information from respondents and was used.

2.3.2.3. Contingent valuation elicitation format questions

The elicitation question can be asked in a number of different ways. The choice of elicitation format is of considerable importance as different elicitation formats typically produce different estimates. However, in all approaches respondents must be reminded of substitute goods, the need to trade-off money for benefits, and their budget constraints.
(Bateman *et al*., 2002; Tietenberg, 2012).

In CVM surveys, there are four major elicitation methods or choice format questions which are open-ended question, the bidding game, payment card, and the dichotomous choice formats which includes the take-it-or-leave it approach (single bounded dichotomous choice) and take-it-or-leave- it with follow up question (double bounded dichotomous choice) formats. Of which 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).

Open-ended question: in open-ended question format respondents are asked to state their maximum WTP for the service or amenity to be valued and no amounts are given beforehand. Desvouges and Smith (1993), pointed out that this method leads to a number of zero responses or protest bids because the respondents may find it difficult to answer the question or provide truthful answers. And it was just to address this problem that dichotomous choice formats, take-it-or-leave-it method developed by Bishop and Heberlein in 1979 and take-it-or-leave-it with follow-up, which is statistically more efficient was introduced by Hanemann in 1984 by assigning one more bid to the initial bid (Antoušková, 2012).

The bidding game: In bidding game question format, individuals are iteratively asked whether they would be willing to pay a certain amount or not. The amounts will be increased or decreased based on the respondent was or was not willing to pay the previous offered amount and ends when the iterations have converged to a point estimate of WTP. Despite

this approach has its own limitations like, problems associated with the bidding game method are higher costs (the interviewers have to be present), starting point bias because the final value is systematically related to the initial bid value and also there is a tendency of annoying or tiring respondents that cause them to answer yes or no to a stated amount in hopes of terminating the interview (Venkatachalam, 2002; Mussa *et al.,* 2015) these methods has an advantage of providing better results than market-like situations and the researcher can obtain a maximum willingness-to-pay value.

Payment card question: The payment card approach was developed by Mitchell and Carson for estimating national freshwaters benefit in 1984 (Venkatachalam, 2004). Individuals are asked to choose a WTP point estimate from a list of values predetermined by the surveyors, and shown to the respondent on a card. This approach is also criticized on the ground that the respondents might limit their announced WTP to the values listed on the card (Tietenberg, 2012).

Dichotomous choice formats: The Dichotomous Choice Contingent Valuation Method (DC-CVM) has been the most popular technique among practitioners of contingent valuation in the last several years due to its simplicity of use in data collection and its purported advantages in avoiding many of the biases known to be inherent in other formats used in the contingent valuation (CV) method (Cameron and Quiggin, 1994). When this elicitation method is used, the respondent is only required to answer YES or NO when asked if she/he is willing to pay a given amount (bid) for the public good provided.

The dichotomous choice can be further divided into two types: single-bounded (take-it-or-leave-it) choice and double-bounded dichotomous (take-it-or leave-it with follow-up) choice (Antoušková, 2012). In single-bounded dichotomous choice, respondents are asked only once about WTP and is expected to answer yes or no. In this case, WTP can be estimated by probit model and 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 WTP and makes clear bounds on unobservable 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; Arrow *et al*., 1993; Cameron and Quiggin, 1994; Haab and McConnell, 2002).

It is applied in such a way that a respondent is asked a follow-up question contingent upon the response to the initial question. That is the first question is followed by another question specifying a lower amount, if the answer to the first question was no and higher if yes. This means in double bound model, the interval is enclosed within two bids. If one answers to the two questions was positive and the other negative (double bound); otherwise, the interval is bounded by the second bid and the limit of the WTP distribution. In order to gather more information about the support of the true WTP distribution, the initial bids are varied among individuals.

This study will employ the double-bounded dichotomous choice format to elicit respondents' WTP for soil conservation practices in the study area. Then, the bivariate probit model is more appropriate and were used to estimate WTP.

Although the above merits the double bounded dichotomous model do have over single bounded dichotomous model, it does not mean that double-bounded dichotomous choice method by itself is free from critics. It has the following biases identified by researchers in CVM studies:-

Starting point bias: occurs when the respondent's WTP is influenced by the initial value suggested (Tamirat *et al*., 2014). It may arise if the good being valued is not well defined or the respondent may think the true value for the service to be around the starting point (Boyle and Bishop, 1985). For example choosing a low (high) starting point leads to a low (high) mean WTP respectively.

Compliance bias: occurs when the interviewer is leading the respondent towards the answer he/she is expecting. 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 but something that they think will affect the research outcome

in favour of them. Giving a detailed description of the good being valued and the whole purpose of the study can reduce this bias (Tamirat, 2014).

Hypothetical bias: inherent in CVM is its hypothetical nature. If respondents are not familiar with the scenario presented, their response cannot be taken as their real WTP. This bias can be minimized by a careful description of the good under consideration for the respondents.

Part–whole bias: this bias occurs when the respondent fails to distinguish between the parts of the good being evaluated and the total group of the goods into which that part falls.

All the above-mentioned biases can be minimized by a careful designing of the survey, proper training of the interviewer, conducting a pilot survey and monitoring and supervision of the main survey. All these measures will be taken to minimize the potential impacts of the above biases on the result of this study.

2.4. Empirical Studies

There are many researches done on valuation of the environmental goods and services in Ethiopia. Nevertheless, a single study could not be found that estimate willingness to pay for soil conservation on cultivated lands. This literature review covered the empirical findings regarding the WTP for soil conservation practices.

Alemayehu (2016), assessed determinant of farmers' willingness to pay for soil conservation practices undertaken in Jarso District, Eastern Hararg Zone of Ethiopia. The study adopts Single bounded dichotomous choice with an open ended follow up format to elicit households' willingness to pay for soil conservation practices. Probit model was employed and resulted that age, sex, education, labor availability, frequency of extension contact, land tenure, social position and distance to the nearest market were the important variables determining willingness to pay for soil conservation practices in the study area.

A study by Bamlaku and Yirdaw (2015), on willingness to pay for soil conservation practice on communal lands have applied a double bounded dichotomous choice contingent valuation techniques to attach values for the change in quality of the non-marketed environmental resources, soil. Using double bounded bivariate probit model result the annual MWTP of

respondent households' for the proposed conservation project is 36.08 birr per household per year with an aggregate annual benefit of 1,336,873 for five consecutive years. On the above studies conducted on willingness to pay for soil and water conservation activities households' age, household size, education level of household head, income of household, total livestock unit, slop of land, perception about soil erosion and initial bids, are the key determinants of soil and water conservation activities that are empirically proved.

Belay (2015), analyzed farmers' willingness to pay for improved soil conservation practices on communal lands in Ethiopia. By employing a probit model variables such as education level of the head, income of household, slope of the land owned, total livestock unit, frequency of extension agents' visit and perception of household head about soil erosion were found to have a positive and significant influence on the probability of willingness to pay for soil conservation. Whereas sex (femaleness) and initial bids were found to have a negative and significant influence on the probability of willingness to pay for soil conservation. Using double bounded bivariate probit model result the annual MWTP of respondent households' for the proposed conservation project is 85.36, labour days per year per household per year and from the open ended elicitation format the MWTP of respondent households were estimated to be 83.22 labour days per year per household per year which were planned to do for five consecutive years and we can see the result that the contribution is higher for households if it is computed from a double bounded dichotomous than the open ended choice format questions.

Lillo *et al*. (2015*)*, employed the Contingent Valuation Method to determine the extent of welfare in smallholders by means of the application of soil restoration projects, income, land surface, access to credit presence of low yields as a result of erosion, perception of the problem were found to be significant variables for WTP by applying the logit model.

Musa *et al*. (2015), employed Tobit regression model in the valuation of soil conservation practices using contingent valuation technique evidence from the central rift valley of Ethiopia. Double bounded dichotomous choice with an open-ended follow up format was used to elicit the households' willingness to pay using data collected from randomly selected 140 sample households. Results show that the mean willingness to participate in soil conservation practices was about 25 person days per annum. Moreover, the Tobit regression model results indicate that the education level of the household head, initial-bid, income and

labour shortage were found to be important factors influencing the willingness to participate in soil conservation practices.

Alem *et al*. (2013), analyzed economic values of irrigation water in Wondo Genet district, Ethiopia. Through the application of contingent valuation approach and double bounded elicitation format with an open ended follow up question the probit model estimation results of variables, households' income, age of the respondents, education level of the respondents, size of cultivated land and initial Bid were found to be significant factors influencing the response variable, WTP. In the paper estimation of mean willingness to pay from both the close ended double bound and open ended elicitation method were estimated and found to be156,785.1 and 128,264.55 birr with the timely exchange rate of ETH birr to dollar (1 US$=17 birr) per annum for five years. This study suggests that using monetary measures in countries whose per capital income is low leads to a high number of zero bids resulting from severe financial constraints Hence, payment vehicles play a crucial role in CV studies. Therefore, in developing countries other measuring units than money, especially labour contribution, time contribution can be suggested for the valuation of public goods based on the interest of the community who values the resource in question.

Gebrelibanos (2012), was conducted a contingent valuation study in order to investigate the value that the farmers have attached to soil conservation practices and the determinants of willingness to pay for such conservation practices in the Northern part of Ethiopia. In the CVM survey, double bounded dichotomous choice format with an open ended follow up was used to elicit the households' willingness to pay. The result of this study shows that age, sex, education level, family size, perception, tenure, total livestock and initial bid were the important variables in determining willingness to pay for soil conservation practices in the study area. The study also shows that the mean willingness to pay (WTP) estimated from the double bounded dichotomous choice format was computed to be 56.65 person days per household.

Summing up, the above empirical review offers evidence that CVM is a powerful and viable tool to elicit and quantify farm households' WTP for valuation of environmental goods using a bivariate probit model both in developed and developing countries.

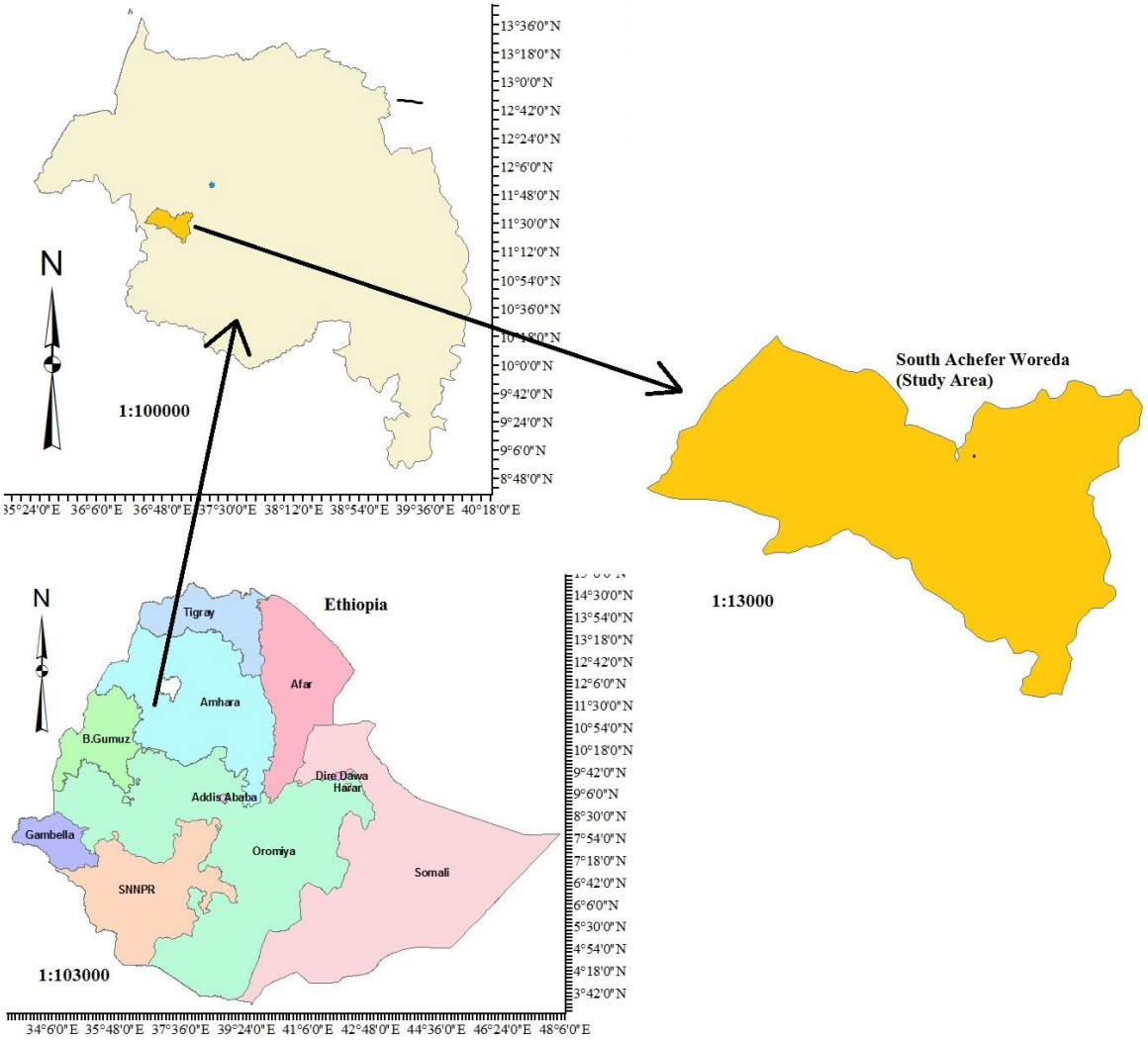
3. RESEARCH METHODOLOGY

This chapter presents the research methodology that were used in the study including description of study area, sampling method and sample size, methods of data collection, methods of data analysis and variable definitions and hypothesis.

3.1. Description of the Study Area

The study were conducted in South Achefer district of Amhara Regional State comprising 18 rural and 2 urban kebele administrations. The study area is located at a distance 505 km from the national capital, Addis Ababa to the north and 60 km south west from the regional capital Bahir Dar. Geographically the district is located between 11˚49' 59.99'' north of latitude and 37˚ 09' 60'' east of longitude. It borders North Achefer to the north, Awi Zone to the South and West and Mecha district to the East. According to the district agriculture office sources, the total geographical area of South Achefer is about 118,228 ha. The most recent population projection census of the CSA2014/2017 report estimates that the total population of the district is 156,866, of which 11.11% of the total populations are urban dwellers and the rest of 88.89% are rural (CSA2014/2017)

When we come to the agro ecological condition the altitude of South Achefer district ranges from 1,500 to 2,500 m above sea level. Eighty seven percent of the district has a temperate climate and the remaining 13% has cold climatic conditions. The district is known for its flat and gentle slope topography, but there are also mountains, valleys and undulating areas. The mean annual rainfall ranges from 1,450 to 1,594 mm. The arable and grazing lands are known to be 39,195 and 18,018 ha respectively. The forest land covers about 4,850 ha or 4% of the total geographical area. There are three types of soil in the district 50% of the soil is red, 40% brown and the rest are 10 %.The most commonly grown crops in the area are maize, *teff*, *dagussa*, barely, sorghum, *nug*, bean, and pea (BOFED, 2011).



Source: Own GIS mapping, (2017)

Figure 2: Map of the study area

3.2. Data Types, Source and Methods of Collection

Primary data were collected on demographic, social, institutional, and economic awareness on the land use concept and WTP for soil conservation practice of land owner households that ensures improved and sustainable soil conservation practices using structured questionnaire through personal interview. Additional information were also gathered through Focus Group Discussion and secondary data were also collected from different sources like District agricultural office, population census records, journal articles and websites. The primary data utilized in the descriptive and empirical analysis of this study were also mainly collected using structured questionnaire from sample households. Due to its superior merit for the efficiency and better result over other CVM elicitation methods

double-bounded dichotomous choice format (DBDCF) question were used to elicit respondents' WTP for soil conservation practices in this study.

The elicitation were undertaken using the following procedure. First, the hypothetical scenario were developed and provided to the respondents. A hypothetical scenario refers to the practice of telling respondents about the existing state of the environmental good to be valued, soil, its degradation condition along with productivity trend and the current and future impact of such soil degradation if an appropriate measure do not be undertaken to restore the problem by conservation practices. In the scenario it was also be an important task to tell respondents that the conservation and rehabilitation activities need initial investment, running cost and labor. Because the respondent's status-quo state do have a number of attributes, including rehabilitation of the soil by making soil structures and planting trees that a stated preference researcher may choose to change through constructing a hypothetical scenario. This is done if and only if respondents as the owner and indigenous people of that area are participating.

Secondly, a respondent were asked to pretend or to assume that she /he lives in a condition different from where she (he) actually lives now. She/he was then be asked whether she/he would vote for the hypothetical management plan if she/he lived in the hypothetical condition (Whittington and Adamowicz, 2010). Finally their willingness to contribute using double-bounded dichotomous choice format (DBDCF) and other supplementary questions affecting their willingness to pay were asked accordingly.

3.3. Sampling Procedure and Sample Size Determination

A three stage sampling procedure were adopted to undertake the study. On the first stage South Achefer District was selected purposively as it is one of the erosion prone areas of the region for which agricultural productivity is declining due. In the second stage 4 rural kebeles were randomly selected from the 18 kebeles of the district. Finally 156 farm households were selected from the four kebeles using the probability proportional to size of simple random sampling technique.

Then the sample size was determined by following the formula given by Yamane (1967) which is more appropriate when the population is homogeneous and random sampling procedure is to take place. The formula is given as follow:-

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

Where, 'n' is the sample size required, 'N' is the total number of households with in the district and 'e' is the level of sampling precision which is assumed to be 8% in this study. The total households in the district are 26,198. Therefore, using the above formula the sample size required from the district is calculated as:-

$$n = \frac{\mathrm{N}}{(1 + \mathrm{N}(\mathrm{e}^2)} = \frac{26{,}198}{(1 + 26{,}198(0.08^2))} = 156 \text{ households.}$$

Then, using proportional to household size, the number of samples from each of the four randomly selected kebeles of the district is computed as follow in the table 1 below.

Table 1: The sampled household numbers from each four sampled kebeles

Kebeles	**Number of households**	**Sample household**
Lalibella	1683	41
Abchiklizuriya	1917	47
NifasaAshuda	1361	33
Yebodenaboshema	1434	35
Total	**6395**	**156**

Source: own computation from S/Achefer district agriculture office, (2017)

3.4. Method of Data Analysis

The quantitative data collected were analyzed using descriptive statistics and Econometric model.

3.4.1. Descriptive statistics

Descriptive statistics such as mean, standard deviation, percentage and test statistics (t-test and chi square test), were used to explain the different socio economic, institutional and other characteristics of the sample respondents along with the econometric model to analyze the data that were collected using contingent valuation method (CVM).

3.4.2. Econometric model

In this study, the bivariate probit model were used to identify both factors affecting the WTP of households for soil conservation practices and to estimate the parametric MWTP of farmers for soil conservation practices. The bivariate probit is based on relaxing the assumption of the distribution of willingness to pay, that is the model bases on the assumption of possibility of existence of different distribution of willingness to pay across the initial and follow up question and then two correlated WTP equations were simultaneously modeled. The bivariate probit CVM solves distortion which is introduced from the follow up questions of the double-bounded contingent valuation survey. The model shows 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 cash that has to be subtracted from a given households' income for the proposed 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 respondent farmer either to accept or reject the initial bid depends on his or her utility derived from the different scenarios. Following Hanemann (1984) the decision process of the farmer can be modeled in a simple utility framework. Let the utility of a given farmer is given by:

$$U_i = U_i(I, Z, Q) \qquad (2)$$

Where, U_i is the utility of the household i, I is total income of the household in a year, Z are socio economic characteristics of the household and other exogenous factors that affect WTP, 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 income of the particular household is a principal or most limiting asset of the household, it is assumed that the individual are willing to contribute the suggested cash reduction from its total income they have so as to maximize his or her utility under the following condition or reject it otherwise;

$$U_i(I - Bid, Z, Q^*) + e_1 \geq U_i(L, Z, Q) + e_0 \qquad (3)$$

Where, U_i, I, Z, Q and Q* are as defined above, Bid is the initial Cash payment requirement per year for the soil conservation practices $\mathbf{e_1}$ and $\mathbf{e_0}$ are the error terms which are assumed to be normally distributed with mean zero and constant variance. Therefore, the probability that a household will decide to pay for the soil conservation is the probability that the conditional indirect utility function for the proposed intervention is greater than the conditional indirect utility function for the status quo. It is called indirect utility because utility is a function of income which is conditioned on the status of goods but not directly a function of goods, improved soil.

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:

$$U^t = f(X_{ti}) + e_{ti},\ t = 0,1\ i = 1,2, \qquad n_i \tag{4}$$

What we are going to do in this model is to determine the probability of accepting the initial bid. The i^{th} household will be willing to accept the initial Bid when $Ui^1 \geq Ui^0$. Therefore, the choice problem can be modeled as binary response variable Y;

$$Where,\ Y_i = \begin{cases} 1, \text{if } U_i^1(I - Bid, Z, Q^*) + e_i \geq U_i^o(I, Z, Q) + e_o \\ 0, \text{otherwise} \end{cases} \tag{5}$$

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

$$\Pr ob(Y_i = 1) = (U_i^1 \geq U_i^o) \tag{6}$$

When we substitute equation 5 to 3 we get

$$\Pr ob(Y_i = 1) = prob\ (\alpha_1 X_i + \varepsilon_{1i} > \alpha_0 X_i + \varepsilon_{0i}) \tag{7}$$

Rearranging the equation 6 we get.

$$\Pr ob(Y_i = 1) = prob\ [(\varepsilon_{1i} - \varepsilon_{0i} > X_i(\alpha_0 - \alpha_1)] \tag{8}$$

$$Let\ u_i = (\varepsilon_{1i} - \varepsilon_{0i})\ and\ \beta = (\alpha_0 - \alpha_1)$$

$$\Pr ob(Y_i = 1) = \Pr ob(u_i > X_i\beta) = \mathrm{F}(\mathrm{X}_i\beta) \tag{9}$$

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).

Double bounded dichotomous choice format is an alternative format in which each participant is presented with two bids. Let Bid1 be the first Bid price and Bid2 be the second (which might be upper or lower contingent up on the response of the households for the first bid provided).The take-it-or-leave-it with follow up format starts with an initial bid, Bid1. 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 Bid2 $_{(max)}$ if she/he answers "no" for the initial Bid, Bid1 she/he receives a lower follow up Bid Bid2 $_{(min)}$. 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. Bid1 $\leq$ WTP <Bid2 $_{(max)}$ for the yes-no responses;

2. Bid1 > WTP $\geq$ Bid2 $_{(min)}$ for the no- yes responses

3. WTP $\geq$ Bid2 $_{(max)}$ for the yes- yes responses;

4. WTP <Bid2 $_{(min)}$ for the no-no responses;

The most general econometric model for the double–bounded data is:

$$WTP_{ij} = \mu_j + \varepsilon_{ji} \qquad (10)$$

Where, WTP_{ij} represents the i^{th} respondent's willingness to pay, and j=1, 2 represents the first and second answers.

μ_1 and μ_2 are the means for the first and second responses.

ε_{ij} are the error terms distributed normally 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.

$$pr(yes, yes) = pr(wtp_{1i} \geq Bid_1, wtp_{2i} \geq Bid_{2i} = pr(\mu_i + \varepsilon_{1i} \geq Bid_1, \mu_j + \varepsilon_{2i} \geq Bid_{2i})$$

$$pr(yes, no) = pr(wtp_{1i} \geq Bid_1, wtp_{2i} < Bid_{2i} = pr(\mu_i + \varepsilon_{1i} \geq Bid_1, \mu_j + \varepsilon_{2i} < Bid_{2i})$$

$$pr(no, yes) = pr(wtp_{1i} < Bid_1, wtp_{2i} \geq Bid_{2i} = pr(\mu_i + \varepsilon_{1i} < Bid_1, \mu_j + \varepsilon_{2i} \geq Bid_{2i})$$

$$pr(no,no) = pr(wtp_{1i} < Bid_1, wtp_{2i} < Bid_{2i} = pr(\mu_i + \varepsilon_{1i} < Bid_1, \mu_j + \varepsilon_{2i} < Bid_{2i}) \quad (11)$$

Each individual respondent (i^{th}) contribution to the likelihood function becomes:

$$L_i(\mu / Bid) = pr(\mu_i + \varepsilon_{1i} \geq Bid_1, \mu_j + \varepsilon_{2i} \geq Bid_{2i})^{yy} * pr(\mu_i + \varepsilon_{1i} \geq Bid_1, \mu_j + \varepsilon_{2i} < Bid_{2i})^{yn} * pr(\mu_i + \varepsilon_{1i} < Bid_1, \mu_j + \varepsilon_{2i} \geq Bid_{2i})^{ny} * pr(\mu_i + \varepsilon_{1i} < Bid_1, \mu_j + \varepsilon_{2i} < Bid_{2i})^{nn} \quad (12)$$

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.

Based on the assumption that the error terms are normally distributed with means 0 and respective variances σ_1^2 and σ_2^2, then WTP_{1i} and WTP_{2i} have a bivariate normal distribution with mean μ_1 and μ_2, variances σ_1^2 and σ_2^2 and correlation coefficient ρ, which is the covariance between the errors for the two WTP function. The appropriate variant of a bivariate probit regression model is used when explaining the "true" willingness-to-pay, with the assumption that the two decisions are interconnected and the errors of the two regressions are correlated.

Given the dichotomous choice responses to each question, the normally distributed model is referred to as the bivariate probit model. The values of regression coefficients are estimated by applying the maximum likelihood (ML) estimator. The likelihood function for the bivariate probit model can be derived as follows. The probability that the respondent replies each pair of responses for the two Bids is as follows:-

$$\Pr(yes,yes) = pr(\mu_1 + \varepsilon_{1i} \geq Bid_1, \mu_2 + \varepsilon_{2i} \geq Bid_{2i}) = \phi\varepsilon_1\varepsilon_2(\frac{B_1 - \mu_1}{\sigma_1}, \frac{B_2 - \mu_2}{\sigma_2}, \rho) \quad (13)$$

$$\Pr(yes,no) = pr(\mu_1 + \varepsilon_{1i} \geq Bid_1, \mu_2 + \varepsilon_{2i} < Bid_{2i}) = \phi\varepsilon_1\varepsilon_2(\frac{B_1 - \mu_1}{\sigma_1}, \frac{B_2 - \mu_2}{\sigma_2}, \rho) \quad (14)$$

$$\Pr(no,no) = pr(\mu_1 + \varepsilon_{1i} < Bid_1, \mu_2 + \varepsilon_{2i} < Bid_{2i}) = \phi\varepsilon_1\varepsilon_2(\frac{B_1 - \mu_1}{\sigma_1}, \frac{B_2 - \mu_2}{\sigma_2}, \rho) \quad (15)$$

$$\Pr(no,yes) = pr(\mu_1 + \varepsilon_{1i} < Bid_1, \mu_2 + \varepsilon_{2i} \geq Bid_{2i}) = \phi\varepsilon_1\varepsilon_2(\frac{B_1 - \mu_1}{\sigma_1}, \frac{B_2 - \mu_2}{\sigma_2}, \rho) \quad (16)$$

Where, $\Phi\varepsilon 1\varepsilon_2$ (.) is the standard bivariate normal cumulative distribution function with zero 1mean, unit variance, correlation coefficient of ρ and B_1 and B_2 represent for Bid_1 and Bid_2 respectively.

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 if not, $d_{1i} = 2Y_{1i} - 1$, $d_{2i} = 2Y_{2i} - 1$ and the i^{th} contribution to the bivariate probit likelihood function becomes;

$$L_i(\mu / Bid) = \phi\varepsilon_1\varepsilon_2(d_{1i}(\frac{B_{1-}\mu_1}{\sigma_1}), d_{2i}(\frac{B_2 - \mu_2}{\sigma_2}), d_{1i}, d_{2i}, \rho) \quad (17)$$

The double bounded (or bivariate) CV model was first proposed by Hanemann (1985) and applied by Hanemann, Loomis and Kanninen (1991) with the main aim to show how the statistical efficiency of single-bounded dichotomous choice pioneered by Bishop and Heberlien (1979) can be improved by asking respondents farther questions with higher or lower bid based on the responses to the initial bids.

Bivariate probit model were used to estimate the mean WTP of the respondents from the double bounded format. In the bivariate probit regression model, dependent variables represent the respondents' response to the initial (BID_1) and the follow-up willingness-to-pay value (BID_2). These are binary variables that take the value 1, if the respondent accepts the proposed value and 0 otherwise. According to Greene (2003), general specification of the bivariate probit model can be formulated as:

$$y_1^* = \beta_1 X_1 + \varepsilon_1$$

$$y_2^* = \beta_2 X_2 + \varepsilon_2$$

$$E(\varepsilon_1 / X_1, X_2) = E(\varepsilon_2 / X_1, X_2) = 0$$

$$Var(\varepsilon_1 / X_1 X_2) = Var(\varepsilon_2 / X_1, X_2) = 1 \quad (18)$$
$$Cov(\varepsilon_1, \varepsilon_2 / X_1, X_2) = \rho$$

Where, y_1^* is i^{th} respondent unobservable true WTP at the time of the first bid offered.

WTP_1=1 if y_1 *>Bid1 (Initial bids), 0 otherwise and WTP_2 =1 if y_2^* > Bid_2 (Follow up bid), 0 otherwise

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

x_1 and x_2 are the first and second bids offered to the respondents respectively

ß$_1$ and ß$_2$ are coefficients of the first and second bids offered

Ɛ$_1$ and Ɛ$_2$ are error terms for the first and second equations

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

$$MWTP = \frac{-\alpha}{\beta} \quad (19)$$

Where, α=a coefficient for the constant (intercept) term, β= is the coefficient of the 'bid' value posed to the respondent in the bivariate probit regression model, The explanatory variables used for computing MWTP are the initial (BID1) and the follow-up willingness-to-pay values (BID2) that were proposed to respondents in the survey.

3.5. Definition of Variables and hypothesis

3.5.1. Dependent variable

WTP bids: It is a dummy variable which denotes the individual's decision to contribute an existing bid or/and higher/lower bid for the proposed improved soil conservation practices. It represents the willingness of households to contribute the amount of money in cash/household/year[1] for soil conservation practices. The dependent variables of the model are Y_1 and Y_2 for Bid$_1$ and Bid$_2$ respectively in which both of them have a dichotomous nature measuring the willingness of a farmer to contribute for soil conservation practices. In both cases, the value 1 would represent for a willing household and 0 for a non-willing household.

3.5.2. Independent variables

Based on the findings of past studies, the following variables are hypothesized to determine household' willingness to participate in soil conservation practices.

[1] One US dollar were sold with twenty two point two seven Ethiopian birr (1$ USD = 22.27 ETH Birr) during the survey.

AGE: is a continuous variable that refers to the age of the household head in years. According to different studies young farmers may have a longer planning time horizon and, hence, may be more likely to invest in conservation. (Gebrelibans, 2012; Bamlaku and Yirdaw, 2015; Alemayehu, 2016) the age of farm household head had negative effect on willingness to pay for soil conservation. To the same token, older age may shorten planning time horizon and reduce the WTP. Then in this study, the effect of age is hypothesized to be negative.

Sex: it is the sex of the household head which is measured as a dummy variable taking a value of 1 for male headed household and 0 otherwise. The sex of the household head is included to differentiate between male and female household heads in their WTP for soil conservation practice. Belay (2015), Gebrelibanos (2012); Behailu (2009) and Doss and Morries (2010), confirmed that women farmers tend to adopt improved technologies at a lower rate than men because of limited access to information and resource. Thus, the probability of female headed households are expected to pay less for SC practices compared to male headed households.

Education level of the household head (EDUCATION): It is continuous variable representing the number of years that the respondent household spent in school. Education may increase farmers' ability to use information about soil erosion as well as soil conservation practice. In many literatures (e.g. Paulos *et al*., 2004; Bamlaku *et al.,* 2015; Jonse, 2005; Ogunniyi *et al*., 2011), indicated that education has been shown to be positively related to farmers' willingness to participate in soil conservation practices. Therefore, it is hypothesized to have a positive influence on farmers' willingness to pay cash.

Farming experience: This refers to the total number of years the respondent household has spent in farming. With longer experience in farming, a wide knowledge and experiences are gained on the issue of soil erosion and associated problems resulted. Thus, it is more likely that farmers with longer farm experience will be ready to pay for the soil conservation practices **(**Mussa *et al*., 2015**).** Hence, farm experience is expected to influence households' willingness to pay for soil conservation practice positively.

Slop of the land: it is the categorical variable indicating the gradient that the plot of the respondent has. It takes the value 1 if the plot of land is steep or very steep and 2 if gentle slope and 3 if flat. A farmer who has a land with very steep and steep slope is more likely to

understand soil erosion problem and apply conservation structures than the farmer who has flat sloped land (Wagayehu and Lars 2003, Bett 2004, and Belay 2015). Therefore, it is expected to have a positive relationship between the dependent variable and the average slope of the respondents' plot of land owned.

Annual income of the household (Income): this is a continuous variable measured in thousands and it is the income that households collected in the year 2016/17 from different sources like crop production, livestock selling, laboring and off farm activities measured in Birr. According to studies Annual income of households have positive impact on the willingness of respondents 'to invest on soil conservation activities (Bamlaku and Yirdaw, 2015; Belay, 2015). Therefore, in this study income is hypothesized to affect WTP positively.

Total livestock owned: this is a continuous variable indicating the number of livestock that respondent households' have in terms of tropical livestock unit (TLU). Livestock is considered as a measure of wealth and increased availability of capital which makes WTP in soil conservation more feasible (Gebrelibanos, 2012; Alem *et al.*, 2013; Belay, 2015). In this study, livestock number of respondents is expected to have positive influence on farmers' willingness to contribute cash for soil conservation practices.

Family size: It is a continuous variable measured in number of people living under one roof. There are two opposing views about the effects of family size on households' WTP. One view argues that higher family size is accompanied with higher labour and as soil conservation activities are labour intensive, the higher the number of labour is the more likely for households to invest more on conservation activities on a labour day per household basis on condition that the payment vehicle is labour in terms of man days (Lemi, 2015; Gebrelibanos, 2012).The other view claims that given limited income of rural households, family with larger members have low income left over to contribute for soil conservation practices if the payment vehicle is in cash contribution, in effect family size of household has negative effect on the response variable(Jonse, 2005; Bamlaku *et al*., 2015; Bamlaku and Yirdaw, 2015). Thus, the effect of family size on the dependent variable is not hypothesized in priory for this study as far as the payment vehicle is not specified.

Perception of soil erosion (Perception): it is a dummy variable which takes the value 1 if the respondent household perceives about the existence of soil erosion problem and 0 otherwise. Farmers who have already perceived the problem of soil erosion are more likely to be willing to contribute the specified initial cash for soil conservation activities. The probability of willingness to contribute for the households that perceive the problem of soil erosion is greater than those who didn't feel the existence of the problem (Paulos, 2002, Gebrelibanos, 2012; Huenchuleo *et al*., 2012; Bamilaku and Yirdaw, 2015). Thus, the perception variable is expected to be positively associated with farmers' willingness to contribute for soil conservation practices.

Initial bid value: This is a continuous variable measured in cash and included in the regression analysis to check weather starting bid bias exist or not. In this study, the bid cash contribution was used as one of the explanatory variables in the analysis. According to Bamlaku and Yirdaw (2015) and Gebrelibanos (2012), the initial bid influences the willingness of the respondents negatively. Thus, in this study it is expected to affect the willingness of the respondents to contribute cash for the proposed conservation program negatively.

Frequency of extension contact: This is continuous variable which is the number of days that the farmer had contact with extension agent in a year. Extension service widens the farmers' knowledge with regard to physical and biological soil conservation activities and other agricultural technologies and hence affects the dependent variable positively (Paulos, 2002; Chilot, 2007; Belay, 2015). In this study, it was also hypothesized that frequency of extension contact would affect willingness to contribute positively.

Access to credit: It is a dummy variable which takes the value 1, if the household had got formal credit access in the last three years and 0, if not. Credit is a cash or in-kind like input which will improve the financial capacity of respondent farmers as to enable them to invest more on conservation practices. Credit might relax cash constraint and might enhance willingness to pay (Belay, 2015). Hence, it is hypothesized that there would be a positive relationship.

Labour shortage: it is a dummy variable taking a value 1 if there is shortage of family labour for farm activities and 0 otherwise. Obviously, in the country of less developed like

Ethiopia, the conservation activity is manually done with human labor and shortage in this resource have an adverse effect on the success of the conservation activities. This is hypothesized based on to the findings of Alemayehu, (2016) and Gebrelibanos, (2012).Therefore, labour shortage was hypothesized to have a negative relationship with willingness to contribute for the soil conservation activities proposed.

Social position: Is a dummy variable which takes 1 if the household has a certain type of social position within its community; and 0 if not. Social position of the household head is expected to affect willingness to pay positively (Gabrelibanos, 2012; Alemayehu, 2016). This is because of the fact that those household heads who have social position in the community have better access to get and participate different capacity building programs from different governmental and non-governmental organization. This enables them to have better awareness on the resource to which the willingness to pay of households is investigated. Hence, having social position enhances the likelihood of saying 'yes' to the initially proposed bid as compared with those household heads who have no social position in the community.

Table 2: Summary of definition, measurement and hypothesis of the Variables

List of variables	Nature of variables	Measurement unit	Expected effect
Dependent variables			
WTP_1/WTP_2	Dummy	(1 if Yes, 0 if No)	
Independent variables			
Age of household head	Continuous	In years	_
Sex of household head	Dummy	1 if male or, 0 otherwise	+
Educational status	Continuous	Year of schooling	+
Farm experience	Continuous	Number of years	+
Slope of land	categorical	1 if steep and very steep, 2 if gentle slope and 3 if flat	+
Income	Continuous	Eth. Birr (ETB)	+
Total livestock owned	Continuous	In tropical livestock unit (TLU)	+
family size	Discrete	Number	+/-
Perception of soil erosion	Dummy	1 if Perceive, 0 otherwise	+
Initial bid	Discrete	In cash (ETB)	_
Extension contact	Continuous	Number of days	+
Access to credit	Dummy	1 if access, 0 if not	+
Labour shortage	Dummy	1 if shortage, 0 if not	_
Social position	Dummy	1, if have, 0 if not	+

4. RESULTS AND DISCUSSION

This chapter presents the results obtained from the contingent valuation survey. It is divided in to four sections. The first section provides the descriptive statistics results. It deals about the socioeconomic characteristics of sample households and major soil conservation practices that are being implemented in the district. The second section deals with the analysis of determinants of respondents' WTP for soil conservation practices. It describes the significant variables that affect willingness to pay for soil conservation practices obtained from bivariate probit model. The third section presents the estimated mean willingness to pay for soil conservation practices by sample households. The last section provides the estimates of total WTP and aggregate conservation demand for soil conservation practices.

4.1. Descriptive Statistics Results

This section presents the socioeconomic characteristics of sample households and the major soil conservation practices that have been undertaken by sample households in the study areas.

4.1.1. Socioeconomic characteristics of sample households

Data from 156 respondents were utilized for the analysis purpose. Out of the total sample households, 48.08% were willing to contribute the pre-specified initial bid offered and 51.92% of the households were not willing to contribute the initial pre specified bid offered in cash contribution. Overall, the socioeconomic characteristics of sample households are described as follows.

Table 3: Summary statistics of variables by willingness status for initial bid

Variable		Willing (N=75)	non-willing (N=81)	Total (N=156)	Min	Max	Test Statistic (t, chi2)
AGE		43.88	42.73	43.28	28	64	-0.10
SEX		0.99	0.89	0.94	0	1	6.21**
EDUCATION		3.36	1.49	2.39	0	10	-4.12***
FARM EXPERIANCE		24.11	20.67	22.32	2	47	-2.59***
SLOPE OF THE LAND	>15%	24	3.71	13.46	1	3	15.62***
	6-15%	64	71.6	67.95			
	0-6%	12	24.69	18.59			
SOCIAL POSITION		0.48	0.40	0.44	0	1	1.14
FAMILY SIZE		6.47	6.30	6.38	1	11	-0.67
INCOME		29.45	17.56	23.28	5	80	-4.27***
PERCEPTION		0.96	0.84	0.90	0	1	6.14***
INITIAL BID		21.31	30.35	26.00	18	34	11.88***
LABOUR SHORTAGE		0.73	0.59	0.66	0	1	3.44***
EXTENSION CONTACT		18.52	10.89	14.56	0	60	-6.30***
LIVESTOCK OWNED		10.07	7.49	8.73	1.85	30.42	-3.81***
ACCESS TO CREDIT		0.47	0.48	0.47	0	1	0.03

***, ** implies statistically significant at 1% and 5% significance level.

Source: Own Survey result, (2017).

NB: The t-test is for continuous variables and chi2-test is for categorical variables in the Test Statistics column of table 3 above.

Age of the household head: The data on age revealed a wide range of responses starting from 28 to 65 years where the average was found to be 43.28 years. The mean age of non-willing respondents was 42.73 years and that of mean age of willing respondents was 43.88 years. But as the summary statistics in the table 3 above reveals, the mean age difference between willing and non-willing households was not statistically significant.

Sex of the household head: From the total sample households, 94% of the respondents were male headed households while 6% of them were female headed households. From the statistical result we can see that out of the total willing households, the share of male headed households were 99% while female accounted 1% share. Out of the total non-willing households 89% were male while female shares 11.11%. In Table 3 above, the value chi-square ($\chi 2$) indicates that there was a significant difference in willingness to pay status for soil conservation between female headed and male headed households at less than 5% probability level. This underlines that sex difference is an important component in willingness to contribute decision.

Education: The mean number of years that a household head spent on school was also computed in table 3 above. The result shows that the mean of years that the household head spent in school from the total sampled respondent was 2.39 and from those of the willing respondent was computed to be 3.36 and from those of non-willing respondent was 1.49. Comparing the willing and the non-willing respondents based on the mean number of years spent in school indicates that those willing household heads spent more number of years than the non-willing respondents. The respective independent t-test result shows that, the difference in mean years of education between the willing respondents and the non-willing ones is statistically significant at 1% significance level (Table 3).

Farm experience: the surveyed households do have a minimum of 2 and a maximum of 47 total farm experience. And willing households have 24.11 mean years of farm experience while non-willing surveyed households' farm experience was computed to be 20.67. The value of chi-square ($\chi 2$) in the table above reveals that there was a significant relationship between the mean farming experience difference and the willingness to pay status of households' for soil conservation practice at 1% significance level.

Slope of the land: as the statistical result indicated out of the total willing households 24% of the respondent households were reported as the average steepness of their land is under steep and very steep category while 64% of the willing category were reported as their average steepness of land is under gentle slope category and the remaining 12% households reported as their average land owned is under flat topography category. When we come to the non-willing household categories, out of the total households who were non-willing to pay the initial cash contribution 3.71% of them were reported as their average steepness of land is under steep and very steep category while 71.6% of the willing category were reported as their average steepness of land is under gentle slope category and the remaining 24.69 households were reported as their average land owned is under flat topography category. The value of chi-square ($\chi 2$) in the table revealed that there is a significant relationship between the mean slope difference of households' land and their willingness to pay status for the soil conservation practice at 1% significance level.

Social position of household head: from the total respondents surveyed, about 44% of the households had different social position in the community and the rest did not have social position. As shown in the table 3 above, about 48% of the willing category and 40% the non-willing category has social position. The value of chi-square ($\chi 2$) in Table 3 above indicates

that there was no significant difference between household heads who had social position and those who did not have with regard to willingness to pay for soil conservation program.

Family size: The average household family size was 6.43 with a minimum of 1 and maximum of 11 household members per household. The sampled willing households had a mean family size of 6.64 people and that of the non-willing households had a mean family size of 6.23 people. However, the statistical result of t-value shows that the mean difference in family size between willing and non- willing respondents was not significant influence for their willingness status for soil conservation program.

Annual income: The mean annual income of the total sample households that was collected from farm, off-farm and non-farm activities was found to be 23.28 thousand with a minimum of 5 thousand and a maximum of 80 thousand per household. As shown in table 3 above those households who were willing to contribute the initial cash bid contribution for the proposed soil conservation activities had a mean total annual income of 29.45 thousands per household which is much greater than the mean total annual income of those households who were not willing to contribute for the same. The t-value in the table above shows that there was a statistical significance difference of the mean total income between the willing and the non-willing households. This implies that income plays a great role in the willingness to pay status of households for the hypothetically designed soil conservation program.

Farmers' perception on soil erosion: From the total of sample households surveyed, 90% perceived the existence of soil erosion problem in the area and the balance (10%) of them did not perceive. About 96% of the total 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, 84% of the non- willing households also perceived the problem of soil erosion in their area. As the statistical result indicates the proportion of households who perceived the existence of soil erosion and associated problems in the willing category is greater than that of the share in the non-willing category. The value of chi-square ($\chi 2$) in Table 3 above also shows that there was a significant difference in willingness to pay status for the proposed soil conservation program between those households who perceived soil erosion and those who did not perceive at 1% probability level.

Initial Bid value: Before implementing the final survey, the pilot survey was conducted using open-ended elicitation format to set up starting bids and decide on the payment vehicle.

During the pilot survey, 40 randomly selected households were interviewed so as to determine the payment vehicle for soil conservation practices and the initial bid contribution. To this end, the households selected cash contribution as a payment vehicle and three cash bid contributions i.e.18, 26, and 34 birr per year were used for the hypothetically proposed soil conservation practice. The bids were chosen based on the frequency that they were selected by those sampled respondents during the preliminary survey. These bids were then used as starting point for the willingness to pay bidding game and equally distributed to the target sample households during the survey. Based on the first responses of them (9, 13, 17) and (36, 52, 68) bids were posed to them for those who rejected and accepted the pre-specified bids, respectively. The statistical results of the bid distribution reveals that the mean values of the initial bid for the willing respondents was 21.31 whereas the mean values of the initial bid for the non- willing respondents were 30.35. The chi-square ($\chi 2$) results in Table 3 above shows that there was a statistically significant difference between the willingness status of households and the value of initial bid offered at 1% probability level. This underlines that initial bid value difference is an important component in willingness to contribution decision.

Labor shortage: As shown in the table 3 above, 66 % of the total respondents reported labour shortage as a problem whereas labour shortage was not a problem for 34 % of the sampled respondents. From the total willing respondents, 73.33% of them reported labour shortage as a problem and from total non-willing category, 59% of them considered labour shortage as a major problem. The chi-square ($\chi 2$) result in the table above justifies that there was a statistically significant difference between those reported labour shortage as a problem and those who did not report with respect to willingness status for the soil conservation activities at 1% significant level and showed that labor is an important factor in determining willingness to pay for soil conservation practices.

Frequency of extension contact: the total sampled household had 14.56 total mean number of extension contact with a minimum of 0 and a maximum of 60 days of contact per year. The mean number of extension contact per year for willing households was 18.52 and that of the non-willing households was 10.89. The mean extension contact difference among willing and non-willing households was statistically significance at 1% probability. This implies that access to extension contact had an important role in households' decision to invest on soil conservation programs that is designed hypothetically.

Livestock owned (TLU): The average livestock number of sampled respondent was 4 with a minimum of 1.85 TLU and a maximum of 30.42. In Ethiopia, livestock are important source of cash income, food, household energy and manure. The statistical results in the table 3 above reveals that the mean number of livestock in TLU per household in the willing category were higher than those of the non-willing respondents. The t- test statistics also shows that the mean difference in the number of livestock had a significant difference between the willing and non-willing households at less than 1% probability level. This result shows that mean livestock availability difference brings a willingness status difference among respondents and hence, is an important variable for willingness to pay decision for the proposed soil conservation program.

Access to credit: from the total of sampled households 47% of them reported as they accessed to credit in the last three years from different sources like Amhara credit and saving institution (ACSI), cooperative associations on the other hand 53% didn't get access to it due to different reasons like fear of interests and complexity of lending-borrowing system like group borrowing. From the non-willing households' category, 48% of them accessed to credit in the last specified years whereas 47% of the willing category report as they did not get credit with in the last three years. The statistical result of chi-2 ($\chi 2$) in the Table 3 above revealed that there was no significant difference among households that had access to credit and with those who did not access credit with regard to the willingness status for the proposed conservation program. This implies that prevalence of access to credit in the area is not as such important variable with regard to the decision of households to invest on soil conservation activities.

4.1.2. Major soil conservation practice in the study area

According to the finding of the survey, most of the farmers agreed that soil conservation practices are important to minimize the rate of soil erosion on cultivated lands. This indicates that households had good perception and participation towards the adoption of soil conservation methods on farm lands. Almost all sampled farmers stated that they were used to practice both physical and biological soil conservation methods on their own farm lands since 1970s up to now. But the way that they were used to do so was in a campaign approach which is emanated from the interest of certain authorized party with no participatory approach. This resulted that most of the conservation structured done on cultivated lands were being dismantled from year to year.

The survey results also showed that despite households perceive the importance of conservation activities and the problem of soil erosion hazards there were other problems reported by them associated with those physical and biological conservation outcomes. Those physical conservation mechanisms mostly implemented in the area like bunds, terraces (soil, stone….) and biological conservation activities (like plantation) are used as a habitat for rodents (mice, rats…) and birds respectively which have disastrous side effects for the crops to be grown. These were the mostly mentioned hindrances not to provide more than their maximum possible contributions for the hypothetically designed conservation activities that they stated. More than 50% from the non-willing and 46% from the willing respondents reasoned this as a major problem not to actively and willingly involve in the conservation activity through accepting the initial cash bid contribution (Table 8).

According to the survey results there are different kinds of soil conservation methods applied despite side effects noticed by the farmers were reported on some of the methods. Practice terracing, plantation and manure application are the three top practices appreciated by the respondents, on the other hand, crop rotation, strip cropping and intercropping are also practiced as a mechanism for restoring the fertility of their cultivated land as well (Fig 3).

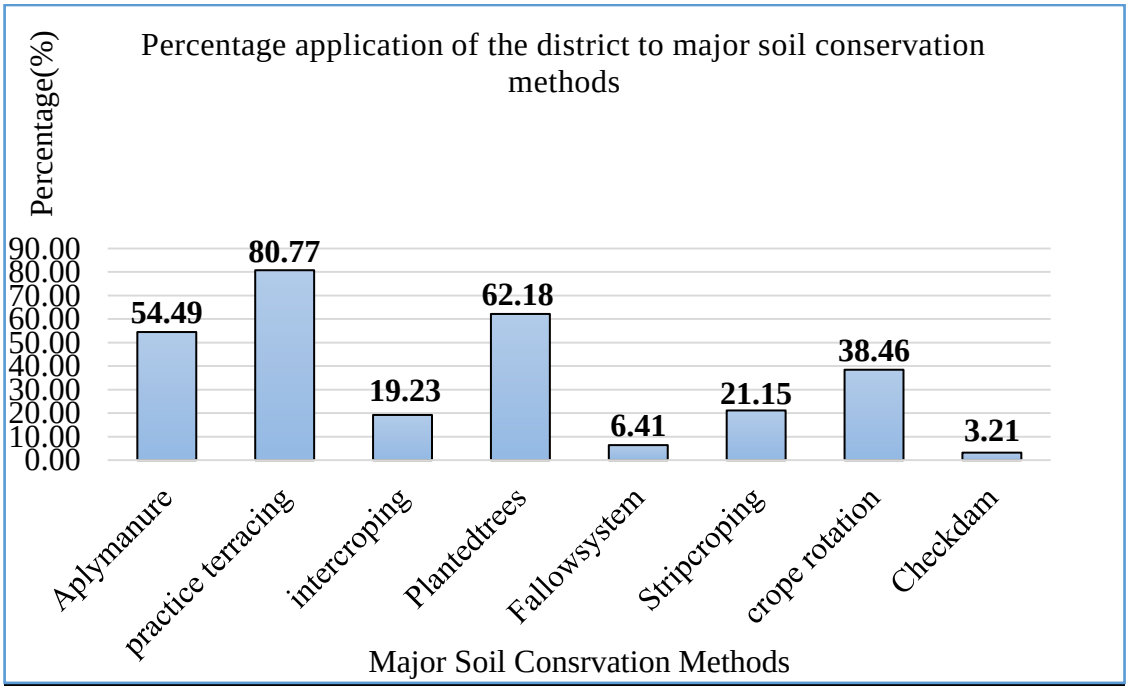


Figure 3: major soil conservation methods in the study area

Source: Own Survey, (2017)

4.2. Determinants of Households' Willingness to Pay

Estimation of the bivariate probit model are reported based on the theoretical model that has already been discussed 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 fourteen explanatory variables were considered in the econometric model out of which five variables were found to significantly influence the probability of willingness to pay among the farm households for the initial and follow up response in common with allowable significant probability level.

The result again shows that the value of the correlation coefficient (ρ) between random errors of both regression equations is perfect (–1) and is statistically significantly different from 0. This basically disproves the null hypothesis which says that there is no linear relationship between the random components of the responses to the initial bid and the second bid (between the regression equation of the two bivariate probit models). Besides, the value of correlation coefficient of the error term implies that the random component of WTP for the first question is perfectly correlated with the random component from the follow-up question. Similarly, estimation of the bivariate probit model resulted in greater estimation efficiency. This also shows that simultaneously measuring the estimation of willingness to pay brings the greatest advantage in the evaluation of the respondents' further response where the standard errors of evaluation of regression constant and regression coefficient are reduced significantly.

As indicated in appendix Table results (Table 5) the predicted probability of the joint marginal effect for the two simultaneously modeled probit regression indicates the probability of success and failure for both responses (initial and follow up responses) is 9.24 and zero percent respectively. These implies that the probability of accepting both bid values the initial and follow up bid is 9.24% and the probability of rejecting those two bid values is 0 percent. Similarly the predicted probability of accepting only the first Bid value 44.77 percent and the predicted probability of accepting the second Bid value is 64.47 percent. The result indicates that more respondents are more likely to accept the second bid value as compared to the initial bids provided to them.

Table 4: Determinants of willingness to pay from bivariate probit model

Variables	For the first response (WTP1)		For the second response (WTP2)		Joint marginal effect
	Coef.	Std. Err	Coef.	Std. Err	
AGE	-0.0703	0.0431	0.0000	0.0248	-0.0278
SEX	1.8676*	1.0202	0.9810*	0.5394	0.1585
EDUCATION	-0.0238	0.0740	-0.0400	0.0500	-0.0243
FARM EXPERIANCE	0.0823	0.3032	0.0203	0.0225	0.0401
SLOPE OF LAND	0.0607	0.3689	0.2690	0.2542	0.1242
SOCIALPOSITION	-0.2138	0.3490	0.0813	0.2691	0.1985
FAMILY SIZE	-0.0493	0.0923	-0.0448	0.0796	-0.0362
INCOME	0.0314**	0.0147	0.0287*	0.0109	0.0231
PERCEPTION	0.0754**	0.0346	0.8425**	0.4324	0.1271
INITIAL BID	-0.2086***	0.0351	-0.0942***	0.0226	-0.0474
LABOUR SHORTAGE	0.2254	0.3370	-0.1864	0.2631	0.0200
FEXTENSIONCONTACT	0.0586*	0.0317	0.0437**	0.0189	0.0395
LIVESTOCK OWNED	0.0328	0.0684	-0.0563	0.0449	-0.0080
ACCES TO CREDIT	0.6382	0.4345	0.2927	0.2811	0.2810
_cons	2.8691	2.7642	-5.5618	1.6051	
/athrho	-14.8928	848.6941			
rho	-1.0000	0.0000			
Bivariate probit regression					
Number of obs = 156			Marginal effects after biprobit		
LR test of rho=0: chi2(1) = 41.0698					
Wald chi2(28) = 77.87			y = (WTP1=1,WTP2=1) (predict)= .0924		
Log likelihood = -96.622917					
Prob > chi2 = 0.0000					

***, ** and * statistically significant at 1% and 5% and 10% respectively

Source: Own Survey, (2017)

Sex of the respondents (SEX): Results from the bivariate probit model show that sex of the respondents and bid assigned for conservation activities are significantly and positively related below 10% for the specified initial and follow up bids respectively (Table 4). This implies that male headed households were found to be willing to pay more for soil conservation practices than female headed households. The marginal effect result of the bivariate probit model above reveals that keeping other factors constant, being male increases the probability of saying 'yes' to the specified initial and follow up bid by 1.6%. The sign of sex turned out to be consistent with the prior expectation and it was positively and significantly related with the dependent variable. This is mainly because; female headed households have less resources possession endowment as well as some cultural constraints than male headed households. Alemayehu (2016); Belay (2015) and Gabrelibanos (2012) reported the same result.

Annual income of households' (INCOME): Annual income of the respondent has positive and significant relationship with the households' WTP at 5% and 1% probability level for both the initial and the follow up responses. The common marginal effect result of the model shows that keeping the influence of other factors constant, when annual income of a household increases by one unit (1000 ETH birr), the probability of the households' willingness to pay for soil conservation activities increases by 2.31% for both the initial and follow up bid responses (*ceteris paribus*), (similar to finding of Dabbert and Arouna, 2012). This income and WTP relationship is also in line with the economic theory and findings of previous researches by Jonse (2005), Bamlaku and Yirdaw (2015), and Belay (2015).

Perception of soil erosion (PERCEPTION): The coefficient of the variable perception of soil erosion appeared to be significant at 5% probability level with the expected sign for the first and the second responses respectively. The implication of the positive sign is that holding other things constant, a perception on soil erosion and associated problems on their cultivated land increases the probability of a farmer to support the proposed voluntary contributions. This result implies that perception on soil erosion and associated problems on farm land is an important determinant of the WTP for soil conservation practices. The common marginal effect results of the bivariate probit model revealed that perceiving the existence and problem associated with soil erosion increases the probability of accepting the specified initial bid contribution by 12.71%. The result is consistent with the result of previous research finding of Huenchuleo *et al*. (2012), Rulleau *et al*. (2014) and Belay (2015).

Initial bid value: For bivariate probit model, the results indicate that the initial bid (IBID) have a statistically significant negative impact on both the respondents' initial and subsequent decision towards willingness to contribute the specified cash for conservation of soil at 1% probability level. This implies, the probability of a 'yes' response to the initial and follow up 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. The marginal effect results of the bivariate probit model shows that as the discrete values of initial bid increases by one unit the probability of saying 'yes' to the initial bid decreases by 4.7% for both response decision. The result was in line with the findings of previous researchers which was undertaken by Musa (2015), Belay (2015) and Gebrelibanos (2012).

Frequency of extension contact (EXTENSION CONTACT): The variable frequency of extension contact is positively and significantly related to the willingness of respondents for both the initial and follow up decisions of households at 10% and 5% significant levels, respectively. The model result shows that as we proceed a follow up questions to the respondents they reconsider their responses and their likelihood of accepting the follow up bid increases so that the level of significance increased. The marginal effect estimation of the model indicates that a one day increase in the frequency of extension contact increases the probability of accepting the initial and the follow up specified cash contribution by a percentage of 3.95 keeping other variables constant at their mean values. This shows that as households get access for extension services associated with soil erosion and its problems, they become more aware and become more flexible to accept the yearly offered cash contribution for five consecutive years to minimize the problem in a sustainable manner. This findings were in line with past research findings Paulos (2002), Gebrelibanos (2012), Bamilaku and Yirdaw (2015) and Belay (2015).

4.3. Estimation of Mean Willingness to Pay

The mean willingness to pay can be estimated using both close ended double bounded dichotomous choice question and open ended question formats. The results from the two formats are given below.

1. Mean willingness to pay from double bounded dichotomous choice question

One of the main objectives of estimating an empirical WTP model based on the CV survey responses is to derive a central value (or mean) of the WTP distribution. The estimation of mean willingness to pay from the double bounded dichotomous choice format of the bivariate probit model was computed using the parameter estimates following the formula developed by Haab and McConnel, (2002) as it is stated in the theoretical section of chapter three.

$$MWTP = \frac{-\alpha}{\beta} \qquad (4.1)$$

Based on this premise the mean values of the cash that the surveyed households payed for the hypothetically proposed conservation activities were found to be 36.46 Birr per year (Equation 4.2). This was the average value of parameter estimates of both the initial and the

follow up responses of the two simultaneously modeled bivariate regression models. This annual cash payment for the proposed hypothetical soil conservation program was planned to be continued for five consecutive years as per the agreement made during the survey.

Table 5: Parameter estimates of the double bounded bivariate probit model

Variable	Coeff.	Std. Err
Initial bid	-0.2086***	0.0351
Constant	2.8691	2.7642
Second bid	-0.0942***	0.0226
Constant	5.5618	1.6051
/athrho	-14.8928***	848.6941
Rho	-1.0000	0.0000
Bivariate probit regression	Number of obs = 156	
Wald chi2(28) = 77.87	Prob> chi2 = 0.0000	
Log likelihood = -96.622917		
LR test of rho=0: chi2(1) = 41.0698	Prob> chi2 = 0.0000	

***statistically significant at 1%.

Source: Own Survey, (2017)

$$MWTP = Ave(\frac{-\alpha 1}{\beta 1} + \frac{-\alpha 2}{\beta 2}) / 2 = (\frac{-2.87}{-0.21} + \frac{-5.56}{-0.09}) / 2 = 36.46 \qquad (4.2)$$

Where: MWTP = Mean willingness to pay,

$\alpha 1$ and $\alpha 2$, are the coefficients of the constant term for the two regression equations.

Ave implies average values,

$\beta 1$ and $\beta 2$, are the coefficients of the initial and follow up bids posed to the surveyed respondents in the first and second regression models.

The Wald Chi-square ($\chi 2$) distribution was used as the measure of overall significance of a model in the bivariate probit model estimation. The result of the bivariate model shows that, the probability of the chi-square distribution was 41.07 with 13 degree of freedom less than the tabulated counter factual is 0.0000, which is less than 1%. So, this shows that, the variables included to explain willingness to pay fits the bivariate model at less than 1% probability level. In other words, we reject the null hypothesis which stated that the coefficients of all explanatory variables included in the model are zero.

2. Mean WTP estimation from the open ended format

In the open ended question, respondents were asked to state the maximum amount in cash they would like to pay for soil conservation practices. The amount of cash that the households would contribute to the improved soil conservation ranges from 0 to 60 ETH Birr per year to be extended for five consecutive years.

Table 6: Sampled households' conservation demand

Amount of cash	**number of respondents**	**Percent**
0	2	1.28
1-15	26	16.67
16-30	83	53.21
31-45	32	20.51
46-60	13	8.33
Total No of Obs.	156	100.00
Mean=27.2308	Std. err =12.8915	

Source: Own Survey, (2017)

From the total of 156 sample respondents, only 2 households were not willing to contribute cash for soil conservation practices (zero bid). On the other hand, the remaining 154 were willing to contribute some amount of money that they already stated during the survey despite the amount of money they willingly contribute differs from one respondent to the other. The average amount of money that farmers were willing to contribute for soil conservation practices from the open ended format was 27.23 ETH Birr per year.

The information obtained from the household maximum willingness to pay result can also be used to draw a frequency curve and to make aggregation for the willingness to pay for conservation of soil resource activities. The frequency curve for willingness to pay for conservation of soil resource is derived to see the extent of cost recovery. The frequency curve can be derived in terms of the total number of households and their associated maximum WTP. Figure 4 below shows the frequency curve of the sampled households for the conservation of soil resources. For this, we measure the total number of the households along the vertical axis and the birr stated by the households per year along the horizontal axis. The frequency on the maximum willingness to pay by table is adding class by class. The frequency in a specific class can then be clearly indicated by the number of households

that are below or above the class. In other words, from cumulative frequency tables a curve can be drawn, to reflect data in a graphic manner.

As shown in Figure 4, the demand curve is first positively sloped and then negatively sloped as the bid amounts increases indicating the decline in the demand for conservation of soil resources.

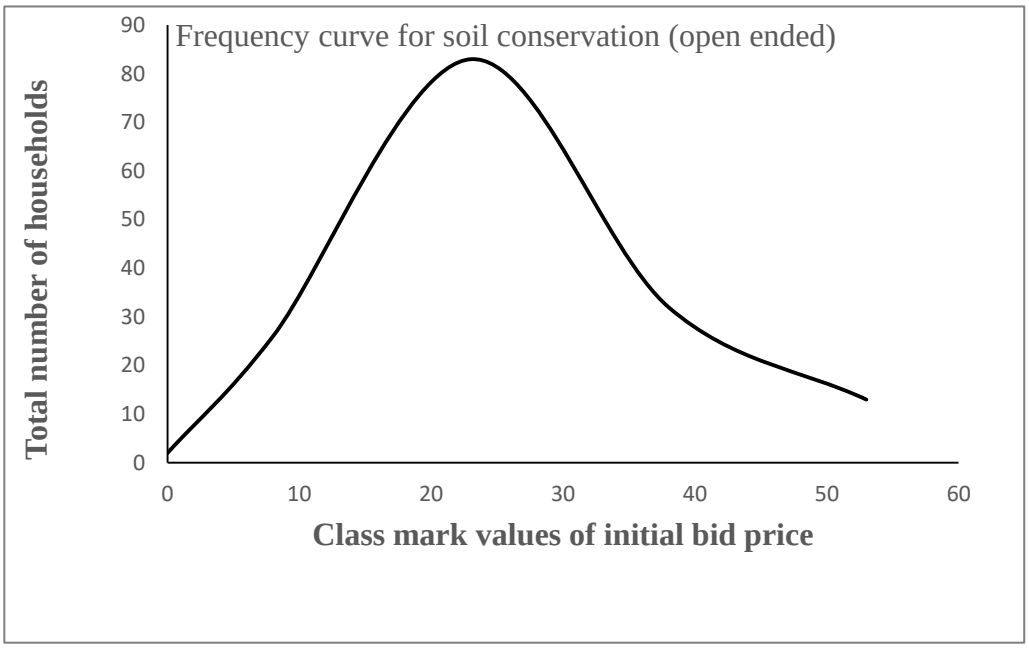


Figure 4: Frequency Curve of respondents for maximum willingness to pay

Source: own survey result, (2017)

For the open-ended contingent valuation survey responses, the maximum willingness to pay figures reported by the households can simply be averaged to produce an estimate of mean willingness to pay:

$$MWTP = \sum Yi/n \qquad (4.3)$$

Where ‘n’ is the sample size and each ‘y’ is an openly reported willingness to pay amount by surveyed households. Using the above formula, the average amount of money that farmers were willing to contribute for soil conservation practices was estimated to be 27.23 ETH Birr per year per household only for the sampled households in this study. This value is lower than the average values of money contribution computed from the bivariate probit mean estimates of the parameter. One possible reason for this is resulted from the fact that respondents troubled for answering open ended questions with no bases and the other possible reason might be that they want to free ride from the benefit of the conservation

activities with the expense of other as it is the very nature of human beings response to the conservation and/or preservation of public goods like soil in our case

The major reasons for not contributing (zero bid) to the conservation activities which were reported by 1.28% of the total respondents was luck of enough money which is a genuine zero bid according to the discussion of NOAA guidelines and there were no protests[2] that were against the implementation of the hypothetically designed conservation program. The aggregate yearly money contribution of the district from both the close ended double bounded dichotomous choice elicitation format question and the open ended format question becomes as follow in the table below (Table 7).

4.4. Estimating Aggregate Willingness to Pay

Ultimately, the important benefit of contingent valuation analysis is the estimation of households' WTP and the aggregation of this measure over the population. There are different approaches to aggregating WTP from a sample to the population. Traditionally, CV analyses have calculated the aggregate WTP by multiplying either the mean or median WTP by the total number of households in the population and the yearly conservation demand. Aggregation using mean WTP gives the social benefits of the offered improvement and is consistent with cost-benefit analysis. Consequently, aggregation using mean WTP was chosen for its compatibility with cost-benefit analysis (Arouna and Dabbert, 2012).

In order to aggregate the willingness to contribution of the district, the average values of both the open and closed ended format estimation results were used. Then multiply the total number of households expected to have a valid responses with the respective computed mean values of the open and closed ended contingent valuation survey responses (see table 7). Following this, the total yearly willingness to pay of the district from both the close ended double bounded dichotomous format question and the open ended question was found to be 942,928.52 and 704,242.95 Birr per year per district, respectively. This cash contribution plan will be extended for five consecutive years as per the agreement made with the surveyed households during the survey and then the five years total aggregate conservation demand from both methods were computed to be 4,714,642.60 and 3,521,214.75 Ethiopian Birr per

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

five years per district. This result indicated that different elicitation methods give different WTP and therefore, policy makers should take care of when selecting the elicitation method.

To the same token, selecting appropriate payment vehicle based on participatory approaches helps to minimize biases resulted from overestimation and under estimation. In the aggregation process zero bid responses was accounted in the estimation of the total aggregate demand of conservation activities.

Table 7: Households aggregate willingness to pay

Category	Total HHs	Expected HHs to have a zero Bid	Expected HHs' with Valid Responses	Mean WTP	Yearly Aggregate Benefit	The five years total benefit
Closed	26198	336	25862	36.46	942928.52 Birr/year	4,714,642.60 Birr/5 year
Open	26198	336	25862	27.23	704,242.95 Birr/year	3,521,214.75 Birr/5year

Source: Own Survey, (2017)

The result on the above table shows that the willingness of households to pay for conservation activities on cultivated land was relatively less than from those other researches previously done on conservation activities which did not specified a specific land use types on which the conservation activities have to be done (e.g. Alemayehu, 2016; Gebrelibanos, 2012). This means that households' willingness to pay for soil conservation might differ according to land use types.

Respondents were also asked to point out their major reasons for not to contribute more than what they described as their maximum capacity and they provided different reason for their maximum WTP. From the 75 households who had a positive willingness to pay for the initial bid provided to them (Table. 8), 46.67% of them reported 'the major conservation activities that they are implementing have side effects' as a reason for their maximum contribution. And 26.67% of them reported as they couldn't afford more than what they stated, 21.33% think that the amount they already stated is worth enough and the rest 5.33% of them believe that others like government should contribute for the conservation of such public goods. Those respondents who were not-willing to accept the first specified initial bid value reasoned the same way as what those willing respondents reported. More than 50% of the non-willing respondents also mentioned that the major conservation activities that had been implementing on farm lands in the area (bund construction, plantation etc. activities) are

used as a habitat for rodents and birds that have detrimental effects for the crop to be grown. And 35.44% of them reported as they couldn't afford more than what they willingly stated due to different reasons like shortage of money. Similarly, 11.39% of the non-willing ones think that the amount they willingly stated is worth enough or satisfactory for the conservation activities and the rest 2.54% believe that conservation of such public goods should be incentivized by the governments.

Table 8: Reason for their maximum willingness to pay cash

Reasons	**Non willing**		**Willing**	
What is the main reason for your maximum willingness to pay cash	Freq.	Percent	Freq.	Percent
I think it is worth that amount	9	11.39	16	21.33
Others should pay(government)	2	2.54	4	5.33
I could not afford more	28	35.44	20	26.67
other reason[3]	40	50.63	35	46.67
Total	79	100.00	75	100

Source: Own Survey, (2017)

Households were also categorized based on their joint responses to the initial and the follow up offered bids. As shown in the survey statistical result, out of the total 156 surveyed respondents 33(21.15%) of the households accepted both the initial offers as well as the follow up increased bids (yes-yes), and the percentage of households that did accept the initial bid but not the second incremental follow-up bid was found to be 42(26.92%). The third category of households presented in Table 9 below was those households that rejected the initial bid but accepted the second discounted follow-up bid. This category accounts 62(39.74%) of the households. The last category represents households who rejected both responses (no-no) for the first initial bid as well as for the discounted follow up bids. Those households were 19(12.18%) of the total sampled households.

[3] "Other reason" specified by respondents as their reason for maximum willingness to pay is prevalence of side effects associated with major conservation activities.

Table 9: Willingness to pay categories

WTP categories	Sex of household				Total	
	Male		Female			
	Freq.	percent	Freq.	percent	Freq.	percent
No –no	13	8.90	6	60	19	12.18
No –yes	59	40.41	3	30	62	39.74
Yes –no	41	28.08	1	10	42	26.92
Yes –yes	33	22.60	0	0	33	21.15
Total	146	100.00	10	100	156	100.00

Source: Own Survey, (2017)

5. SUMMARY, CONCLUSION AND RECOMMENDATION

This chapter has two sections. The first section presents briefly the overall summary and conclusion of the findings of the study and the second section forwards recommendation or policy implication emanated from the findings of the study.

5.1. Summary and Conclusion

The objective of this study was to determine the willingness of household respondents in South Achefer District to pay for conservation of soil. A contingent valuation approach has been used to estimate WTP. Particular attention was paid to the distribution of the WTP. Based on a double-bounded dichotomous choice format question, which relaxes distributional assumptions to estimate WTP, bivariate probit (biprobit) was introduced into the contingent valuation approach.

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 worse 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. 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.

Despite, farmers understand the existence of soil erosion and problems associated with it they were not willing to pay the specified initial cash contribution as to enable to avert the problem due to different hindrances that they stated such as prevalence of side effects associated with the soil conservation activities most commonly implemented in the area.

The study used relevant secondary data from various publications, journals reports and websites but the major sources of data were obtained from a contingent valuation survey of 156 sample respondents using three stage sampling procedure with structured questionnaire administered with trained enumerators. Probability proportional to size sampling technique

was employed to select the farm households from four sampled kebeles, which were selected first by simple random sampling technique.

The result of descriptive statistics revealed that households clearly understands the existence of soil erosion on cultivated land and the maladies associated with the erosion. But not less than half of the surveyed respondents were not willing to pay the initial specified cash bid contribution. This was due to reported reasons of side-by-side problems associated with conservation methods that they have been adopting most such as terracing and plantation.

The estimates of the bivariate probit model (the first and the follow-up responses) found that sex of the respondents, annual income of households, perception about soil erosion, the initial bid and frequency of extension contact were the common determinants of households' WTP for soil conservation on cultivated land. Sex of the household head, annual income of the household, perception of the household about soil erosion have positive effect for the households willingness to pay for soil conservation activities while initial bid value affects it negatively.

In the study, the mean annual cash contribution of each household from both DBDC elicitation format and open ended format was computed to be 36.46 and 27.23 birr. Then using this individual mean value, total WTP from the double bounded dichotomies choice was computed to be *942,928.52* Birr per year per district. Whereas, the aggregate WTP from the open ended format was computed to be 704, 242. 95 Birr per year per district. In the meantime, the total five years conservation demand from both the double bounded dichotomous choice format and the open ended format was calculated to be 4,714,642.60 and 3,521,214.75 Birr per district per five years.

5.2. Recommendations

The results of the study have shown that the socio economic characteristics of the household 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.

Based on the results of this study sex of the household head had a positive effect on willingness to pay decision. This shows that female headed households were 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.

It can also be clearly seen from the result that the annual income of households has a statistically significant, positive impact on both the respondent's initial and subsequent decision on contributions towards the realization of the targeted conservation scenario. One policy implication of these findings is that for the realization of the targeted hypothetical conservation program, any concerned body designed to address soil erosion problems in the study area should invest on improving the annual income of households in priory. This is because of the fact that as annual income of household increases the income left over from family expenditure increases and this in turn creates an opportunity for investing a lot for the soil conservation activities.

The results of this study also show that, perception that the household respondents have on existence of soil erosion and associated problems do have a positive and significant effect for their willingness to pay status for the hypothetically designed conservation program. Hence, any concerned body who try to design and implement such conservation programs on the area should firstly increase the awareness of households.

The result also encourages to recommend that increasing the frequency of extension services, which develop capacity of the household farmers with regard to erosion and conservation activities, increase the likelihood of farmers to accept the conservation program and willing to pay for the same. Therefore interaction between extension agents and farmers should be strengthened. Moreover, frequent contact between the two could enhance farmers understanding of the environmental problems in general and soil erosion problems in particular.

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7. APPENDICES

Appendix 1: Questionnaire

This questionnaire is prepared by **Lamesgin Tebeje Workie** to collect data for the research entitled: "**Households' Willingness to Pay for Soil Conservation Practices on Cultivated Land in South Achefer District"**. All the information that you will provide will only be used for academic purpose. Hence, you're honest and genuine response is required.

General Information:

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

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

1. HOUSEHOLD HEAD INFORMATION

1.1. Age_____

1.2. Gender (SEX) Male = 1 Female = 0

1.3. Marital status: Married =1 Divorced =3 Single =2 Widowed =4

1.4. Education: 1. Illiterate 2. Read & write 3. Years of schooling--------

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. Family size M……..F…….T…….

2. INFORMATION ABOUT SAMPLEHOUSEHOLDLAND USE

2.1. Do you have land? 1. Yes 0. No

2.2. If yes for 3.1, fill the following Table.

No	**Type of land use**	**Area in hectare**
1	Cultivated land	
2	Grazing land	
3	Forest land	
4	Fallow land (left for recovery)	
5	degraded land	
6	Others	

3). AWARENESS ASSOCIATED WITH SOIL EROSION AND EROSION HAZARDS

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

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

1 productivity decrease 2 soil depth decrease 3 soil colour 4 others……..

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

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

3.5 How do you perceive the level of parcel's (land) exposure to soil erosion?

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

3.6 Has your farmland been severely affected by soil erosion before? 1. Yes 0. No

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

1. Very severe 2. Severe 3. Minor

3.8. 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) ----------

3.9. 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

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

1. Apply manure 2. Strip cropping 3. Practice terracing

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

3. 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

3. 12. Do you think soil erosion will affect your farmland in the future if situations remain unchanged? 1. Yes 0. No

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

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

3.14. 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) ---------

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

1. Fertile2. Moderately fertile 3. Infertile 4. Others (specify) --------.

3. 16. If infertile, what was the cause of infertility?

1. Intensive cultivation for many years 2. Erosion 3. Do not know 4. Others (specify) --

3.17. Do you observe change in the level of crop yield on your cultivated land? 1. Yes 0. No

4. AWARENESS TO TECHNOLOGY

4.1. Do you know the existence of soil conservation practices? 1. Yes 0.no

4.2. 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

4.3. 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) ----------

4.4. Have you participated in community conservation activities this year? 1. Yes 0. No

4.5 Do you use fertilizer on your farm to maintain soil fertility? 1. Yes 0. No

4.6 If yes, amount per ha in kg……..

5. WILLINGNESS TO PARTICIPATE IN SOIL CONSERVATION PRACTICES (Enumerator read the scenario and let them determine the initial bids)

5.1. Are you willing to contribute **18**/**26**/**34** birr in a year? (Circle one) Yes= 1 No= 0

If the answer for question 1is "yes" go to question number 6.2, if the answer is no go to question number 6.3.

5.2. Are you willing to contribute **36**/**52**/**68** birr in a year? Yes= 1 No= 0

5.3. Are you willing to contribute **9**/**13**/**17** birr for the conservation activities in a year?

Yes= 1 No= 0

5.4. What is the maximum amount of money you are willing to pay in a year? -----birr.

5.5. What is the main reason for your maximum willingness to contribute money 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 ……...

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

a). I do not trust in rehabilitation c). I do not observe the problem of soil erosion

b). I do have Shortage of money c). The government should pay for it e. Other……..

6) INFORMATION ABOUT THE AVERAGE LAND CHARACTERISTICS OWNED AND SOIL CONVERSION MEASURES

No	**Descriptions**	Parcel owned
1.	Color of the soil 1) red 2) black 3) brown	
2.	Service year of the plot	
3.	Irrigated or not 1) yes 2) no	
4.	Presence of at least one type of improved Conservation structures 1) yes 2)no	
5.	Improved soil conservation structures built in meter	
	Stone bund	
	Soil bund	
	Cut off drain	
	Fanyajuu (sewahili word)	
	Others, specify	
6.	Estimated area covered with improved soil conservation structures	
	Stone bund	
	Soil bund	
	Cut off drain	
7.	Who constructed the structures? 1)Community participation 2) Family (hired)labor 3) Financial incentives by government 4)labor exchange	
8.	Status (degree) of use of improved soil conservation structures (practices)1) Removed totally 2) Partially removed3) Not removed; 4) Modified	
9.	Who did the maintenance work? 1) Community participation 2) Family/hired labor 3) labor exchange	

7. LABOUR AVAILABILITY

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

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

1. Crop production 2. Livestock production

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

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

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

7.4. If labour is hired, what type of labour do you hire? Permanent =1 casual =2 both =3

7.5. If permanent, how much do you pay per annum? (Birr)_____

7.6. If casual, how much do you pay per day? (Birr)_____

7.7. Can you get labour to hire when you are in need? Yes =1 no =0

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

7.9. If the answer to question 8.8 is yes, fill in the following table For 2007/08

0	Type of off-farm (nonfarm) activity	Family members working in			Total income obtained in one year (birr)
		1)men	2)women	3)children	
1	Pity trade				
2	Pottery				
3	Weaving				
4	Leather making				
5	selling of fire wood				
6	Labor hire out				
7	Remittance				

8. INSTITUTIONAL CONTACT AND ASSISTANCE

8.1. Frequency of visit by development workers per year? ---------- (In days)

8. 2. Have you received extension advice on soil conservation practices so far? 1. Yes 0. No

8. 3. Are there any governmental or non-governmental organizations working on soil conservation activities in your area? 1. Yes 0.no

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

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

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

8.6. Have you attend any soil conservation training in the past? 1. Yes 0. No

9. TENURE OR PROPERTY RIGHT

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

9.2. Do you feel secure that the land belongs to you at least in your lifetime? 1. Yes 0. No

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

9.4. 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)

10. INCOME SOURCE OR WEALTH INDICATORS

10.1. 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------

10.2 Do you have enough ox for your own (2 oxen) for ploughing? Yes 1 No 0

10.3. 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)

10.4. 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 (2008 EC)

Type of Crop	**From land used For**				Total output (kg)	For sells (kg)	Average selling price(Birr)
	Rain feed agriculture (2008/2009)		Irrigation farming (2008/2009)				
	Output in (kg)	Selling price	Output in(Kg)	Selling price			
Teff							
Wheat							
Barley							
Sorghum							
Maize							
Beans							
Field peas							
Pea							
Linseed(telba)							
Lentil							
Noug							
Tomato							
Potato							
Garlic							
Onion							
Cabbage							
Other							

B) Animal Ownership

No	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			

11. CREDIT

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

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

Commercial Bank (birr)	ACSI (birr)	Cooperatives (birr)	Informal money lenders (birr)	others	Total (birr)

11.3. If no, why? 1) No access to get loan 2) high interest rate 3) no need of borrowing

4) Specify others……

Appendix 2: Hypothetical Market Scenario

As you might notice it by yourself through time or heard about it, the yield and productivity of land is declining from time to time as compared to the past due to lose of fertile soil by different natural and anthropogenic factors like intensive cultivation. With this rate of degradation, the futurity of the soil resource is endangered. Now a days, It is obvious that to obtain the potential yield from a given plot of land, we have to apply a huge amount of manures and chemical fertilizers which incurs considerable amount of costs (labour, time, financial cost…etc.) besides an adverse effect on the future productivity of soil due to its soil PH alteration effect.

But there are a number of possible future agricultural landscapes that may exist in 2030 despite, such soil conservation activities need initial investment, running cost and labor. This will be done if and only if you as the owner and indigenous people of this area are participating. In this regard, we want to know the amount of money you are willing to spend on such activities for the coming five years. An ever expanding world population, higher

demand for food and land shortage which could result in agriculture in the area becoming much more intensive. For these reasons, the environmental pressures on the rural arable land in the area may increase. Therefore, under future Common Agricultural Policy reform it may be the case that farmers will be paid more for conservation activities rather than for the security of food production.

Bearing in mind the importance or unimportance of conserving soil for you personally; if you could be sure that your money would go towards conservation of soil only, would you be prepared to pay to support agricultural activities contributing to the protection of the traditional farm landscape as portrayed in this bid
(Please keep in mind your personal income constraints and your necessary expenses). Given this, you are requested to answer the following willingness to pay questions:

1 Respondents were told the money put aside for this conservation fund would involve an increase in general taxation (income tax) levels. Respondents were also asked to remember that they already pay for the soil conservation of cultivated lands generally through income tax through the **Rural Environment Protection Scheme**.

2 To minimize hypothetical bias respondents in the pilot were also reminded about their budget what they could afford to spend just on this site and particularly what they were actually paying for the characteristics and facilities of the protected cultivated land.

Appendix 3: Open ended question

Open ended question that was used to find the Payment Vehicle and the Starting Point Bids during the pre-test:
After opening statement
1. Which payment vehicle do you want for the soil conservation program that we are intended to do (labour/ cash)?

2. What is the maximum amount of time (number of days)/ money in cash, you would be willing to spend per year on soil conservation activities?

Appendix Table 4: Conversion factors used to estimate Tropical Livestock Unit (TLU)

Tables 1 Conversion factors used to estimate Tropical Livestock Unit

Animal Category	Tropical Livestock Unit (TLU)
Calf	0.25
Donkey (young)	0.35
Weaned calf	0.34
Camel	1.25
Heifer	0.75
Goat/sheep (adult)	0.13
Cow and ox	1.0
Goats/sheep (young)	0.06
Horse	1.10
Donkey (adult)	0.70
Mule	0.7
Chicken	0.013

Source: Storck*et al.* (1991)

Appendix Table 5: The Predicted probability of accepting bid values and marginal effects

. mfx compute, at (mean WTP1=1, WTP2=1) predict (p11)

Marginal effects after biprobit: y = Pr (WTP1=1, WTP2=1) (predict, p11) = **0.0924**

Variable	dy/dx	Std. Err.	z	P>z	[95%	C.I.]	X
AGE	-0.03	0.02	-1.54	0.12	-0.06	0.01	43.28
SEX	0.16	0.07	2.40	0.02	0.03	0.29	0.94
EDUCATION	-0.02	0.03	-0.78	0.44	-0.09	0.04	2.39
FARM EXPERIANCE	0.04	0.01	2.97	0.00	0.01	0.07	22.32
SLOPE OF LAND	0.12	0.16	0.79	0.43	-0.18	0.43	2.05
SOCIAL POSITION	0.20	0.11	1.87	0.06	-0.01	0.41	0.44
FAMSIZE	-0.04	0.04	-1.02	0.31	-0.11	0.03	6.38
INCOME	0.02	0.01	3.81	0.00	0.01	0.03	23.28
PERCEPTION	0.13	0.08	1.65	0.10	-0.02	0.28	0.90
INITIAL BID	-0.05	0.01	-3.72	0.00	-0.07	-0.02	26.00
LABOUR SHORTAGE	0.02	0.13	0.16	0.88	-0.23	0.27	0.66
EXTENTION CONTACT	0.04	0.01	3.02	0.00	0.01	0.07	14.56
LIVESTOCK OWNED	-0.01	0.03	-0.31	0.76	-0.06	0.04	8.73
ACCESS TO CREDIT	0.28	0.11	2.58	0.01	0.07	0.49	0.47

(*) dy/dx is for discrete change of dummy variable from 0 to 1

mfx compute, at (mean WTP1=1) predict (pmarg1)

Marginal effects after biprobit: y = Pr (WTP1=1) (predict, pmarg1) = **0.4477**

Variable	dy/dx	Std. Err.	z	P>z	[95%	C.I.]	X
AGE	-0.03	0.02	-1.63	0.10	-0.06	0.01	43.28
SEX	0.45	0.12	3.66	0.00	0.21	0.69	0.94
EDUCATION	-0.01	0.03	-0.32	0.75	-0.07	0.05	2.39
FARM EXPERIANCE	0.03	0.01	2.49	0.01	0.01	0.06	22.32
SLOPE OF LAND	0.02	0.15	0.16	0.87	-0.26	0.31	2.05
SOCIAL POSITION	-0.08	0.14	-0.62	0.54	-0.35	0.18	0.44
FAMSIZE	-0.02	0.04	-0.53	0.59	-0.09	0.05	6.38
INCOME	0.01	0.01	2.10	0.04	0.00	0.02	23.28
PERCEPTION	0.03	0.28	0.11	0.92	-0.52	0.58	0.90
INITIAL BID	-0.08	0.01	-6.29	0.00	-0.11	-0.06	26.00
LABOUR SHORTAGE	0.09	0.13	0.67	0.50	-0.17	0.35	0.66
EXTENTION CONTACT	0.02	0.01	1.84	0.07	0.00	0.05	14.56
LIVESTOCK OWNED	0.01	0.03	0.48	0.63	-0.04	0.07	8.73
ACCESS TO CREDIT	0.25	0.16	1.52	0.13	-0.07	0.57	0.47

(*) dy/dx is for discrete change of dummy variable from 0 to 1

mfx compute, at (mean WTP2=1) predict (pmarg2)

Marginal effects after biprobit: y = Pr (WTP2=1) (predict, pmarg2) = 0.**6447**

Variable	dy/dx	Std. Err.	z	P>z	[95%	C.I.]	X
AGE	0.00	0.01	0.00	1.00	-0.02	0.02	43.28
SEX	0.38	0.19	2.02	0.04	0.01	0.74	0.94
EDUCATION	-0.01	0.02	-0.80	0.43	-0.05	0.02	2.39
FARM EXPERIANCE	0.01	0.01	0.90	0.37	-0.01	0.02	22.32
SLOPE OF LAND	0.10	0.09	1.06	0.29	-0.09	0.29	2.05
SOCIAL POSITION	0.29	0.09	3.31	0.00	0.12	0.47	0.44
FAMSIZE	-0.02	0.03	-0.56	0.57	-0.07	0.04	6.38
INCOME	0.01	0.00	2.65	0.01	0.00	0.02	23.28
PERCEPTION	0.33	0.16	2.04	0.04	0.01	0.64	0.90
INITIAL BID	-0.04	0.01	-4.25	0.00	-0.02	-0.05	26.00
LABOUR SHORTAGE	-0.07	0.10	-0.72	0.47	-0.26	0.12	0.66
EXTENTION CONTACT	0.02	0.01	2.32	0.02	0.00	0.03	14.56
LIVESTOCK OWNED	-0.02	0.02	-1.26	0.21	-0.05	0.01	8.73
ACCESS TO CREDIT	0.11	0.10	1.05	0.29	-0.09	0.31	0.47

(*) dy/dx is for discrete change of dummy variable from 0 to 1

. mfx compute, at (mean WTP1=0, WTP2=0) predict (p00)

Marginal effects after biprobit: y = Pr (WTP1=0, WTP2=0) (predict, p00) = **0**

Variable	dy/dx	Std. Err.	z	P>z	[95%	C.I.]	X
AGE	0.00	0.00	.	.	0.00	0.00	43.28
SEX	-0.66	0.21	-3.24	0.00	-1.07	-0.26	0.94
EDUCATION	0.00	0.00	.	.	0.00	0.00	2.39
FARM EXPERIANCE	0.00	0.00	.	.	0.00	0.00	22.32
SLOPE OF LAND	0.00	0.00	.	.	0.00	0.00	2.05
SOCIAL POSITION	-0.01	0.09	-0.11	0.91	-0.19	0.17	0.44
FAMSIZE	0.00	0.00	.	.	0.00	0.00	6.38
INCOME	0.00	0.00	.	.	0.00	0.00	23.28
PERCEPTION	-0.23	0.27	-0.84	0.40	-0.76	0.31	0.90
INITIAL BID	0.00	0.00	.	.	0.00	0.00	26.00
LABOUR SHORTAGE	0.00	0.00	.	.	0.00	0.00	0.66
EXTENTION CONTACT	0.00	0.00	.	.	0.00	0.00	14.56
LIVESTOCK OWNED	0.00	0.00	.	.	0.00	0.00	8.73
ACCESS TO CREDIT	-0.08	0.11	-0.67	0.50	-0.30	0.15	0.47

(*) dy/dx is for discrete change of dummy variable from 0 to 1