

**HARAMAYA UNIVERSITY
SCHOOL OF GRADUATE STUDIES**

**DETERMINANTS OF FARMERS' WILLINGNESS TO PAY FOR SOIL
CONSERVATION PRACTICES:THE CASE OF JARSO DISTRICT, EASTERN
HARARGHE ZONE, OROMIA REGION, ETHIOPIA**

M.Sc. Thesis

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November, 2016

Haramaya

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SOIL CONSERVATION PRACTICES:
THE CASE OF JARSO DISTRICT, EASTERN HARARGHE ZONE,
OROMIA REGION, ETHIOPIA**

**A Thesis Submitted to School of Agricultural Economics and
Agribusiness Directorate for postgraduate programs
HARAMAYA UNIVERSITY**

**In Partial Fulfillment of the Requirements for the Degree of
MASTER OF SCIENCE IN AGRICULTURE ECONOMICS**

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November, 2016

Haramaya

**SCHOOL OF GRADUATE STUDIES
HARAMAYA UNIVERSITY**

Director for Post Graduate programs

As thesis research advisor, I hereby certify that I have read and evaluated this thesis prepared under my direction, by Alemayehu Gobena, entitled Determinants of Farmers' Willingness for soil conservation practices in Jarso District, East Hararghe Zone, Oromia Region, Ethiopia and recommend that it be accepted as fulfilling the thesis requirement.

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DEDICATION

This thesis work is dedicated to my wife Jalane Dida for taking care of my family while I on a study leave.

STATEMENT OF THE AUTHOR

I declare that all sources of materials used for this thesis have been duly acknowledged. This thesis has been submitted in partial fulfillment of the requirements of M.Sc. Degree at the Haramaya University and is deposited at the University Library to be made available to borrowers under rules of the Library. I declare that this thesis is not submitted to any other institution for award of any academic degree, diploma, or certificate.

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LIST OF ABBREVIATIONS AND ACRONYMS

CEM	Choice Experiment Method
CIM	Cost of Illness Method
CV	Contingent Valuation
CVM	Contingent Valuation Method
DA	Development Agents
FAO	Food and Agricultural Organization
GDP	Gross Domestic Product
GO	Governmental Organization
HPM	Hedonic Pricing Method
Km	Kilometer
LPM	Linear Probability Model
MoARD	Ministry of Agriculture and Rural Development
MPM	Market Price Method
NGO	Non-Governmental Organization
OLS	Ordinary Least Squares
PES	Payments for Ecosystem services
RCM	Replacement Cost Method
SSA	Sub- Saharan Africa
TCM	Travel Cost Method
VIF	Variance Inflation Factor
WTP	Willingness to Pay
FTC	Farmer training Center

BIOGRAPHICAL SKETCH

The author was born in west ShoaZone of Oromia region, Gedo town, on June 1986 GC. He attended his elementary and high school education at Gedoprimary and secondary school and Gedosenior comprehensive school respectively. After passing University Entrance examination, he joined MekelleUniversity in September 2006 and successfullycompleted his Bachelor of Science Degree studies in Natural Resource Economics and Management in July 2009. Immediately after graduation, the author was employed byEast Hararghe Zone Agriculture and Rural Development Office and serviced for two years. After that he had worked for non-governmental organization as Livelihood Specialist. In October 2012, he joined Haramaya University CEP program to pursue his MSc degree in Agricultural Economics.

ACKNOWLEDGEMENT

First and foremost, I would like to praise and extend my unshared thanks to Almighty God, for providing me the opportunity, smoothening all aspects of my study and being with me in all aspects during my stay at Haramaya University and throughout my life.

I extend my heartfelt thanks to my major advisor Dr. Jema Haji for his valuable advice, insight and guidance starting from proposal development to the completion of the research work and his provision of reference materials. I am also highly indebted to Dr. Lemma Zemedu for his constructive comments at the early stage of this thesis.

My special thanks and heartfelt gratitude goes to my appreciations go to Mr. Mohammed Amino and Mr. Daniel Mamuye for their contribution in the data collection process.

Finally, I wish to express my deepest gratitude to my family and my friends and particularly to Largesse Merga and Senbeto Boyessa for their moral as well as material support in my long way towards this achievement.

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Determinant of Farmers' Willingness to Pay for Soil Conservation Practices: The case of Jarso District, Eastern Hararghe Zone, Oromia region, Ethiopia

ABSTRACT

Soil erosion is one of the most serious environmental problems in the highlands of Ethiopia. The prevalence of traditional methods of agricultural land use and the absence of appropriate resource management practices often result in the degradation of natural soil fertility. Hence, this study assesses farm households' willingness to pay for soil conservation practices in Jarso district. Single bounded dichotomous choice with an open ended follow up format was used to elicit households' willingness to pay for soil conservation practices. Based on the data collected from 120 randomly selected households, descriptive statistics results indicated that most of the respondents had perceived the problem of soil erosion and were willing to pay for conservation practices. Probit model was employed to assess the determinants of willingness to pay. Results of the probit model showed 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. Age of the household head and distance to the nearest market significantly and negatively affect willingness to pay while remaining variables had positive and significant influence on the willingness to pay for soil conservation practices. Therefore, policy interventions designed to address soil erosion problems in the study area need to take into account.

Key Words: Soil, WTP, SBDC and Probit Model

1. INTRODUCTION

1.1. Background

Land degradation is a serious global environmental problem. However, wide disparity exists on the extent, depth, type and drivers of the problem. A global assessment of human-induced soil degradation (GLASOD) indicated that globally about 560 million hectares (36% of total) of farmlands had degraded at an annual rate of 5 to 6 million hectares and land degradation is severe in developing countries, particularly in Africa, where almost all inhabited lands in Sub-Saharan Africa (SSA) are prone to soil and environmental degradation (Shiberu, 2010).

There is a strong relationship between natural resources and rural livelihoods as healthy land ecosystem is crucial to sustainable development (Von Braun *et al.*, 2013). These resources provide social, economic and ecological functions and services to the existing society (Gessesse, 2014). From the record of human achievements, history tells us that civilization and soil fertility are closely interlinked. However, today land degradation is almost universally recognized as a serious threat to human wellbeing (Akter and Gathala, 2014).

Land degradation is defined as a persistent reduction of the land's biological and/or economic production capacity (Vogt *et al.*, 2011). Globally, it is estimated that about a quarter of used land is degraded with consequences for more than 2.5 billion people (Lalet *et al.*, 2012). This worldwide depletion of land resources continues to be a serious hazard, particularly, in the developing countries, where agriculture is the main pillar of their economy (Brüntrup and Zimmermann, 2009). For instance, in Sub Saharan Africa, crop production growth lags behind population growth and poor soils and nutrient depletion are described as the root cause of declining per capita food production in the region (Diao *et al.*, 2010).

Soil erosion has both on-site and off-site effects including soil and nutrient loss, long-term productivity loss and a wide range of environmental problems meanwhile, the immediate consequence of land degradation is a crop yield reduction followed by economic decline and social stress. In general, environmental damage can impede development in two ways. First, it reduces the level of welfare of the society by depleting the environmental resources and then, it reduces long-term productivity and thereby the future earnings. This integrated process of land degradation and increased poverty has been referred to as the downhill spiral of unsustainability leading to the poverty traps (Ramos and Martí'nez-Casasnovas, 2004).

Natural and environmental resources conservation in Ethiopia, specifically soil, is therefore not only closely related to the improvement and conservation of ecological environment, but also to the sustainable development of its agricultural sector and its economy at large. According to Alemneh (2003), there was no Government policy on soil conservation or natural resources management in Ethiopia prior to 1974. The 1974-1975 famine was the turning point in Ethiopian history in terms of establishing a linkage between degradation of natural resources and famine. Since then, different soil conserving technologies with a varied approach has been underway.

Despite the fact, there is severe land degradation in the Ethiopian high lands, efforts undertaken so far to reverse the scenario have been minimal and mainly been in the form of campaigns and quite often farmers have not been involved in the planning process (Pauloset *et al.*, 2004). Attitudes of local land users, such as farmers, are critical for sustainable conservation endeavors. For instance, in a research conducted by Hu *et al.*, (2006) on the Loess hilly area of China, the contribution of attitude in the conservation of natural resources was found to have a significant role in the successful implementation of soil conservation projects.

In Ethiopia soil conservation has been carried out with limited success. There is less-willingness to accept and maintain the extensively introduced practices of soil conservation. Besides, soil erosion is a major contributor to the prevailing food insecurity

of Ethiopia. Thus, soil conservation is vital to the achievement of food security, poverty reduction and environmental sustainability in the country (Woldeamlak, 2007).

In Ethiopia, agriculture accounts for about half of GDP, 90% of exports and 85% of total employment (EEA, 2012). Currently, however, the sector is seriously eroded by unsustainable land management practices (Kassie *et al.*, 2009). The country's inherently fragile soils, undulating terrain, highly erosive rainfall and the environmentally destructive farming methods that many farmers practice coupled with high population density make it highly vulnerable to soil erosion (Tesfayeet *et al.*, 2014).

In agriculture-based poor economy with fast growing populations (increasing nearly by 3% annually) degradation of natural resources poses a serious threat to both current and future food production potential and the country loses annually 1.5 billion metric tons of topsoil from the highlands by erosion, which could have added about 1 to 1.5 million metric tons of grain (UNDP, 2009).

The causes of soil degradation in Oromia are rapid population increase, severe soil loss, deforestation, poor vegetative cover and unbalanced crop and livestock production. With steady growth in population, clearing of woodland for agriculture has been a continuous process at an estimated rate of 50,000 ha a year; methods of cereal production are conducive to soil loss, besides to these dung and crop residues are needed for fuel, reducing their use as fertilizers (Berry 2003). And among these multiple interacting forces, which have caused and are causing soil degradation in Oromia, the major causes include clearing of woodlands and forests, unsustainable arable land farming techniques, the use of dung and crop residues for fuel and overstocking of grazing lands. On the other hand, due to its favorable climatic condition for production and presence of relatively more fertile soils as well as less disease incidence, most of the population in Oromia lives in highland area. According to Berry (2003), 11 million ha or almost 25% of the highland area was significantly eroded, 5million ha seriously eroded. Erosion rates were estimated at 45 tons/ha/year for crop land and 12 tons/ha/year averages for all land in the high lands.

Likewise, the Oromya Highlands, including that of East Hararghe Zone, intense pressure because of fast population growth and inappropriate farming and management practices. Small scale farmers, who depend on these resources, face severe constraints related to intensive cultivation, overgrazing and deforestation, soil erosion and soil fertility decline, water scarcity, and fuel wood crisis (East Hararghe Zone Agricultural Office, 2016).

The economy of community in this study area relies upon agriculture (crop production and livestock production) is generated from the topographically steeply and rugged mountainous farmland. Due to population pressure and scarcity of land for cultivation, they plough the mountainous areas which are not recommended for cultivation from land suitability point of view. The area is characterized by high environmental degradation, few shrubs and forests coverage with high risk of exposure to deforestation and environmental degradation. The farm land has no fertility and rock outcrop are rampant. In addition, these mountainous areas are used for grazing, collect firewood for domestic fuel consumption, and sold to market for income generation, wood for building houses that leads to soil degradation in the study area (JarsoDistrict Agricultural Office, 2016).

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

1.2. Statement of the Problem

Soil is the second most important to life next to water. From the record of past achievements, history tells us that civilization and fertility of soils are closely interlinked. The decline of the fertility of soils had occurred due to accelerated erosion caused by human interference. Today soil erosion is almost universally recognized as a serious threat to human wellbeing. Soil erosion is one of the most serious environmental problems in the highlands of Ethiopia. The prevalence of traditional agricultural land use and the absence of appropriate resource management often result in the degradation of natural soil fertility. This has important implications for soil productivity, household food security, and poverty in those areas of the country (Teklewold and Kohlin, 2010).

Serious soil erosion is estimated to have affected 25% of the area of the highlands. The average annual rate of soil loss in the country is estimated to be 42 tons/hectare/year which results to 1 to 2% of crop loss and it can be even higher on steep slopes and on places where the vegetation cover is low (Biniyam, 2013).

(Vogt *et al.*, 2011) argues that natural resources such as soil are important as they have useful effects on ecological balances and also for they are the means for the livelihood of many local people worldwide; especially in the developing countries. However, due to lack of efficient property right, increased population growth, lower productivity of agriculture and fast expansion of farmlands in most developing countries many environmentally important areas are highly degraded. According to the same author, the non-participatory nature of environmental policies, which gives less priority to the local communities need and priorities in the management and use of natural resources, has worsened the problem of natural resource degradation in most developing countries.

Participatory conservation practices was given less emphasis in the past, conservation activities were mainly undertaken in campaign often without involvement of the land users. As a result, the conservation structures were not sustained as evidenced by farmers' dismantling of the structures entirely or selectively. Hence, formulation of

conservation projects with participation of farmers from the very beginning is useful for sustainability of the practice. From an economic perspective, perception of the degree of soil degradation problem and its impact on short term returns and land values should be highly correlated with the farmers' willingness to pay for soil conservation measures (Teklewold and Kohlin, 2010).

Like other parts of Ethiopia, soil erosion in Jarso District is severely affecting community and cultivated lands. Unrestricted access to community land use (free grazing), traditional land use, and lack of awareness and absence of appropriate sustainable soil conservation measures lead to land degradation in the district. In general, the well-being of the community in the study area has been severely affected by soil erosion.

Therefore, the challenge is how to adapt to the changing climate that affects the livelihood of the people in the country in general and Jarso District in particular. 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 activities especially soil conservation practices in the study area.

In response to the extensive soil degradation of its resource base, the Jarso District has taken some efforts to mitigate the problem of soil erosion and enhance or maintain the production potential of agricultural soil. New soil conservation practices were introduced in some degraded and food deficit area of the highlands, mainly through food-for-work incentives since the early 1980s. Currently, in the study area government incorporated soil conservation practices in growth and transformation development plan through community participation in the form of campaign or individual participation on communal lands and on their own plots of land. NGOs like World Vision have been implementing on soil conservation practices through community capacity building; establish youths and women groups on water shade development to ensure sustainability issues regarding to soil conservation practices. Owing to this fact, however, even though

soil conservation technologies were promoted by the Government and concerned Non-Government Organizations, the farmers' perception to the problem of soil degradation and their response to conservation practices have not been well studied (Jarso Agricultural Office, 2016).

In Ethiopia, very few studies employ valuation techniques to understand the farmers' willingness to pay for SWC activities. But, there are no earlier empirical studies on the willingness to pay for soil conservation in the study area.

Therefore, this kind of research is necessary and helps the government or other development agents to design intervention mechanisms and mobilize the local people for more conservation activities.

1.3. Objectives of the Study

The general objective of the study is to assess the willingness to pay of farm households for soil conservation in the study area.

The specific objectives of the study are:

1. To evaluate farm households willingness to pay for soil conservation practices
2. To identify factors affecting the willingness to pay of households for soil conservation and
3. Identifying perception of farmers' willingness to pay for soil conservation practices in the study area.

1.4. Significance of the Study

This study provides firsthand information on farmers' perception of soil degradation problem, their willingness to pay in conservation practices and the factors affecting their participation in soil conservation practices.

Accordingly, knowing farmers' perception about soil degradation and identification of factors that influence farmers' willingness to participate in long-term conservation practices can help policy makers and other concerned bodies to take appropriate action in formulating projects that curb the problem of soil degradation with active participation of farmers. This in turn will improve the productivity of the land and hence improve the livelihood and food security of the farm households.

Generally, understanding the factors behind farmers' willingness to pay for soil conservation practices would help policy makers to design and implement more effective soil conservation practices.

1.5. Scope and Limitations of the Study

The study aims at estimating and identifying factors that determine farmers' willingness to pay for soil conservation practices in Jarso District, East Hararghe zone, and Oromia National State, Ethiopia. This study has some limitations. The first limitation is that only one district is selected for this study due to financial and time limitation. The second limitation is absence of quantitative information such as amount of soil loss and previous empirical studies conducted in the study area. This would help the researcher to inform farmers and other concerned bodies the severity of the soil erosion problem in the area. Another limitation is use of cross sectional data which will not capture inter-temporal variation in soil degradations, farmers' willingness to pay and their determinants. There is also methodological limitation it looks only at the demand side of the public good. It is argued that as an expressed-preference valuation method, CVM is

inherently susceptible to various types of biases including starting point bias, Hypothetical bias, strategic bias, compliant bias and etc.

Therefore, the researcher uses contingent valuation methodology, efforts have been made to minimize its limitations by using different elicitation formats and attempting to create a common understanding on the good or service going to be valued between respondents and the researcher.

1.6. Organization of the Thesis

With the above brief introduction, the remaining part of the thesis is organized as follows. Chapter 2 presents review of literature on farm households' willingness to pay for soil conservation practices. Subsequently, methodologies and description of study area and data collection, sampling and analysis are presented in chapter 3. Chapter 4 presents results and discussions both of descriptive statics and econometric model. Summary, conclusion and recommendations are presented in chapter 5. References and Appendices are presented in chapter 6 and 7, respectively.

2. LITERATURE REVIEW

This chapter presents concepts and definitions of basic terminologies related to conservation and willingness to pay. Basic concepts and definitions, theoretical framework, methodological framework, analytical framework, empirical reviews of related literatures and conceptual framework are presented in this order.

2.1. Basic Concepts and Definitions

Willingness to pay: It refers to measures the amount of money the individual is willing to pay for an increase in the quantity or quality of the environmental good. It is the amount that leaves the household indifferent between the expected marginal utility under the old set of technologies and the discounted expected marginal utility of the change in future incomes as a result of the new set of agricultural technologies (Horn et al., 2005).

Willingness to accept: The price or dollar amount that someone is willing to receive or accept to give up a good or service. Willingness to accept is the source of the supply price of a good. However, unlike supply price, in which sellers are on the spot of actually giving up a good to receive payment, willingness to accept does not require an actual exchange. This concept is important to benefit-cost analysis, welfare economics, and efficiency criteria, especially Kaldor-Hicks efficiency (Horn et al., 2005). Also used to ask individuals how much they would be willing to pay for a certain improvement in quality or quantity of environmental situation, or alternatively, how much they would be willing to accept for its deterioration (TEEB, 2010, Alberini and Kahn, 2006).

Land degradation: is the long-term 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 and among the more visible forms of land degradation are desertification, deforestation, overgrazing and soil erosion, all of which can result from either human activities or natural causes (IFPRI, 2011b).

Soil degradation: 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 (Shiberu, 2010).

Soil conservation: Most soil conservation practices are location specific and accordingly vary in purpose. Soil conservation measures are broadly classified into physical soil conservation measures and biological soil conservation measures. Physical soil conservation measures are structural engineering measures that are used to control runoff and minimize soil erosion that include: bunds, terraces, moisture retention structures check dams, sediment storage dams, cutoff drains and waterways. Biological soil conservation measures include vegetative barriers, agronomic and soil fertility improving practices which are reinforcement measures (Shiberu, 2010).

2.2. Theoretical Framework

Economists are striving in the valuation of environmental goods and services to give attention for the protection and wise use of environmental resources. A concise definition of valuation is an attempt to put monetary values to environmental goods and services. It is a key exercise in economic analysis and its results provide important information about 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).

Economic valuation seeks to determine the monetary value of goods to individuals. Whether these goods are associated with ecosystem services or not, economics attempts to measure value in terms of what people are prepared to give up in order obtaining the goods in question. The most obvious measuring rod (and the one which is most compatible with decision-making) is to examine the amount of money individuals are prepared to pay for a given good: their willingness to pay. An immediate problem for valuation is that even goods which are traded in markets may have prices which are

distorted by subsidies, non-competitive practices or other imperfections such that they have to be adjusted before we can observe the underlying value of the goods in question. This problem becomes much more complex for the large proportion of environmental goods which are not traded in markets and so, have no readily observable prices. However, the last thirty years or so has seen the rapid development of numerous methods for estimating monetary values for non-market environmental goods. These are reviewed in the detailed methodology for the economics of the UK NEA (Bateman *et al.*, 2011).

The Total Economic Value (TEV) that people attach to an environmental good is the summation of use value and non-use value. Use value refers to the benefit people get by making actual use of the good now or in the future. Use value is divided into direct use value, indirect use value and option values. Protection from soil erosion is a direct benefit that comes from better soil management practices. By definition, use values derive from the actual use of the environment while non-use values are non-instrumental values which are in the real nature of the thing but unassociated with actual use, or the option to use the thing. Existence value is the value people attach to soil conservation service not because they want to use the soil now or in the future, but because they just want to make sure the soil exists. Bequest value is a non-use value that one expects his/her descendants to get from the soil conservation services. Prepared to sacrifice something else in order to obtain or safeguard a quantity of it. Total economic value comprises the sum of use and non-use values. Use values may be direct (for instance by consuming the good, visiting a site) or indirect (for instance, by securing some benefit from the good (Balmford *et al.* 2011)).

Theoretical framework of total economic value of improved soil conservations practices

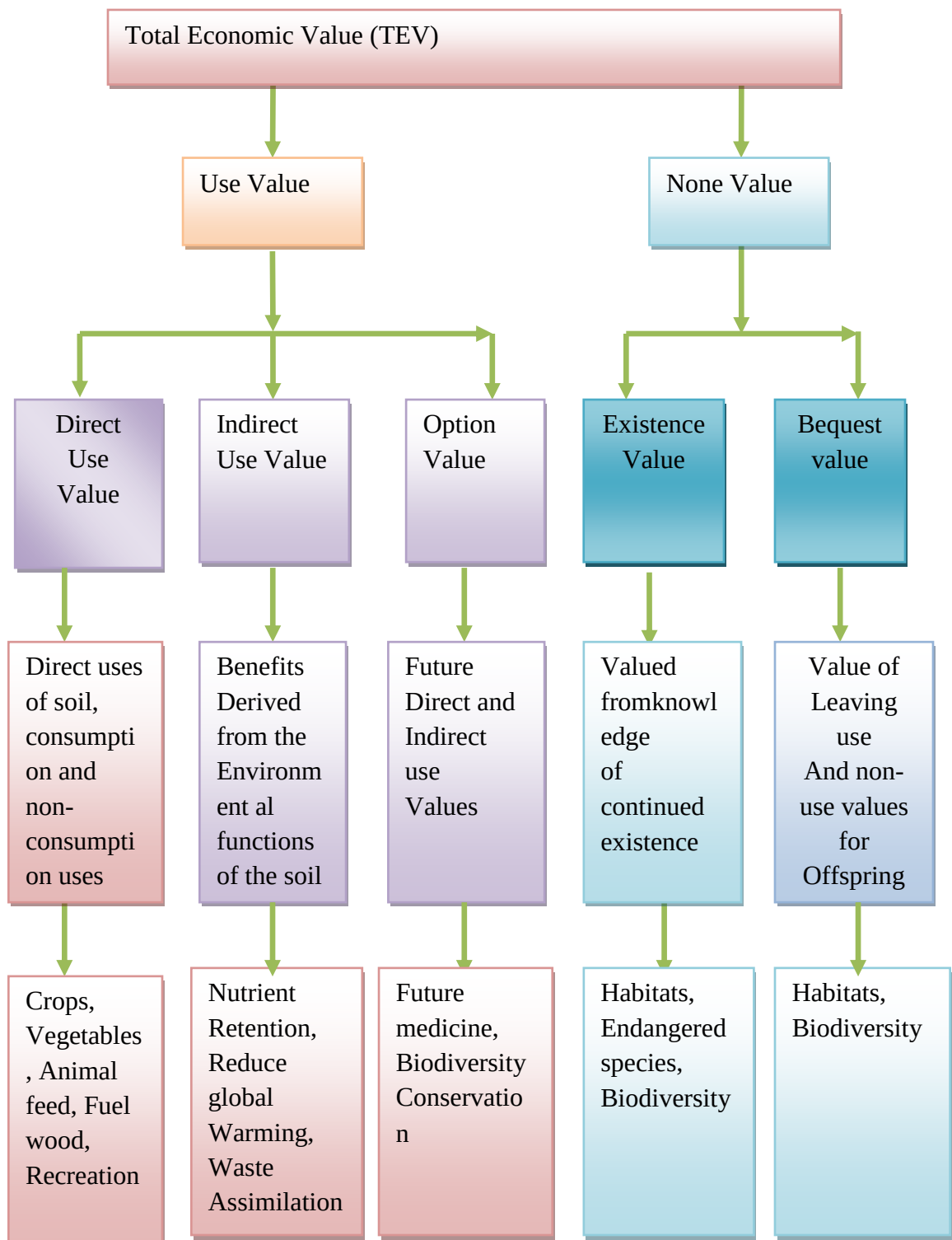


Figure 1: The theoretical framework of total economic value of soil conservations
Source: Marcouiller and Coggins (1999)

2.3. Methodological Framework

A number of valuation techniques have been developed by economists to value non-market environmental and cultural amenities consistent with the valuation of marketed goods. The methods of valuating environmental resources have been distinguished between ‘observed’ methods and ‘hypothetical methods’. These methods are also referred as revealed preference methods and stated preference methods (Freeman, 2003).

2.3.1. Revealed preference methods

Revealed preference methods are based on actual observable choices that allow resource values to be directly inferred from those choices and infer the value of a non-market good by studying actual (revealed) behavior on a closely related market (Tietenberg, 2012).

In general, the revealed preference approach has the advantage of being based on actual choices made by individuals. However, there are also a number of drawbacks; most notably that the valuation is conditioned on current and previous levels of the non-market good and the impossibility of measuring non-use values, i.e. the value of the non-market good not related to usage such as existence value, altruistic value and bequest value. Thus, research in the area of valuation of non-market goods has therefore seen an increased interest in another branch, the stated preference method, during the last 20 years. Revealed preference approaches identify the ways in which a non-marketed good influences actual markets for some other good, i.e. value is revealed through a complementary (Shiberu, 2010).

Hedonic pricing method (HPM): The hedonic pricing method is an indirect valuation method that is used to estimate economic values for environmental services that directly affect market prices. It is most commonly applied to variations in housing prices that reflect the value of local environmental attributes. It can be used to estimate economic

benefits or costs associated with environmental quality, including air pollution, water pollution, or noise (Abila *et.al.*, 2011)

The hedonic price approach is based on the theory that value of a commodity is a bundle of valuable characteristics, one or more of which may be environmental. The basic premise of the hedonic pricing method is that the price of a marketed good is related to its characteristics, or the services it provides. It assumes that goods and services are defined by the attributes embodied in them, and the values of these goods and services are the sum of the values of the attributes which they contain. When goods or services contain an environmental characteristic, the market value of the environmental characteristic is “embedded” in the market price of the good or service which contains the characteristic (Abila *et.al.*, 2011). The hedonic pricing method uses the prices of traded commodities to determine the value of environmental characteristics that are thought to affect the price of the item. The main disadvantage of this valuation method (HPM) it cannot be used to estimate nonuse values of an environmental resource. Therefore the method has limited importance in the research methodology.

Travel cost method (TCM): Travel cost methods have been used extensively to estimate the value of recreation. Using these methods, researchers can calculate the economic costs necessary to reach a recreational site as an estimate of user willingness to pay for recreation. That economic cost may include entry fees, monetary costs of travel, and foregone earnings. In effect, these travel expenses represent the “price” of the recreational experience and are an indirect but observable indicator of user value. By comparing the number of visits that individuals make at different levels of travel cost, economists are able to estimate economic value for site attributes, such as improved environmental quality (Abila *et.al.*, 2011).

The travel cost method uses costs, such as travel costs, entrance fees and time, incurred in visiting a particular site for recreation or other purposes as a proxy of the value of that site for the purpose (Graveset. *al.*, 2009).

The travel cost method is used to estimate economic use values associated with ecosystems or sites that are used for recreation. The method involves using travel costs as a proxy for the price of visiting outdoor recreational sites. The basic premise of this method is that the time and travel cost expenses that people incur to visit a site represent the price of access to the site. Thus, households' willingness to pay to visit the site can be estimated based on the number of trips that they make at different travel costs. This is analogous to estimating households' willingness to pay for a marketed good based on the quantity demanded at different prices and the main benefit of travel cost approaches is their reliance on observable market behavior. Individuals routinely spend their money and time to attend recreational sites, and easily obtained visitation records offer much of the data needed to deduce economic values. The main disadvantage of this method is it cannot be used to estimate nonuse values (Abila *et. al.*, 2011).

2.3.2. Stated preference methods

The direct approach (stated preference method) refers to the direct expression of individual willingness to pay or willingness to accept in compensation for any change in environmental quantities and qualities or both. That is, direct valuation method involves direct estimation of environmental value based on the responses of individuals to the hypothetical valuation questions and hence it does not depend on market information (Graveset. *al.*, 2009).

Stated preference methods use survey techniques to elicit willingness to pay for a marginal improvement or for avoiding a marginal loss. Stated preference techniques rely on asking people hypothetical questions based on constructed market. That means ask people what economic value they attach to goods and services. In other words, the economic value is revealed through a hypothetical or constructed market. Stated preference contrasted with revealed preference analysis which aims to deduce household's willingness to pay from observed evidence of how they behave in the face of real choices. Stated preference is based on what people say rather than what they do, but it is more flexible than revealed preference and potentially applied in almost any valuation

context (Tietenberg, 2012). Among the frequently used methods of stated preferences, the Choice Modeling (CM) and Contingent Valuation Method (CVM) are the most commonly used methods.

Choice modeling: Choice model surveys are complex by nature. Each possible choice comprises bundles of attributes, with each attribute having different levels. It has its origin in conjoint analysis, information integration theory in psychology and discrete choice theory in economics and econometrics (Graves *et al.*, 2009). The contingent ranking and rating methods are variant techniques widely used in marketing known as conjoint analysis. A common feature of this type of approach is the requirement that survey respondents consider alternatives which are described in terms of their component characteristics or alternatives. The alternatives are constructed by combining attributes at different level.

Contingent Valuation Method: It is a survey-based technique for valuation of nonmarket resources, typically environmental attributes and amenities that involves asking people directly what they would be willing to pay or willing to accept compensation for change in preferences. This method is called contingent valuation because the valuation is contingent on the hypothetical scenario put to respondents. CVM has two major advantages over the indirect valuation methods. First, CVM deals with both the use and nonuse values of the environmental resource while the indirect methods deal only with the use value. Second, survey responses to willingness to pay or willingness to accept hypothetical questions go directly to the monetary measures of utility change (Alberini and Kahn, 2009; Cho *et al.*, 2008).

In practice, however, the applicability of the CVM becomes problematic in countries where household incomes are very low. This problem is fundamental in developing countries where labor markets are imperfect and disposable incomes are low (O'Garra *et al.*, 2009). Using monetary measures in those countries valuation studies leads to a high number of zero bids resulting from severe financial constraints (Cho *et al.*, 2008). Hence, payment vehicles play a crucial role in CV studies. Therefore, in developing countries other measuring units than money, especially the labor contribution is suggested for the

valuation of public goods (Hung *et al.*, 2007). In this case, instead of asking people how much money they would be willing to give up to obtain a certain public good they are will be asked how many working days they would be willing to contribute to the provision of that good.

2.3.3. Strength of contingent valuation method

A major strength of CVM is that, because it does not rely on actual markets or observed behavior, it can in theory be applied to any situation, good or service. They remain one of the only methods that can be applied to option and existence values, and are widely used in combination with other valuation method, in order to supplement or cross-check their results (Tamiratet *al.*, 2014).

2.3.4. Elicitation formats and related biases in CVM analysis

The main value elicitation formats used in CV studies are briefly described below:

Open ended format- using this format respondents are simply asked to state their maximum WTP or minimum WTA for any proposed environmental change. A major problem associated with this elicitation format is it is exposed to strategic bias and loose answers or do not know answers. To deal with such problems economists proposed the following elicitation formats even if they are not also free of bias.

Payment card approach –in this format respondents are asked to choose WTP/WTa estimate or a range of estimates from a range of values shown to respondents on a card (Tietenberg, 2012).

Bidding game format- in this format respondents are asked a series of questions whether they are willing to pay a certain amount say \$X. If he/she refuses a proposed amount then another offer with lower value will be proposed for the respondent, lower than \$X amount, and the procedure continues until the respondent says yes. The last amount can be taken as his/her maximum WTP. And if he/she accepts to pay the proposed amount then he/she will be asked to pay a larger value until he/she says no to the proposed WTP

amount. Likewise the last offer will be taken as the maximum willingness to pay for the respondent. In this elicitation format the starting point has a sizable influence on the final willingness to pay estimate. In this sense this format is exposed to starting point bias, i.e. if we start at inappropriate amount we will arrive at inappropriate WTP estimates (Tietenberg, 2012).

Dichotomous or discrete choice format- respondents are asked simply whether he/she is WTP the assigned value for the environmental improvement. This format has yes or no responses. Compared to open ended this format provides limited information about the respondents WTP. Show the gain in efficiency of the double bounded dichotomous choice model over the single bounded elicitation format by asking respondents a second binary question based on the response of the first offer. If the first response is “yes” the second bid is some amount higher than the first bid. In the same manner if the first response is “no” the second bid will be some amount lower than the second bid. Even though CVM is a good method in non-market valuation for environmental goods, it suffers from potential biases. Of these biases the following can be mentioned (Tietenberg, 2012).

Starting point bias: This is a bias that occurs when the respondent’s willingness to pay is influenced by the initial value suggested to the respondent to take it or leave it. This problem is encountered when the elicitation format involves starting values. First, starting point bias may arise if the good being valued is not well defined or when the respondents do not well perceive the good clearly. Secondly, if the bidding game is used and the starting value is significantly different from the respondent’s actual WTP, the respondent may get bored with the process, and stop the bid before her/his real WTP is reached. Thirdly, the respondent may think the true value for the service to be around the starting point (Tamirat *et al.*, 2014).

Hypothetical bias: The unique feature of CVM is its hypothetical nature of the good and hence could be suffered from hypothetical bias. If respondents are not familiar with the scenario presented, their response cannot be taken as their real willingness to pay. This

bias can be minimized by a careful description of the good under consideration for the respondents.

Compliance bias: Occurs when the interviewer is leading the respondent towards the answer he/she is expecting. Compliance bias can also come because of the sponsor of the good being valued. This bias can be reduced by carefully designing the survey, good training of the interviewers and good supervision of the main survey ((Tamiratet *al.*, 2014).

Strategic bias: Arises when the respondents expect something out of the result of the study and report not their real WTP/WTB but something which they think will affect the research outcome in favor of them. Respondents may tend to understate their true willingness to pay if they think they have to pay their reported willingness to pay, but their response will not affect the supply of the good. But if they think they will not pay their reported willingness to pay and if they want the good to be supplied they overstate their WTP for the good (Tamiratet *al.*, 2014)). To reduce this bias, giving detailed description of the good being valued and telling the respondent that the objective of the study is only for designing policy also helps:-

Therefore, for the mentioned biases the researcher have to give emphasis on the best way to minimize these biases by using different elicitation formats and by attempting to create a common understanding on the good or service going to be valued between respondents and the researcher.

2.4. Analytical Framework

The choice of probit model and binary logit model mainly depends on personal interest since the interpretation and diagnostic checking procedures are similar. The dependent variable should be binary or dichotomous in nature to use binary logit model and odds ratios are used to interpret the parameters estimated by maximum likelihood estimation. The estimation procedure of binary logit model is more complex than the usual multiple linear regression which is estimated by the ordinary least square method. Multiple linear

regressions are used when the dependent variable under consideration is continuous (Greene, 2000).

Bi-variate probit regression for model is used when the two dependent variables depend on the same list of independent variables and are correlated and also used to estimate the mean willingness to pay from the double bounded dichotomous choice format (Haab and McConnell, 2002).

Multinomial logit formulation is widely used to capture the potential interdependencies among the alternatives. Multinomial logit model is used where the assumption of independence of irrelevant alternatives which states that the odds in each outcome are mutually exclusive is fitted.

The multinomial probit (MNP) model provides the most general framework for interdependent alternatives in discrete choice analysis. The interdependencies are accounted for through the correlation structure of normally distributed error terms. The primary impediment to the application of the Multinomial probit model is related to the dimensionality of the multifold normal choice probability integrals of about the size of the choice set.

Probit is commonly used when the acceptance process is dichotomous one. In this model, a functional relation between the probabilities of acceptance and a set of independent variables is estimated econometrically using the normal distribution for the probit procedure (Mutuli, 2002). Probit model was adopted to analyze factors influencing the farmers' willingness to pay for soil conservation practices in this case. Therefore the researcher used the probit model to analyze the responses obtained from single bound closed-ended dichotomous format where household heads are given the initial bid that has 'yes' or 'no' responses.

2.5. Review of Empirical Studies

2.5.1. Studies on willingness to pay for soil conservation practices

There are very few studies that were conducted on the WTP for soil conservation practices. Among them most of the studies applied CVM.

Pauloset *al.*(2009) examined the determinants of farmers WTP for soil conservation practices in southeastern highlands of Ethiopia & reported that the majority of the farmers in the study area were less willing to pay cash. However, they are willing to spend substantial amount of labor time on soil conservation. Here they found that the size of non-crop land was significant determinants of WTP.

Wagayehu and Drake (2003) conducted a research on adoption of soil and water conservation decision of households in Hunde-Lafto; Eastern Ethiopia. Accordingly adoption of such conservation measures on farmers' plot was analyzed using multinomial logistic regression using sample of 145 households that had 265 farm plots. The explanatory variable which was positively linked to adoption was access to information, support programs for initial investment, slope, and area of the plot. Others like land holding per economically active person of the family was found to have a negative influence on conservation decision. Participation of women in fieldwork activities, farmers' age group, use duration of a plot, credit for fertilizer and food, livestock holding, type of crop grown, and plot soil type did not influence plot-level conservation decisions by farmers in the study area. These results suggest the need for designing and implementing appropriate policies and programs that will influence farmers' behavior towards the introduction of soil and water conservation measures in their agricultural practices.

Tessema and Holden(2006) assessed farmers' willingness to pay for soil conservation practices in southern Ethiopia. Based on data collected from 140 farm households operating 556 plots, descriptive statistics indicate that majority of the households in the

study area perceive the severity of land degradation in their village and especially on their private farms, in terms of soil erosion and nutrient depletion. Contingent valuation results indicate that about 96 percent of the respondents were willing to contribute labor to conserve soil in their farms. When the payment is in cash, about 84% were willing to pay. Household random effect model was used to empirically investigate the determinants of the farm households' willingness to pay or contribute for soil conservation. The empirical result shows that WTP is affected by perception of erosion, poverty in terms of resource endowment and cash, and plot characteristics.

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

A Contingent Valuation Study was conducted by (Gebremariam *et al.*, 2012) in order to investigate the value that the farmers had attached to soil conservation practices and the determinants of willingness to pay for it 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 showed 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 estimated from the Double Bounded Dichotomous Choice format was computed at 56.65 person days per household.

Belay *et al.* (2015) employed CVM to assess farmers' willingness to pay for soil conservation practices in community lands in the Kuyudistrict, Oromia regional state, Ethiopia. The objective is to identify determinants of farmers' willingness to pay for soil conservation practices and estimate the total economic values. A contingent valuation method (CVM) is used to analyse the determinants of farmers' WTP for soil conservation practices. Double-bounded dichotomous format is used to elicit

respondents' WTP for improved soil conservation practice in terms of labor contribution. A survey on 184 households was conducted to elicit farmers WTP and gather other relevant information such as socioeconomic characteristics of sample households. Both descriptive and econometric models were employed for the analysis. The result of descriptive statistics indicated that most of the respondents have perceived the problem of soil erosion and are willing to pay for conservation practices. The econometric result also show that sex of household head, education level of the head, amount of livestock, and income have a positive and significant influence on the probability of willingness to pay for soil conservation. Variables such as slope of land, perception about soil erosion problem, and the frequency of extension visit have also a positive and significant effect on the WTP for soil conservation.

According to Paulo *et al.* (2004) farmers' willing to pay for soil conservation practice was influenced positively by education level of household, farmers' perception of erosion hazard, awareness of soil conservation technique, attitude towards soil conservation, parcel area, total family size, area of land under crop and slope category of farm land owned. The same study indicated size of rented-in land, size of no-crop land was affecting conservation decision negatively. Moreover (Tesfaye, 2003) revealed that the perception of farmers on soil erosion and measures to be taken to combat it was highly related to the slope of the land. This shows that slope is determining factor to management decision.

Study conducted by Million and Belay (2015) on factors influencing on soil conservation measures, in Southern High land of Ethiopia, result of binomial logit found out that the perception of erosion problem, family size technological attribute, number of economically active family members; and location of farm land positively affect farmers' decision. On the other hand, wealth status of the farmer and farm size influenced conservation decision negatively.

2. 6. Conceptual Framework

Farmers' WTP for different technologies across space and time are influenced by different factors and their associations. Factors such as personal, HHs characteristics, institutional and demographic determine the probability of WTP pay for soil conservation practices. Soil conservation can be used to address some of the major problems experienced in the study. Conservation provides environmental sustainability and production. The framework emphasized mainly on the relationship of the explanatory variables with the dependent variables and among explanatory variables themselves. Therefore, the researcher tries to identify and analyze relationships among factors influencing willingness to pay for soil conservation by small holder farmers in the study area.

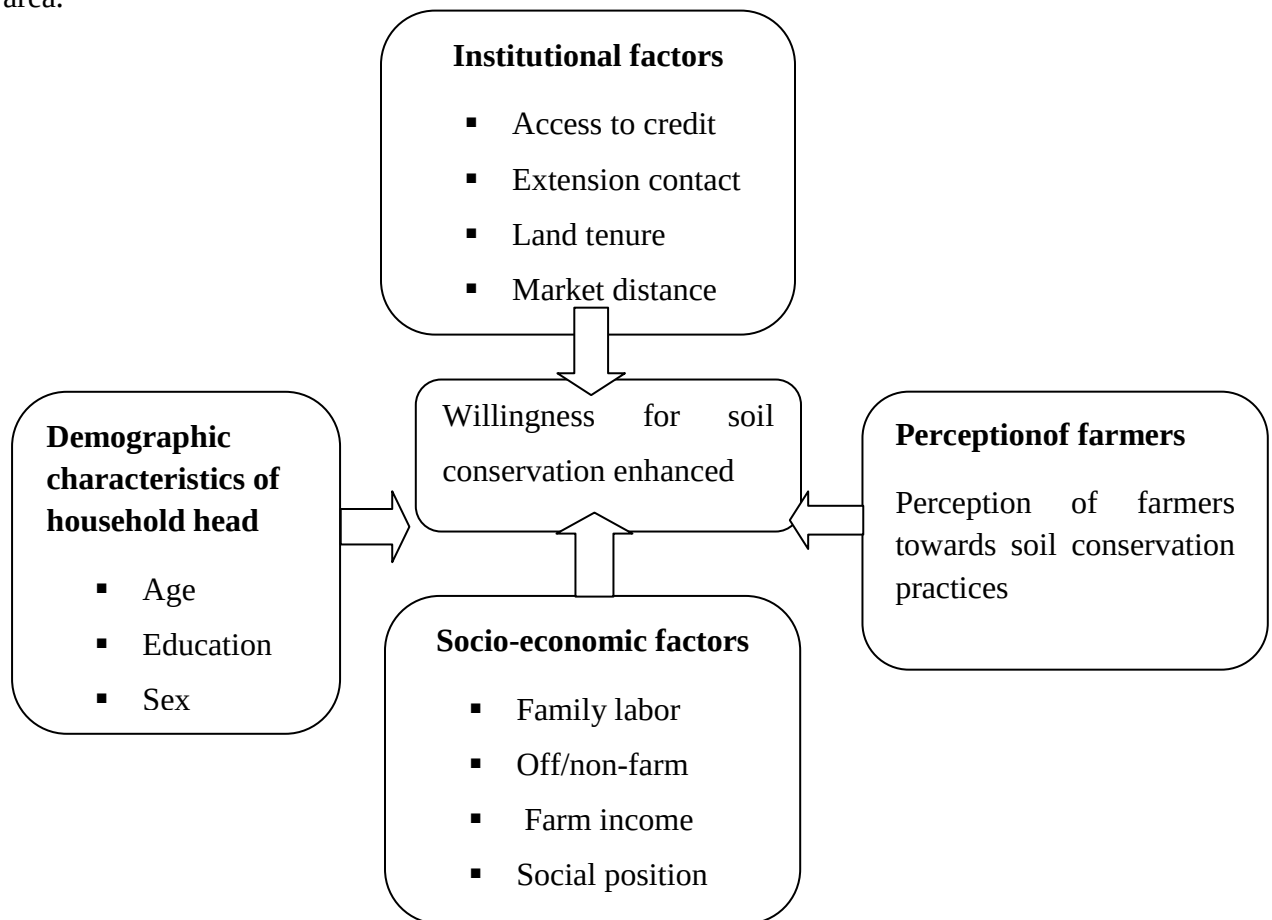


Figure 2. Conceptual frame-work for this study

Source: Adapted from Berhanu *et al.* (2003)

3. RESEARCH METHODOLOGY

This chapter presents the research methodology 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

Jarso District is one of the 18 Districts found in Eastern Hararghe Zone of Oromia National Regional State. The woreda is located at 561km from Addis ababa and 36 km from the zonal capital, Harar city. Jarso District has area coverage of 633 square kilometers. Administratively, the District is sub-divided into 19 rural kebeles and two rural town namely: Afgug, IfaJalala, MelkaJebdu, Badhasa, Ahmed Diro, Aman, GaraAbdula, Burka Misoma, LafinFedho, Weltahi, Chala, DhabeloKaba, DhabeloKiba, GidaLita, Gida Baha, Biftu Mite, Burka Mite, OdaMuda, Mulata and Ejersagoro town (Jarso Agricultural office, 2016).

According to data from Jarso District Agriculture Office (2016), the District has an elevation ranging from 1500-3060 meters above sea level. As far as the agro-ecology of the area is concerned, Dega (highland), Woinadega (mid highland) and Kolla (lowland) account for 28%, 55% and 17% of the District respectively. In the District there are 19 Farmers Training Centers, 57 DAs and 19,284 households of which 94% male headed households and 6% female headed households. The mean annual rainfall ranges between 650 mm and 950 mm.

The population of the District for FY'15 was 134,426, out of which 49.6% are male and 50.4% are female. The population density (in persons per square kilometer) of the area was 253.7 which is by far greater than the national level population density (68 according to population department, Ministry of Finance and Economic Development, 2007). The major population of the district resides in the high and mid high land that was topographically characterized as steeply mountainous. Ethnic composition of the District

residents comprises majority of Oromo ethnic group and few Amharic and others. Regarding religious majority of the District populations are Muslim about 99% (Jarso District Administrative Office, 2016).

The road from Harar city to Jarso District capital, EjersaGoro town is primary gravel road and there is all weather road access to Jigjiga through Gursum district and Somali land through Chinaksen district. This access road helps the District to sell their agricultural products to nearby markets. Only the District capital, Ejersagoro town has electric power supply. In the District there is only one credit and saving institution /Oromia credit and saving association.

The farming system of the area is of mixed type, featuring both crops and livestock production. Crop production is the predominant activity of farming. According to District Agricultural office, land use pattern of the District has 21 percent cultivated land. The remaining are grazing land, lands under forests and bushes occupied by chain of mountains.

Sorghum, maize, wheat and potato are the dominant crops grown in the area, both rain fed and irrigated production of maize, wheat and potato are practiced in the District. Potato is mainly cultivated under irrigation. According to District agriculture office by the year 2014/15 the annual maize, potato, wheat and sorghum production were estimated to be 165,634, 148,807, 108,212 and 46,660 quintals respectively. From total crops produced in the Area, potato accounts about 29%. The crops were produced by irrigation and rain fed and improved seeds and inorganic fertilizers were utilized by 13% and 31% respectively. The District has livestock resource with an estimate of about 61,974 goats, 59,597 cattle, 54,300 polluters, 38,220 sheep, 12,727 donkeys and 3,013 camels (Jarso Agricultural Office, 2016).

In the District there are supporting institutions that provide extension service, veterinary service, and farm input suppliers. The District Agricultural Office assigned three DAs per

kebele to provide extension services. Farmers can get credit from credit providing institution Oromia credit and saving association.

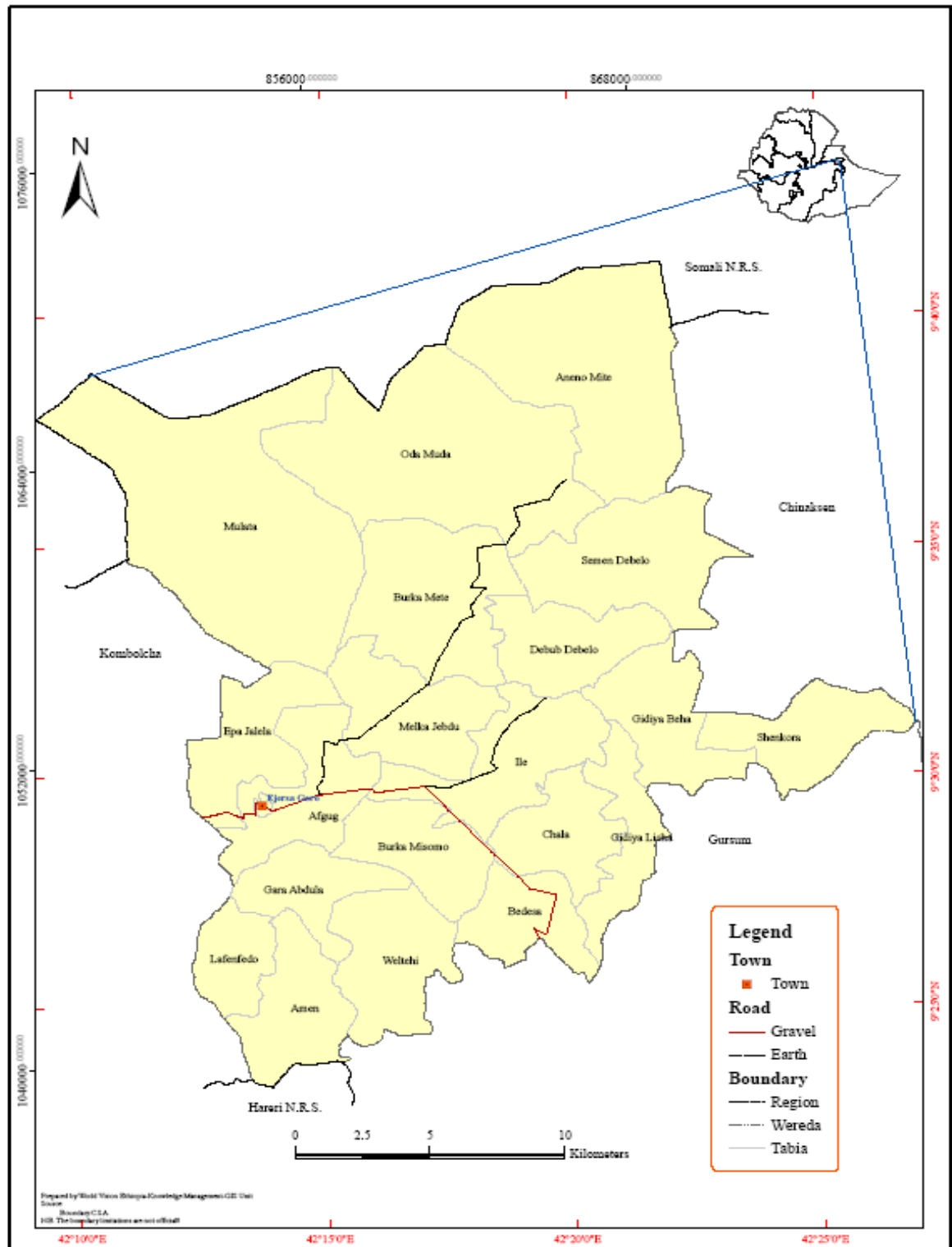


Figure 3. Map of the study area

3.2. Sampling Method and Sample Size

A three-stage sampling technique was used to select the sample farmers. In the first stage, district Jarso selected as it most affected area in Hararghe Zones. Second stage three Kebeles were selected randomly from the 19 *kebeles* found in Jarso district. In the third stage, farmers in the three sampled *kebeles* were listed down. Then a total of 120 farm households were selected randomly using probability proportional to size technique.

The sample size was determined using a formula given by Yamane (1967) as follows:

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

Where n is the sample size required, N is the total number of households and e is the level of sampling precision assumed to be 9% in this study. Given a population of 3001 households from the three Kebeles, the sample size was:

$$n = \frac{N}{1 + N(e^2)} = \frac{3001}{1 + 3001(0.09)^2} = \frac{3001}{25} = 120$$

Table 1. Number of households and sample size

Name of kebele	Total households	Sample households
MelkaJebdu	1,178	47
AmedDiro	931	37
Afgug	892	36
Total	3,001	120

Source: Own survey (2016)

3.3. Methods of Data Collection

Both primary and secondary data were collected for this study. The primary data were collected from sample of farmers in the study area through semi -structured questionnaire using face to face interview. Besides, the data were supplemented by key informants' interviews to generate qualitative information. The data were collected by five experienced and competent enumerators who completed diploma and were selected from respective Kebeles for data collection.

The enumerators were trained on how to conduct and manage questions and how to approach farmers during the interview. The enumerators were fluent speakers of the local language, Afan Oromo. They were given training on data collection procedures, interviewing techniques and the detailed contents of the questionnaire. The questionnaire was translated to Afan Oromo to allow enumerators better understand the questions and properly administer the interviews and the researcher strictly supervised each enumerator to validate and control the data collection and make valuable correction when necessary.

The first part of the survey questionnaire included information about some socio economic variables of households, perception of respondents, soil erosion and soil conservation practices. The second part of the questionnaire presented the valuation scenario in question and the different willingness to pay questions. The valuation scenario section of the questionnaire tried to give as much information as possible about detailed description of the hypothetical market of soil conservation practices to be undertaken. Specifically, the valuation scenario included descriptions of the good (what is going to be valued), the constructed market (how the good will be provided) and the method of payment (how could be paid for the good). In the single-bounded dichotomous choice elicitation question a respondent was asked about his/her WTP of a pre-specified amount of initial bid during pre-test for the proposed soil conservation practices (Alberini and Kahn, 2006).

The questionnaire contains questions on the number of person days that households could be willing to pay for soil conservation practices per year. Only person days payment vehicles was taken based on the pilot survey i.e. the respondents were not willing to pay any amount of cash for the proposed soil conservation practices. This can be justified by the fact that several rural people experience cash constraints and have cheap labor (Ahlheimet *al.*, 2010, Anemut, 2006).

A pre-test of the draft questionnaire was done on three focus groups of 5-6 individuals and pilot survey was conducted with 30 selected respondents living in the three Kebeles. The main purpose of the pre-test survey was to determine sets of bids, to understand about the preference and perception of farmers about the soil conservation and to select appropriate wording and ordering of questions. In view of this, three starting bids 36, 44 and 50 person days per year and averaged at 43 labor day per year and also used to modify in to the survey questionnaire before finalize it.

Secondary data were collected from relevant sources like books, journals, internet, DistrictAgricultural office, Land and environmental Protection office and other relevant organizations. The survey was intended to collect data and information on various aspects of land degradation including perception of the degradation problem, its severity, and farmers' willingness to pay for conservation practices.

3.4. Methods of Data Analysis

To address the objectives of the study, the data collected were analyzed using both descriptive statistics and econometric model.

3.4.1. Descriptive statistics

Descriptive statistics is important to have clear picture of the characteristics of sample units. By applying descriptive statistics one can compare and contrast different categories of sample units (farm households) with respect to the desired characteristics. In the study, descriptive statistics such as mean, standard deviation, percentages and frequency of

occurrence were used along the econometric model, to analyze the collected data. The statistical significance of the variables was tested for both dummy and continuous variables using chi-square (χ^2) and t-tests, respectively.

3.4.2. Econometric model

Probit model was used to analyze the responses obtained from single bound closed-ended dichotomous format where household heads are given the initial bid that has ‘yes’ or ‘no’ responses. According to Hanneman (1984), the basic model for analyzing dichotomous CV responses was the random utility model.

Farmers’ decision to pay or not for improved soil conservation practices at any time is influenced by a complex set of socio-economic, demographic, institutional and biophysical factors.

The decision process of the farmer can be modeled in a simple utility framework following Hanemann (1984). Let the utility or satisfaction of a given farmer is given by: the willingness to pay to improve the productivity of the land using the concept of the Hicksian compensated surplus measure can be represented as follows (Holden and Shiferaw, 2002).

$$WTP = e(P, EU_0, K_0, Z_h) - e(P, EU_0, K_1, Z^h) \quad (1)$$

Where WTP is Hicksian compensating surplus, P is vector of prices, EU_0 is the current expected utility level, K_0 is the old soil conservation practice, and K_1 is the new soil conservation practice that helps to maintain productivity, and Z_h represents farm and household characteristics as well as other exogenous variables that affect the WTP. The function $e(.)$ is an expenditure function that represents the minimum expenditure level required to attain the initial level of utility EU_0 before and after the change.

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

Following Yu and Abler (2010), if the indirect utility function for a respondent is given by $V(p, q^*, l)$ given labor endowment of the household l soil conservation quality q and an exogenous price vector p . If the respondent decides not to protest and participate in bidding, and she/he is willing to contribute some labor $t(t \geq 0)$ for improving soil conservation quality(e) the indirect utility function can be represented by $V(p, q^* + e - t)$ under the market equilibrium, the indirect utility function becomes,

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

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

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

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

$$WPT = \frac{\frac{\alpha V(p, q^*, l)}{\alpha q^*} e}{\frac{\alpha V(p, q^*, l)}{\alpha l}} \quad (4)$$

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

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

$$U_i = U_i(L, Z, q) \quad (5)$$

Where U_i is the utility of the household L is total labor endowment of the household in a year, Z are socio economic characteristics of the household where as 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 labor endowment of the particular household is a principal or most limiting asset of the household, it is assumed that the individual will be willing to pay the suggested reduction from its total labor endowment so as to maximize his or her utility under the following condition or reject it otherwise

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

Where U, L, Z, q and q^* are as defined above, BID is the initial labor payment requirement per year for the soil conservation practices e_1 and e_0 are the error terms

which are with zero means and independently distributed. Therefore, the probability that a household will decide to pay for the soil conservation is the probability that the conditional indirect utility function for the proposed intervention is greater than the conditional indirect utility function for the status quo.

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

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

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

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

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

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

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

By re arranging equation (10), we get:

$$\text{Pr ob}(Y = 1) = \text{Pr ob}(\varepsilon_{1i} - \varepsilon_{0i}) > X_i(\alpha_1 - \alpha_0) \quad (11)$$

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

$$\text{Prob}(Y = 1) = \text{Prob}(U_i > X_i \beta) = F(X_i \beta) \quad (12)$$

Where, F is the cumulative distribution function (cdf). This provides an underlying structural model for estimating the probability and it can be estimated either using a probit or logit model, depending on the assumption on the distribution of the error term (ε) and computational convenience (Green, 2002). Assuming a normal distribution of the error terms the probit model can be specified. Following Hanemann (1984), the probit model can be specified as:

$$Y_i^* = \beta X_i + \varepsilon_i$$

$$Y_i = 1 \text{ if } Y_i^* \geq t^* \quad (13)$$

$$Y_i = 0 \text{ if } Y_i^* < t^*$$

Where:

β is vector of unknown parameters of the model

X_i is vector of explanatory variables

Y_i^* is Unobservable households' actual WTP for soil conservation. Y_i^* is simply a latent variable.

Y_i = Discrete response of the respondents for the WTP

t = the offered initial bid assigned arbitrarily to the respondent

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

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

3.5. Definition of Variables and Working Hypotheses

3.5.1. Dependent variable

The dependent variable is a binary choice variable and measuring the willingness of households to pay for soil conservation practices by contributing labor. The value of the dependent variable takes 1 for “yes” to the initial bid, zero otherwise.

3.5.2. Independent variables

The independent variables hypothesized to be associated with the willingness to pay for soil conservation measures are presented below.

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

Education level of the household head (Education): This is the number of years that the household head had spent in a formal school. Household heads who have high level of education can better understand the problem of soil erosion, hence would be willing to contribute to the specified bid. Household heads with better education are expected to understand consequences of soil degradation and be willing to invest more in soil

conservation (Tessema and Holden, 2006). Paulos (2002), reported a positive relationship. It had a positive and strong relationship with the dependent variable showing that literate household heads were more to recognize the advantages of soil conservation and was willing to take part in it. Similarly, Yitayal (2004), in his study in Jimmazon found a positive relationship. So, the expected sign of Education level of the household head is positive.

Social position (Sposition): Is a dummy variable which takes 1 if the household has some social position in its community; 0, otherwise. Social position of the household head is expected to affect willingness to pay positively (Gabrelibanos, 2012).

Household size (Hsize): It is continuous variable and refers to the total number of household members. Imperfections in labor markets imply that households with large human capital may invest more in conservation. This is precisely because soil conservation structures are labor intensive to build and maintain and hence households with large human capital may invest more in conservation. Moreover, the larger the family, the higher the probability that future generation will farm the land and reap the future benefits of conservation investments (Featherstone and Goodwin, 1993). Thus, in this study family size is hypothesized to have a positive influence on the WTP for soil conservation practices.

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

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

Farmers' perception of erosion hazard (Perception): This is a dummy variable which takes 1 if the household perceives the problem of soil erosion and zero otherwise. The recognition of the soil erosion problem is considered to be vital for soil conservation decision. In other words, farmers who have already perceived the problem of soil erosion are more likely to be willing to participate in soil conservation activities than those who have not perceived the problem (Paulos, 2004). Thus, the perception variable will be expected to be strongly and positively associated with farmers' willingness to pay for soil conservation.

Severity of farm land erosion (FSeverity): This is a dummy variable which takes 1 if the farmer had affected a farm land because of soil erosion, zero otherwise (Aklilu, 2006). It is expected to have a positive influence on willingness to pay.

Distance to the nearest market (Mkt distance): This is a continuous variable which refers to the amount of time in minutes that a farmer spends to reach to the nearest market from home. The average time the farmer must travel from the residential area to the nearest market may have an effect on the willingness to pay for conservation practices (Belay, 2015). It is hypothesized that the further away the residential area of the household from the nearest market, less is expected to be willing to participate in soil conservation practices because it is expected to compete with selling of products. So, distance to the nearest market is expected to have a negative effect on WTP.

Farm income (Fincome): This is a continuous variable which refers to the total income from crop and livestock selling, non-farm activities as well as remittance that the household gets in a year, valued in Ethiopian birr (Ayalneh and Berhanu 2012). It is expected to have a positive relationship with WTP.

Perception to security of tenure (Tenure): It is a dummy variable, which is a proxy for security of land tenure that takes a value 1 if the farmer considered that he/ she would be able to use the plot area at least during his/her life time, zero otherwise. The incentive to land improvement decision is based on part of secured future access to land. Hence, a positive effect was expected (Akalu, 2009).

Frequency of extension contact (Efrequency): This is continuous variable which is the number of days that the farmer had contact with extension agent in a year. Extension is a way of building the human capital of farmers by exposing them to information that reduces uncertainty (Yitayalet *et al.*, 2006). In this study this variable is expected to affect willingness for soil conservation of farmers positively. This is because extension intervention is expected to strengthen technology usage of the farmers which further improves the income status and thus resulting in increase in the willingness of the households to use soil conservation practices.

Labor shortage (Lshortage): This is a dummy variable which takes 1 if the household has a labour shortage for farm activities and had hired some labour for farm activities and 0, otherwise. We expect to have a negative relationship with willingness to pay. Other studies also support this hypothesis (Gabrelibanos, 2012).

Amount of credit (Acredit): This is a continuous variable which is the amount of money that the household gets annually from formal and informal credit sources.

Marital status (Mstatus): Marital status of respondent is included as a dummy variable which take one for married respondent and zero otherwise. Married respondents may have

the responsibility of feeding family and labor force than single respondents. Therefore, marital status is expected to have negative relationship with willingness to pay for soil conservation. Previous studies also support this hypothesis (Belay, 2015).

Participation in off/non-farm activities (OFFINCO): It is an involvement in some activities out of farming to generate additional income to farming households. This variable takes away labor from farm operation and is likely to be negatively related to WTP for soil conservation practice. It is a dummy variable and takes value of 1 for nonparticipants and 0 for participants in off/non-farm employment. Results from other researchers also support this hypothesis (Mulugeta, 2009).

4. RESULTS AND DISCUSSION

This chapter presents, the results obtained from descriptive statics and econometric model. The first section provides descriptive statistics of the survey results. The second section presents the econometric analysis of the determinants of respondents' WTP for soil conservation practices. The descriptive analysis made use of tools such as mean, percentages, standard deviation and frequency. Probit model was used to identify the determinants of willingness to pay for soil conservation practices. The statistical significance of the variables between the willingness to pay and non-willingness to pay households was tested using chi-square (χ^2) and t-tests.

4.1. Descriptive Statistics Results

4.1.1. Measurement of households' willingness to pay

Data from 120 respondents were utilized for the analysis. From the total sample households, 96 (80%) of the respondents were male headed households and 24 (20%) were female headed households. Out of the total sample households, 81 (67.5%) were willing to contribute the pre- specified initial offered bid and 39 (32.5%) of the households were not willing to pay the initially offered pre specified bid in labor contribution. Out of the 39 non willing households, male headed households contribute 59% while female headed households were 41%. On the other hand, from the total 81 willing households, 90.1% were male headed households and 9.9% were female headed households. Table 2 indicates that there was a significant difference between willingness to pay and non-willingness to pay households' in terms of sex of the household heads at less than 1% probability level. This underlines that sex difference is an important component in willingness to pay decision.

Table 2. Sex composition of sample households and willingness to pay

Sex	Non Willing		Willing		Total		χ^2 -value
	No	%	No	%	No	%	
Male	23	59	73	90.1	96	80	15.96***
Female	16	41	8	9.9	24	20	
Total	39	100	81	100	120	100	

*** & **Probability level significant at less than 1% and 5% non-willing is a “no” answer for the first bid while willing is a “yes” answer for the first bid

Source: Own Survey, 2016

In addition, out of the 96 male headed households, 23 (24%) of them were not willing to contribute the pre-specified labor and the remaining 73 (76%) were willing to contribute the pre specified person days for soil conservation practices. From the total 24 female headed households, 16 (66.7%) were not willing to take the initial person days offered and the remaining 8 (33.3%) were willing to take up the initial bid of person days per year.

Table 3 presents the willingness to pay and marital status and social position of households on the sample households. Of the total farmers surveyed, 90 (75%) were married, 30 (25%) were single (Divorced and Widowed).

In addition there was statistically significant difference between willingness status in terms of marital status of the household head. Showing that, marital status systematically and significantly relates with WTP status. This is mostly because married households had the capacity to accept the offered initial bid because they have more labor force than single households. Moreover, there were significant differences between the two groups in terms of social position, due to the fact that social position increases the responsibility and hence willingness to pay for soil conservation practices.

Table 3. WTP and marital status and social position

Marital Status	NonWilling		Willing		Total		χ^2 -value
	No	%	No	%	No	%	
Married	27	69.2	63	77.8	90	75	20.94***
Single	12	30.8	18	22.2	30	25	
Total	39	100	81	100	120	100	
Social Position							
Yes	4	10.3	14	82.7	18	15	19.02***
No	35	89.7	67	17.3	102	85	
Total	39	100	81	100	120	100	

*** & **Probability level significant at less than 1% and 5% non-willing is a “no” answer for the first bid while willing is a “yes” answer for the first bid

Source: Own Survey, 2016

The mean number of years that the household head spent in school was also computed as shown in Table 4. The result showed that, the average years that the household head spent in school for the willing and non-willing households were 0.48 and 0.44 years respectively. The total sample mean education level of the sampled households was 0.47 years. The mean education level of the household heads of the willing and non-willing household as statistically significant at less than 1% probability level. The significance difference of the variable indicated that the importance of education in influencing farmers to pay for soil conservation practices.

Furthermore, the total sample age of the household heads of the respondents was 52 years. The willing households had a sample mean age of 50 years, while the counterfactuals had a sample mean of 56 years. The mean difference between the two groups was statistically significant at less than 1% probability level of significant showed that there was a strong relationship between age and willingness to pay. On the other hand, the mean time was 68 minutes and the value for willing household was 66 and that of the non-willing household was 72.

Table 4. Age, education and distance to market of the sample households and WTP

Variable	Non Willing (N=39)		Willing (N=81)		t- test	Total Mean(N=120)
	Mean	St.Err	Mean	St.Err		
Age	56.1	1.59	49.5	0.99	3.69***	52.22
Education	0.44	0.75	0.48	0.85	4.24***	0.47
H size	4.85	0.20	6.89	0.18	7.36***	6.05
Mrk distance	71.678	5.5	66.21	4.33	0.788	68.47

*** & **Probability level significant at less than 1% and 5% non-willing is a “no” answer for the first bid while willing is a “yes” answer for the first bid

Source: Own survey, 2016

4.1.2. Resources ownership

The survey results showed that the households' possession of cultivable land ranged from the smallest 0.125 ha to the highest 0.5 ha. The average size of cultivated land owned by the sample respondents was about 0.61 ha. Willing and non-willing farmers owned on the average 0.65 and 0.54 ha of cultivated land respectively. The mean difference of own cultivated land for the two groups was significant at 5 % significance level (Table 5). This means, willingness to pay tends to increase as farm size increases. This is probably because soil conservation practices take proportionally more space on small land holdings and the benefit from such practices on these small land holdings will not be enough to compensate for the decline in production due to the loss in area devoted to the conservation structures. On the other hand, households who have small land holdings may need to subsidize their income from off farm activities given productions are low from small land holdings and might not get time to spend on conservation practices.

Table 5. Farm income and farm size of sample households

Variable	Non Willing (N=39)		Willing (N=81)		t- test	Total Mean(N=120)
	Mean	St.Err	Mean	St.Err		
F income	4781.29	354.06	7865.98	316.4	6.42***	6592.48
FA size	0.54	0.026	0.652	0.032	2.57**	0.605

*** & ** Probability level significant at less than 1% and 5% non-willing is a “no” answer for the first bid while willing is a “yes” answer for the first bid

The mean income of the average households was estimated to be 6592.48 Ethiopian birr per annum. The main sources of income were crop production, livestock selling, and off farm activities. The mean total income of the willing and non-willing was estimated to be 7865.98 Birr and 4781.29 Birr respectively. Table 5 shows that there is statistically significant difference between the two groups in terms of total income at less than 1% probability level of significance.

4.1.3. Perception of soil erosion hazard by sample households

More than 93% of the respondents who were willing to take the pre specified initial bid in soil conservation practices perceived soil erosion as a problem in their area. Similarly more than 87% of the non-willing households also perceived the problem of soil erosion in their area. This showed that the problem of soil erosion hazard was well perceived in the study area and there was a need to take action. Table 6 shows that, there was statistically significant difference between willingness status and perception of soil erosion hazard at less than 5% probability level.

Table 6. Perception of soil erosion hazard

	Non Willing		Willing		Total		χ^2 -value
	No	%	No	%	No	%	
Perception							
Yes	34	87.2	75	92.6	109	91	4.5**
No	5	12.8	6	7.4	11	9	
Total	39	100	81	100	120	100	

*** & **Probability level significant at less than 1% and 5% non-willing is a “no” answer for the first bid while willing is a “yes” answer for the first bid

4.1.4. Land tenure

Land tenure system which is the result of a complex interrelated linkage of social, cultural, economic, political and institutional system needs a special attention. In Ethiopia, government owns land and farmers are given right of using it and they can also rent their land (Behailu, 2009). The sampled households were also classified based on tenure security of their farm lands. About 94 percent of the respondents who were willing to take the offered initial bid for soil conservation practices feel secured that their farm land will be with them at least until their life time. Of the 39 respondents who were not willing to participate in soil conservation practices, 85% feel secured that their farm land will be with them at least until their life time. Table 7 shows that there is a statistically significant relationship between land tenure security and willingness to pay at less than 5% probability level showing that land tenure security was an important variable for households decision to participate in soil conservation practices. This implies that security of land at least until life time gives farmers opportunity to invest in soil conservation practices.

Table 7. Land tenure security of sampled households

Land tenure	Non Willing		Willing		Total		χ^2 - value
	No	%	No	%	No	%	
Yes	33	84.6	76	93.8	109	90.8	9.68**
No	6	15.4	5	6.2	11	9.2	
Total	39	100	81	100	120	100	

*** & **Probability level significant at less than 1% and 5% non-willing is a “no” answer for the first bid while willing is a “yes” answer for the first bid

Source: Own survey, 2016

4.1.5. Labor availability

Table 9 shows that a large number of non-willing farmers (about 48.7%) reported labor shortage as a problem as compared to the willing households which was only 11.1%. As can be seen from Table 8, 23.3% of the total respondents had reported labor shortage as a problem, whereas labor shortage was not reported as a problem by 76.7% of the respondents and there was a statistically significant difference between willingness status and problem of labor shortage at 1% showed that, labor is an important factor in determining willingness to pay for soil conservation practices.

Table 8. Labor availability of households

Labor Shortage	Non Willing		Willing		Total		χ^2 value
	No	%	No	%	No	%	
Yes	19	48.7	9	11.1	18	23.3	
No	20	51.3	72	88.9	92	76.7	20.81***
Total	39	100	81	100	120	100	

*** & ** Probability level significant at less than 1% and 5% non-willing is a “no” answer for the first bid while willing is a “yes” answer for the first bid

Source: Own survey, 2016

4.2. Analysis of the Determinants of Households' WTP

Estimation results of the probit model are reported based on the theoretical model that has already been developed in chapter three. The model was used to examine whether WTP for soil conservation of surveyed households are related to the explanatory variables or not. A total of 16 explanatory variables were considered in the econometric model out of which only 7 variables were found to significantly influence the probability of willingness to pay among the farm households at less than 5% probability level.

Before running the econometric model, the independent variables were tested for the presence of multicollinearity (Appendices I and II). The result showed that there were no

multicollinearity problems between the variables. The value for contingent coefficient (Appendices II) for the dummy variable were less than 0.75 and the value of Variance Inflation Factor (Appendices I) for the continuous variables were less than 10, which are obviously the indicators for the absence of multicollinearity among explanatory variables. The value of chi-square (χ^2) distribution is used as the measure of overall significance of a model in probit model estimation. The result of the probit model shows that the probability of the chi-square distributions (119.11) with 16 degree of freedom less than the tabulated counterfactual is 0.0000, which is significant at less than 1%. So, this shows that, the variables included for explaining willingness to pay fits the probit model at less than 1% probability level. This implies that the joint null hypothesis of coefficients of all explanatory variables included in the model were zero should be rejected. In general, it shows that, the data fits the model very well. The results are given in Table 9.

As indicated in Table 9 of the probit estimate, out of the total 16 explanatory variables hypothesized, six explanatory variables have positive and significant effects on the probability of respondents accepting the offered initial bid, and two had negative and significant effect on the likelihood of accepting the offered initial bid. On the other hand, the rest seven explanatory variables were found to be not significant at 5% probability level.

Table 6. Probit model estimates of willingness to pay for soil conservation practices and marginal effects

Variable	Coef.	Std.Err.	z-value	P-value	Marginal effect
Sposition	2.677	1.581	1.69	0.129	0.282
L size	0.894	0.746	1.20	0.231	0.069
Fseverity	1.164	0.732	1.59	0.112	0.089
M status	0.505	0.528	0.96	0.338	0.039
Age	-0.267**	0.121	-2.21	0.027	-0.205
Off-farm	0.794	0.635	1.25	0.213	0.044
Sex	2.191**	0.987	2.22	0.026	0.168
Acredit	0.451	0.706	0.64	0.523	0.035
Education	1.986**	0.883	2.25	0.024	0.152
Mrkt distance	-0.076**	0.032	-2.40	0.016	-0.584
H size	-0.097	0.111	-0.87	0.384	-0.743
Perception	-1.405	1.281	-1.10	0.273	-0.108
Lshortage	7.863***	2.577	3.05	0.002	0.603
Efrequency	0.118**	0.051	2.34	0.019	0.906
Tenure	6.731**	2.802	2.40	0.016	-0.516
FA income	0.017	0.037	0.46	0.644	0.001
Constant	-1.244	2.357	-0.53	0.598	
Observation	120				
Log likelihood	-17.097				
LR chi ²	119.110				
pseudoR ²	0.304				
Prob>chi ²	0.0000				

*** & ** Significant 1% and 5% probability level of significance respectively

Age of the household head (Age): Age of the household head had negative effect on the willingness to pay of households for soil conservation practices. It had negative and significant effect on households' WTP in person day's contribution at less than 5% level of significance.

The negative and significant correlation between age and willingness to pay for soil conservation practices might be perhaps because of two reasons. Older age may shorten planning time horizon and reduce the WTP. Thus, older were less likely willing to pay for soil conservation practices as they expect they would benefit less from the investment relative to young household heads, given that the benefits are generally longer term in nature. On the other hand, young farmers may have a longer planning horizon and, hence, may be more likely to be willing for conservation. Besides, an older aged

household heads were more likely to have a labor shortage and reduce willingness to pay for soil conservation practices. The negative relationship between age and investment for environmental protection is consistent with the findings Belay (2015) and Solomon (2004). The result shows that keeping the influences of other factors constant at their mean value, a one year increase in the age of the household head reduces the probability of accepting the bid by about 20.5% and was happened to be significant at less than 5% probability level of significance. This indicated that older household heads were less willing to pay more for soil conservation practices in the study area.

Sex of the household head (Sex): Sex of the household head was found to have a positive effect to willingness to pay for soil conservation. The result of probit model revealed that male headed household heads were found to be willing to pay more for soil conservation practices than female headed households. The sign of sex turned out to be consistent with the prior expectation and it was positively and significantly related with the dependent variable at less than 5% level of significance. Gabrelibanos (2011) and Animut (2006) reported the same result. This was mainly because; female headed households had less resources possession endowment as well as some cultural constraints than household women and cultivation for male.

As it was hypothesized before, being male household head (sex) in the model showed positive and significant influence on soil conservation at 5% probability level. This indicates that male household heads have high expected sacrifice to pay and are highly dependent on soil conservation than their female counterparts. The marginal effect shows that male headed households willing to pay for soil conservation practices increases at 16.8% than female headed households because of fewer resources possession endowment as well as some cultural constraints that is cooking for women and cultivation for male, keeping other variables constant.

Education level of the household head (Education): This variable took the expected sign and its coefficient was significant at less than 1 percent probability level. It had a positive and strong relationship with the dependent variable showed that as the education

level of the household head increases, willingness to pay for conservation practices increased. This could be possibly because, education increases environmental awareness and value for environmental goods such as soil. Previous studies by Belay(2015) and Paulos (2002) reported a similar result.

The marginal effect estimates of the probit model showed education level of the household head has been found to relate to the probability of willingness to pay for the soil conservation practices positively and significantly. The result showed that for each additional increment of education, the probability of the willingness of the household to pay for soil conservation practices will increase by 15.2%, *ceteris paribus* at less than 5% probability level.

Distance to the nearest market (Mkt distance): Location also matters in the farmer's WTP for soil conservation. Those who are located far away from the market have a negative and significant influence on their WTP for soil conservation. This may be because of low opportunity cost of labor contribution (as a result of a possible absence of adequate labour market for alternative employment) as a farmer far away from the market center. The residential area of the household from the nearest market, less was expected to be willing to participate in soil conservation practices because it is expected to compete with selling of products. So, distance to the nearest market is expected to have a negative effect on WTP(Belay, 2015).The marginal effect results showed that for each minute that the household is far from nearest to market decrease willingness to pay by 58.4% per time per annum, other variables being held constant.

Labor shortage(Lshortage): This variable took the expected sign and its coefficient was significant at less than 1 percent probability level of significance. It had a positive and strong relationship with the dependent variable showing that labour is an important factor in determining willingness to pay for soil conservation practices. This is precisely because soil conservation practices are labour intensive to build and maintain, hence households with large labour were willing to invest more in conservation(Gabrelibanos, 2012).The marginal effect results for Labour shortage show that for one unit of additional labour increases willingness to pay by 60.3% per annum, ceteris paribus.

Frequency of extension contact (Efrequency):Extension was a way of building the human capital of farmers by exposing them to information that reduces uncertainty. In this study, this variable was expected to affect willingness for soil conservation of farmers positively and significant at less than 5%. This was because extension intervention expected to strengthen technology usage of the farmers which further improves in investment in the sustainable land and management practices and thus resulting in increased in the willingness of the households to pay for soil conservation practices (Chilot, 2007). Marginal effect result showed that, contact with the extension agents increased the probability of farmers' willingness to pay for soil conservation practices by 90.6%.

Land tenure (Tenure):The coefficient of the variable land tenure appeared to be significant at 5% probability level with the expected sign. The implication of the positive sign is that a perception of security of the cultivated land at least until life time increases the probability of a farmer to support the proposed voluntary labour contributions. This result implies that it is land tenure security of farm land is an important determinant of the WTP for soil conservation practices (Bekele and Holden, 1998).The marginal effect for tenure variable shows that as the household head is comfortwith the existing land tenure system, the probability of his / her willingness to pay for the soil conservation will increase by 60.9 %, being other variables constant.

5. SUMMARY, CONCLUSION AND RECOMMENDATION

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

5.1. Summary and conclusion

Soil erosion is one of the most chronic environmental and economic problems of the present situation in Ethiopia, in general, and in the study area in particular. It is getting worst than it was ever before. Hillsides stripped of their protective covering of vegetation are rapidly eroding, depositing huge amount of silt into downstream reservoirs and river valleys. Floods are becoming more frequent and more sever. To avert the global as well as local environmental disaster being brought by soil erosion, it is imperative to take action quickly and on a vast scale.

It is therefore, very necessary to induce in every one mind the importance of conserving soil resources. To this end, in this study, an attempt was made to analyze samplehouse holds' willingness to pay for soil conservation practices by contributing labor. The principal specific objective of this study was to estimate farm house holds willingness to pay for soil conservation practicesand to identify factors that affects the willingness to pay of households for soil conservation practices in JarsoDistrict, Ethiopia.The data were generated from sample of 120 households randomly selected from three Kebeles.

The study used relevant secondary data and information collected from various publications, journals and reports but the major sources of data were obtained from a contingent valuation survey of 120 sample respondents using three stage simple random sampling technique with structured questionnaire administered with trained enumerators. Probability proportional to size sampling technique was employed to select the farm

households from three Kebeles, which were selected first by simple random sampling technique.

This study made use of the CVM technique to elicit farmers' willingness to contribute labor for soil conservation practices. Before the final survey was undertaken a pilot survey was conducted on 30 randomly selected respondents. The open ended format was used on the pilot survey to come up with the starting bids. Person days of 36, 44 and 50 were used as starting bid or labor contribution soil conservation practice in the final survey. In the final survey, the elicitation method used was single bounded dichotomous choice format which was 43 person day per year. The chi-square (χ^2) test was used to confirm the presence of difference between acceptance of the offered initial based on the dummy explanatory variables and the t-statistics was used for the continuous explanatory variables in descriptive statics.

A probit model was employed to determine the effect of the explanatory variables on farmers' willingness to pay for soil conservation practices. In addition to the probit model, descriptive statistics were also used to assess farmers' perception of soil erosion problem and to estimate households' WTP for soil conservation practices. Results from descriptive statistics further showed that the willing and non-willing households differed significantly in some substantial explanatory variables. The marginal effects of the explanatory variables were also calculated. Before estimating the models, the problem of multicollinearity was checked by variance inflation factor (VIF) for the continuous variables were less than 10, which were obviously the indicators for the absence of multicollinearity among explanatory variables and for the dummy variable were less than 0.75. The value of chi-square (χ^2) distribution was used as the measure of overall significance of a model in probit model estimation. The result of the probit model showed that the probability of the chi-square distributions (119.11) with 16 degree of freedom less than the tabulated counterfactual was 0.0000, which is significant at less than 1% probability of significance. So, this showed that, the variables included for explaining willingness to pay fits the probit model at less than 1% probability level. Sixteen variables were used for examining modeling of the determinants of

willingness to pay for soil conservation practices. Age of the household head and distance nearest to market were found to significantly affect WTP decision negatively. On the other hand, education level of the household head, labor shortage, sex of the household head, frequency of extension contact and land tenure were found to be significant to affect willingness to pay positively.

5.2. Policy Implications

The recommendations or policy implications to be made from this study are based on the significant variables for all dependent variables under consideration.

- ✚ Farmers who were educated had higher demand for conservation and higher probability of accepting soil conservation projects than those who were not literate. So, the government should take into account to increase farmers' education in the rural area and the school age at which their children attend school. This could be done through FTC and adult informal education.
- ✚ The interaction between extension agents and farmers should be strengthened and also assist the households to increase their on-farm visits. More frequent contact between the two could enhance farmers understanding of the environmental problems in general and soil erosion problems in particular. It will be productive if the district agricultural and rural development bureau follows up the effectiveness and efforts of DAs so as to improve closeness with farmers and enhance interest in soil conservation measures.
- ✚ The probit model showed that age of household negatively and significantly influenced households' willingness to pay for soil conservation. This may be due to the fact that young household heads consider the future importance of soil conservation to the livelihood of their family and may be interested to conserve it. However, this does not mean that aged people should not be targeted in the development efforts of soil conservation. Though, these people faced labor shortage and ability to participate, but, they have rich experience and indigenous knowledge that could be used usefully. Additionally, implying the need for projects and development intervention to pay due attention to younger household heads than the older households for the effectiveness of the conservation practices.

- ✚ Successful long-term practice of structural soil conservation measures require land tenure systems that secure continued ownership of land. There are still farmers without certification of their land ownership. The land tenure policy of the country should be integrated with rewarding farmers those who invested more in soil conservation measures, especially, for those investing in long-term structures. Besides, development agents and other concerned organizations should create awareness even for the farmers who are landless and practicing share cropping, because these people showed reluctance to practice structural soil conservation. Otherwise, when the landowners lease their land to others, they might reach an agreement to practice necessary conservation measures. Therefore, improving security of land tenure would enhance the probability of the willingness to pay of the households for soil conservation.

- ✚ Location also matters in the farmer's willingness to pay for soil conservation. Those who were located far away from the market had negative and significant influence on their WTP for soil conservation which is unexpected result. This may be because of low opportunity cost of labor contribution (as a result of a possible absence of adequate labor market for alternative employment) as a farmer far away from the market center. So government should organize the households in cooperative to store their production and brought to near market for selling of their production effectively and use the conservation practices timely, or concerned body should improve markets access for farmers and also mechanisms to improve cooperation between stakeholders and way of increase farmers' income.

- ✚ Soil conservations are labor intensive to build and maintain, hence households with large laborforce had the probability to invest more in conservation. Therefore, it is very crucial to consider working labour during the planning of soil conservation practices in any development interventions performed by government and non-government organization in soil conservation.

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7. APPENDICES

APPENDIX I

Appendix Tables

Appendix Table 1.VIF For Continuous Explanatory Variables

Variable	VIF	1/VIF
Land size	1.50	0.67
Marital status	1.43	0.70
Age	1.42	0.70
Credit	1.37	0.73
Education	1.34	0.75
Distance of market	1.29	0.78
Household size	1.27	0.79
Extension	1.22	0.82
Farm income	1.06	0.94
Mean	1.32	

Appendix Table 2.Contingency Coefficient for Dummy Variables

Variable	Sex	Mstatus	Sposition	Perception	Fseverity	Lshortage	Tenure
Sex	1.00						
Mstatus	0.10	1.00					
Sposition	0.02	0.10	1.00				
Perception	0.11	0.08	0.40	1.00			
FSeverity	0.18	0.03	0.03	0.04	1.00		
Lshortage	0.15	0.07	0.04	0.03	0.08	1.00	
Tenure	0.13	0.03	0.01	0.04	0.06	0.23	1.00

APPENDIX II

Questionnaire used for the study

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

I. General Information

Questionnaire number _____

Enumerator's name _____ Signature _____

Supervisor's name _____ Signature _____

Date data collected _____ G.C.

II. Household's Socio-demographic characteristics and resource ownership

2.1. Demographic characteristics

1.1. Age _____

1.2. Gender Male = 1 Female = 0

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

Religion _____

1. Orthodox 2. Muslim 3. Protestant 4. Traditional 5. Other specify _____

1.4. Education Level (0 = Illiterate, 1 = read and write(informal education), 2 = Primary education, 3= Secondary education 4 = High school and above

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

2.7. Did you have some social position in the community so far? 1.Yes 0. No

2.8. If yes, what is your position in the community? _____

2.9. Distance from home to the nearest market in walking minutes_____

2.10. Family members

No .	Name	Age	Sex	Education level	Relation ship	The average working hour per day		
						On- farm	Off- farm	On both
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

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

3. Resource Ownership and Land Use

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

3.2. 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	
5	Homestead	
6	Other	

4.Awareness towards Erosion and Erosion Hazards

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

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

(i)-----

(ii) -----

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

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

4.5.What is your perception about the level of your parcel's exposure to soil erosion?

1. No risk 2. Low 3. Medium 4. High

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

4.7. If yes, severity of erosion on your farming plots since started farming? 1. Very high
2. High 3. Medium 4. Low

4.8. When did soil erosion problem start in your farm? 1. Prior to birth (heard from parents) 2. Since childhood 3. In recent years (before ----- years) 4. Others (specify)-----

4.9. How does the household perceive the soil depth/fertility since you started farming as compared to the past? 1. Increasing 2. Decreasing 3. No change 4. Do not know

4.10. If answer to 4.9 is increasing, what measures did the household take to rehabilitate the conditions? 1. Apply manure 2. Apply chemical fertilizer 3. Practice terracing
4. Planted trees or grass 5. Fallow system 6. Strip cropping along the contour 7. Bunding
8. Check dams 9. Others (specify)_____

4.11. How serious is the decline in soil fertility on the main plot since started farming with reference to normal year/ adequate rainfall? 1. Very serious 2. Serious 3. Minor 4. No problem

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

4.13. Slope of the land you have (as perceived by the farmer) 1. Very steep 2. Steep
3. Gentle slope 4. Flat 5. Others (specify)_____

4.14. Have you taken any of the following measures because of erosion? 1. Abandoned your cultivated land 2. Expanded to marginal land 3. Have started off/non-farm activities
4. Others (specify)_____

4.15. How is the fertility of your farmland? (As perceived by the farmer) 1. low
2. medium 3. high

4.16. If non-fertile, what was the cause of non-fertility? 1. Intensive cultivation for many years 2. Erosion 3. Do not know 4. Others (specify) _____

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

4.18. If yes, what are the likely reasons for the same? _____

5. Awareness about Soil Conservation Practices

5.1. Do you know the existence of soil conservation practices? 1. Yes 0. No

5.2. If yes to 5.1, have you used any one of the following physical soil conservation practice(s)?

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

5.3. If you did not use any soil conservation practice, mention reasons for not using. 1. Lack of money 2. Labor shortage 3. Others (specify) _____

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

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

5.6. If yes, amount per ha in kg _____

6. Contingent valuation scenarios and questionnaire (enumerator read the scenario)

1. Are you willing to contribute labor 22,40,65 person days in a year? (circle one which provided for the respondents" during survey equally or this three starting points were distributed over the 120 respondents' equally. for example 22 starting point delivered for 40 respondents' and etc)

Yes= 1 No= 0

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

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

Yes= 1 No= 0

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

Yes= 1 No= 0

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

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

a. I think it is worth that amount

b. Others should pay

c. I could not afford more

d. Other reason (specify)_____

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

a. I do not trust in rehabilitation

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

c. The government should pay for it

d. I do not observe the problem of soil erosion

e. Other (specify, if any) _____

7. Information about the plot characteristics and soil conservation measures

No	Descriptions	Plot-1	Plot-2	Plot-3	Plot-4
1	Area of the plot(Qoti)				
2	Source of the plot 1) inherited 2) received from kebele 3)rented in				
3	Distance from home (walking minutes)				
4	Soil fertility status of the plot 1)low 2)medium 3) high				
5	Slope: 1) Flat (0-6%) 2) gentle slope (6-15%)3) Steep slope & Mountainous (> 15%)				
6	Color of the soil 1) red 2) black 3) brown				
7	Service year of the plot				
8	Degree of erosion problem on the plot1) high 2)medium 3)low				
9	Irrigated or not 1) yes 2) no				

10	Presence of at least one type of improved Conservation structures 1) yes 2)no				
11	Improved soil conservation structures built in meter				
	Stone bund				
	Soil bund				
	Cut off drain				
	Others, specify				
12	Estimated area covered with improved soil conservation structures				
	Stone bund				
	Soil bund				
	Cut off drain				
13	When start the construction of improved soil conservation structure on the plot?				
14	Who constructed the structures? 1)Community participation 2) Family (hired)labor 3) Financial incentives by government 4)labor exchange				
15	Status (degree) of use of improved soil conservation structures (practices)1) Removed totally 2) Partially removed3) Not removed; 4) Modified				
16	Who did the maintenance work? 1) Community participation 2) Family/hired labor 3) labor exchange				
17	Traditional soil conservation structures built (in meter)				
	Traditional stone bund				
	Traditional soil bund				
	Cut off-drain				
	Traditional ditches				
	Trash lines				
	Others, specify				

8. Labour Availability

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

8.2. If yes, for which kind of farm activities? 1. Crop production 2. Livestock production

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

8.3. If yes to 7.1, how do you solve labour shortage?

1.Hiringlabour 2.Use communal labour 3.Other (specify)_____

8.4. If labour is hired, what type of labour do you hire? 1.Permanent 2. Casual 3. Both

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

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

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

8.8. Do you or your family member work on off- farm activities? 1.Yes 0. No

8.9. If the answer to question 8.8 is yes, fill in the following table For 2006/07

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

9. Institutional Services

9.1. Do you have contact with extension agents this year? 1.Yes 0. No

9.1. If yes, what is frequency of contact with development workers this year?

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

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

9.4. Have you been advised by any of these organizations to undertake soil conservation practices? 1.Yes 0. No

9.5. In which kind of soil conservation programs have you been involved? 1. Food for work 2. Money for work 3. Free 4. Others (Specify)-----

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

9.7.How much time do you take to travel the nearest market to sell your agricultural products? _____

9.8.How much time take to travel to nearest to town to sell agricultural products?_____

9.9.How much time take to travel to nearest to town to sell agricultural products?_____

9.10.How much time take to travel to nearest to Road to sell agricultural products?_____

9.11.How much time take to travel to nearest to clinic ?_____

9.12.How much time take to travel to nearest to DA Office to take extension services?_____

10. Tenure or Property Right

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

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

10.3. If no, what are the reasons?_____

10.4. How would the newly married member(s) of the household get land? 1. Share the household land 2. The PA provide him/her 3.Other (Specify)_____

10.5. Do you think that land tenure system affected soil fertility management practices?

1.yes 2.No

10.6. If yes, what are the reasons?_____

11. Income Sources

11.1. What are your main sources of income (in order of importance)? 1. Crop sale 2.Livestock sale 3. Off/non-farm income 4.Others (specify) _____

11.2. What was the estimated amount of off/non-farm income in birr (in 2007)?_____

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

1. Rented ox 2. Pairing with others 3. Shared out/rent out the land 4. Other (specify)_____

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

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

A) Please indicate amount of crops produced and sold in this year (2007 EC)

Type of Crop	Land used For rain feed agriculture in 'Qotxi' (2007)	Output in (kg)	Land irrigation farming	Output in (Kg)	For sells (kg)	Average selling price
Wheat						
Barley						
Sorghum						
Maize						
Beans						
Pea						
Linseed						
Lentil						
Tomato						
Potato						
Garlic						
Onion						
Cabbage						
other						

B) Animal Ownership

No	Type of livestock	Number	Sold	revenue
1	Ox			
2	Cow			
3	Calve			
4	Heifer			
7	Donkey			
8	Goats			
9	Sheep			
10	Chicken			

12. Credit

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

12.2. If yes, how much have you borrowed in the last years for agricultural production?

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

12.3. If no, why? _____

Contingent Valuation Scenario

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