FARMERS' WILLINGNESS TO PAY FOR IMPROVED SOIL CONSERVATION PRACTICES ON COMMUNAL LANDS IN ETHIOPIA (CASE STUDY IN KUYU WOREDA)

A thesis submitted to the school of graduate studies of Addis Ababa University in partial fulfillment of the requirement for the degree of Masters of Science in Economics (Resource and Environmental Economics)

By: BELAY KASAYE

Advisor: ABEBE DAMTE (PhD)

ADDIS ABABA UNIVERSITY
FACULTY OF BUSINESS AND ECONOMICS
DEPARTMENT OF ECONOMICS

May, 2015
Addis Ababa, Ethiopia

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SCHOOL OF GRADUATE STUDIES

This is to certify that the thesis entitled 'Farmers' willingness to pay for improved soil conservation practices: application of contingent valuation method' is done by Belay Kasaye. It is submitted to the school of graduate studies of Addis Ababa University in partial fulfillment of the requirement for the degree of Masters of Science in Economics (Resource and Environmental Economics) and complies with the regulations of the university and meets the accepted standards with respect to originality and quality.

Signed by the examining committee:

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Advisor _____ signature_____ Date_____

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Farmers' Willingness to Pay for Improved Soil Conservation Practices on Communal Lands in Ethiopia (Case Study in Kuyu Woreda)

Name: Belay Kasey

Addis Ababa University, 2015

Abstract

This study examines the farmers' willingness to pay for improved soil conservation practices on communal lands of Kuyu woreda in Ethiopia. The objective of this study is to investigate the farmers' willingness to pay for improved soil conservation practices on communal lands of Kuyu woreda. Both single and double-bounded dichotomous format of contingent valuation method is used to elicit respondents' WTP for improved soil conservation practice in terms of labor contribution. Data collected from 184 household heads were used for analysis. Both the Probit and Bivariate Probit models were estimated. The result of the study indicated that most of the respondents have perceived the problem of soil erosion and are willing to pay for conservation practices. Household characteristics such as sex of household head, education level of the head are significant determinants of farmers' WTP for soil conservation. Farmer's wealth indictors such as livestock and income were included and found to have a positive and significant influence on the probability of WTP 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. The study also show that the mean willingness to pay estimated from the Double Bounded Dichotomous Choice and open ended formats was 85.36 and 83.22 Labor days per annum, respectively. The respective total aggregate value of soil conservation in the study varies from 10,649,907 Labor days per annum (191,698,326 ETB) in open ended to 10,909,349 person days per annum (196,368,282 ETB) from double bound CVM. Therefore, policy and program intervention designed to address soil erosion problems in the study area have needed to take in to account these characteristics.

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Acronyms

CEM: Choice Experiment Method

CROP: Comparative research program on poverty

CSA: Central Statistics Agency

CVM: Contingent Valuation Method

DLDD: Desertification, Land Degradation and Drought

EDRI: Ethiopian Development Research Institute

EEPFE: Environmental Economics Policy Forum for Ethiopia

EfD: Environment for Development

EPA: Environment Protection Authority

ETB: Ethiopia Birr

FAO: Food and Agricultural Organization

GDP: Gross Domestic Product

GEF: Global Environmental Forum

IID: Independent and Identically Distributed

IFAD: International Fund for Agricultural Development

ILRI: International Livestock Research Institute (ILRI)

IFPRI: International Food and Policy Research Institute

MDG: Millennium Development Goal

MNL: Multinominal Logit Model

MoFED: Ministry of Finance and Economic Development

MWTP: Marginal Willingness to pay

OADB: Agricultural Development Bureau

PA: Peasant Association

RPL: Random Parameter Logit

RUM: Random Utility Model

SUBPE: Seemingly Unrelated Bivariate Probit Estimates

SWC: Soil and Water Conservation

TEV: Total Economic Value

TLU: Total Livestock Unit

UNCCD: United Nations Convention to Combat Desertification

USDA: United State Department of agriculture

WMO: World Meteorological Organization

WCED: World Commission on Environment and Development

WFP: World Food Program

WTA: Willingness to Accept

WTP: Willingness to Pay

CHAPTER ONE

Introduction

1.1. Background

Land degradation is an increasing and serious problem in many parts of the developing world. It results in loss of fertility of land that in turn leads to food insecurity and loss of farmers' welfare. Especially in the form of soil erosion, nutrient depletion and soil moisture stress, it severed the highlands of East African countries of Ethiopia, Kenya, Tanzania and Uganda. It has been the most severe environmental problem in these countries since the early 1970s (Gebremedhin, 1998).

In Ethiopia, efforts towards soil and water conservation were started since the 1970s and 1980s. Since then a huge amount of money has been invested in an attempt to introduce soil and water conservation measures. The conservation measures were in most cases physical measures and undertaken throughout the country by government and World Food Program (WFP). New land conservation technologies were introduced in soil erosion and food deficit areas of Ethiopia through food-for-work in the early 1980s (Shiferaw and Holden, 1998). Nevertheless, soil erosion problem still persists and becomes the major cause for food insecurity.

Soil and water conservation (SWC) interventions in general have played a considerable role in maintaining and/or restoring soil fertility, crop production, restoring vegetation cover and ecological health, and in mitigating anthropogenic land degradation. However, the interventions need improvement to maximize the benefit and balance people current and future need (Shimeles, 2012).

Following coming to power of the military-socialist government in 1974, the PAs would have some area of land under their jurisdiction, part of which is allocated for individual use by peasants and part for communal use by members of the PA, such as communal grazing. However, projects such as structural soil conservation measures have been initiated and implemented using the top–down approach whereby the main decisions were taken outside the communities (Alemu, 2000). Still now the decisions on conservation programs are taking without community's participation

Soil erosion has characteristics of public goods (non- marketed goods) though it is not pure public goods. Hence for improved soil conservation program, active participation of farmers and estimating economic value of soil conservation is needed. An economic value of change in environmental goods like a reduction of soil fertility is cannot be measured by conventional economic tool because of absence of market for environmental goods. Thus, the valuation methods of non-marketed goods have become crucial in the area of environment. Stated preference method and Revealed preference method are two methods of environmental valuation method. Stated preference method is one of the environmental valuation methods that assess the value of environment by using individuals' stated behavior in a hypothetical market. The method includes different approaches such as contingent valuation method (CVM) and choice experiment (Alpizar, 2001). In this study stated preference valuation method, namely contingent valuation method was employed to estimate the value of improved soil conservation program in a hypothetical market.

Some studies of soil conservation have been done by using contingent valuation. However, to the best of our knowledge, studies about farmers' willingness to pay for conservation practices in communal area of a community do not exist in Ethiopia. Hence, In order to design a useful plan

of action for environmental protection, it is necessary to understand local people's attitudes towards environmental plans. Therefore, thorough investigation of farmers' willingness to take part in soil conservation practices is of utmost importance for policy intervention.

1.2. Statement of the problem

Land is a vital resource for producing food, preserving biodiversity, facilitating the natural management of water systems and acting as a carbon store. Appropriate land management can protect and maximize these services for society. Conversely, desertification, land degradation and drought (DLDD) have accelerated during the 20th and 21st centuries, particularly in arid, semi-arid and dry sub-humid areas. The productivity of land is diminishing at an alarming pace worldwide. Higher input may offset lower productivity in the industrial countries, but most developing countries like Ethiopia lack the capabilities for this. Every year, 5-7 million hectare of agricultural land is lost worldwide. Although the problem of soil erosion is as old as settled agriculture, its extent and impact on human welfare and global environment are more now than ever before (UNCCD, 2013).

Like other parts of Ethiopia, soil erosion in Kuyu Woreda is severely affecting communal and cultivation lands. Of the total area of the Woreda around 38570.546 hectares are communally owned. Unrestricted access to communal 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 woreda. In general, the well-being of the community in the study area has been severely affected by the environmental problems already mentioned above.

Therefore, the challenge is how to adapt to the changing climate that affects the livelihood of the people in the country in general and Kuyu woreda 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 of activities especially soil conservation practices in communal areas of the study area.

In Ethiopia, very few studies employ valuation techniques to understand the farmers' willingness to pay for SWC activities. Asrat et al. (2004) examines the determinants of farmers' willingness to pay for soil conservation practices in the highlands of Bale, southeast Ethiopia; Tessema and Holden (2006) assessed farmers' willingness to pay for soil conservation practices in southern Ethiopia; and Gebremariam et al. (2012) investigate the value that the farmers have attached to soil conservation practices and the determinants of willingness to pay for it in the Northern part of Ethiopia by using CVM. But it is not clear whether these studies value conservation of private land or public or communal lands. To our knowledge, there has no empirical study on soil conservation that applied valuation techniques on communal lands in Ethiopia in general and the study area in particular. 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

1.3.1. General objective

The main objective of this study is to investigate the farmers' willingness to pay for improved soil conservation practices on communal lands of Kuyu woreda.

1.3.2. Specific objective

- To identify the determinants of farmers' WTP for improved soil conservation practices
- To estimate the amount of farmers willingness to pay for improved soil conservation practices
- To estimate the welfare gain using CVM
- To suggest policy implications based on the findings of the study

1.4. Significance of the Study

Soil erosion is one of the most important environmental problems in Ethiopia. It is a primary source of the decline in land productivity in particular and welfare of the society in general. In order to reverse this and minimize its impact on the livelihood of the people, the government of Ethiopia has put a lot of efforts and takes different measures. Among these measures, the mobilization of the local people to participate in the conservation activities is one of the encouraging activities being undertaken in most parts of the country. As this is not based on research it is necessary to know how people value these activities or practices in order to design appropriate intervention mechanisms.

Therefore, the findings of this study would provide some information regarding farmers' valuation of soil conservation practices to policy makers and environmental protection agencies;

and may also be important as base line information for future related works. Moreover, this study contributes to the limited literature on the area and be useful for academic purpose.

1.5. Scope of the Study

The study is limited to examining the farmers' willingness to pay for improved soil conservation practices on communal lands in Kuyu Woreda by using contingent valuation. The sample size in this study is limited to 200 farmers selected from five kebeles

1.6. Limitation of the study

This study was faced some limitations. One limitation of this study is that quantitative information such as amount of soil loss is not available in the study areas. This would have informed readers regarding the severity of the soil erosion problem in the area; though both local people and experts' opinion indicate there is a serious problem in the degradation of the land and other natural resources as well. Another limitation was because of budget constraint, the difficulty to cover a large number of households for the survey. Even though these limitations were faced, the researcher has tried to justify his effort for the reasonable outcome of the study.

1.7. Organization of the study

This paper is organized as follows. Chapter one has already introduced the study. Chapter two review about the theoretical and empirical literature about the soil conservation and environmental valuation methods. The third chapter deals with methodology part: whereby data source, method of data collection, sampling techniques, designing CVM survey questionnaire and elicitation format, method of data analysis and model specification will be discussed. Chapter four concern with analysis of the data and then pick up the finding of the study. The last chapter concludes the study based on the obtained finding before it provides policy implication

CHAPTER TWO

Literature Review

2.1. Definition and Concept

2.1.1. The concept of Land Degradation and Soil degradation

UNCCD defines land degradation as a reduction of the biological or economic productivity of land resulting from land uses or from a process arising from human activities and habitation patterns (WMO, 2005, No-989). Land degradation is the loss of beneficial goods and services derived from terrestrial ecosystems, which include soil, vegetation, other plant and animal life, and the ecological and hydrological processes that operate within these systems (IFPRI, 2011b). Among the more visible forms of land degradation are desertification, deforestation, overgrazing, salinization, and soil erosion, all of which can result from either human activities or natural causes (IFPRI, 2011b). Examples of land degradation include soil erosion, soil nutrient depletion, and salinization, loss of vegetation cover (USDA, 2003; IFPRI, 2011).

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 (Mbagwu, 2003). Soil degradation is a chemical, physical, or biological change in the soil that lowers its contribution to the economic value (Lindert, 2000). Examples of soil degradation include loss of top soil, depletion of soil nutrients, and loss of soil organic matter, water logging, salinization, and acidification (USDA, 2003). Some forms of soil degradation are irreversible and there are no economically feasible substitutes for soil erosion (USDA, 2003).

Most soil and water 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 (IFAD, 1992 cited in Shiberu, 2010).

2.1.2. Causes and Consequences of land degradation

Land degradation causes fit into two categories: proximate and underlying. Proximate causes are those that have a direct effect on the terrestrial ecosystem and related to unsustainable land management practices such as over-cultivation, overgrazing and excessive forest conversion (IFPRI, 2011; WMO, 2005). The underlying causes are those that indirectly affect proximate causes. Some of the underlying causes of land degradation are population density, poverty, land tenure and lack of access to agricultural extension, infrastructure, and markets, lack of institutions to promote land conservation practices, and political instability (FAO, 2007). Underlying causes of land degradation often have self-perpetuating characteristics. For example, poverty can lead to underinvestment in sustainable land management practices. At the same time, poverty can be induced or increased by degraded soil productivity (IFPRI, 2011b). In general the literature identified overstocking and overgrazing, deforestation, cultivation of steep slopes, poor management or farming using inappropriate techniques, cultivation on river banks, inappropriate road drainage, land tenure, market, lack of institution, and poverty as the causes of land degradation.

Land degradation has multiple and complex impacts on the global environment through a range of direct and indirect processes affecting a wide array of ecosystem functions and services. Impacts occur on global development issues, especially food security and human health. An analysis from the scientific literature of the severity and importance of these impacts suggests that the process linkages may be graded according to the degree of sensitivity involved and the certainty of the impacts creating a dangerous condition consequent upon land degradation (GEF, 2006). In general the consequences of land degradation specifically soil erosion are decrease in the production and productivity of the agricultural land and negatively affects the livelihood of the people.

2.1.3. Poverty – Environment Nexus

There is much controversy surrounding the poverty-environmental degradation nexus. The predominant school of thought argues that poverty is a major cause of environmental degradation and if policy makers want to address environmental issues, then they must first address the poverty problem. Another school of thought argues that a direct link between poverty and environmental degradation is too simplistic and the nexus is governed by a complex web of factors (Reardon, T. and S. A. Vosti, 1995). Poverty reduction and environmental conservation represent two of the main global challenges (UNDP, 1998)

Many parts of the world are caught in a vicious downwards spiral: Poor people are forced to overuse environmental resources to survive from day to day, and their impoverishment of their environment further impoverishes them, making their survival ever more difficult and uncertain (WCED, 1987: 27). Environmental degradation and poverty reinforce each other: the poor are both *agents* and *victims* of environmental destruction (Reardon, T. and S. A. Vosti, 1995).

The coexistence of poverty and environmental disruption can be understood as the outcome of two processes having the same root causes. Insecure property rights to natural resources, or a complete lack thereof, create both a situation of poverty and give small incentives for sound resource management (CROP, 1998).

The links between poverty and environment in a given setting depend on the level, distribution, and type of poverty, on the type of environmental problem, and on conditioning variables. Reducing poverty can reduce resource degradation. But in the short term, reducing poverty will not necessarily protect the environment, nor will protecting the environment necessarily alleviate poverty. Specific policy actions that affect the set of conditioning variables will be needed to maximize the achievement of both goals at once (Reardon, T. and S. A. Vosti, 1995).

2.2. Theoretical framework

Most economists accept the desirability of environmental valuation. The original, and still the principal, motivation for environmental valuation was to enable environmental impacts to be included in cost–benefit analysis. Environmental valuation for cost–benefit analysis has a history of some 30 years. In the past few years there have emerged two further sources of demand for environmental valuations. The first is the perceived need to take account of environmental damage in measuring economic performance and second in the USA since the late 1980s, economists' valuations of environmental damage are admissible evidence in fixing the compensation to be paid by those responsible for the damage (Perman et al., 2003). The basic strategy for environmental valuation is the 'commodification' of the environmental services that used by households and treated as arguments in utility functions. The standard theories for

consumer behavior can then be used to derive methods for assigning values to environmental services (Perman et al., 2003)

2.2.1. Environmental Valuation Techniques: Revealed and Stated Preference

The principle that public goods and goods with externalities are not efficiently allocated by the market suggests the possibility of improvement by public action. An improvement in resource allocation requires that the benefits of a decision exceed its costs, which in turn requires the measurement of benefits and costs. To meet the demands for measurement, economists have devised a variety of empirical tools for estimating the benefits and costs of public actions. These tools are called valuation method (Haab and McConnel, 2002)

The valuation methods of non-marketed goods have become crucial when determining the costs and benefits of public projects. Non- market valuation has been conducted in many different areas, ranging from health and environmental applications to transport and public infrastructure projects. In the case of a good that is not traded in a market, an economic value of that good obviously cannot be directly obtained from the market. Markets fail to exist for some goods either because these goods simply do not exist yet, or because they are public goods, for which exclusion is not possible. Another crucial application of valuation techniques is the determination of damages associated with a certain event (Alpizar et al., 2001).

Under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 in the US, and after the events that followed the Exxon Valdez oil spill in 1989, the methods of valuation have become a central part of litigation for environmental and health related damages in the United States and in several other countries (Alpizar et al., 2001). The categories of

environmental valuation methods: stated preference and revealed preference methods are briefly discussed.

2.2.1.1. Stated preference Methods

The direct approach (or 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, 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 (Freeman, 1993).

Stated preference methods use survey techniques to elicit willingness to pay for a marginal improvement or for avoiding a marginal loss (Tietenberg, 2012). 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 people'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 (David et.al, 2002).

Stated preference method includes a number of different approaches such as conjoint analysis, contingent valuation method (CVM) and choice experiments (CEM) (Alpizar et al., 2001). Contingent valuation concentrates on the non-market good or service as a whole, while choice modeling seeks people's preferences for the individual characteristics of these goods and services.

Contingent valuation

The contingent valuation method (CVM) is a direct method in which it involves asking a sample of the relevant population questions about their WTP or WTA. It is called 'contingent valuation' because the valuation is contingent on the hypothetical scenario put to respondents. Its main use is to provide inputs to analyses of changes in the level of provision of public goods/bads, and especially of environmental 'commodities' which have the characteristics of non-excludability and non-divisibility (Perman et al., 2003).

In the contingent valuation method, respondents are asked various questions on the basic issues such as the maximum amount they are willing to pay (WTP) to access and enjoy any welfare gain due to an improvement in environmental quantities, qualities or both or the minimum amount they are willing to accept (WTA) in compensation for welfare loss due to deterioration in environmental quantities or qualities or both. The basic idea of the contingent valuation method is that in the hypothetical market it provides a means of deriving values when they are not observed in the real market.

CVM has two advantages over indirect methods. First, it can deal with both use and non-use values, whereas the indirect methods cover only the former, and involves weak complementarity assumptions. Second, unlike the indirect methods, CVM answers to WTP or WTA question go directly to the theoretically correct monetary measures of utility change (Perman et al., 2003).

A CVM study could be undertaken using different elicitation methods. These are: Open Ended Format: in which the respondent is asked to provide the interviewer with a point estimate of his or her willingness to pay; Bidding Games: This method starts by asking respondents whether they accept a given price for the good and higher or lower prices will be offered depending on

the answer given to the initial prices. The bidding stops when iterations have converged to a point estimate of willingness to pay; Payment Cards: A CVM question format in which individuals are asked to choose a willingness to pay point estimate (or a range of estimates) from a list of values predetermined by the surveyors, and shown to the respondent on a card; Dichotomous or Discrete Choice CVM: A CVM question format in which respondents are asked simple yes or no questions of the stylized form (Haab and McConnell, 2002)

CVM study could be undertaken using one of the above methods. But the first three methods have been shown to suffer from compatibility problems in which survey respondents can influence potential outcome by revealing values other than their true willingness to pay. The dichotomous choice approach has become quite widely adopted, despite criticisms and doubts, in parts because it appears to be incentive compatible in theory. When respondents do not give a direct estimate of their willingness to pay, they have diminished ability to influence the aggregate outcome. However, this advantage of compatibility has a limitation. Estimates of willingness to pay are not revealed by respondents (Haab and McConnell, 2002).

A. **Choice Experiment**

In a choice experiment, individuals are given a hypothetical setting and asked to choose their preferred alternative among several alternatives in a choice set, and they are usually asked to perform a sequence of such choices. Each alternative is described by a number of attributes or characteristics. A monetary value is included as one of the attributes, along with other attributes of importance, when describing the profile of the alternative presented. Thus, when individuals make their choice, they implicitly make trade-offs between the levels of the attributes in the different alternatives presented in a choice set (Alpizar et al., 2001).

2.2.1.2. Revealed preference

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

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 (Alpizar, 2001). 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 (surrogate or proxy) market (David, 2002).

2.2.2. Economic value of Natural Resource

Economic valuation refers to the assignment of money values to non-marketed assets, goods and services, where the money values have a particular and precise meaning. Non-marketed goods and services refer to those which may not be directly bought and sold in the market place. Examples of non-marketed services would be clean air and neighborhood amenity (David, 2002).

The Total Economic Value (TEV) that people attach to an environmental good is the summation of use value and non-use value. Use value refers to the benefit people get by making actual use

of the good now or in the future. Use value is divided into direct use value, indirect use value and option values. Protection from soil erosion is a direct benefit that comes from better soil management practices. By definition, use values derive from the actual use of the environment while non-use values are non-instrumental values which are in the real nature of the thing but unassociated with actual use, or the option to use the thing. Instead such values are taken to be entities that reflect people's preferences, but include concern for, sympathy with, and respect for the rights or welfare of non-human beings. Soil resources can be also valued for their potential to be available in the future. These potential future benefits constitute an option value. It may be Non-use value is divided into existence and bequest value. Existence value is the value people attach to soil conservation service not because they want to use the soil now or in the future, but because they just want to make sure the soil exists. Bequest value is a non-use value that one expects his/her descendants to get from the soil conservation services.

Theoretical framework of total economic value of improved soil conservations practices.

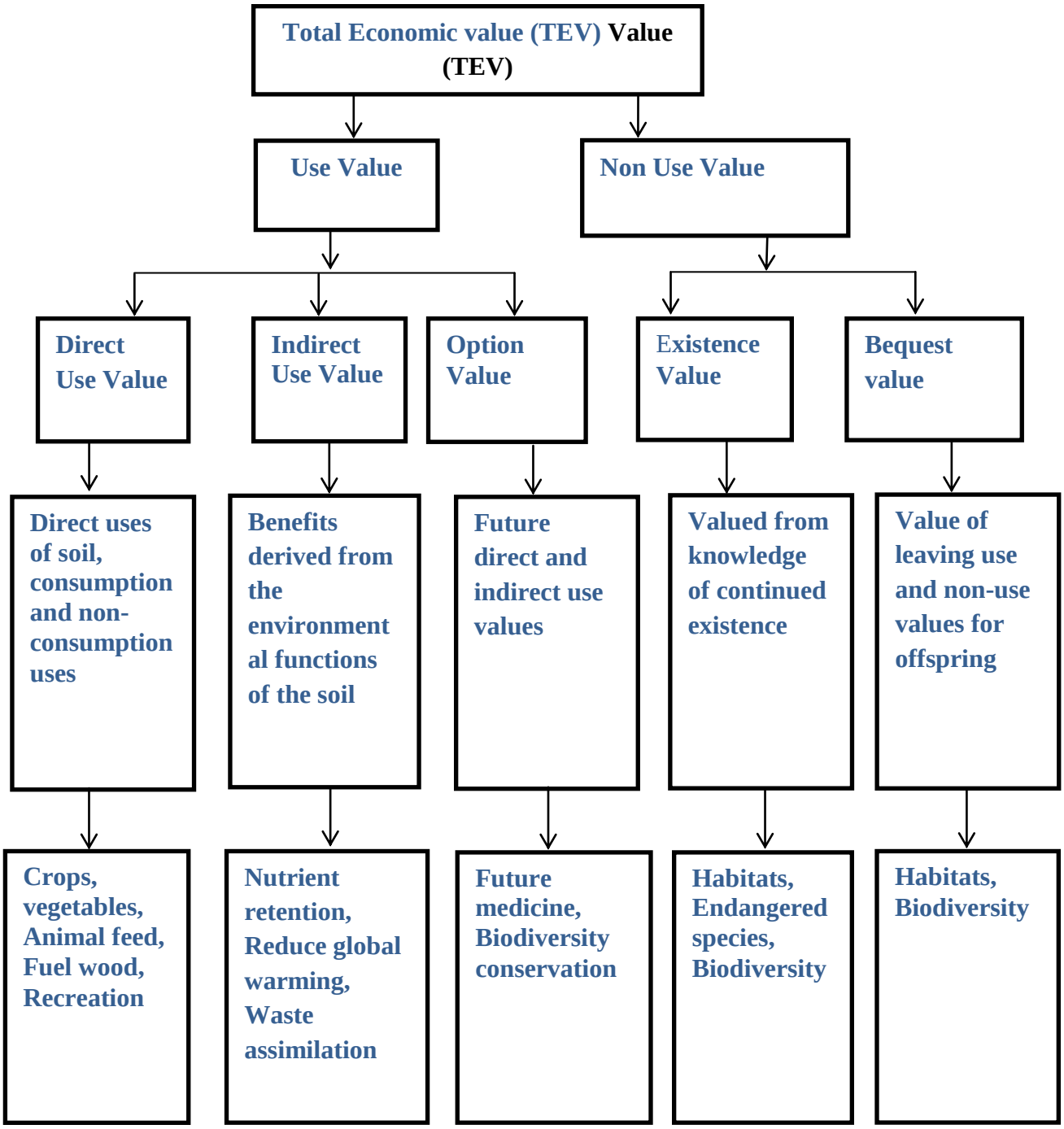


Figure 1: The theoretical framework of total economic value of soil conservations.
(Source: Marcouiller, D., and S. Coggins (1999))

The economic value of something can be regarded as the extent to which people would be 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). A forest, for example, serves both direct and indirect use functions. Visitors to the forest make direct use of it. The role of the forest in protecting the regional watershed would be an example of an indirect use, as would the role of the forest in sequestering carbon dioxide (David, 2002).

2.3. Empirical Review

2.3.1. Soil conservation related studies

Several studies on valuation of soil conservation have been done by using choice experiment and contingent valuation. Among Choice Experiment Studies Carried out in the EU to inform Environmental, Agricultural, Food and Natural Resources Management Policies is: Colombo et al. 2005, 2006, 2007) estimate the value of reducing soil erosion in Spain. Among the attributes used in this study are surface and ground water quality, landscape change and flora and fauna quality. Their results indicate that water quality is a significant factor affecting publics' choice of policy alternatives for soil conservation. Furthermore, the public is WTP the most for high levels of water quality, followed by improvement in landscape desertification.

Jianjun et al. (2013) studies the public preferences for cultivated land protection in Wenling City of China by using the CE approach. The estimation results indicate that the most important attribute for cultivated land protection in Wenling City was land facility, followed by land fertility and then by landscape improvement. The study concludes that CE is a reliable tool in the analysis of respondent preferences for the development of suitable cultivated land protection schemes in China.

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 have 265 farm plots. The explanatory variables which are positively linked to adoption are 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 is found to have a negative influence on conservation decision. Participation of women in fieldwork activities, farmer's 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.

Abdrohman (2010) employed CVM to assess farmers' willingness to pay for rehabilitation of degraded natural resources in watershed projects in Ethiopia; Case study in Dejen Woreda. A total of 185 households were selected and the bivariate probit model was applied for the estimation of the parameters. The study claimed that age, fertilizer expenditure, education, and land per capita are the main factors that determine the farmers demand for rehabilitation of degraded natural resources. The total economic value of the conservation project varies from 91561.6 ETB in open ended to 109602.3 ETB from double bound CVM and 119,990 ETB for in-kind and 376067.12 ETB for labor as a contribution mechanism.

Asrat et al. (2004) examines the determinants of farmers' willingness to pay for soil conservation practices in the highlands of Bale, southeast Ethiopia. The study applied Contingent Valuation Method for the purpose of eliciting farmers' valuation of soil conservation practices in terms of

both cash payment and labour contribution. The results of this study reveal that farmers in the study area are less willing to pay cash for soil conservation measures. In terms of labour contribution, however, it was found that they are willing to spend a substantial amount of time per week.

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 labour to conserve soil in their farms. When the payment is in cash, about 84% were willing to pay. Household random effect model was used to empirically investigate the determinants of the farm households' willingness to pay or contribute for soil conservation. The empirical result shows that WTP is affected by perception of erosion, poverty in terms of resource endowment and cash, and plot characteristics. The study noted that the farm households are able to contribute more in terms of labour than money due to sever cash poverty. Using labour days as a payment vehicle for WTP studies in similar areas would provide a more sensible outcomes than using monetary payments.

A Contingent Valuation Study was conducted by Gebremariam et al. (2012) in order to investigate the value that the farmers have 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 shows that age, sex, education level, family size, perception, tenure, total livestock and initial bid were the important variables in

determining willingness to pay for soil conservation practices in the study area. The study also shows that the mean willingness to pay (WTP) estimated from the Double Bounded Dichotomous Choice format was computed at 56.65 person days per household.

2.3.2. Other Related CVM and CEM Empirical Studies

A study entitled 'Application of a Choice Experiment to Estimate Farmers Preferences for Different Land Use Options in Northern Tajikistan' was conducted by Goibov et al. (2012). Based on farmers' preferences this study estimates the non-market values of agro-environmental attributes and their changes within the study area. The results of both the RPL models reveal that preference heterogeneity exists amongst farmers in the study area, implicating that a decision for land allocation under different crops is jointly associated with other socio-economic and environmental factors, influencing one another.

Carlsson et al. (2005) employ a choice experiment to understand farmers' choices between an agricultural extension package and a local public good in Ethiopia in two zones in the Amhara regional state namely, East Gojjam and south Wollo .a total of 1520 households from the two zones were asked The result from random effects binary probit model indicated that a large majority opted for the public good. Another interesting result of the study was that when the extension package is combined with insurance in terms of no pay back of the credit in case of crop failure, a significant increase in the choice of the extension package was observed. This result gives a clear indication of the importance of risk aversion in reducing the adoption rate of modern inputs in Ethiopian agriculture and gives evidence of how stated preference (choice experiment) methodologies can be utilized for development policy design.

Tegenge (1999) also applied the CVM to elicit respondents' WTP for environmental protection in terms of cash requirements and time spent (or labor contribution) in Sekota district (Northern Ethiopia) for the sample size of 98 farmers. The study found that about 70% of the sampled farmers are willing to pay zero Birr for environmental protection. However, farmers are willing to spend considerable amount of their time for environmental protection particularly during the slack period. Farmers' willingness to contribute labor for environmental protection is affected by education level, age, sex and households' size of respondents. Using the CVM study, Tekie (1998) tried to obtain ex-ante valuation of farmers for improved land tenure system in Ethiopia. The study also identified factors that trigger the choice for a positive WTP and the amount farmers are willing to pay for land tenure improvements. The study concluded that farmers are willing to pay for changes in existing tenure arrangements and probability of paying for any institutional change is affected by number of factors like area of land owned by respondents, literacy of household head, non-farm income, and number of adult members and mean distance of plots to homestead of the household.

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So far, farmers have not been involved in the soil conservation planning process. This shows that soil conservation programs implemented in the country failed to consider the involvement of local people. In order to design a useful plan of action for environmental protection, it is necessary to understand local people's attitudes towards environmental plans. Moreover important variables such as attitude of farmers, assistance of non-government organization, distance of communal land from home, are included in this study.

CHAPTER THREE

Methodology

3.1. Brief Description of the StudyArea

The study was undertaken in Kuyu woreda, Oromiya Regional State, Ethiopia. Kuyu is one of the 13 woredas of North Shoa zone which is located 156 km far from a capital city, Addis Ababa. The woreda is bounded on the West by West Shoa zone, on the North by Wara Jarso woreda and Hidabu Abote woreda, on the South by West Shoa zone and on the East by Dagam woreda. Kuyu woreda has 23 rural kebeles, 2 towns and 661 development teams. The total number of households in the woreda is 139,982. From this 115,498 households live in 23 rural kebeles and 24,484 households live in the town. From total population, 83.6% depend on agriculture (Agricultural Bureau of Kuyu Woreda, 2014).

Of the total area covered by Kuyu woreda (97,400 ha) around 38.05% is used for farmland, 17.87% is used for grazing, 9.53% is covered by forest, 12.61% is covered by vegetation, 6.74% is hillside and 15.2% is used for various construction and other purpose. Topography of this is 43.9% plain, 19.8% mountain, 7.4% hillside and 28.9% undulating plateaus. The altitude of this woreda ranges from 1080m to 3541m (Agricultural Bureau of Kuyu Woreda, 2014).

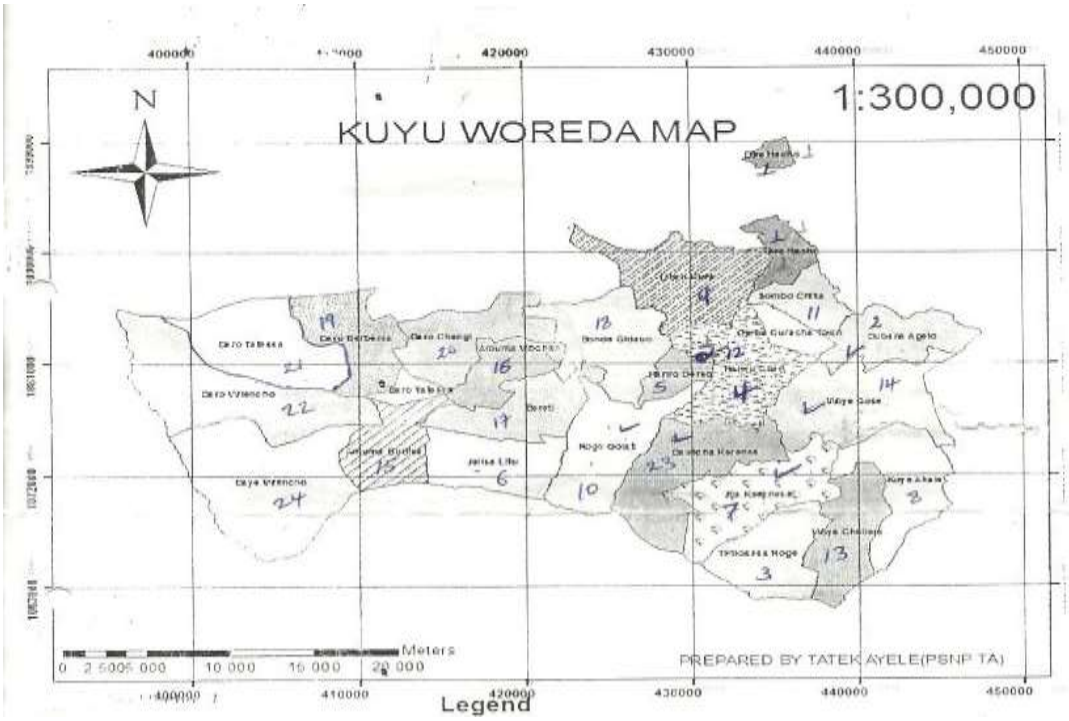


Figure 2: Map of Kuyu Woreda

Source: Agricultural Bureau of Kuyu Woreda, 2014.

Climate condition of Kuyu woreda shows that 38.8% Dega, 50.7% Weyna dega, and 15.5% kola. The rainfall shows a bimodal type of distribution. Starting from February up to May there is very small rain and from June up to September have the big rain. In average the rainfall per year is 1253.84mm. Farmers in the study area produce crops once in a year. The temperature condition ranges from 23.7-30.6 degree centigrade. The soil types of the study area are silly, sandy, clay, loam. From this soil type silly soil is the most abundant in percentage. The effect of soil erosion on soil productivity is especially severe in these soil types, and is likely to cause a sharp decline of soil fertility, mainly on very steep slopes (Agricultural Bureau of Kuyu Woreda, 2014).

The dominant farming practice of the woreda is based on traditional agricultural methods and tools and undertaken using a pair of oxen. Agriculture in the study area is virtually small-scale,

subsistence oriented and crucially dependent on rainfall. Though it is possible to grow different crops such as pulses, oilseeds, vegetables and root crops, Kuyu woreda is highly suitable for cereal-crop production. It is especially high potential area for teff, wheat, sorghum, and barley and bean production. The livestock raised in the woreda are cow and oxen, sheep, goat donkey, and horse. The farmers use these livestock as a supporter to produce cereal crops (Agricultural Bureau of Kuyu Woreda, 2014).

Natural resources in the study area are degraded from time to time. Due to the degradation of natural resources the productivity of the land is declining from time to time. The principal factors responsible for the problem include unrestricted access to communal land use, absence of appropriate conservation measure taken by relevant stake holders, erodible nature of the soils and expansion of farmland by clearing forest (Agricultural Bureau of Kuyu Woreda, 2014). Therefore it is needed to look at a measure that accommodate the participation of community and reverse the problem of soil erosion. By recognizing these problems the people are practicing SWC activities and plant trees around the watershed.

3.2. Source of data and Method of data collection

The primary data utilized in the descriptive and empirical analyses of this study were collected from 200 randomly selected households in five Kebeles in Kuyu woreda of North Shoa zone of the Oromia Regional State of Ethiopia. The data were obtained through well designed CV and CE survey questionnaire that prepared and then organized in a way that can capture all relevant information by employing face-to-face data collection techniques. A double-bounded dichotomous- or discrete-choice format is used to elicit respondents' WTP for improved soil conservation practice in terms of labor contribution. In addition, information regarding the

socioeconomic characteristics of households was collected. Secondary data collected from books, journals, articles and magazines were also consulted to supplement the study.

Before the main survey, a pilot survey was conducted to determine the starting bids for the dichotomous-choice valuation question in soil conservation practice.

3.3. Sampling Techniques

There are 23 kebeles in Kuyu woreda. Five kebeles were purposely selected. This is based on the existence of communal land and erosion severity. Then, two stage sampling technique was employed to select interviewed households. Accordingly, five development teams were randomly selected from each kebele. Finally, eight households were randomly selected from each development teams. A simple random sampling technique was employed by using lottery criteria to select the sampled household from sampling frame of each development teams. Hence the total number of households was 200.

3.4. Designing Survey Questionnaires and Elicitation Format

For most environmental goods, markets fail to exist due to public nature of environmental goods and externalities. In such cases researchers have developed hypothetical markets in which they elicit from consumers or potential consumers their WTP/WTA on a change in quality, quantity or both of environmental goods.

Designing CV survey questionnaires usually includes detailed description of the good under consideration and its possible substitutes and hypothetical circumstances under which the good is

made available to users, questions that elicit WTP/WTA of the respondents for a proposed change and respondents socio-economic and other basic variables.

CV survey questionnaires of this study have two different parts. The first sections provide general information and try to collect information on demographic structure and socio economic level of respondents; the second section provides contingent valuation scenarios and elicits farmers' WTP for improved soil conservation.

Generally, there are four types of value elicitation formats, namely, open-ended; bidding game; payment card and dichotomous or discrete choice formats. Each format has its own advantages and disadvantages. Double-bounded CV elicitation format can improve statistical efficiency over single-bounded through a number of ways. First, yes-no and no-yes answer to the initial bid make clear bounds on unobservable true WTP. Second, even though yes-yes or no-no answers do not bound actual WTP, additional questions will sharpen the true WTP and hence there are also efficiency gain. Finally, more questions in double-bounded elicitation format lead to large number of responses so that a given function will be fitted with greater observations (Haab and McConnell, 2002; HanemanN, 1991). As a result, this study employs double-bounded elicitation format.

3.5. Field Work Procedure

In order to generate primary data, which are used in this study, the field survey was undertaken in Kuyu woreda which is a study area. Before the final survey was implemented the pilot survey that included 20 households was carried out. The main objective of the pilot survey is to setup the starting point price, which are part of the main survey. In the pilot survey, the open-

ended election format is employed, which takes the form ‘What is the maximum amount you are willing to pay for improved soil conservation for five year?’ In the pilot survey we also elicit maximum willing to pay for improved conservation. The result obtained from the pilot survey averaged at 50 labor day per year and also used to modify in to the survey questionnaire before finalize it.

Then based on the pilot results three starting point price were introduced and total sampled households were divided randomly into three equal groups (two groups with 6 7 households and one group with 66 households).The field survey was undertaken from September 03 – 15, 2014 and from September 19, 2014 to October 02, 2014. It was successfully completed with low invalid responses (about 8.7% protest zeros).

3.6. Method of data analysis

In order to analyses the data, both descriptive analysis and econometrics analysis were employed. Both the probit and bivariate probit models were applied for the estimation of contingent valuation. Application of bivariate model in estimating the double bound contingent valuation can lead to efficiency (Geniusn et al., 2005). Cameron (1994) cited in Haab (1997) propose the use of a bivariate probit contingent valuation model when respondents are offered a follow-up bid to an initial contingent valuation question. The bivariate probit CVM solves distortion which is introduced from the follow up questions of the double-bounded contingent valuation survey.

3.7. Model specification

3.7.1. Contingent valuation

The Contingent Valuation Method (CVM) is a well-established technique to measure the benefit from changes in the quality of the environment. Respondents to a contingent valuation survey were presented with a realistic but hypothetical scenario and asked questions about the maximum amount of money that they would be willing to pay (WTP) for an amelioration from a status quo. The 'yes/no' response to the willingness to pay (WTP) questions, the offered amount and the additional information about the respondents' characteristics are used to fit binary response models such as probit (Albertini, 1995).

Farmers' decision to pay or not to pay for improved soil conservation practices at any time is influenced by a complex set of socio-economic, demographic, institutional and biophysical factors. Modeling farmers' response to improved soil conservation practices is important both theoretically and empirically.

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:

$$U_i = U_i(L, Z, q) \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots 1$$

Where U_i is the utility of the household i, L is total labour endowment of the household in a year, Z are socioeconomic characteristics of the household, whereas q is soil conservation quality as perceived by the farmer. Furthermore, let us assume that there are two states of the world corresponding to different levels of soil conservation quality: q* as the quality after the soil conservation practice is undertaken and q as the quality before the soil conservation practices is undertaken or if the practice is not pursued.

Since the total labour endowment of the particular household is a principal or most limiting asset of the household, it is assumed that the individual will be willing to pay the suggested reduction from its total labor endowment so as to maximize his or her utility under the following condition or reject it otherwise;

$$U_i^1(L - bid, Z, q^*) + e_i \geq U_i^0(L - bid, Z, q) + e_0 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2$$

Where $u_i, L. Z, q \; and \; q^*$ are as defined above, BID is the initial labor payment requirement per year for the soil conservation practices e_i 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.

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

$$U^t = f(X_{ti}) + e_{ti}, t = 0,1 \quad i = 1,2, \ldots n_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

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

Where, $Y_i = \begin{cases} 1, if \;\; U_i^1(L - bid, Z, q^*) + e_i \geq U_i^0(L - bid, Z, q) + e_0 \\ 0, \; otherwise \end{cases}$ ……4

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

$$\text{Prob}(Y_i = 1) = (U_i^1 \geq U_i^0) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 5$$

If we substitute equation 5 to 3

$$\text{Prob}(Y_i = 1) = prob(\alpha_1 X_i + \varepsilon_{1i} > \alpha_0 X_i + \varepsilon_{0i}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 6$$

By rearranging Equation, we get,

$$\text{Prob}(Y_i = 1) = prob[(\varepsilon_{1i} - \varepsilon_{0i}) > X_i(\alpha_0 - \alpha_1)] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 7$$

If $u_i = (\varepsilon_{1i} - \varepsilon_{0i})$ and $\beta = \alpha_0 - \alpha_1$ we have;

$$\text{Prob}(Y_i = 1) = prob(u_i > X_i\beta) = \text{F}(X_i\beta) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 8$$

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;

$$Y^* = \beta' X_i + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 9$$

$$Y_i = 1 \; if \; Y^* \geq bid1$$

$$Y_i = 0 \; if \; Y^* < bi$$

Where: β=is vector of unknown parameters of the model

X_i=is vector of explanatory variables

Y^*= Unobservable households' actual WTP for soil conservation.

Y_i = Discrete response of the respondents for the WTP

$bid1$ = the offered initial bids assigned arbitrarily to the i^{th} respondents

ε_i = Unobservable random component distributed N (0, σ)

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

Estimation of the Mean Willingness to Pay

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

Let bid1be the first bid price and *bid2* be the second. The take-it-or-leave-it with follow up format starts with an initial bid, *bid1*. The level of the second bid depends on the response to the first bid. That is, if the respondent answers "yes" for the initial bids, she/he receives an upper follow-up bid *bid2*; if she/he answers "no" for the initial bid, *bid1* she/he receives a lower follow-up bid *bid2*. In general, there are four possible outcomes: both answers "yes"; both answers "no"; "yes" followed by a "no"; and "no" followed by a "yes". The bounds on WTP are (Haab and McConnell, 2002):

1. $bid1 \leq WTP < bid2$ for the yes-no responses;
2. $bid1 > WTP \geq bid2$ for the no-yes responses
3. $WTP \geq bid2$ for the yes-yes responses;
4. $WTP < bid2$ for the no-no responses; ……..10

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

$$WTP_{ij} = \mu_j + \varepsilon_{ji} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 11$$

Where WTP_{ij} represents the i^{th} respondent's willingness to pay, and j=1,2 represents the first and second answer. The mean for the first and second responses are represented by μ_1 and μ_2. The probability of observing each of the possible two-bid response sequences (yes-yes, yes-no, no-yes, no-no) can be represented as follows:

$$P(yes,no) = pr(WTP_{1i} \geq b1,\ WTP_{2i} < b2) = pr(\mu_1 + \varepsilon_{1i} \geq b1,\ \mu_2 + \varepsilon_{2i} < b2)$$

$$P(yes,yes) = pr(WTP_{1i} \geq b1, WTP_{2i} \geq b1 = pr(\mu_1 + \varepsilon_{1i} \geq b1,\ \mu_2 + \varepsilon_{2i} \geq b2)$$

$$P(no,yes) = pr(WTP_{1i} < b1,\ WTP_{2i} \geq b2) = pr(\mu_1 + \varepsilon_{1i} < b1,\ \mu_2 + \varepsilon_{2i} \geq b2)$$

$$P(no,no) = pr(WTP_{1i} < b1,\ WTP_{2i} < b2) = pr(\mu_1 + \varepsilon_{1i} < b1,\ \mu_2 + \varepsilon_{2i} < b2) \ldots\ldots 12$$

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

$$L_i(\mu/b) = pr(\mu_1 + \varepsilon_{1i} \geq b1,\ \mu_2 + \varepsilon_{2i} < b2)^{YN}\ Xpr(\mu_1 + \varepsilon_{1i} \geq b1,\ \mu_2 + \varepsilon_{2i} \geq b2)^{YY}\ X\ pr(\mu_1 + \varepsilon_{1i} < b1,\ \mu_2 + \varepsilon_{2i} \geq b2)^{NY}\ X\ pr(\mu_1 + \varepsilon_{1i} < b1,\ \mu_2 + \varepsilon_{2i} < b2)^{NN} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 13$$

Where YY=1for a yes-yes answer, 0 otherwise, NY=1for a no-yes answer, 0 otherwise, NN=1for a no-no answer, 0 otherwise and YN=1for a yes-no answer, 0 otherwise. Assuming the error terms are normally distributed withmeans0and respective variances σ_1^2 and σ_2^2, then WTP_{1i} and WTP_{2i} have a bivariate normal distribution with mean μ_1 and μ_2, variances σ_1^2 and σ_2^2 and correlation coefficient ρ, which is the covariance between the errors for the two WTP function.

Given the dichotomous choice responses to each question, the normally distributed model is referred to as the bivariate probit model. The likelihood function for the bivariate probit model can be derived as follows. The probability that $WTP_{1i} < bid1$ and $WTP_{2i} < bid2$, i.e. the probability of a no-no response is;

$$\text{pr}(\mu_1 + \varepsilon_{1i} < bid1,\ \mu_2 + \varepsilon_{2i} < bid2) = \phi_{\varepsilon 1 \varepsilon 2}\left(\frac{\text{bid1} - \mu_1}{\sigma_1}, \frac{\text{bid2} - \mu_2}{\sigma_2}, \rho\right) \ldots\ldots\ldots\ldots .14$$

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

$$\text{pr}(\mu_1 + \varepsilon_{1i} < bid1,\ \mu_2 + \varepsilon_{2i} \geq \text{bid2}) = \phi_{\varepsilon 1 \varepsilon 2}\left(\frac{\text{bid1} - \mu_1}{\sigma_1}, \frac{\text{bid2} - \mu_2}{\sigma_2}, \rho\right) \ldots\ldots\ldots\ldots .15$$

The probability of yes–no response is;

$$\text{pr}(\mu_1 + \varepsilon_{1i} \geq \text{bid1},\ \mu_2 + \varepsilon_{2i} < bid2) = \phi_{\varepsilon 1 \varepsilon 2}\left(\frac{\text{bid1} - \mu_1}{\sigma_1}, \frac{\text{bid2} - \mu_2}{\sigma_2}, \rho\right) \ldots\ldots\ldots\ldots .16$$

And, the probability of yes-yes response is;

$$\text{pr}(\mu_1 + \varepsilon_{1i} \geq \text{bid1},\ \mu_2 + \varepsilon_{2i} \geq \text{bid2}) = \phi_{\varepsilon 1 \varepsilon 2}\left(\frac{\text{bid1} - \mu_1}{\sigma_1}, \frac{\text{bid2} - \mu_2}{\sigma_2}, \rho\right) \ldots\ldots\ldots\ldots .17$$

Defining $Y_{1i} = 1$ if the response to the first question is yes, and 0 otherwise,$Y_{2i} = 1$ if the response to the second question is yes, and 0 if no, $d_{1i} = 2Y_{1i} - 1$ and $d_{2i} = 2Y_{2i} - 1$ the i^{th} contribution to the bivariate probit likelihood function becomes;

$$L_i\ (\mu/\text{bid}) = \phi_{\varepsilon 1 \varepsilon 2}\left(d_{1i}\left(\frac{\text{bid1} - \mu_1}{\sigma_1}\right), d_{2i}\left(\frac{\text{bid2} - \mu_2}{\sigma_2}\right), d_{1i} d_{2i}\ \rho\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 18$$

But, when the estimated correlation co-efficient of the error terms in bivariate probit model are assumed to follow normal distributions with zero mean and distinguishable from zero the system of equations could be estimated as seemingly unrelated bivariate probit (SUBVP) model

(Cameron,1994). Hence, in this study a SUBVP was used to estimate the mean WTP of the respondents from the double bounded format.

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

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

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

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

$$\text{var}(\varepsilon_1/X_1, X_2) = \text{var}(\varepsilon_2/X_1, X_2) = 1$$

$$\text{cov}(\varepsilon_1, \varepsilon_2/X_1, X_2) = \rho \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 19$$

Where y_1^*: is i[th] respondents' unobservable true WTP at the time of the first bid offered. $\text{WTP} = 1 \text{ if } y_1^* > bid1; \textit{otherwise zero}$. y_2^*: is the i^{th} respondent implicit underlying point estimate at the time of the second bid is offered.

The mean willingness to pay (MWTP) from bivariate probit model (Equation16) can be calculated using the formula specified by Haab and McConnell (2002).

$$\text{MWTP} = \frac{-\alpha}{\beta} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 20$$

Where α=a coefficient for the constant term

β=a coefficient offered bids to the respondents

3.7.2. Variable Specification

In this study, a dichotomous dependent variable (WTP) is defined and indicates whether or not farmers are willing to pay for soil conservation measures. WTP=1, for a farmer that is willing to pay labor and WTP = 0, otherwise. The independent variables are those which are hypothesized to be associated with the willingness to pay for soil conservation measures are presented below.

A. Sex of household head

This is a dummy variable, which takes a value 1 if the household head is male and 0 otherwise. The sex of the household head is included to differentiate between males and females in their valuation of environmental protection. Tegegne (1999) reported that females tend to participate more in environmental protection during the peak season while males tend to participate more during the slack season. The net effect of this variable may not be determined a priori.

B. Marital status

Marital status of respondent's is included as a dummy variable which take one for married respondent and zero for single respondent. Married respondents may have the responsibility of feeding family and labor force than single respondents. Therefore, married household expected to have negative relationship with willingness to pay for soil conservation.

C. Education level

This is a dummy variable, which takes a value 1 if the household head is literate and 0, otherwise. Education increases farmers' ability to get process and use information. Therefore, it is hypothesized to have a positive role in the decision to pay for soil conservation practices. This hypothesis is supported by the findings of other studies on farmers' WTP for environmental

protection and on adoption of soil conservation practices (Tegegne, 1999; and Ervin, 1982; Noris and Batie, 1987, Pender and Kerr, 1998).

D. Family size

This refers to the total number of family members. Imperfections in labour markets imply that households with large human capital may invest more in conservation (Pender and Kerr, 1998; Shiferaw and Holden, 1998). This is precisely because soil conservation structures are labour 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.

E. Dependency ratio

This variable represents the ratio of the number of children below 15 years of age, disabled members and elders above 65 years of age to the number of economically active family members (15–65 years of age). An increase in consumer–worker ratio (dependency ratio) reduces the ability to meet subsistence needs, and also increases the personal rate of time preference (Shiferaw and Holden, 1998). This variable is expected to have a negative effect on farmers' WTP for soil conservation activities.

F. Size of farm land

This variable stands for the total area of the land in hectares owned by the sample respondents at the time of the survey. Farm size is often correlated with the wealth that may help ease the

needed liquidity constraint (Norris and Batie, 1987; Bekele and Drake, 2003). 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. Therefore, it is hypothesized that size of the cropland is positively related with the willingness to pay for soil conservation activity.

G. Total livestock

This variable measures the total number of livestock holding in tropical livestock units (TLU). The size of livestock holding reduces subjective rate of time preference and provides security (lower risk) to land users, which may enhance conservation investments (Holden et al., 1998). On the other hand, more specialization in livestock, away from cropping, may reduce the economic impact of soil erosion, and thus lower the need for soil conservation. Hence, the effect of the size of livestock holding on conservation decision is difficult to hypothesize a priori.

H. Farm Income

This is the total income obtained from crop production, animal selling that the household gets in a year, valued in Ethiopian birr. In addition to cash income, in-kind assets endowments of farmers that converted to the local markets prices were taken into account. It is expected to have a positive relationship with WTP.

I. Off-farm income

This variable measures the amount of off-farm income (in birr) that the sample household earned in a year. The direction of influence for this variable on adoption of soil conservation measures is indeterminate (Mbaga-Semgalawe and Folmer, 2000). On one hand, this variable is expected to

have a positive influence on the assumption that diversification out of agriculture (involvement in off-farm activities) would enable households to earn income thereby easing the liquidity constraint needed for soil conservation investments (Pender and Kerr, 1998; Shiferaw and Holden, 1998). On the other hand, if farming is not the main income earning activity, off-farm income earners may decide not to invest their financial resources in soil conservation (Gebremedhin and Swinton, 2003). Empirical studies reported both positive (Ervin, 1982; Clay et al., 1998) and negative (Mbaga-Semgalawe and Folmer, 2000; Abera, 2003) relationships between off-farm income and adoption of soil conservation measures

J. Slope of the land

This variable is used as a proxy for the erosion potential. It is a dummy variable that takes the value of 1 if the farmland is steep or very steep and 0 otherwise. Steeper slope has been found to have a positive effect on the adoption of soil conservation measures (Ervin, 1982; Pender and Kerr, 1998). Empirical studies in different parts of Ethiopia reported a positive and significant effect of the slope of a plot on the decision to adopt soil conservation structures (Shiferaw and Holden, 1998; Bekele and Drake, 2003; Gebremedhin and Swinton, 2003). In this study, careful observation and discussion with the farmers were used to classify the farmers' fields into different slope categories. This variable is hypothesized to have a positive influence on adoption of soil conservation measures.

K. Distance to the nearest market

This is a continuous variable which refers to the amount of time (in minutes) it takes to reach to the nearest market from home. It is hypothesized that the further away the residential area of the household from the nearest market, the less will be willingness of farmers to participate in soil

conservation practices. Therefore, distance to the nearest market is expected to have a negative effect on WTP.

L. Distance of communal land from home

This is a continuous variable which refers to the amount of time it takes from a farmer's home to communal land. Distance of communal land is expected to have a negative correlation with willingness to pay for conservation.

M. Soil fertility forgone by erosion

This is a dummy variable which takes 1 if the farmers' land fertility severely eroded (fertility of soil don't decreased) and takes zero (0) if soil fertility is not eroded (fertility of soil don't decreased). Farmers who are highly affected by soil erosion are more willing to pay to recover their land fertility than those their land is don't eroded. Therefore, it is expected to have a positive influence on willingness to pay.

N. Perception of soil conservation

This variable measures farmers' perception of the soil erosion problem. It takes the value of 1 if a household head perceived the soil erosion problem and 0 otherwise. Perception of the soil-erosion problem is considered to be vital for making conservation decisions. Farmers who have already perceived the problem of soil erosion are more likely to be willing to pay for soil conservation activities. Thus, the perception variable is expected to be strongly and positively associated with farmers' willingness to pay for soil conservation practices. Previous research found a positive role of this variable on conservation decisions (Ervin and Ervin, 1982; Shiferaw and Holden, 1998).

O. Attitude of farmers

This variable takes a value 1 if the farmer has a desire to try new conservation measures at own cost and 0 if he/she likes to wait until other land users adopt it. It is a proxy variable for the farmer's attitude towards conservation measures. Economic incentives will increase efforts, but responsiveness will differ with strength of conservation related attitude (Lynne et al., 1988). The findings of some empirical studies in Ethiopia show that peasants with a generally positive attitude towards new measures are keen on undertaking and keeping conservation structures (Shiferaw and Holden, 1998; Abera, 2003). Hence, in this study, attitude is hypothesized to have a positive effect on the WTP for soil conservation practices.

P. Frequency of extension contact

This is continuous variable which is the number of contacts that the farmer had 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. 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.

Q. **Access to Credit**:

This is a dummy variable that represents whether the household has access to credit either from formal and/or informal credit sources. Credit might relax cash constraint and might enhance willingness to pay for SWC.

R. Assistance in soil conservation

This is a dummy variable that indicates any form of support (material, technical, financial and other types of incentives) provided to farmers with a view to encouraging them to use soil conservation measures. Physical soil conservation measures are labour intensive and require financial and material inputs, which farmers may not be able to afford. As a result, assistance from government and non-government organization encourages farmers to adopt physical conservation measures. Therefore, it is expected that in areas where governmental and non-government is involved in agricultural development activities, the propensity to invest in land-conservation measures increases. Empirical studies have shown that this variable has been positively correlated with adoption and soil conservation effort (Bekele and Drake, 2003).

Initial offered Bid

This is bid price offered to the respondents. In this study the bid price is used as one of the explanatory variables in the analysis. The bid price is expected to influence negatively to the willingness to pay of the respondents.

CHAPTER FOUR

RESULTS AND DISCUSSION

Data collected can be analyzed in two different ways. The data analyzed through descriptive analysis of socio-economic characteristics of surveyed households and econometric models can be employed to examine determinants of WTP responses of sampled households. Accordingly, this chapter is organized as follows. The first section provides descriptive statistics of the survey results. The second section deals with multivariate analysis of determinants of respondents' willing to pay for improved soil conservation practices. The last section computes mean WTP and estimate total WTP.

4.1. Descriptive analysis

For this study, data randomly collected from 184 respondents were utilized for the analysis. Out of the total sample households 162 (88%) were willing to take and contribute to the pre specified initial offered bid and 22 (12%) of the households were not willing to pay the initially offered pre specified bid. Table 4.1 shows the descriptive statistics of variables.

Table 4. 1: Descriptive statistics of variables used in the empirical analysis

Variable	Mean	Std. Dev.	Min	Max
Sex of household head (Sex)	0.79	0.41	0	1
Marital Status, 1 if married 0 otherwise (Mstatus)	0.93	0.26	0	1
Education of the household head (1=literate, 0 otherwise) (Edu)	0.38	0.49	0	1
Family size(Fmlysize)	7.02	2.38	1	12
Dratio	90.55	60.48	0	300
Farm size(Frmsize)	1.24	0.94	0	4.75
Livestock ownership in TLU(TLU)	3.44	2.74	0.2	16
Income of the household (Income)	20225.66	11455.39	3200	62850
Off farm income (OffFarminc)	0.15	0.36	0	1
Slope of the land (SlopeLand)	0.64	0.48	0	1
Perception of soil erosion (SFerosion)	0.85	0.35	0	1
Distance to market (Distmarket)	127.02	90.21	10	345
Distance of communal land from home (Distcomland)	25.52	34.7	1	270
Perception of soil erosion problem (Perc)	0.95	0.23	0	1
(Attit)	0.74	0.44	0	1
Frequency of extension agents visit (FreqDA)	21.88	29.64	0	144
Access to credit (ACredit)	0.48	0.50	0	1
Assistance in soil conservation (Assist)	0.092	0.29	0	1

The descriptive statistics shows that around 79 % of respondent are males and the remaining are females. More than 93 % of the sample households are married and the rest are single. Literacy rate in the study area is very low and only 38 % of the samples are literate (can read and write). This is one area the local government needs to focus on as it has implications for the sustainable land management practices in general. The average family size is 7, which is a bit higher than the national average.

In terms of asset endowments, on average, a household has 3.44 TLU with a minimum of 0.2 TLU and a maximum of 16 TLU. The average farm size is 1.24 hectare which is a bit higher than the national average of one hectare. Farmers' average annual income is estimated to be 20226 Birr with a significant variation among households included in the study sample.

Physical characteristics such as slope of the farm land and farmers' perception on soil erosion are also included. Around 64% of farmers have a steep farm land and are easily affected by soil erosion unless appropriate measures are taken.

Table 4.2: Descriptive statistics of variables by their willingness to pay

	WTP N=162				NWTP N=22			
Variable	Mean	Std. D.	Min	Max	Mean	Std. D.	Min	Max
Bid1	45.37	22.32	20	80	67.73	23.89	20	80
Ans1	1.00	0.00	1	1	0.00	0.00	0	0
Bid2	90.09	45.58	10	160	33.86	11.95	10	40
Ans2	0.60	0.49	0	1	0.55	0.51	0	1
MaxWTP	89.31	38.50	12	200	38.41	27.27	0	72
Sex	0.81	0.39	0	1	0.64	0.49	0	1
Mstatus	0.93	0.25	0	1	0.91	0.29	0	1
Edu	0.42	0.50	0	1	0.05	0.21	0	1
Fmlysize	7.02	2.30	2	12	6.95	3.00	1	11
Dratio	89.63	62.81	0	300	97.28	39.78	25	166.67
Frmsize	1.24	0.95	0	4.75	1.19	0.86	0.25	3
TLU	3.61	2.82	0.2	16	2.20	1.55	0.7	8.2
Income('000)	20.67	11.85	3.40	62.85	16.92	7.307	3.20	32.60
OffFarminc	0.15	0.36	0	1	0.14	0.35	0	1
SlopeLand	0.66	0.48	0	1	0.50	0.51	0	1
SFerosion	0.86	0.34	0	1	0.77	0.43	0	1
Distmarket	129.11	90.24	10	345	111.59	90.59	15	300
Distcomland	24.14	34.85	1	270	35.68	32.55	1	120
Perc	0.98	0.14	0	1	0.68	0.48	0	1
Attit	0.77	0.43	1	1	0.54	0.51	0	0
FreqDA	23.17	29.85	0	144	12.41	26.79	0	96
ACredit	0.49	0.50	0	1	0.41	0.50	0	1
Assist	0.10	0.30	0	1	0.05	0.21	0	1

Out of the total162 households willing to pay 81% were male headed households and 19% were female headed households. From the total 22 households who don't not willing to pay female headed household share 36% and male headed household share 64%. This indicated that the percentage of male WTP is larger than the percentage of male not WTP

Out of 22 non-willing to pay literate household head contribute 55% while illiterate household head contribute 95%. This implies that education has direct and positive relation with willingness to pay for soil conservation practice. Similarly, About 98% 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, and 68% of the non-willing households also perceive the problem of soil erosion in their area. On other hand the share of those didn't perceived soil erosion as a problem between willing to pay and non-willing to pay are 30% and 70% respectively. This shows that household head who perceived soil erosion as problem more willing to pay for soil conservation than those who didn't perceived. The same procedure will be followed to make decision for others variables.

4.2.Econometrics analysis of Households' WTP

In addition to the descriptive statistics, we have estimated an econometric model specified in section 3.7.1 in equation 9 to analyses the various factors that affect farmers' willingness to pay for soil conservation practices in the communal lands of the study area. Table 4.3 reports the estimation results of the probit model. The estimated results show the relationship between various socioeconomic variables and farmer's willingness to pay for soil conservation practices.

Before running the econometric model, the independent variables were tested for the presence of multicollinearity. The result showed that there were no multicollinearity problems between the variables. The value for Contingency Coefficient(CC) for the dummy variables were less than 0.75 and the value of Variance Inflation Factor (VIF) for the continuous variables were less than 10; which indicate that multicollinearity is not a serious problem.

The Wald chi-square test 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 (73.73) at 19 degrees of freedom is 0.0000, which is significant at 1%. So, this shows that the variables included in explaining farmer's willingness to pay fits the model at 1% probability level. In other words, we reject the null hypothesis which stated that the coefficients of all explanatory variables included in the model are zero.

Table 4.3: Probit model estimation of the WTP for SWC.

Exp. Variables					Marginal Effect			
	Coef.	Std. Err.	z	P>z	dy/dx	Std. Err.	z	P>z
Bid1	-0.04	0.01	-3.69	0.000	0.00	0.001	-4.34	0.000
Sex	0.95	0.39	2.43	0.015	0.08	0.033	2.47	0.014
Mstatus	0.58	0.67	0.86	0.388	0.05	0.056	0.88	0.378
Edu	1.50	0.49	3.08	0.002	0.13	0.044	2.92	0.003
Fmlysize	0.06	0.08	0.81	0.417	0.01	0.007	0.80	0.424
Dratio	0.00	0.00	-0.65	0.515	0.00	0.000	-0.64	0.524
Frmsize	0.19	0.24	0.79	0.428	0.02	0.020	0.82	0.411
TLU	0.26	0.11	2.38	0.017	0.02	0.010	2.22	0.027
Lnincome	0.80	0.44	1.83	0.067	0.07	0.037	1.85	0.065
OffFarminc	0.39	0.40	0.96	0.338	0.03	0.035	0.94	0.346
SlopeLand	0.68	0.39	1.73	0.083	0.06	0.031	1.90	0.057
SFerosion	0.51	0.40	1.28	0.200	0.04	0.034	1.28	0.200
Distmarket	0.01	0.00	2.4	0.016	0.00	0.000	2.43	0.015
Distcomland	0.00	0.01	-0.63	0.526	0.00	0.000	-0.65	0.514
Perc	2.24	0.48	4.69	0.000	0.19	0.037	5.13	0.000
Attit	0.47	0.44	1.05	0.292	0.04	0.036	1.12	0.265
FreqDA	0.01	0.01	2.1	0.036	0.00	0.001	1.99	0.047
ACredit	0.33	0.51	0.65	0.519	0.03	0.042	0.66	0.507
Assist	0.16	0.55	0.29	0.771	0.01	0.048	0.29	0.772
_cons	-11.05	4.66	-2.37	0.018				
Num. Obs.		184				184		

The robust standard errors are used to account for any form heteroscedasticity. A number of household characteristics are found to be significant determinants of improved soil conservation

practices. *Sex*, education, livestock, income, slope of land, distance to market, perception, frequency of extension agents visit all have a positive and significant influence on the probability of farmers willingness to pay for soil conservation practices in their communal land area. Sex of the household head (male headed) has a positive and statistically significant effect at five percent. As sex is male the probability of yes for WTP is increase by 8%. The result is not surprising as female headed households have fewer resources necessary for the conservation activities than male headed households. As expected, literate households are more willing to pay for the soil conservation practices of their communal land areas then those with illiterate heads. The marginal effect shows that the probability of the willingness to pay for soil conservation increases by 13 % if the head of the household is literate. It is clear that education increases environmental awareness and enhance their understanding of the value for environmental goods such as soil. Previous studies by Tegegne (1999) and Paulos (2002) reported a similar result.

Asset endowments such as livestock were also included in the analysis**.** The probability of WTP increases by 2 percent for a unit increase in livestock ownership. Therefore, having a large number of livestock can strengthen farmers' capacity to contribute to the soil conservation efforts the area. Another possible justification could be those with large number of livestock are more willing to pay because they are affected by the degradation of the grazing land used for their livestock. Other CVM studies also find a positive and significant relationship between farmers' willingness to pay and possession of livestock. For example Jonse (2005) indicated that number of livestock plays an important role for willingness to pay for irrigation water. Similarly, income is positively and significantly related to the probability of WTP for soil conservation. This result is again consistent with the findings for livestock explained above. Both the theory and empirical studies also show that income is positively correlates with people's WTP.

The sign of the variable farmer's perception of soil erosion in a plot is turned out to be consistent with the a priori expectation and statistically significant at 1%. It was positively and strongly related with the yes answer to the first initial bid offered. Comparing with farm households who do not perceive the soil erosion problem the probability of the WTP by those farmers who perceive that there is soil erosion problem increases by 19%. If farmers perceive that there is a problem of soil erosion.

The role of extension agents has been documented in many studies. Instead of a dummy variable that represents whether the farmer has any contact with the extension agent or not, we have considered the frequency of the visit or contact between farmers and extension agents. As expected, the variable has a positive and significant influence on the farmer's willingness to pay. Additional contact with the extension agents increases the probability of farmers' willingness to pay for soil conservation practices by 0.11%. This is in line with most studies that try to address the role of extension agents in investment in the sustainable land and management practices.

This study, unlike most other related studies, has tries to understand the role of physical characteristics of the farm land. Hence the slope of the farmer's land, which represents the degree of steepness of the land, is included. The findings show that those farmers with steep land have a positive and significant effect on the probability of their WTP. Other studies such as Ervin (1982) and Pender and Kerr (1998) also found a positive relationship between steeper slope and the adoption of soil conservation measures. Empirical studies in Ethiopia also reported a positive and significant effect of the slope of a plot on the decision to adopt soil conservation structure.(Shiferaw and Holden,1998;Bekele and Drake, 2003;Gebremedhin and Swinton, 2003). Location also matters in the farmer's WTP for soil conservation. Those who are located far away from the market have a positive 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 labour market for alternative employment) as a farmer far away from the market center.

Bid one is a significant explanatory variable in this model. It is statistically significant at 1% level. The coefficient shows that as the price offered to a household increases the farmers' demand for soil conservation of communal land will decrease, keeping other factor constant. This result is convergence to the law of demand.

Bivariate Probit Model

The test against the null hypothesis is that the two equations can be independently estimated or the correlation between the two error terms is Zero can be checked by looking at the Likelihood-ratio test of the correlation coefficient (i.e. rho=0). The result is significant at 10 % level of significance, showing that the two equations can be estimated simultaneously. Table 4.4 presents the results for the initial and second bid. The full estimation results are given in Appendix A.

Table 4.4: Bivariate Probit Statistical Regression output

		Robust				
	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Ans1						
Bid1	-0.040	0.010	-4.4	0.000	-0.0604278	-0.0232
Ans2						
Bid2	-0.018	0.003	-6.29	0.000	-0.0240276	-0.0126043

The estimated coefficient of the proposed bid values (i.e. both the initial and second bids) are statistically significant and has the expected sign in affecting the probability of household's willingness to pay for SWC at 1% level of significance.

4.3. Summary of Households' WTP and Estimation of Total Welfare

4.3.1. Descriptive Statistics of the Discrete Responses

Households were categorized based on their joint responses to the offered bids (initial and follow up).The response of households in the double bounded contingent valuation reveals that the first response is shared by 88.04% of YES and 11.96% of NO responses. If respondents respond YES to the first bid, then they would be asked additional amount to the previous bid. Accordingly, the response of household are classified in to four set of bundle responses. These are (Yes, Yes), (Yes, No), (No, No) and (No, Yes).

As shown in table 4.5 the first set of bundle (Yes, Yes) represents households who had 'Yes' responses for the first initial bid as well as for the higher follow up bids. Those households were 53.26% of the total sampled households. The second set bundle (Yes, No) indicate that those households that accepted the initial bid but rejected the higher second follow up bid and they account for 34.78% of the total sample households. The third set shows the percentage of households that did not accept the initial bid but accepted the second bid which accounts for 6.52% of total responses. Finally, the results revealed that about 5.44% of the households rejected the initial offers as well as the follow up discounted bids (No, No).

Table 4.5: Frequency of Willingness to pay

WTP Category	Frequency	Percent
Yes-Yes	98	53.26
Yes – No	64	34.78
No – Yes	12	6.52
No –No	10	5.44
Total	184	100

Source: Own Survey, 2014

4.3.2.Estimation of Mean from Double Bounded Dichotomous Format

Table 4.6 presents the descriptive statistics of households' responses to the offered bids in the double bounded dichotomous format. The result shows that the average initial bid was 48.37 Labor days per year. Whereas, the average second bid for soil and water conservation practices was 83.34 Labor days per year. The "yes" response for the first bid is about 88% while the "yes" responses for the second bid is about 59.8%.

Table 4.6: Descriptive Statistics of the Dichotomous Choice Format

Variable	Obs	Mean	Stan. Dev	Min	Max
Bid1	184	48.369	23.622	20	80
Bid2	184	83.342	46.710	10	160
YBid1	184	0.880	0.325	0	1
YBid2	184	0.598	0.492	0	1

Source: Own Survey, 2014

The main objective of the double bounded dichotomous was to estimate the mean WTP from responses of both bids offered. The result revealed that the initial bid and the second bid have the negative signs and statistically significant at 1% probability level. This implies that higher initial bid and second bid lead to lower probability of accepting the bid offered.

Table 4.7: Estimates of the Double Bounded Dichotomous Choice Format.

	Coef.	Robust S.E.	Z	P>z
Bid1	-0.0336697	0.0058	-3.57	0.000
Constant	2.314392	0.3776	6.13	0.000
Bid2	-0.0147951	0.0023	-6.34	0.000
Constant	1.508658	0.2514	6.00	0.000
/athrho	0.752	0.324	2.32	0.020
rho	0.636	0.1928		
Wald test of rho=0: chi2(1)=5.38423; Prob > chi2 = 0.0203				
Log pseudolikelihood = -166.38832 Number of obs = 184 Wald chi2(2) = 47.06 Prob > chi2 = 0.0000				

In the double-bounded estimates reported in table 4.7 the initial bid and the second bid have the expected signs and both are statistically significant at 1 % level of significance. Both results imply that higher initial bid and second bid lead to lower probability of accepting that bid.

In the Seemingly Unrelated Bivariate Probit Estimates (SUBPE) Rho (ρ), coefficient of correlation of error terms of the double-bounded model, is positive and statistically significant at 1% level of significance. This basically shows that there is positive linear relationship between the random components of the responses to the initial bid and the second bid. The fact that Rho (ρ) is less than unity indicates that the correlation between the random components of the responses to the initial bid and the second bid is not perfect. This implies that there is positive correlation between the two responses. Besides, the correlation coefficient of the error term is less than one implying that the random component of WTP for the first question is not perfectly correlated with the random component from the follow-up question.

Using the coefficients of bid and constant in Table 4.7, the mean WTP for soil conservation practices from the double bounded probit estimate was estimated using the formula by Haab and McConnell (2002) to be 85.36 Labor days per year per household. At 95% confidence interval the WTP varies between 68.68 to 101.94 Labor days per year. The result shows that the mean WTP from double bound format was greater than the mean value from the open ended response which was computed at 83.22 Labor days per year per household for five years.

4.3.3. Analysis of Results of the Open Ended Format

In the open ended question, respondents were asked to state the maximum amount they would like to pay for soil conservation practices. The amount of labour that the households would contribute to the improved soil conservation ranges from 0 to 200 Labor days per year for five years. The table shows that about 95% of the farmers were willing to pay some amount of labor for soil conservation practices. In the practice of CVM, 0 bidders are presented with follow-up questions to ascertain whether they are expressing a protest bid against the valuation or they place no value on the resource (Paulos, 2002). The frequency distribution of the responses of the sampled households of the open ended responses is also presented in the Table 4.8.

Table 4.8: frequency distribution of the open ended responses

Number of person days	Frequency	Percent
0	5	2.72
1 – 20	7	3.8
21 – 40	17	9.24
41 – 60	46	25
61 – 80	11	5.98
81 – 100	39	21.20
101 – 120	41	22.28
121 – 140	4	2.17
141 – 160	9	4.89
161 – 180	2	1.09
181 - 200	3	1.63
	184	100

Observations	184
Mean	83.22283
Standard Deviation	40.79148
Maximum	200
Minimum	0

Of the184 sample respondents, only 5 households were not willing to contribute labor for soil conservation practices. On the other hand, the remaining 179 were willing to contribute some amount of labor. The average number of days that farmers were willing to contribute for soil conservation practices was 83.22. Figure 4 shows the frequency curve of sample households' maximum willingness to contribute labor for soil conservation practices in a year. The curve shows that the number of respondents gets lower as the bid gets higher.

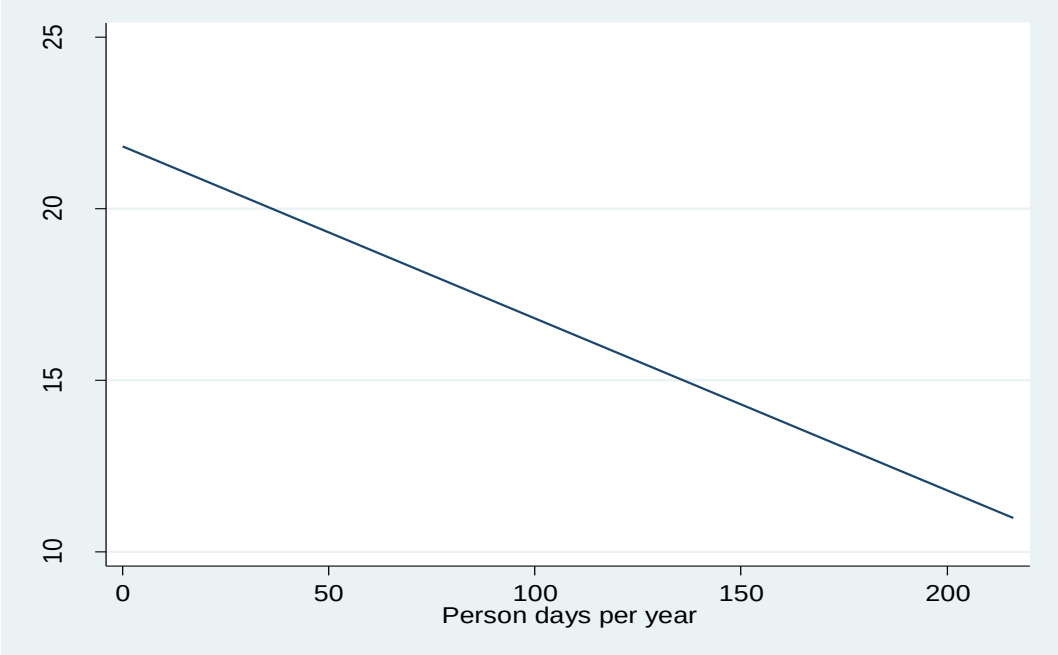


Figure 3: Frequency of respondents and Person day Contribution

4.3.4. Welfare Measures and Aggregation

Aggregation of benefit (TEV) of conservation work is the final step in the contingent valuation research. An important issue related to the measurement of welfare using WTP is aggregation of benefit (Alemu, 2000). According to Mitchell and Carson (1989), there are four important issues to be considered regarding sample design and execution in order to have a valid aggregation of benefits: Population choice bias, sampling frame bias, samples non response

bias and sample selection bias should be considered before aggregating a contingent valuation results. This study used random sampling method from the recent updated lists of households (sampling frame). A face to face interview method is used and Protest zero responses were excluded from the analysis and possibility of protest zeros was accounted in the estimation of the aggregate benefit. Hence, none of the above biases was expected in the analysis. Mean was used as a measure of aggregate value of soil conservation in this study. The mean is perhaps better than the median since the good dealt with is not a pure public good (Alemu, 2000) as there are purely private benefits from soil erosion conservation measures.

Table 4.9: Welfare Measures and Aggregate Benefits by Peasant Associations

Name of kebeles	Total HHs of Keb-eles	Sampled HHs with valid response	Sampled HHs with invalid response	Proportion of invalid response	Expected Total HH with invalid response	Expected Total HH with valid response	Mean WTP	Total WTP
H/Cari	3150	40	0	0.000	000.00	3150.00	85.36	268884.00
R/kolati	2110	37	3	0.075	158.25	1951.75	85.36	166601.38
J/kerensa	2550	34	6	0.15	382.5	2167.5	85.36	185017.80
W/gose	3000	38	2	0.05	150	2850	85.36	243276.00
D/kerensa	2400	35	5	0.125	300	2100	85.36	179256.00
Total	**13,210**	**184**	**16**		**990.75**	**12219.25**		**1,043,035**

In Table 4.9 the aggregate WTP was calculated by multiplying the mean WTP by the total number of households who are expected to have a valid response in the selected kebeles. The aggregate WTP in terms of labor days per year was converted into monetary value by using wage rate in the local labor market. Shadow wage rate which is good measure of economic

value didn't available. Therefore, based on the mean from the double bounded dichotomous choice format, the aggregate WTP for soil conservation practices is 1,043,035 Labor days per year (18,774,630 ETB) in the selected five kebeles From the open ended questions, the total WTP for soil conservation practices was 1,018,230 Labor days per year (18,328,140). This shows that there is high level of WTP for soil conservation practices in the study area.

There are 139982 households in the study area (Kuyu Woreda). It is therefore possible to calculate the total aggregate value of soil conservation practices for the whole Woreda. After deducting the 12,178 protests zeros, the expected total households with valid responses are 127,804 households. The total willingness to pay in the whole study area is simply the product of the respective means and the number of expected households who have valid responses. Hence, the aggregate value of soil conservation in the study area from the double bounded and open ended formats are 10,909,349 person days per annum (196,368,282 ETB) and 10,649.907person days per annum (191,698,326ETB), respectively.

CHAPTER FIVE

Conclusion and Policy implications

5.1. Conclusion

This study attempted to elicit farmers' WTP for soil conservation practices in communal lands in the Kuyu woreda, Oromia regional state, Ethiopia. The objective is to identify determinants of famers' willingness to pay for soil conservation practices and estimate the total economic values. A contingent valuation method (CVM) is used to analyses the determinants of farmers WTP for soil conservation practices. A 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 abut soil erosion problem, and the frequency of extension visit have also a positive and significant effect on the WTP for soil conservation

The study also show that the mean willingness to pay estimated from the Double Bounded Dichotomous Choice and open ended formats was computed at 85.36 and 83.33 person days per annum, respectively. The respective total aggregate value of soil conservation in the study varies from 10,649,907 person days per annum (191,698,326 ETB) in open ended to 10,909,349 person days per annum (196,368,282 ETB) from double bound CVM.

Therefore, this study concludes that farmers have perceived the problem of soil erosion and to overcome the problem, they are willing to pay in terms of labor contribution for improved soil conservation practice.

5.2. Policy Implications

Based on the finding of this study, the following policy recommendations are drawn.

- The findings of this study indicate that any plan for intervention in the soil conservation should recognize the existing heterogeneity in household characteristics, perception level of the soil-erosion hazard, physical factors, institutional and demographic factors. In this respect, increasing the level of farmers' perception about soil erosion and the merits of soil conservation technologies through training and centered participatory will help them to develop a positive attitude towards conservation work.

- Moreover, policy makers can target those areas where soil erosion is severe so as to plan more appropriate projects in the future.

- Similarly, as farmers who have educated have higher demand for conservation and higher probability of accepting soil conservation projects than those who are not literate policy makers should take into account increasing farmers' education in the rural area of Ethiopia.

- The interaction between extension agents and farmers should be strengthened. More frequent contact between the two could enhance farmers understanding of the environmental problems in general and soil erosion problems in particular.

- The relatively better off farmers are more willing to contribute to the soil conservation efforts in the study area. Policy makers may target these households especially at the beginning of the conservation efforts.

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Appendixes

Appendix I: Households' Socio- Economic Characteristics and Demographic Questionnaire

Addis Ababa University

Faculty of Business and Economics

Department of Economics

Contingent Valuation Survey Questionnaire for Elicitation of Farmers' WTP for Improved Soil Conservation Practices: Household Questionnaire

Hello, how are you? Thank you in advance for giving time for this interview. My name is _____. This survey is being undertaken by Mr. Belay Kasaye who is a postgraduate student at Addis Ababa University, economics department as a partial fulfillment for the award of MSc in economics. His studies focus on farmers' WTP for improved soil conservation practices in Kuyu woreda. 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 research will help the regional government to develop a mechanism in improving the degraded land through appropriate conservation practices in collaboration with you. The information that you have delivered to us 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

Name of the enumerator _____ Sign _____

Name of the kebele _____ Interviewee number_____

Name of the Village_____ Date of interview_____

1. HOUSEHOLD INFORMATION FOR RESPONDENT

1.1. Age : active =1 inactive = 0

1.2. Gender: Male =1 Female =0

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

1.4. Family size_____

1.5. Education Level: literate=1 illiterate = 0

1.6. What are your main sources of income?

1.7. Do you have off-farm activities to support your livelihood? Yes = 1 No = 0

1.8. If yes, in which type of businesses? _____

1.9. How much is a total annual income of your household? _____

Information about Family Members

No	Name	Age[1]	Sex[2]	Education[3]	Marital[4] status	Relationship[5]	Occupation[6]	Unique id/no
1								
2								
3								
4								
5								
6								
7								

Code : [1] 1=in working age 2=out of working age; [2] 1 = male 2 = female;
[3] 1= illiterate 2= primary 3= high school 4= preparatory 5= bachelor 6= > bachelor
[4]1=Married 2=Single 3=Divorced 4=Widowed 5=Other specify
[5]1=head2=Wife/Husband/Partner3=Son/Daughter, 4=Grandchild5=Father/Mother
6=Sister/Brother7=Nice/Nephew8=Uncle/Aunt9=Grandparents,10=OtherRelatives,11=Servant,12=Tenant
[6] 1=Agriculture 2=wageworker 3=business 4=Government service5=NGO6=Private sector 7=Student 8=Foreign employment 9=Elderly/disabled/ 10=household work 11=unemployed 12=other(specify)___

2. HOUSEHOLD'S COMMUNAL LAND USE

2.1. Slope of communal land in your village : Very steep=1 Steep=2 Gentle slope=3 Flat = 5 Others specify= 6

2.2. Distance from home to communally used land _____ Minute?

2.3. Distance from home to the nearest town _____ Minute?

2.4. Major types and numbers of livestock you have? Cow___ ox___ horse____ mule___ sheep_____ goat _____ others

3. AWARENESS AND PERCEPTION COMMUNAL LAND

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

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

3.3. If question 3.1 is yes, how much of land affected by erosion in? _____ha

3.4. Has this land been severely affected by soil erosion before? Yes=1 No = 0

3.5. If yes, severity of erosion on communal land since started used?

1. Very severe 2.Severe 3. Minor

3.6. How do you perceive current soil fertility as compared to the past?

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

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

3.8. Do you think that erosion will severe in the future if situations remain unchecked? Yes=1 No = 0

3.9. What were the causes of decline in fertility of soil?

1. Intensive cultivation 2. Erosion 3. Grazing 4. Others (specify_____

3.10. If you did not use any of the soil conservation practice, mention reasons for not using.

1. Lack of money 2. Labor shortage 3. Others specify_____

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

4. AVAILABILITY OF ASSISTANCE

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

4.2. If you want to borrow enough money at low interest rate, can you get a lender in a year? Yes=1 no=0

4.3. If question 4.2 is no specify the reason

4.4. Frequency of visit by development workers per year? ----------times

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

4.6. In which kind of soil conservation programs on communal land have you been involved?

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

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

Appendix II: CONTINGENT VALUATION SCENARIOS AND QUESTIONNAIRE

II. CONTINGENT VALUATION SCENARIOS AND QUESTIONNAIRE

In your woreda Soil erosion is one of the most serious environmental problems that affect agricultural productivity especially the productivity of communal land. The woreda administration and the community realized this fact.

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 appropriate conservation practices 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.

Even though, the government has been taking some measure of soil conservation practice, till now it is being difficult to overcome the problem of land degradation particularly soil erosion due to a budget constraint and other priorities. Now we are planning to invest a program that aims at improving the soil conservation practices through the contribution of the farmers in study area and providing benefits to farmers from improved soil conservation practices.

The program cost is expected to be covered by the woreda community who are going to benefit from improved soil conservation practices. The payment will be in the form of labor and cash contribution. The cash will be collected every year following the harvest Season (These are the times in which you have relatively better cash in hand) and labor contribution for the construction and maintenance of soil conservation practices is at a time when you are free (at a season of no production).

Therefore, we want to know the amount of days you are willing to spend on such activities for the coming five years. We would now like you to answer the following questions on the amount of person days/or cash in birr you are willing to spend on the activities. If the program comes true, then you will get benefit from conserved soil which will enable you to increase your land productivity. The program will be realized only if all the prospective soil conservation practices users are willing to contribute.

Did you understand the above story? If you have questions, please ask me now. If everything is clear, Based on the scenario proposed above, please answer the following questions.

1. Are you willing to contribute for the improved soil conservation practice program?

   A. Yes B. No

If the answer for question one is yes, proceed for question 2

2. In what form you are willing to contribute? A. labor B cash C. Both

3. Would your household be willing to pay an annually payment of Birr (54, 162, 270) or (20, 50, 80 person day per year) every year for the improved soil conservation practices?

   A. Yes B. No

If the answer for this question is yes, proceed for question 4 and otherwise go to question 5.

4. Would your household be now agreed to pay if the annually payment is Birr (108, 324, 540) or (40,100,160 person day per year) for the improved solid waste management system?

   A. Yes B. No

5. Would your household be now agreed to pay if the annually payment is Birr (27, 81,135)? Or (10,25,40 person day per year)

   A. Yes B. No

If the answer to question 4 is yes, proceed to questions 6

6. Would your household be now agreed to pay if the annually payment is greater than Birr (108, 324, 540) or (40,100,160 person day per year) for the improved soil conservation program?

   A. Yes B. No

If the answer to question 6 is yes go to question 7, otherwise go to question 8

7. How much is your household at least willing to pay for this program?_____ Birr per year or _____person day per year

If the answer to question 5 is no, proceed to questions 8 and 9

8. How much is your household at most willing to pay for this the improved service?

_____ Birr per year, or _____person day per year

9. If you are not willing to contribute any amount to the improved soil conservation practice program, please identify your reason/s

A. I do not have enough income to pay.

B.I thinks the government should finance the program

C.I does not believe the program will result in more reliable improved soil conservation?

D. I am satisfied with current improved soil conservation practices.

E. The proposed charge is expensive

F. I do not like the service to be provided by the government.

G. Other, please specify_____

Appendix III: VIF of Continuous Explanatory Variables

Variable	VIF	1/VIF
Income	1.21	0.829379
Frmsize	1.18	0.849844
Distmarket	1.16	0.862693
FreqDA	1.14	0.879746
Fmlysize	1.10	0.911568
Dratio	1.07	0.931168
TLU	1.05	0.956054
Distcomland	1.04	0.960316
Mean VIF	1.12	

Appendix VI: Contingency Coefficient for Discrete Variables

	Sex	Mstatus	Edu	OffFar~c	SlopeL~d	SFeros~n	Perc	Attit
Sex	1.0000							
Mstatus	-0.0359	1.0000						
Edu	0.3397	-0.0493	1.0000					
OffFarminc	0.1414	0.0578	0.0781	1.0000				
SlopeLand	-0.0456	-0.0293	-0.1229	-0.1248	1.0000			
SFerosion	0.1299	0.0055	0.0040	-0.0809	0.0741	1.0000		
Perc	-0.0631	0.0275	0.0867	-0.0319	0.1706	0.0361	1.0000	
Attit	0.0332	-0.1155	0.1534	-0.0584	-0.0830	0.1384	0.0760	1.0000
ACredit	0.0316	0.0517	0.0674	0.0184	-0.1460	0.0588	0.0856	0.1476
Assist	-0.1154	-0.0585	-0.0145	-0.1352	0.1995	0.0793	0.0765	-0.0242

	ACredit	Assist
ACredit	1.0000	
Assist	-0.0425	1.0000

Appendix V. Bivariate Probit Statistical Regression output

```
Seemingly unrelated bivariate probit              Number of obs   =        184
                                                  Wald chi2(38)   =     218.25
Log pseudolikelihood = -113.85123                 Prob > chi2     =     0.0000
------------------------------------------------------------------------------
             |               Robust
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
Ans1         |
        Bid1 |  -.0415125   .0098879    -4.20   0.000    -.0608924   -.0221327
         Sex |   .8951579   .3819344     2.34   0.019     .1465802    1.643736
     Mstatus |   .7473804   .6015483     1.24   0.214    -.4316327    1.926393
         Edu |   1.407846   .4456205     3.16   0.002     .5344463    2.281246
    Fmlysize |   .0895791    .068782     1.30   0.193    -.0452312    .2243893
      Dratio |   -.001652   .0032452    -0.51   0.611    -.0080124    .0047084
     Frmsize |   .1924194   .2317907     0.83   0.406     -.261882    .6467207
         TLU |   .1871727   .0857037     2.18   0.029     .0191966    .3551489
    Lnincome |   .9023307   .3841378     2.35   0.019     .1494344    1.655227
  OffFarminc |   .4055344   .3501304     1.16   0.247    -.2807086    1.091777
   SlopeLand |   .6062467   .3825218     1.58   0.113    -.1434823    1.355976
   SFerosion |   .5951282    .355491     1.67   0.094    -.1016213    1.291878
  Distmarket |   .0075024   .0026104     2.87   0.004     .0023861    .0126187
 Distcomland |  -.0034955   .0054462    -0.64   0.521    -.0141699    .0071788
        Perc |   2.216759   .4629885     4.79   0.000     1.309318    3.124199
       Attit |   .4124165   .4221685     0.98   0.329    -.4150185    1.239851
      FreqDA |   .0169067   .0072701     2.33   0.020     .0026575    .0311559
     ACredit |   .1697472    .477684     0.36   0.722    -.7664962    1.105991
      Assist |  -.0179257    .517432    -0.03   0.972    -1.032074    .9962223
       _cons |  -12.33808   4.230201    -2.92   0.004    -20.62912   -4.047036
-------------+----------------------------------------------------------------
Ans2         |
        Bid2 |   -.017999   .0029229    -6.16   0.000    -.0237278   -.0122701
         Sex |   .7747865   .3159918     2.45   0.014     .1554539    1.394119
     Mstatus |   .0576431   .5102817     0.11   0.910    -.9424907    1.057777
         Edu |   .1780279   .2545594     0.70   0.484    -.3208993    .6769551
    Fmlysize |   .0634806   .0527725     1.20   0.229    -.0399517    .1669129
      Dratio |  -.0020267   .0019163    -1.06   0.290    -.0057827    .0017292
     Frmsize |   .1320859   .1300281     1.02   0.310    -.1227645    .3869364
         TLU |  -.0351002    .044912    -0.78   0.434    -.1231262    .0529257
    Lnincome |  -.0192335   .2380393    -0.08   0.936    -.4857819    .4473149
  OffFarminc |   -.306602   .3090667    -0.99   0.321    -.9123616    .2991575
   SlopeLand |   .5674221   .2522012     2.25   0.024     .0731168    1.061727
   SFerosion |  -1.061202   .3603762    -2.94   0.003    -1.767527    -.354878
  Distmarket |   .0010013   .0012151     0.82   0.410    -.0013802    .0033828
 Distcomland |  -.0023703   .0034006    -0.70   0.486    -.0090353    .0042947
        Perc |   1.224557   .5426978     2.26   0.024     .1608891    2.288225
       Attit |    .072101    .247518     0.29   0.771    -.4130253    .5572273
      FreqDA |   .0085496   .0044267     1.93   0.053    -.0001266    .0172259
     ACredit |   .0699327   .2602821     0.27   0.788    -.4402108    .5800762
      Assist |   .9714241   .4795172     2.03   0.043     .0315877    1.911261
       _cons |   -.000902   2.461218    -0.00   1.000    -4.824801    4.822997
-------------+----------------------------------------------------------------
     /athrho |   .6951308   .4154926     1.67   0.094    -.1192198    1.509481
-------------+----------------------------------------------------------------
         rho |    .601268   .2652824                     -.1186581     .906847
------------------------------------------------------------------------------
Wald test of rho=0:                chi2(1) =  2.79902    Prob > chi2 = 0.0943
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Declaration

I declare that this thesis is my original work and has not been presented in other universities; all sources of materials used have been duly acknowledged.

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Signature: _____

Submission Date: May, 2015

This thesis has been submitted for examination with the approval of university advisor

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