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DETERMINANTS OF HOUSEHOLDS' WILLINGNESS TO PAY FOR SOIL CONSERVATION ON COMMUNAL LANDS IN RAYA KOBO WOREDA, NORTH WOLLO ZONE, ETHIOPIA

MSc THESIS

GETACHEW BELAY

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Determinants of Households' Willingness to Pay for Soil Conservation on Communal Lands in Raya Kobo Woreda, North Wollo Zone, Ethiopia

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Getachew Belay

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HARAMAYA UNIVERSITY
POSTGRADUATE PROGRAM DIRECTORATE

I hereby certify that I have read and evaluated this Thesis entitled **' Determinants of households' willingness to pay for soil conservation on communal lands in Raya Kobo Woreda, North Wollo Zone, Ethiopia,'** prepared, under my guidance by Getachew Belay. I recommend that it be submitted as fulfilling the thesis requirement.

Mengistu Ketema (PhD)	_____	_____
Major Advisor	Signature	Date
Musa Hasen (Assi.Proffesor)	_____	_____
Co-advisor	Signature	Date

As a members of the Board of Examiners of the MSc Thesis Open Defense Examination, I certify that we have read and evaluated the Thesis prepared by Getachew Belay and examined the candidate. I recommend that the thesis be accepted as fulfilling the Thesis requirements for the Degree of Master of Science in Agricultural and Applied Economics

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This manuscript is dedicated to my families and beloved friends

STATEMENT OF THE AUTHOR

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Name: Getachew Belay
Signature: _____
Date _____
School: Agricultural Economics and Agribusiness Management

BIOGRAPHICAL SKETCH

The author was born on October 01, 1992 in Zobile Kebele, Raya Kobo Woreda, North Wollo Zone, Amhara Regional State, Ethiopia. He attended his Elementary education at Zobile Elementary school and attended his secondary education at Kobo Secondary and Preparatory school. After successful completion of his preparatory school, he joined Wollo University in 2012 and graduated with Bachelor of Sciences Degree in Agricultural Economics in July 2014. Since his graduation he has served Wollo University as graduate assistant for two years. Then, he joined Haramaya University in September 2016 to pursue his MSc degree in Agricultural and Applied Economics in regular program.

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ACRONYMS AND ABBREVIATIONS

ACSI	Amhara Credit and Saving Institution
CC	Contingency Coefficient
CE	Choice Experiment
CS	Compensating Surplus
CSA	Central Statistical Agency
CV	Contingent Valuation
CVM	Contingent Valuation Method
DBDC	Double Bounded Dichotomous Choice
ES	Equivalent Surplus
EV	Equivalent Variation
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
NOAA	National Oceanic and Atmospheric Administration
RCM	Replacement Cost Method
RKWAO	Raya Kobo Woreda Agricultural Office
RKWAO	Ryaya Kobo Woreda Agricultural office
RP	Revealed Preference
SBDC	Single Bounded Dichotomous Choice
SP	Stated Preference
SUBP	Seemingly Unrelated Bivariate Probit
SWC	Soil and Water Conservation
TEV	Total Economic Value
TLU	Tropical Livestock Unit
TVC	Total Vale Curve
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
VIF	Variance Inflation Factor
WTA	Willingness to Accept
WTP	Willingness to Pay

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Determinants of Households' Willingness to Pay for Soil Conservation on Communal Lands in Raya Kobo Woreda, North Wollo Zone, Ethiopia

ABSTRACT

Currently, soil erosion is one of the most serious environmental problems in Ethiopia which are affecting the livelihood of the rural farmers. In order to combat this critical soil erosion problem, active participation of the local communities through labor-day contribution is vital. Cognizant of this fact, identifying the determinants of farmers' willingness to pay (WTP) is an important issue for policymakers in order to have an effective and sustainable conservation programs. Therefore, this study was initiated with the objective of examining the determinants of households' willingness to pay for soil conservation practice on communal lands and to estimate the aggregate welfare gain of the proposed program in Raya Kobo Woreda. A multi-stage sampling technique was employed to select the target respondents. Double bounded contingent valuation survey with an open-ended follow up question was conducted on 245 randomly selected rural households' to elicit their preferences for communal land soil conservation. The collected data were analyzed using descriptive and inferential statistics and econometric model. Inferential statistics such as t-test and chi-square test were used to see the significant mean/percentage difference between willing and non-willing households in terms of the hypothesized continuous and dummy variables, respectively. In the econometric part, bivariate probit model was used to identify the determinants of households' willingness to pay for soil conservation on communal lands and to compute the mean willingness to pay. The results of the bivariate probit model shows that size of total livestock holding, perception of communal land soil erosion problem, credit utilization, frequency of extension contact and farm size near to communal land have a positive and statistically significant effect on households' willingness to pay for communal land soil conservation, while dependency ratio, migration, participation in off-farm activities and initial starting bid have a negative and significant effect on WTP. Hence, overcoming those negative factors and encouraging the positive factors can enhance farmers' willingness to pay for communal land soil conservation practice. For instance, the positive significant effect of frequency of extension contact infers the need of intervention to enhance the frequency of farmers contact with development agents. Besides, migration is found to be one of the hindering factors for willingness to pay. The mean willingness to pay result from the double bounded format revealed that the sampled households are willing to contribute a mean of 47.526 labor-days per year. Besides, the aggregate benefit that results for the community of the study area by conserving the communal lands soil was estimated to be 2,262,386 .83 labor days per year which is equivalent to 135,743,209.8 birr per year. The estimated values are indicative of the WTP potentials of the local community and hence designing a bottom-up approach of intervention might work better.

***Keywords**: Raya kobo Woreda, communal land, WTP, CVM, DBDC and Bivariate probit*

1. INTRODUCTION

1.1. Background of the Study

The degradation of natural resources is among the main problems facing human beings all over the world. Soil loss due to erosion, depletion of surface and ground water and loss of biodiversity are among the principal global environmental problems (Lal, 2001; Pimentel, 2006). From a global perspective, the effect of soil erosion, in particular, can seriously affect agricultural production, and the well-being of small-scale farmers. This, in turn negatively affects the national economy (Scherr, 2000; Chappell *et al.*, 2010). These studies confirm that soil erosion results in the loss of an important natural resource and any negligence to control it now will enlarge investment in soil conservation measures for the future.

The economic development of Africa, more than any other continents, depends on the development of the agricultural and agro-industry sectors, which are primarily affected by the productivity of land resources so that the depletion of natural resource in these countries matters significantly. This is particularly true for sub-Saharan Africa where agriculture is the main contributor to the majority of their gross domestic product (GDP) and it is the main source of income and employment (Henao and Baanante, 2006). As a result, one of the main policy concerns of governments in these countries nowadays is to achieve sustainable development that fulfills both economic and ecological objectives (Girmay, 2006). Sound policies and investment strategies are key contributors to the joint goals of increased agricultural production, food security, economic development, land conservation, and environmental protection (Henao and Baanante, 2006). However, these policies cannot be attained if the local communities' participation is given little emphasis.

Like most of the African countries, agriculture is a key sector for Ethiopia. The sector plays a central role in the livelihoods of most Ethiopians, where about 12 million smallholder farming households account for an estimated 95 percent of agricultural production and 85 percent of all employment (FAO, 2018). It also accounts for 85% of the national export earnings (UNDP, 2016).

Because agriculture is the main engine of economic development of the country; and exports are almost entirely on the agricultural commodities depletion of soil, water, and vegetation resource bases will have adverse impacts on agriculture and other sectors of the economy (Daniel, 2002; Wogayehu, 2003; Aklilu and de Graaff, 2006). Particularly, soil erosion by water remains to be the most important factors and poses an ominous threat to the nation's future food security and development prospects (Wogayehu and Drake, 2003). The effect of erosion is also severing in the livestock sub-sector.

Ethiopia has the largest livestock population in Africa and the livestock sub-sector is an important and integral component of the agricultural sector. However, the contribution of the sub-sector to the country's economic growth and development remains far below its potential due to the fact that communal grazing lands have been severely degraded (Berhanu *et al*., 2001). As communal grazing lands are a source of livestock feed in rural Ethiopia, its conservation is a serious issue for the productivity of the livestock sector (Wolde *et al*., 2011). Moreover, communal lands are one of the vital land uses that connect the different patches of church forests, farmlands and have significant contributions to minimize habitat fragmentation and improve the conservation of biodiversity if they are conserved properly (Dagninet *et al*., 2016). Hence, sustainable management of communal lands in Ethiopia is crucial to sustain livestock productivity as well to reduce the loss of ecosystem services and minimize habitat fragmentation in the biosphere (Dagninet *et al*., 2017).

In Ethiopia, indigenous soil and water conservation (SWC) practices are poorly recorded and not considered by soil and water conservation experts and policymakers. Conservation practices have mainly been undertaken in a form of a campaign (top-down approach) and quite often farmers have not been involved in the planning process (Paulos *et al*., 2004; Berhanu 2004; Mitiku *et al*., 2006). This shows that lack of importance given to farmer's knowledge and perception towards soil and water conservation is a major factor responsible for the failure of conservation programs. The United Nations Convention to Combat Desertification (UNCCD, 2015) report released the necessity to integrate both scientific and local knowledge in the recent special mission. This can be achieved when the local communities are allowed to participate in designing of soil and water conservation programs.

Currently, the government of Ethiopia had implemented a 30-day national SWC based watershed management campaign program which is targeted on both communal lands and farmlands, which is started in 2010/11 and expected to continue. Although these programs may be designed to maximize environmental conservation objectives, non-consultation of the affected population (did not consider the willingness and ability to work of farmers) during the designing phase and the lack of a more integral approach may reduce the potential for success. Thus, examining the willingness of the local farmers may lead to better achievements.

In the study area, communal lands have a significant role for livestock grazing, erosion control for their home and farmlands, for collecting firewood, cutting farm equipment and fence for their farm. However, the valuable communal lands are severely being affected by soil erosion so that it would be hard to get these benefits. To protect these vital resources from further degradation, appropriate conservation strategy must be put in place. Therefore, if better records in SWC on communal lands is needed for the future which is both socially acceptable and economically sustainable, an improved planning methodology is required that includes a procedure for eliciting information on farmers' indigenous knowledge and determinants that motivate or hinder for improved communal land soil conservation and the communities value placed on these valuable resources.

1.2. Statement of the Problem

Soil erosion is a common problem in developing countries (Gomiery, 2016). Negative impacts of technical change, inappropriate government policies, and poor institutions are largely responsible for the continued soil erosion in developing countries (Ananda and Herath, 2003). In African countries, land is being used without conservation measures and it results in a continued degradation of soils. Consequently, it would mean a future of increased poverty, food insecurity, environmental damage, and social and political instability (Henao and Baanante, 2006). About 60-70% of the population in the rural areas of Sub-Saharan Africa depends on agriculture to earn a livelihood but soil erosion has an enormous negative impact on agriculture of those countries (Loulseged and McCartney, 2000). The problem has far-reaching economic, political, social and environmental implications because of both on-site and off-site damages (Grepperud, 1995).

Like many other production factors, soil requires conservation measures to protect it from progressive degradation and maintain its productive capacity constant. In Ethiopia, soil erosion and its consequence belong to more serious problems (Kebede, 2014). Despite the fact that agriculture is the main sector of the country, the sector is seriously affected by unsustainable land management practices that resulted in a declining agricultural production and increased poverty and food insecurity (Musa *et al.*, 2015). In the study area, farming and livestock production are the major sources of income for the rural farmers. However, the valuable soil resource on the communal land and farmlands is being removed by soil erosion. Consequently, it is contributing to poor livestock production due to lack of pasture grass to feed on, loss of grazing land and poor bush re-growth and it also results in a poor crop production due to offsite effects. Meanwhile, most of the communal lands are mountainous and found in the upper part of the farmlands. As a result, during rainy seasons eroded soil from the communal lands deposited down to the farmlands that bring the off-site effect of erosion such as delay emerging of seed and seedling and necessitates replanting in the affected areas. Additionally, soil erosion on communal lands creates huge sediment and these sediments deposited down and contribute to damage of irrigation canals and roads. Thus, it will create an additional cost for the community.

When farmers' ownership of land is well-established through property rights or land tenure arrangements, and there is a functioning market for agricultural land, farmers internalize costs associated with loss of the land's productive capacity (Henao and Baanante, 2006). With well-defined property rights, bargaining and trading will occur amongst the property owners and a Pareto optimal solution with the optimal level of erosion will be achieved (Coase, 1960). However, many literatures argue that private property rights are not the only ways that help arrest communal resource degradation rather they should be used sustainably by farmers through collective action and social capital (Ostrom, 1990; Sandler, 1992; Runge, 1992; Bromley, 1992.; McKean, 1992; Agrawal, 2001; Dietz *et al.*, 2003; Araral Jr, 2009; Moritz *et al*. 2013). However, the existing empirical studies which are done on common resource have focused mainly on communities as opposed to households in describing the success of common good management (Bhim, 2003).

Effective collective action for communally used resource management necessitates that the beneficiaries prepare and agree to arrange for financial, labor or other contributions required for the management of the resource (Berhanu *et al.*, 2001). Government policy would encourage popular participation where the role of the government is limited to observer, facilitator or regulator (Ananda and Herath, 2003). In the study area, communal lands have been used communally for many years. Hence, establishing a well-defined property right for each household or making a total area closures system by the state might not be achieved in the short term. Thus, the sustainable management of these communal lands requires the participation of local communities, who are the existing owners.

There are plethora of valuation literatures in Ethiopia regarding farmers' general willingness to pay for soil conservation on farmlands (for example, Paulos *et al*., 2002; Gebrelibanos *et al*. 2013; Bamlaku and Yirdaw, 2015; Musa *et al.* 2015). However, these researcher works focused on private farmlands, but asking farmers WTP to value their own private property is not appropriate way in contingent valuation principles. When individuals have some right to a future state of the environment, asking their WTP to secure that right seems inappropriate as a measure of welfare change, whereas their WTA to forego that improvement seems more relevant (Pearce *et al*., 2006). Recognizing this evidence, using farmers WTP to value their own private farmland may lead a biased parameter and welfare results. In addition, different land types give a different economic benefit for the farmers so that farmers' might have different willingness to pay for those different lands. Hence, the determinant factors which influence the willingness of farmers for farmlands soil conservation might be different from the determinant factors which affect the willingness of communal land soil conservation. To the best of the researcher's knowledge, only limited studies were carried out on investigating the farmers' WTP for communal land soil conservation at *woreda* level (Belay, 2015 and Dagninet *et al*., 2017). Consequently, there is inadequate empirical evidence regarding farmers' willingness to pay for the conservation of communally used lands and the welfare gain from the conservation of these resources. Therefore, further research on ascertaining the preferences of farmers for such communal land in Raya kobo *woreda* is needed. Therefore, this study was initiated towards narrowing this gap of knowledge.

1.3. Research Questions

This research answered the following basic research questions:

1. Are households willing to pay for soil conservation on communal lands and how much they are willing to pay?
2. What are the factors that influence households' willingness to pay for soil conservation on communal lands?
3. How much is the aggregate welfare gain of the proposed communal land soil conservation practice in the study area?

1.4. Objectives of the Study

1.4.1. General objective

The general objective of the study was to identify the determinants of household's willingness to pay for soil conservation practice on communal lands and to estimate the aggregate welfare gain of the proposed conservation program.

1.4.2. Specific Objectives

This study specifically aimed to address the following specific objectives

1. To examine the willingness to pay characteristics of households and identify the determinants of willingness to pay for soil conservation practices on communal lands.
2. To estimate the welfare gain of the communal land conservation program in the study area.

1.5. Significance of the Study

So far, government projects undertaken in the country on soil and water conservation activities were not based on valuation studies. As a result, conservation structures were not sustained, and soil erosion still becomes a severe obstacle for the growth and development of the country. Hence, formulation of conservation projects which is based on the willingness of farmers from the very beginning is useful for the sustainability of the conservation programs.

Therefore, the output of this study is expected to be significant in providing relevant information regarding the willingness of farmers for the proposed project, their determinants and the aggregate welfare benefit of the conservation program on the community of the study area. As a result, a policy can be implemented based on the farmers WTP and conservation process can be enhanced by targeting those factors. Moreover, this study provides information to policymakers, project evaluators and the community around the research area that will enable effective measures to be undertaken to protect the communal lands from severe degradation, which are happening in the study area. Finally, the effective performance of this study is essential to provide secondary data to other researchers to conduct further research on this and related issues.

1.6. Scope and Limitations of the Study

The study was limited to examining the households' willingness to pay for soil conservation on communal land in Raya Kobo *woreda* by using contingent valuation method. The study has some limitations. The study employed only contingent valuation method via WTP. So, a further research can be done by employing other non-demand curve and cost based techniques (replacement cost, opportunity cost) that can examine the costs associated with the conservation of communal lands. There would be also the occurrence of bias in setting the initial bids; indeed efforts were devoted to minimize it. Furthermore, the researcher did not saw the institutions and regulations the community will take for the successful complementation of the conservation program. Hence, a further research can be done by assessing the regulations the community will desire so that it would facilitates the inclusion of the needs and priorities of the different groups of the community and avoids conflicts. Finally, the study was limited in time, area, objective and sample size. Even though these limitations were faced, the researcher has tried to come up good outcome from the study.

1.7. Organization of the Thesis

The forgoing chapter presented the introduction of the study. The rest of the thesis is organized as follows. Chapter two presents the literature review. In this chapter, definition of concepts and terms, economic valuation of soil, economic valuation techniques, the theory of welfare change, the theoretical framework for environmental valuation and empirical findings of previous works were reviewed. The third chapter outlines the research methodology used in this study. In this chapter, overview of the study area, sampling procedure, the method of valuation technique, the CVM elicitation methods, the methods of designing the CVM scenario, methods of data collection and data analysis as well as variable definition and hypothesis are discussed in detail. Chapter four presents the descriptive and econometric results of the study. This chapter presents the results related to factors influencing determinant of households WTP for communal land soil conservation, aggregate welfare gain of the proposed conservation program and the communal land soil conservation strategies preferred by sampled households. The final chapter concludes the study and presents the policy implications drawn from the study.

2. REVIEW OF LITERATURE

The purpose of this chapter is to provide background information on definition of concepts and terms, the economic value of soil resource, the economic valuation techniques of non-marketed environmental goods and services, the theory of welfare economics and empirical findings of previous studies on households' willingness to pay for natural resource conservation and households' adoption decision for SWC practice. The reviews are presented as follows.

2.1. Definition and Concepts of Terms

Land degradation: It is defined as 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 (Nkony *et al*., 2011). Land degradation is the result of complex interactions between physical, environmental, biological, socio-economical, and political issues of local, country wide or global nature. The causes of land degradation can be grouped into proximate and underlying factors. Some of the proximate causes of land degradation include cultivation of steep slopes and erodible soils, low vegetation cover of the soil, burning of dung and crop residues, declining fallow periods, and limited application of organic or inorganic fertilizers. The underlying causes of land degradation are those factors that indirectly affect the proximate causes. Some of the underlying causes of land degradation include population pressure; poverty; high costs or limited access of farmers to extension service, infrastructure, fuel and animal feed; insecure land tenure; limited farmer knowledge of improved integrated soil and water management measures; political instability and limited or lack of access to credit (Berhanu, 2004). The 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 (Nkony *et al*., 2011).

Soil degradation: It is defined as a long-term decline in soil's productivity and its environment moderating capacity. In other words, it means decline in soil quality, or reduction in attributes of the soil in relation to specific functions of value to humans (Doran and Jones, 1996). Causes of soil degradation are the agents that determine the rate of soil degradation. These are biophysical (land use and soil management, including deforestation and tillage methods), socioeconomic (land tenure, marketing, institutional support, income and human health), and political (incentives, political stability) forces that influence the effectiveness of processes and factors of soil degradation (Lal, 1997). In most cases, the term land degradation and soil degradation used interchangeably. However, as it is defined earlier land degradation is much broader than soil degradation and the effects of land degradation are more complex than the effects of soil degradation.

Soil erosion: It is the wearing away of the land surface by physical forces such as rainfall, runoff water, wind, ice, temperature change, gravity or other natural or anthropogenic agents detach and remove soil or geological material from one point on the earth's surface to be deposited elsewhere (Jones, 2007). Soil erosion by water constitutes a threat to the maintenance of the subsistence living of the Ethiopian rural population (Woldeamlak and Sterk, 2002). The main effects of soil erosion include reduction of soil depth, removal of soil organic matter, removal of essential soil nutrients, and depleting the water holding capacities of soil which cumulatively lead to a decline in agricultural production (Aklilu and de Graaff, 2006).

Soil Conservation: It is the protection of soil from erosion and other types of deterioration, so as to maintain soil fertility and productivity. In Ethiopia, the soil conservation measures that can be applied in communal lands can be physical or structural measures (terraces, hillside terrace, stone bund, check dam etc), biological (tree planting) and area closure methods.

Valuation: It is an attempt to put monetary values to non-marketed goods and services through direct or indirect methods. Both methods derive from the fact that markets do not exist for the environmental services, due to non-excludability and/or non-rivalry nature of the good. The indirect approach involves recovering estimates from the observed behavior of individuals in regard to marketed commodities; the direct approach involves asking individuals questions relating to the affected environmental services (Perman *et al*., 2003).

Willingness to pay: It is the maximum amount of income or labor day a person will pay in an exchange for an improvement in circumstances, or the maximum amount a person will pay to avoid a decline in circumstances (Haab and McConnell, 2002; Freeman *et al*., 2014).

Willingness to accept: It is the minimum amount of income a person will accept in an exchange for a decline in circumstances, or the minimum amount a person will accept to forgo a decline in circumstances (Haab and McConnell, 2002; Freeman *et al*., 2014).

2.2. Economic Valuation of Natural Resources

For marketed goods and services the price of the good which is determined by the force of demand and supply can be used as the value an individual attaches to that particular good. Hence, prices of the good are taken an expression of the willingness to pay for the good, which is the total value the buyer has for the good. However, for most environmental goods and services markets are missing due to the non-excludable or non-rival nature of the goods. Even though a market exists for some environmental goods, the existed markets are not perfect so that the price of the good do not fully capture the preference of the individuals (Hanemann, 1994). Thus, it leads the emergence of non-market valuation and it is necessary in order to have a sound policy for the conservation and the damage assessment of these non-marketed environmental goods.

The aim behind the valuation of resources is how much utility in terms of market consumption individuals are willing to give up in order to obtain the utility they expect from the public good. The results have an interesting advantage for welfare estimation and resource allocation based on Pareto improvement criteria (Haab and McConnell, 2002). Besides, estimating and knowing the economic value of natural resources can provide an effective means of regulating the demand resource and providing incentive for sustainable management (Mamat *et al.*, 2013); due to its ability to estimate the non-use values it can also be used to avoid “the tragedy of the commons” (Tao *et al*., 2012). The attitudes of people concerning communal land conservation affect their behavior, and valuing this is important in involving local people in conservation planning and decision-making processes (Yibeltal, 2015). However, determining the value of an individuals or groups use of soil is extremely difficult unless efforts are made to understand the reason why community’s value soils on their communal lands.

The classification of different values of soil begins with the concept of total economic value (TEV). The total economic value of soil resource is the summation of its use and non-use values. The theoretical framework for total economic value of soil conservation is depicted in figure1.

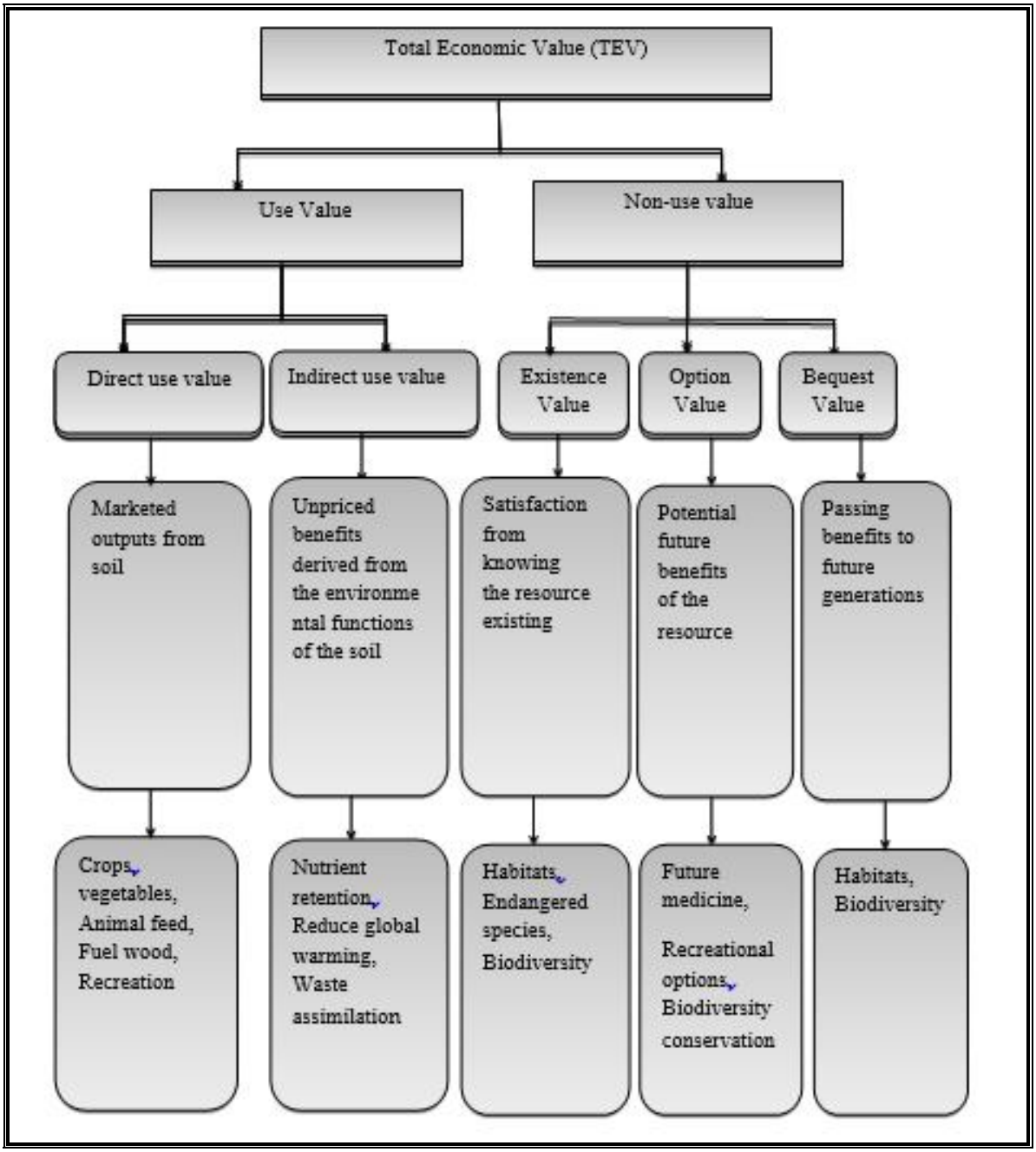

Figure 1. Components of total economic value of soil resource.

Source: Adopted from Marcouiller and Coggins (1999), with little modifications

The economic concept of value is based on ability of goods and services to satisfy human wants and needs. As illustrated in figure 1, the total economic value of soil is divided in to use value and non-use value. Use value includes direct use and indirect use value whereas none use value includes option value, existence value and bequest value.

Use value: By definition use value derive from the actual use of a resource and it includes direct and indirect use value. Direct use value refers to the most obvious value category, as the economic benefits can be calculated by making use of market information. One aspect of soil's use value comes from the direct production of goods and services and support of livelihood. For instance, direct use of soils includes its role for crop production, for fuel wood and for animal feed. Indirect use value refers to those in which soil is not directly used to produce goods and services rather it relates to functional benefits. The outputs provide a social benefit from ecosystem functioning like waste assimilation, water storage, and carbon storage. Hence, by protecting the soil from erosion a household may maximize these benefits.

Non-use value: Unlike use value, non-use value is not based on the actual use of a resource; rather it is predicted on the view that people appreciate a resource when they are not actually using it. It includes existence value, option value, and bequest value. Existence value arises from the knowledge that the service exists and will continue to exist, independently of any actual or prospective use by the individual. The utility derived does not depend on any direct or indirect interaction with the resource or good in question (Portney, 1994; Perman *et al*., 2003). The second part of non-use value is option value. It is the value placed on individual willingness to pay for maintaining an asset or resource even if there is little or no likelihood of the individual ever using it, occurring because of uncertainty about future supply and potential future. Provided the uncertainty concerning future use is an uncertainty relating to the "supply" of the environment, economic theory indicates that this option value is likely to be positive (Bateman and Turner, 1992). The third category of non-use value is bequest values. It is value placed by individuals on environmental resources, which might be passed to future generations. These values are said to arise from a sense of stewardship or responsibility for preserving certain features of natural resources and a desire to preserve options for future use by others.

Bequest value is distinct from option value because it does not preserve an individual's option to use a resource; rather it deals with preserving the use of the resource for later generations (Marcouiller and Coggins, 1999). An example of bequest value occurs when farmers consciously protect their communal land from erosion in order to transfer a productive soil for their coming generations.

Generally, estimating the economic value of soil involves understanding and realizing that farmer's soil value in different ways. Through this understanding, the researcher would try to incorporate the different values of soil in the CVM scenarios so that it would help for better economic valuation of farmers for their communal lands.

2.3. Economic Valuation Techniques

The ordinary market system cannot efficiently allocate public goods or environmental resources with pervasive externalities, or for which property rights are not clearly defined. The principle that public goods and services with externalities are not efficiently allocated by the market suggests the possibility of improvement by public action (Haab and McConnell, 2002). Hence, the public's demand for these goods can be done by a technique called non-market valuation technique. Approaches to non-market valuation can be generally divided into those that attempt to estimate a demand curve for each of the resource's uses and non-uses, and those that estimate a production function linking environmental quality to changes in production relationships or estimate the cost of various regulatory or preventative actions. The production function approach cannot indicate how much the communities are WTP for the improvement or WTA to prevent losses occurring on a resource. As a result, this method is not regarded as sufficient measures of consumer welfare. The demand curve approach is generally considered the better of the two approaches (Robinson, 2001).

The demand curve approaches includes the revealed preference (RP) and stated preference (SP) techniques. Both techniques can be used to estimate the value of non-marketed goods and services, like communal lands in the present study case. However, these methods are different in their way of valuation and the standard distinction among them is based on the source of the data (Mitchell and Carson, 1989).

The data can come either from observations of people acting in real-world settings or from people's responses to hypothetical questions of the form "what would you do if the communal lands soil in your village is protected from erosion?" or "how much of your labor time or money would you be willing to pay for the improved communal land conservation in your village?" It is common in the literature to refer to these as the revealed preference and stated preference methods, respectively (Freeman *et al*., 2014).

2.3.1. Revealed preference techniques

Revealed preference techniques rely on deriving the costs and revenues from surrogate or related markets. Consumer behavior in the related market provides an indication or reveals consumer preferences for the non-marketed environmental resource (Commonwealth Government, 1995). The two most well-known revealed preference methods are the travel cost method and hedonic pricing method (Alpizar *et al*., 2001). The travel cost method was designed to model recreation behavior determines site use by examining the time and travel expenses that people incur when visiting a recreation site. The cost of traveling is a complement to visit to recreation site (Garrod and Willis, 1999). Hedonic pricing method is used to estimate the willingness to pay for variations in property values due to the presence or absence of specific environmental attributes, amenity service of the environment and access to infrastructure. This method is mostly used to estimate the housing market so that it also known as the house price method (Taylor, 2003). For instance, by observing the price differential between two houses that vary only by one characteristic (one is near to the forest than the other), it is possible indirectly to observe the monetary trade-offs individuals are willing to make with respect to the changes in environmental quality due to the forest. As such, the hedonic method is an indirect valuation method in which it is not possible to observe the value consumers have for the additional characteristic directly, but infer it from observable market transactions.

2.3.2. Stated preference techniques

Stated preference methods use survey techniques to elicit individual's willingness to pay for a marginal improvement or for avoiding a marginal loss that occurs in marketed goods (Bromley, 2012). Stated preference method assesses the value of non-market goods by using individuals' stated behavior in a hypothetical setting. The method includes contingent valuation and forms of conjoint analysis such as contingent rating, contingent ranking, paired comparisons and choice experiment (Robinson, 2001; Alpizar *et al*., 2001). Contingent valuation and choice experiment are the most commonly applicable stated preference methods. The choice between contingent valuation and choice experiment depends in part on how much detail is required on the characteristics of the good or effect being valued. CVM will be used for the change in the environmental good or service in total value is needed (which is the case in the present study). On the other hand, choice experiment should be chosen when WTP for changes in individual attributes is required or relative values for different attribute levels of the environmental good (Almansa *et al*., 2012). The two methods detail explanation is given bellow.

I. Choice experiment (CE)

This is a method where individuals are asked to choose between different alternatives, which involve the environment, but where there are no direct questions about valuation. Each alternative is described by many attributes or characteristics. Among these 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). Unlike the contingent valuation method, the choice experiment method lacks direct valuation question. However, the lack of a direct valuation question in CE is both strength and a weakness, relative to CVM. The strength is that people often have a trouble in attaching a monetary value to an environmental good then it may be easier to choose between attribute combinations. A weakness of CE relative to CVM is just it is less direct. When people have a good sense of the value of environmental goods, it is best to ask them directly about this value, in lieu of asking in a circumscribed way.

II. Contingent Valuation Method (CVM)

CVM is mainly developed by economists and is theoretically founded on neo-classical demand theory (Bateman and Willis, 1999; Mitchell and Carson, 1989). CVM requires that individuals express their preferences for some environmental resource, or change in resource status, by responding questions about hypothetical choices (Bateman and Turner, 1992). It is an interview-based direct valuation technique used to estimate social benefits resulting from improvements in the quality of non-marketed environmental goods. These goods can be used directly by the consumer, like, air and water that can be valued by CVM. In addition, CVM can also be used to gauge the existence value of goods such as a preservation of a natural species, soils, and or a wild-life habitat which may confer some indirect benefits (Rox *et al*., 2003).

The main strength of CVM over the other methods is its capacity to capture non-use values, which are very essential for the monetary valuation of non-marketed public goods (Stevens *et al.*, 1994; Hanemann, 1994). For instance existence value of non-marketed goods cannot be measured by direct observation of individuals' behavior, and the only option is direct questioning via surveys (Arrow, 2001).

In this method, individuals are asked about the status quo versus some alternative state of the world. The aim is to elicit information about how the individual feels about the alternative relative to the status quo, and their WTP, if anything, to obtain the alternative (Almansa *et al*., 2012). For instance, farm households will be asked to state their willingness to pay for communal land soil conservation to have an improved communal land soil that will be better than the status quo. The name of the method comes from the behavior of the technique. It is referred to as a "stated preference" method because it asks people directly to state their values to environmental good. It is called "contingent valuation" because the valuation is contingent on the hypothetical scenario put to respondents (Jantzen, 2006). Using contingent valuation method and asking people directly has the potential to inform about the nature, depth, and economic significance of these values (Portney, 1994). Hence, using this method for environmental good valuation may help the analyst to not underestimate the value of the good proposed to be valued.

A. Elicitation methods in CVM

A contingent valuation study could be undertaken using different elicitation methods or method of asking questions. The following are the basic approaches to asking questions that lead directly to willingness to pay or provide information to estimate preferences.

Bidding game: A contingent valuation question format in which, individuals are iteratively asked whether they would be willing to pay a certain amount. The amounts are raised (lowered) depending on whether the respondent was (was not) willing to pay the previously offered amount. The bidding stops when the iterations have converged to a point estimate of willingness to pay or until the individual says "yes" or "no" for the offered bid. Whittington *et al.* (1990) used this method to estimate a water service in developing countries.

Payment card: A CV 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. This approach is criticized because the respondents might limit their announced WTP to the values listed on the card. Hung *et al*. (2007) and Ahlheim *et al.* (2010) used this method to examine households' willingness for forest fire prevention and landslide protection, respectively.

Open-ended question: What is the maximum amount of labor-day or money you would be prepared to pay for improved communal land soil conservation program? This type of question is called "open-ended" since respondent is free to say any amount of labor time or money that they want to pay. It has the advantage to avoid anchor (O'Conor *et al.*, 1999) and save time and expense in the survey process (Almansa *et al*., 2012), but it has also had some problems. For instance, with an oral auction, there are strategic reasons for stating less than one's full value and also the respondent access the difficulty to answer (Hanemann, 1994). Open-ended questions are also subject to a variety of ambiguous responses. For example, individuals protest by responding with zeros or extremely high values (Arrow *et al*, 1993; Haab and McConnell, 2002). Hence, there will be a high degree of individual impreciseness, and responses to open-ended questions will be erratic and finally it makes a biased. Some studies have used this method (Almansa *et al*., 2012; Daginet *et al*., 2017).

Dichotomous or Discrete Choice: A CVM question format in which respondents are asked simple yes or no questions of the stylized form: "Would you be willing to contribute “L” amount of labor day or “B” amount of *birr* to cover the cost of avoiding communal land soil erosion or repairing environmental damage on communal lands?” The dichotomous choice approach has become the presumptive method of elicitation for contingent valuation practitioners. The other three methods have been affected by incentive compatibility problems in which survey respondents can influence potential outcomes by revealing values other than their true willingness to pay (Haab and McConnell, 2002). Unlike the open ended case, in this method there is no strategic reason for the respondent to do other than answer truthfully (Hanemann, 1994). Due to its qualities over the other methods, the NOAA panel guideline recommends this bidding method (Arrow *et al.*, 1993). As a result, this type of bidding mechanism is currently the most applicable method. In Ethiopia, many researchers have used this method (for instance, Gebrelibanos *et al.*, 2013; Bamlaku *et al.*, 2015; Bamlaku and Yirdaw, 2015; Musa *et al*., 2015; Belay, 2015; Gemechisa. 2017).

B. Critiques and bias issues in contingent valuation methods

The conceptual, empirical, and practical problems associated with developing monetary estimates of economic value on the basis of how people respond to hypothetical questions about hypothetical market situations are debated in the economics literature. Although CV is the most frequently used non-market valuation technique for environmental goods and services, it is not without its limitation and debate persists over its reliability (Carson *et al.*, 2001). For instance, preferences for non-use values tend to be less stable, complex questionnaire development and data analysis, budget and time demands are high (Mavsar *et al.*, 2013), responses may reflect the moral satisfaction or “warm glow” derived from contributing the public goods rather than the inherent economic value of those goods (Stevens *et al.*, 1994). Hence, it is believed that these issues may lead to inaccurate WTP estimation. Several individuals and researchers in the area have voiced their opposition by talking the bias issues that make the CV result less reliable. The main bias issues that are commonly discussed in CV literature are presented below.

Strategic bias: It may arise when an individual thinks he/she may influence an investment or policy decision by not answering the interviewer's questions truthfully (Samuelson, 1954). Such strategic behavior may influence an individual's answers in either of two ways. Suppose the farmer is asked how much labor-day he/she would be willing to contribute to have an improved communal land soil. If he thinks the government or donor agency will conserve when the responses of farmers in the village are positive, but that someone else will ultimately pay for the service, he will have an incentive to overstate his actual willingness to pay. On the other hand, if he/she believes the government or donor agency has already made the decision to conserve the communal lands in the village, the farmer will have an incentive to understate his true willingness to pay (Whittington *et al.*, 1990; Carson and Grove, 2007).

Compliance bias: occurs when the interviewer is leading the respondent towards the answer he/she is expecting. This bias can be reduced by carefully designing the survey, good training of the interviewers and good supervision of the main survey (Mitchell and Carson, 1989*)*.

Informational biases: Valuation may depend on how the information about the good and its provision and financing is provided, who makes the interview, what other information the respondents have about a good or incident.

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

Hypothetical bias: It may arise from two kinds of reasons. First, the respondent may not understand or correctly perceive the characteristics of the good being described by the interviewer. Second, it is often alleged, particularly in the context of developing countries, that individuals will not take contingent valuation questions seriously and will simply respond by giving whatever answer first comes to their mind. It reflects the old saying that "there is a difference between saying and doing" (Whittington *et al.*, 1990). However, this type of bias would not be a threat in this study since the farmers are familiar with the type of communal land soil improvement program due to the fact that they were doing similar conservation practice; indeed it was not freely chosen by them. Besides, the bids are randomly distributed without considering the respondents' characteristics.

All the above-mentioned biases can be minimized by a careful designing of the survey, proper training of the interviewer, conducting a pilot survey and monitoring and supervision of the main survey. Therefore, in this study, the researcher took efforts to minimize the above biases by considering these criteria.

2.4. Theory of Welfare Change

Economic values of environmental goods are measured using their effects on human welfare (Mitchell and Carson, 1989). Hence the economic value of environmental goods is measured through their impact and/benefits on the responding individual utilities.

In this study, the farmers are faced the choice between the utility they will drive from the proposed project because of quality improvement on the communal land's soil and the cost (labor time) they will incur to conserve the communal land. From this, it follows that the basis for deriving measures of economic values is based on the effect of the hypothesized program on respondent's wellbeing.

The common way of explaining welfare is based on the Pareto criterion, which stated that policy changes which make at least one person better off without making any one worse off are desirable (Champ *et al*., 2003). According to Haab and McConnell (2002), the idea of a potential Pareto improvement provides the rationale of public intervention to increase the efficiency of resource allocation. That is, if the sum of the benefits from a public action, to whomever they may occur, exceeds the costs of the action, it is deemed worthwhile by this criterion. This allows the calculation of net gain or loss from a policy change, and determination of whether the change is potentially Pareto improving. The gains from changes in environmental quality can be derived from the effects in individuals' welfare. According to Freeman *et al*. (2014) changes in environmental or public goods can affect people's welfare in any of the following different ways. Firstly, such changes can affect individuals through the prices they pay for the goods in the market. Secondly, it also can affect and cause changes in the prices individuals pay for their factors of production. Thirdly, environmental changes can also affect individuals through changes in quality and quantities of other non-marketed goods. Finally, a change in environmental goods can induce changes in risks individuals face.

In the case of this study, an improvement in communities communal land soil can lower money or labor time spent on market goods such as those for preventing behaviors related to farmlands soil fertility loss by using fertilizer and maintenance for roads damage. The communal land improvement can also lower the price of grass currently used for livestock feeding purpose. The improvement can also lower the price of firewood so that farm households can enjoy any benefit from the conserved communal land. Lastly, the improvement can induce aesthetic of the environment in the community thus improving clean background and clean air which alongside can lower the risk of the community. Recognizing this fact, the effects of this program on the communities' welfare is believed to involve both price and non-price effects.

Different methods can be used to estimate the welfare effect of programs on the responding communities. Conventionally, some studies use consumer surplus (the area under the Marshalian demand curve bounded from bellow by the prevailing price) for decision making in examining welfare change. Consumer surplus is the excess of the price that an individual would be willing to pay rather than go without the thing, over that which he actually does pay (Marshall, 1920). However, for many reasons, this method is not appropriate for non-marketed goods. The critical reason for this is that the Marshallian measure holds income constant, whereas for a true measure of welfare change it is welfare (utility, wellbeing) that needs to be held constant (Perman *et al*., 2003; Pearce *et al*., 2006). It is a partial equilibrium analysis so that it does not take account of the general-equilibrium consequences of the actions whose effects are being studied (Harberger, 1971). The absence of a price for environmental or public goods makes them untraded as they do not have private property characteristics. Therefore, one cannot directly observe the price and other information required to estimate the Marshallian demand curve (Bateman and Turner, 1992). Due to these limitations, the welfare's change measurement using consumer surplus may be undermined. Therefore, it is important to use a more accurate welfare measure that is free from this vagueness. Accordingly, to address this vagueness, Hicks (1941) developed four measures of welfare change, which do not require such restrictive assumptions. These are the ideas of compensating variation and equivalent variation (EV) and the ideas of compensating surplus (CS) and equivalent surplus (ES). They measure the same phenomenon that is the increment in income that makes a person indifferent to an exogenous change.

The change might be price change or a quality change (Perman *et al*., 2003). The surplus measures are appropriate for environmental programs that involve change in either quantities or qualities (Lankford, 1988; Breslaw and Smith, 1995), whereas the variation measures are for change in price of non-marketed environmental goods and services (Freeman *et al*., 2014). Quantity-based welfare measures are relevant when dealing with situations where there are constraints on quantities. Price-based welfare measures, in contrast, are useful where there are well-functioning competitive markets such that quantities are fully adjusted (Kim, 1997).

The CS for an environmental improvement is the maximum sum of money (labor) the individual would be willing to pay rather than do without the improvement. This sum is the amount of money (labor) that would make the individual as well off with the improvement as without it, while keeping the money to spend on other things. The CS for an improvement is also known as willingness to pay. The definition of ES is just the opposite of CS. The ES for an improvement it is also known as willingness to accept (WTA) compensation. However, the choice of these methods (WTP/WTA) for welfare measure depends on the value judgment concerning which underlying distribution of property rights is more equitable (Champ *et al*., 2003). Similarly, EV is the amount of money that an individual would be willing to pay to forgo an exogenous change to make him/her as well off as she/he would have been had the change occurred. On the other hand, compensating variation is the amount of money that an individual would need to be paid after an exogenous change for him/her to be just as well off as she/he would have been had the change not occurred (Freeman *et al*., 2014).

The principal difference between these four welfare measurements is the position that is taken as the reference point for welfare measurement. CV and CS are measures of the gains or loss which hold utility constant at the initial level, while EV and ES are measures of welfare change which hold utility constant at some specified alternative level (Gebrelibanous, 2012). It that follows the choice of these methods depend on policy interest in the potential benefits as measured from consumers current or initial level of utility. The aim of this study is a welfare gain through an improvement in communal lands soil (stay at the initial level of utility) so that CS or WTP method is the appropriate method. Hence, for the present study, the farmers' willingness to pay (WTP) or CS for the hypothetical program would be used to estimate the welfare gains of the program and the aggregate demand curve.

2.5. Theoretical Framework of Environmental Valuation

Any economic valuation of environment aiming at addressing the question whether a given household is better off after changes in environmental quality caused by a given intervention must follow two steps. First, individual welfare changes of all people potentially affected by the program in question must be assessed and, second, these individual welfare changes must be aggregated to compute the resulting change in social welfare (Ahlheim *et al.,* 2010). It follows that, estimating willingness to pay from the sampled household is a good method to determine whether individuals are in favor of the proposed program or not. WTP can be derived either from the expenditure function or from the indirect utility function. However, deriving from the indirect utility will be easy since the utility level is not directly observable and cannot be known from the expenditure function.

The individual welfare change can be measured from simple random utility theory following Yu and Abler (2010*)*. For this study, labor contribution is used as a measure for communal land valuation. If the indirect utility function for a respondent is given by $v(p, q^*, l)$ given labor endowment of the household *l,* soil conservation quality ***q**** and an exogenous price vectors p. If the respondent decides not to protest and participate in bidding, and she/he is willing to contribute some labor $t(t \geq 0)$ for improving soil conservation quality (e), the indirect utility function can be represented by $v(p, q^* + e, l - t)$. Under the market equilibrium, the indirect utility function becomes;

$$v(p, q^*, l) = v(p, q^* + e, l - t) \tag{1}$$

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

$$v(p, q^* + e, l - t \approx v(p, q^*, l) + \frac{\partial v(p, q^*, l)}{\partial q^*} e - \frac{\partial v(p, q^*, l)}{\partial l} t \tag{2}$$

Combining equation (1) and (3), we have

$$WTP = t = \frac{\partial v(p, q, l) \ / \partial q^*}{\partial v(p, q^*, l) \ / \partial l} e \tag{3}$$

Equation (3) indicates that WTP may be zero for some person when his/her marginal utility of soil conservation quality $\partial v(p, q^*, l) / \partial q^*$ is zero, or when the marginal utility of labor endowment $\partial v(p, q^*, l) / \partial l$ tends to infinity. Those who have a zero-marginal utility of environmental quality implying that they do not care about environmental quality, or those who have very large marginal utility of labor implying that they are relatively faced with shortage of labor, would bid a zero WTP, which are valid zeros.

2.6. Empirical Studies on Valuation of Natural Resources through CVM

This section tried to present the valuation studies identified by previous researchers through CVM. Several empirical studies have been conducted on the willingness to pay of households' for natural resource conservation activities in Ethiopia as well as elsewhere in the world. Some of the reviewed studies are presented as follows.

In examining households willingness to pay for natural resource conservation through a contingent valuation approach, past studies used different econometric models such as logit, probit, ordered probit, Tobit, bivariate probit and Heckman two stages. For instance, Almansa, *et al*. (2012) who conducted a study on the economic evaluation of erosion control projects in Almería, Spain used a Tobit regression model. Their model output showed that; membership of household whose income is related to livestock sector, material damage in the last significant flood and age of the respondent affects WTP negatively, whereas gender and household income was found to be the main factors that affect WTP positively. They calculated the net annual benefit based on the mean willingness to pay and it was estimated to be 506,797£ per year. Moreover, the researchers compared the environmental value by using CVM and other non-demand curve approach. Their comparison shows that the internal rates of return estimated from CVM and RCM (replacement cost method) are 5.23% and 2.25% respectively. They indicated that the project meets the profitability criteria in the CVM case but not in the RCM. From this, it can be concluded that CVM are relatively useful tool for estimating the cost benefit analysis of environmental projects than other non-demand curve approaches.

Kong *et al*. (2014) used CVM to examine the determinants of farmers' WTP and their payment levels for ecological compensation of the Poyang Lake Wetland in China. Due to the presence of bias in their sampling procedure, they used Heckman's two-step econometric model to correct this sample selection bias. Besides, they used open-ended CV data so that there would be the probability of having zero WTP responses and Heckman two-step model was appropriate to avoid this disturbance on zero WTP responses.

Their finding indicates that, among the total sampled farmers they had survey, 46.58% were found to have a positive WTP with their average annual WTP being $64.3 per household, whereas the remaining 53.42% were not willing to participate in the proposed conservation program. From their probit model result they revealed that, the source of income, residential location, emphasis on improvement of wetland resources, arable land area, and contracted water area was the influencing factors that significantly influence farmers' WTP. In addition, their result from the multiple liner regression model showed that household income, residential location, arable land area, and contracted water area was significant factors that affect the farmers' payment levels.

Gulati and Rai (2015) used a CVM approach to examine farmers' willingness-to-pay towards soil and water conservation measures in agro-ecosystems of Chotanagpur Plateau, India. They used a logistic regression model to determine what factors are significantly determines a farmers' decision to participate. The results from the logit model indicated total income, qualification off-farm income, and previous irrigation farming experience were found to have a strong positive influence on WTP through cash payment, while the respondents WTP through labor-day contribution showed strong negative influence by age, qualification, dependency ratio, market access and livestock holding. Besides, the willing households of the area could generate US$1302.2 and/or 1207 labor days monthly. Amusa *et al*. (2015) was the one who investigated the determinants of willingness-to-pay for agronomic soil conservation practices among crop-based farmers in Ekiti State, Nigeria. To analyze their data they used binary probit model and factor analysis.

From their probit model result, the socio-economic attributes of the farmers that significantly influenced their willingness to pay for agronomic soil conservation measures include: age, education, farming experience, farm size and household size. On the other hand, inputs, finance, institutional challenge and environmental factor were found to be the factor constraints undermining effective application of agronomic soil conservation measures by crop-based farmers.

Dagninet *et al.* (2017) employed CVM to examine the willingness and participation of local communities to manage communal grazing lands Dera Woreda, Ethiopia. They employed a Tobit regression model and open-ended bidding mechanism was applied to elicit the respondents WTP responses. The researchers used both cash and labor as a vehicle mechanism to determine for which contribution (cash or money) households are more willing and to examine their respective determinant factors. However, their result indicated that most of the respondents were willing to contribute labor. This could be due to the fact that in rural areas households are face with budget constraint so that they would be less willing for cash contribution. Their Tobit regression result revealed that total livestock holding and credit were the factors which significantly and positively affect households' willingness to contribute labor. They also observed a negative and significant relation between formal education level and households' willingness to contribute cash. This result is contrasted with what has been said by Yibeltal (2015) and Gemechisa (2017). Furthermore, they also found a negative and significant relation between extension service and households' willingness to contribute labor and this result is incoherent with what has been said by Abera and Desale (2016). Dagninet *et al.* (2017) related extension service with the benefit it will result to shift for other activities. According to them the negative relationship between extension service and willingness to contribute labor was due to the fact the engagement of households in different agricultural activities that resulted from the benefit extension services.

Musa *et al.* (2015) examined farm households' willingness to participate in soil conservation practice in Arsi Negele, Ethiopia. They used a contingent valuation method with double-bounded dichotomous choice with an open-ended follow-up format. Tobit regression model was applied to examine the determinants of households WTP.

The results from the Tobit regression model suggested that education level of the household head, initial bid, income, labor shortage, number of days spent on holiday and social ceremony were important factors influencing the willingness to participate in soil conservation practices. Hence, their result revealed that education would help households to perceive the problem conservation as well the benefits from the conservation as a result it would encourage willingness to pay. They also calculated mean willingness to participate in soil conservation practices from the open ended format and it was about 25-person days per annum per household. Furthermore, the total aggregate value of soil conservation was computed to be at 975622.73-labor days.

A research conducted by Gebrelibanos (2012) used CVM to study households' willingness to pay for soil conservation practice in Adwa Woreda. The researcher used double-bounded dichotomous choice with an open-ended follow-up question. He used a probit regression model to identify the determinant factors for farmers WTP of soil conservation and bivariate probit model to estimate the mean willingness to pay. His probit model result indicated that age, sex, education, farm size, the perception of soil erosion, initial bid, tenure security and total livestock units, were the significant factors that explain households' WTP. The mean WTP estimated from the bivariate probit model was found to be 56.65 labor days per year and it is more than double compared to the mean WTP value what Musa *et al.* (2015) have got. The reason for this large discrepancy might be because of the Adwa Woreda is the most degraded and erosion-prone areas in Ethiopia as stated by the author in statement of problem part. So, households in this area would be more willing to contribute labor to minimize the severity of erosion. However, it seemed that Gebrelibanos (2012) had used a wrong econometric model which might leads lose in efficiency of parameters. From their bivariate probit model result, they found that Rho (ρ) is positively and significantly different from zero at less than 1% probability level; implying that there is a positive correlation between the two WTP responses. In this case, bivariate probit was an appropriate model than independent probit (Haab and McConnel, 2002).

Abdirahman (2014) employed bivariate probit model to assess farmers' willingness to pay for rehabilitation of degraded natural resources in watershed projects in Dejen *woreda*, Ethiopia. His study claimed that age, fertilizer expenditure, education, and land per capita were the main factors that determine the farmers demand for rehabilitation of degraded natural resources. Ayalneh and Berhanu (2012) also employed a bivariate probit model to assess households' willingness to pay for improved water service provision in eastern Ethiopia. Their bivariate probit result revealed that household income, education, sex, time spent to fetch water, quality of water, water treatment practice and expenditure on water have positive and significant effects on WTP for improved water service provision, while age of the respondent has a negative and significant effect.

Belay (2015) conducted a research on farmers' willingness to pay for improved soil conservation practices on communal lands of Kuyu *woreda*, Ethiopia. He used both single and double-bounded dichotomous format to elicit respondents' WTP in terms of labor contribution. He employed probit model to identify the factors which influence farmers' willingness to pay and bivariate probit model to compute the mean labor contribution. His probit model result revealed that sex, education, livestock, income, slope of land, distance to market, perception and frequency of extension contact was the factors which have a positive and significant influence on the probability of farmers' willingness to pay, whereas the starting bid was found to have a negative influence. Furthermore, he computed the mean willingness to pay from the double bounded format and it was calculated to be 85.36 labor days per annum. From an economic policy perspective this mean WTP value revealed that households are willing to contribute 85 of their labor day for the proposed soil conservation program.

In conclusion, the reviewed material on valuation techniques indicated that despite some of the limitation of CVM, it is the widely applied methods for valuation of non-marketed environmental goods and services. In addition, the reviews on the determinants of households' willingness to pay and adoption decision of households for SWC practices indicated that the effect of demographic, socio- economic, cultural, and institutional factors were different in different areas. This indicates that, in order to identify the influence of different factors in different areas; location and resource specific research should be conducted.

3. RESEARCH METHODOLOGY

3.1. Description of the Study Area

The study was conducted at Raya Kobo Woreda, Northeastern part of Amhara National Regional State of Ethiopia (Figure 2). The study area is one of the eight rural districts in North Wollo Zone and lies about 54 Km North to the zonal town Woldia, 189 km South of Mekele and 570 km from Addis Ababa. Raya Kobo is bordered in the North by Tigray Region, in the South by Gubalafto and Habru *woreda*, in the East by Afar Region and in the West Gidan *woreda*. The agro-climatic feature of the *woreda* is tropical as 9.3%, 35% and 55.7% are *Dega*, *Weyna dega* and *Kola*, respectively. The topography of the *woreda* consists of 65% plain and the rest 20%, 6%, 5%, and 4% as mountainous, rugged, gorges and swampy. The principal feature of rainfall in the area is bimodal, characterized by seasonal, poor distribution, and erratic with a mean annual rainfall of 670mm that ranges from 500-850mm. The high amount of intense rainfall during the summer season with their high sensitivity of soils coupled with moderate to steep slopes makes the *woreda* prone to severe erosion. Especially the communal lands in which, neither the government nor the farmers are conserving is severely facing soil erosion (RKWAO, 2015).

In Raya Kobo *woreda*, there are 43 rural and six urban *kebele* administrations. The total population of the Woreda in 2017 is estimated to be 275,981 (138,726 male and 137,165 female). Out of the total population 218,102 (108,737 male and 109,365 female) live in rural areas whereas 57,789 peoples (29,361 male and 28,428 female) live in the urban area of the *woreda* (CSA, 2013). In addition, according to RKWAO (2015) there are 49,841 rural households in the study area. The study area represents an agriculturally potential area with high livestock population density. Mixed farming system is practiced in the area with crop production dominating livestock rearing. Despite the fact that the area is potential for cop production, agricultural productivity is generally low and it is subsistence oriented. Livestock and its product contribute a significant proportion of cash income for households. The livestock population of the *woreda* is estimated as 242621 cattle, 32602 sheep, 118375 goats, 13863 camel, 21611 donkey, 674 mule, 44 horse and 156126 poultry (RKWAO, 2018).

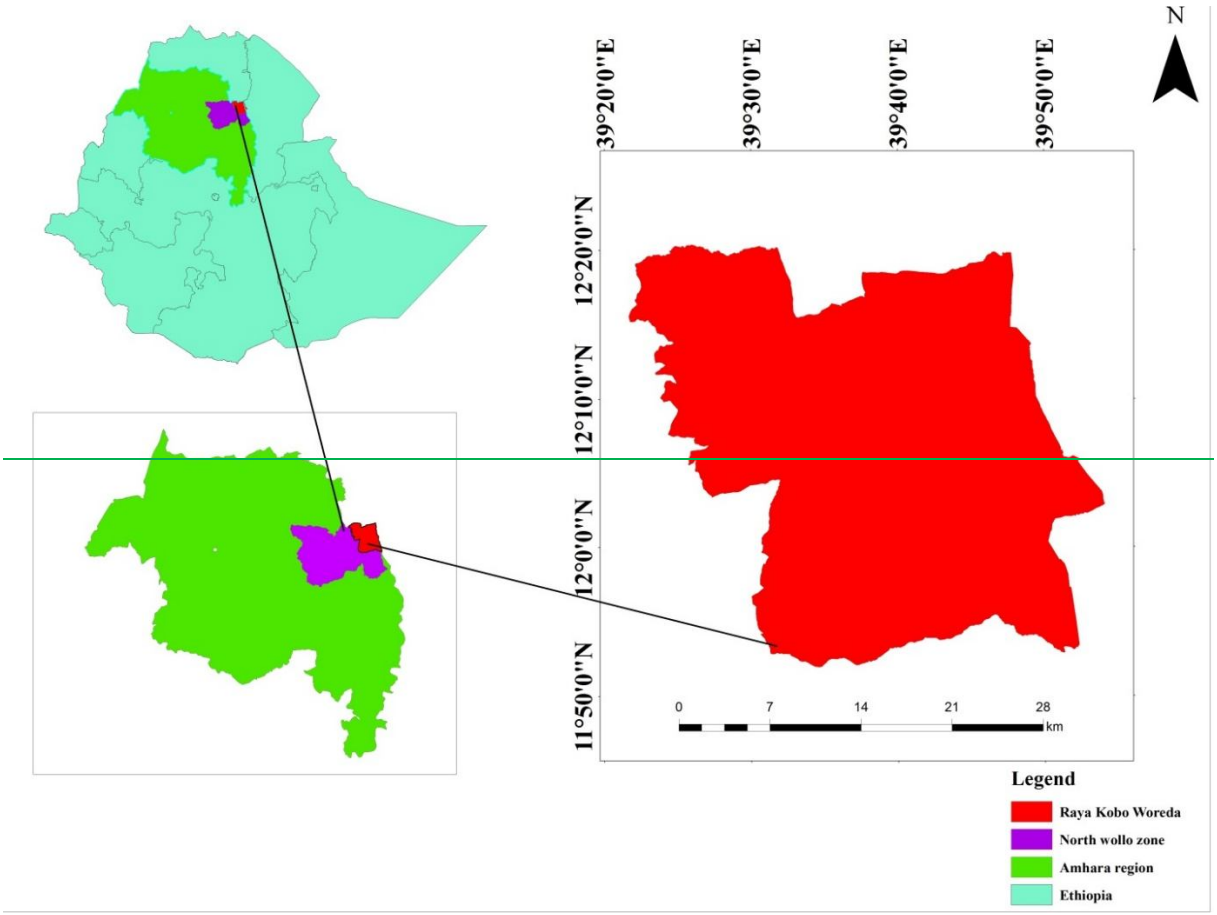

Figure 2. Geographic location of the study area

3.2. Sample Size and Sampling Technique

According to the National Oceanic and Atmospheric Administration (NOAA) panel report regarding CVM guidelines, probability sampling technique is essential for a survey used for environmental valuation. Besides, for such quantitative research, probability sampling technique is appropriate as compared to non-probability sampling technique since the results are going to be statistically interpreted. Using this as a reference, the current study also employed probability sampling techniques. The sample respondents were selected using multi-stages sampling technique. In the first stage, the total *kebeles* of the *woreda* that have communal lands were stratified in to *dega*, *woyna dega* and *kola* agro-ecological zones. \

Agro-ecology based stratification were done with the expectation of that there might be a difference in the rate of communal land degradation, the method of soil conservation strategies and also their WTP for the proposed improved communal land conservation program. Out of the total 43 rural *kebeles*, 4, 15 and 24 of them were *deag, woyina dega* and *kola kebeles*, respectively. In the second stage, from the three agro-ecological zones, four[1] *kebeles* were selected using simple random sampling proportional to each stratum. Therefore, 1, 1, and 2 *kebeles* were selected from *dega, woyina dega* and *kola* agro-ecology, respectively. Consequently, the four selected *kebeles* were Tekuleshi, Zoblie, Amaya and Rama (Table1). In the last step, representative numbers of respondents were selected by probability proportional to size (PPS) techniques of the number of households in each selected *kebeles* (Table1). The total number of households was determined based on the Kothari (2004) formula. This requires estimation of tolerable error margin as 0.05 allowing 95% confidence level. Hence, the formula is stated below.

$$n = \frac{Z^2 pqN}{e^2(N-1) + Z^2 pq} = \quad = \frac{(1.96)^2(0.8)(0.2)(49841)}{(0.05)^2(49841-1) + (1.96)^2(0.8)(0.2)} = 245 \qquad (4)$$

Where n= the minimum number of sample size within the range of acceptable error margin;

N= the total number of households in the Woreda;

Z= confidence interval (95%) and which is 1.96;

e= acceptable error of margin;

p= proportion of sampled population; and

q= estimation of the proportion of population to be sampled.

Therefore, the sample size of this study is 245.

[1] The four *kebeles* were considered to be sufficiently large for drawing valid statistical inferences and were also manageable to be surveyed with the available budget and time.

Table 1. Distribution of sample households in the sample *kebeles*

Agro ecology	*Kebeles*	Total number of household	Sampled household	Percent
Dega	Tekuleshi	1412	64	26%
Woyina dega	Zobile	1288	59	24%
Kola	Rama	1425	65	27%
Kola	Amaya	1254	57	23%
Total		5379	245	100

Source: Own survey result, 2018

3.3. Data Sources, Data Types and Methods of Data Collection

Both primary and secondary data were used for this study. The primary data were collected from sample respondents through a structured questionnaire via face to face interview with the heads of households. Since farmers in the study area speak *Amharic* language, the questionnaire that was initially prepared in English was translated to *Amharic*. Eight enumerators, all degree holders, were recruited from the study area and one-day induction training was given to them by the researcher. The main primary data was obtained from contingent valuation (CV) scenario and it includes information on the physical, personal, institutional, socio-economic characteristics of the households. The data that were collected from CV scenario were quantitative whereas qualitative data were collected from focus group discussion and key informant interviews. Four focus groups with six to eight persons from different backgrounds were established. Checklists were prepared which focused on the problems of communal land soil erosion, communal land management practices by farmers, determinants of communal land management practices and other related issues. These facilitated in obtaining detailed qualitative information and triangulating data from the household survey. Meanwhile, key-informants were drawn from all development agents (DAs) working in the sampled *kebeles* and from farmers. Secondary data were obtained from the *woreda* agricultural office (RKWAO) report.

As it is discussed in the literature review part, there are different types of valuation techniques. However, for this study CVM is applied to generate information about the proposed communal land soil conservation program. The choice of CVM over the other valuation techniques was based on two basic reasons.

Firstly, CVM is used to elicit both use and non-use values from users and non-users that they will derive from an improvement of environmental goods. Secondly, CVM is the appropriate valuation method where markets are often imperfect and where preferences cannot often be revealed through market mechanisms.

3.4. Elicitation Methods and Questionnaire Design

In CV surveys there are four major elicitation methods namely; open ended format, bidding game, payment card and dichotomous choice. Open-ended questions have the advantage of giving respondents the possibility of suggesting whatever WTP amount they like. However, it result in free-riding or strategic overbidding tendencies and pose significant uncertainty so that it leads upwardly or downwardly biased answers (Amoah and Dorm-Adzobu, 2013; Yibeltal, 2015). Closed-ended questions can avoid this problem but can have anchoring effects. Even though the CV question format to use remains an unresolved issue, the NOAA panel endorsed the dichotomous choice format for its ease of use and resemblance to every day decision making (Reaves *et al.*, 1999). The other three methods have been shown to suffer from incentive compatibility problems in which survey respondents can influence potential outcomes by revealing values other than their true willingness to pay (Haab and McConnell, 2002).

The dichotomous choice format can be applied in two different ways. It can be applied either in double bounded or single bounded formats. Some CV researchers rely on single bound dichotomous choice (SBDC) in which respondents are asked whether they would accept a randomly assigned predetermined single bid amount. However, this method can be highly statistically inefficient (Cameron and Quiggin, 1994). On the contrary, a double bounded dichotomous choice (DBDC) approach in which the respondent is asked a follow-up question if the respondent would pay a higher or lower bid depending on the response to the initial bid. This approach yields more precise estimation to parameters and associated welfare estimates (Hanemann *et al.*, 1991; Scarpa and Bateman, 2000). Haab and McConnell (2002) indicated that DBDC questions expand the information base of the WTP estimates and may provide efficient assessment than SBDC in three ways. Firstly, the number of responses is increased so that a given function is fitted with more data points.

Second, the sequential bid offers for yes-no and no-yes responses yields clear bounds on WTP. Finally, for the no-no and yes-yes combinations, efficiency gain comes from the fact that they truncate the distributions where the respondents' WTP are likely to reside. In addition, Warolin (1998) indicated that DBDC is more appropriate for developing countries where most of the trading in daily commodities is informal and guided by a custom bargaining. This approach is like a real life situation in Ethiopia at a market where sellers state the initial price and chance is given to the buyer to negotiate. Following these authors, the researcher in the present study opted to design a DBDC format with an open ended follow up question.

In contingent valuation study, the proposed hypothetical policy change should be described in detail before respondents are asked to make a monetary (labor) contribution for the proposed hypothetical change. According to the NOAA panel guideline report by Arrow *et al.* (1993) the CV survey questionnaires usually includes detailed description of the good under consideration (what is going to be valued), hypothetical circumstances under which the good is made available to users, conditions for provision, timing of provision, description of method of payment and questions that elicit WTP/WTA of the respondents for a proposed change and respondents socio-economic and other basic issues. Besides, the questionnaire should be uniformly, correctly, easily understood by respondents and also it should encourage respondents in a considered and meaningful manner (minimize strategic bias). Considering these criteria the CV survey questionnaires of this study have two different parts. The first parts provide general information and try to collect information on demographic structure and socio economic condition of the respondents. The second section provides contingent valuation scenarios and elicits farmers' WTP for improved communal land soil conservation (Appendix III and IV). In CV questionnaire design one of the most important things is the choice of payment vehicle. The most commonly used vehicles are labor contribution and monetary payment in the form of taxation. Some studies used monetary donation as payment vehicle (Almansa *et al*., 2012; Dagninet *et al*., 2016), whereas some used labor contribution (Gebrelibanos *et al.,* 2013; Belay, 2015; Musa *et al.*, 2015; Bamlaku and Yirdaw, 2015; Gemechisa, 2017) whereas some others give respondents the possibility to state their contributions in terms of labour /or money (Anemut, 2006; Hung *et al*., 2007; Stone, 2008; Saxena, 2008; Gulati and Rai, 2015; Dagninet *et al.,* 2017).

However, the choice of the payment vehicle can be varied depending on the socio-economic characteristics of the communities where the program being conducted. Ahlheim *et al.* (2010) suggested that WTP in terms of money is not a good measure of valuation in developing countries since WTP is harshly restricted by households tight budget constraints.

In addition to the type of payment vehicle used, the timing of contribution in which respondents are asked to contribute has also its own effect. Following this, in the CV scenario, respondents were told that they are supposed to contribute labor during off seasons. This may be useful since at the time of agricultural works the opportunity cost of labor time will be high so that it might underestimate the value of communal lands. The other important issue in the implementation of the CV survey and especially the DBDC is the choice of initial and follow up bid vectors. Bid design is important from the point of view of the efficiency of dichotomous choice parameters and welfare estimates. Using an iterative contingent valuation survey is beneficial in order to have an optimal bid (Kanninen, 1993; Cameron and Quiggin, 1994; Haab and McConnell, 2002). Hence, for this study to decide which kind of payment vehicle should be used and to obtain a preliminary guess about the WTP distribution, a focus group discussion was made in four *kebeles* (one focus group discussion on each of selected *kebeles*). The researcher had also conducted a pilot survey in three *kebeles* on 30 randomly selected households. In the pilot survey open ended format was employed that directly asked the individuals' maximum amount of labor days or money they are willing to pay for the improved communal land soil conservation program.

3.5. Method of Data Analysis

After the necessary data were collected from contingent valuation scenario, zero-protest respondents were dropped. A zero response may represent the true WTP of a respondent, but it can also arise from protest and game-playing behavior by the respondent (protest bidders). Yu and Abler (2010) indicated that respondents might give zero WTPs but their marginal utility of environment quality might not be zero, perhaps because they think other agents such as the government or polluters, rather than themselves, should pay for improvements in environmental quality, or they feel the survey is a waste of time.

Meanwhile, Arrow *et al*. (1993) identified the reason for protest zero bidders and they indicated that a respondent actually willing to pay the stated amount might answer in the negative way if the respondent believes the proposed scenarios distributed the burden unfairly, doubt on the feasibility of the proposed action and refusal to accept the hypothetical choice problem. Labao *et al*. (2008) also suggested that in contingent valuation, reasons other than financial constraint and the goods having no value to the respondent are considered as protest responses. Thus, protesters were excluded by considering these criteria. Descriptive statistics, inferential statistics and econometric model were employed to analyze the collected data.

3.5.1. Descriptive Analysis

Descriptive statistics is applicable to summarize and present the data in a manageable form. So, descriptive statistic such as percentage, frequency, mean and standard deviation were used, and the output was presented using table and charts. Similarly, t-test and chi-square test were used to know the statistical relationship of explanatory variables on the willing and non-willing households for continuous and dummy variables, respectively.

3.5.2. Empirical model specification

One of the main objectives of this study was to examine the determinants of households WTP for soil conservation on communal lands. Different researchers have used different econometric models to identify the determinants of households WTP for environmental valuation. For instance, Probit (Gebrelibanos, 2012; Belay, 2015; Yibeltal, 2015; Bamlaku *et al*., 2015), bivariate probit (Ayalneh and Berhanu, 2012; Gemechisa, 2017), ordered probit (Amoah and Dorm-Adzobu, 2013), logit (Paulos *et al*., 2002; Tao *et al.*, 2012; Bamlaku and Yirdaw, 2015; Gulati and Rai, 2015; Sizya, 2015), Tobit (Dagninet *et al*., 2017; Musa *et al*., 2015; Almansa *et al*., 2012) and Heckman two steps (Kong *et al.*, 2014; Dagninet *et al.*, 2016) have been used by different researchers. Although these researchers have used different models, the type of bidding mechanism that the researchers have employed has a significant role to select the appropriate econometric model. In double bounded CV data, the second response is contingent upon the first response so that in this case bivariate probit model is appropriate (Cameron and Quiggin, 1994; Aprahamian *et al*., 2007).

Haab and McConnell (2002) suggested that, if there is a correlation between the first and the follow-up WTP responses then estimation of independent probit or logit on the two responses would result in a loss of efficiency relative to the bivariate probit model. In the same manner, Cameron and Quiggin (1994) criticized the logistic model for double bounded CVM data and they reach in a conclusion that the standard logistic distribution does not allow for a non-zero correlation between initial and follow up WTP responses. So in DBDC format case the bivariate probit model is appropriate.

Besides, the virtue of the bivariate probit lies in its ability to nest and test other models of two-question responses such as independent probit, random effect probit and interval data model (Haab and McConnell, 2002). On the other hand, Halstead *et al.* (1991) and Boyle *et al.* (1996) reach the conclusion that the Tobit model is the appropriate econometric model when the bidding mechanism is open-ended format. This is due to the fact that in open ended CVM data there would be a zero WTP response so that an econometric model which can be censored at zero WTP value is the most appropriate. However, Haab and McConnell (2002) criticized the use of censoring model and they illuminated that censoring creates another problem because models which are truncated at zero tend to have a fat tail. The fat tails problem typically manifests itself in unrealistically large estimates of expected WTP. For this study the elicitation mechanism is DBDC format. Following this, the researcher assumed that there is a non-zero and significant correlation between the error terms of the first and the second WTP response. Due to these reasons, the researcher has employed a bivariate econometric model.

The bivariate double bounded dichotomous choice model

The bivariate probit model introduced by Cameron and Quiggin (1994) has become a general parametric modeling approach for double-bounded CV survey. The bivariate probit regression model is used when explaining the willingness-to-pay, with the assumption that the two decisions in the double bounded response are interconnected and the errors of the two regressions are correlated and this increases estimation efficiency. In double bounded dichotomous choice model, respondents are presented with two levels of bid where the second bid is contingent upon the response to the first bid. Let z^1 be the first bid price or labor-day and z^2 be the second. The take-it-or-leave-it question with follow up format starts with an initial bid z^1. The level of the second bid depends on the response to the first bid.

That is, if the individual responds "yes" to the first bid, the second bid is some amount greater than the first bid ($z^1 < z^2$); if the individual responds "no" to the first bid, the second bid is some amount smaller than the first bid ($z^2 < z^1$). Thus, there are four possible outcomes: both answers are "yes"; both answers are "no"; a "yes" followed by a "no"; and a "no" followed by a "yes". The bounds on WTP are:

1. $z^1 \leq WTP < z^2$ for the yes–no response;

2. $z^1 > WTP \geq z^2$ for the no-yes response;

3. $WTP \geq z^2$ for the yes-yes response; and

4. $WTP < z^2$ for the no-no response. (5)

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

$$WTP_{ij} = \mu_j + \varepsilon_{ji} \quad (6)$$

Where $WTPij$ represents the i^{th} respondent's willingness to pay that is unobservable, and $j = 1,2$ represents responses to the initial and follow up bid, μ_1 and μ_2 are mean value for the initial and follow up responses and ε_{ji} represents the unobserved random component.

To construct the likelihood function, first we must derive the probability of observing each of the possible two-bid response sequences (yes-yes, yes-no, no-yes, no-no). Following Haab and McConnell (2002) the possible probabilities from the two bid responses can be represented as follows:

$$\begin{aligned}
&\Pr(yes, yes) = \Pr(\mathrm{WTP}_{1i} \geq z^1, WTP_{2i} \geq z^2) = \Pr(\mu_j + \varepsilon_{1i} \geq z^1, \mu_j + \varepsilon_{2i} \geq z^2) \\
&\Pr(yes, no) = \Pr(WTP_{1i} \geq z^1, WTP_{2i} < z^2) = \Pr(\mu_j + \varepsilon_{1i} \geq z^1, \mu_j + \varepsilon_{2i} < z^2) \\
&\Pr(no, yes) = \Pr(WTP_{1i} < z^1, WTP_{2i} \geq z^2) = \Pr(\mu_j + \varepsilon_{1i} < z^1, \mu_j + \varepsilon_{2i} \geq z^2) \\
&\Pr(no, no) = \Pr(WTP_{1i} < z^1, WTP_{2i} < z^2) = \Pr(\mu_j + \varepsilon_{1i} < z^1, \mu_j + \varepsilon_{2i} < z^2)
\end{aligned} \quad (7)$$

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

$$Li(\mu / z) = \Pr(\mu_j + \varepsilon_{1i} \geq z^1, \mu_j + \varepsilon_{2i} \geq z^2)^{YY} \times \Pr(\mu_j + \varepsilon_{1i} \geq z^1, \mu_j + \varepsilon_{2i} < z^2)^{YN} \times \Pr(\mu_j + \varepsilon_{1i} < z^1, \mu_j + \varepsilon_{2i} \geq z^2)^{NY} \times \Pr(\mu_j + \varepsilon_{1i} < z^1, \mu_j + \varepsilon_{2i} < z^2)^{NN} \quad (8)$$

Where $z^1 = \text{first bid price}$, $z^2 = \text{second bid price}$, $YY = 1$ for a yes-yes answer, 0 otherwise, $NY = 1$ for a no-yes answer, 0 otherwise, $NN = 1$ for a no-no answer, 0 otherwise $YN = 1$ for a yes-no answer, 0 otherwise. Assuming that the error terms are normally distributed with means 0 and respective variances σ^2_1 and σ^2_2, then WTP_{1i} and WTP_{2i} have a bivariate normal distribution with mean μ_1 and μ_2, variances σ^2_1 and σ^2_2 and correlation coefficient ρ, which is the covariance between the errors for the two WTP functions.

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:

$$\Pr(yes, yes) = \Pr(\mu_1 + \varepsilon_{1i} \geq z^1, \mu_2 + \varepsilon_{2i} \geq z^2) = \phi\varepsilon_1\varepsilon_2(-\frac{z^1 - \mu_1}{\sigma_1}, -\frac{z^2 - \mu_2}{\sigma_2}, \rho) \quad (9)$$

$$\Pr(yes, no) = \Pr(\mu_1 + \varepsilon_{1i} \geq z^1, \mu_2 + \varepsilon_{2i} < z^2) = \phi\varepsilon_1\varepsilon_2(-\frac{z^1 - \mu_1}{\sigma_1}, \frac{z^2 - \mu_2}{\sigma_2}, -\rho) \quad (10)$$

$$\Pr(no, no) = \Pr(\mu_1 + \varepsilon_{1i} < z^1, \mu_2 + \varepsilon_{2i} < z^2) = \phi\varepsilon_1\varepsilon_2(\frac{z^1 - \mu_1}{\sigma_1}, \frac{z^2 - \mu_2}{\sigma_2}, \rho) \quad (11)$$

$$\Pr(no, yes) = \Pr(\mu_1 + \varepsilon_{1i} < z^1, \mu_2 + \varepsilon_{2i} \geq z^2) = \phi\varepsilon_1\varepsilon_2(\frac{z^1 - \mu_1}{\sigma_1}, \frac{z^2 - \mu_2}{\sigma_2}, -\rho) \quad (12)$$

Where $\phi\varepsilon_1\varepsilon_2(.)$ is the standard bivariate normal cumulative distribution function with zero mean, and unit variance and correlation coefficient ρ. $Y_{1i=1}$ if the response to the first question is yes, and 0 otherwise, $Y_{2i} = 1$ if the response to the second question is yes, and 0 if not, $d_{1i} = 2y_{1i} - 1, d_{2i} = 2y_{1i} - 1$ and the i^{th} contribution to the bivariate Probit likelihood function becomes;

$$L_i(\mu / z) = \phi\varepsilon_1\varepsilon_2(d_{1i}(\frac{z^1 - \mu_2}{\sigma_1}), d_{2i}(\frac{z^2 - \mu_2}{\sigma_2}), d_{1i}, d_{2i}, \rho) \quad (13)$$

But, when the estimated correlation co-efficient of the error terms in bivariate Probit model are assumed to follow normal distributions with zero mean and distinguishable from zero, the system of equations could be estimated as seemingly unrelated bivariate Probit (SUBVP) model (Cameron and Quiggin,1994).

The mean willingness to pay from bivariate Probit model (Equation 14) can be calculated using the formula specified by Haab and McConnell (2002).

$$WTP = -\frac{\alpha}{\beta} \tag{14}$$

Where $\alpha =$ intercept of the model which is the constant term, $\beta =$ coefficient offered bids to the respondents.

Following Green (2012), a bivariate probit model can be specified as:

$$y_1^* = \beta_1 x_1 + \varepsilon_1$$

$$y_2^* = \beta_1 x_2 + \varepsilon_2$$

$$\mathrm{E}(\varepsilon_1 | x_1, x_2) = \mathrm{E}(\varepsilon_2 | x_1, x_2) = 0$$

$$\mathrm{var}(\varepsilon_1 | x_1, x_2) = \mathrm{var}(\varepsilon_2 | x_1, x_2) = 1 \tag{15}$$

$$\mathrm{cov}(\varepsilon_1, \varepsilon_2 | x_1, x_2) = \rho$$

Where, $y_1^* = i^{th}$ respondent unobservable true WTP at the time of the first bid offered. $WTP = 1$ If $y_1^* \geq z^1$ (initial bid), 0 otherwise. $y_2^* = i^{th}$ respondents implicit underlying point estimate at the time of the second bid offered. x_1 and x_2 = the first and second bids offered to the respondents, respectively. ε_1, and ε_2 = error terms for the first and second above equations, respectively which are identically and independently distributed random variable with zero means. β_1 and β_2 = coefficients of the first and second bids offered, respectively. ρ is correlation coefficient, which is the covariance between the errors for the two WTP function.

In limited dependent variable models coefficients of explanatory variables cannot be interpreted rather it is the marginal effect that has to be interpreted. So, the joint marginal effects for the two WTP equations would be estimated after a bivariate probit regression has conducted.

3.5.3. The method of aggregating benefits

According to Mitchell and Carson (1989), there are four essential bias issues that must be considered in order to have a valid aggregate benefit on the responding community. These four bias issues are population choice biases, sampling frame bias, sample non-response bias and sample selection bias. For the current study, random sampling method was used starting from *kebele* selection up to selecting the target respondents. In addition, during data collection, a face to face interview method was used and protests zero responses were excluded from the analysis based on their reasons they respond after their zero minimum response. Furthermore, the possibility of protest zero was accounted in the estimation of the aggregate benefit in each *kebele*. Hence, none of the above biases was expected.

Benefit aggregation from the hypothetical program can be done through mean WTP or median WTP. However, CV researchers are in favor of using mean WTP for aggregation of benefits. For instance, Alemu (2000) used mean WTP for benefit aggregation for community forestry and he suggested that the mean is perhaps better than the median for non-pure public good as exclusion is possible and a voting scheme may not be necessary. Johansson *et al*. (1989) also suggested using mean WTP for benefit aggregation and they reasoned out that mean is more consistent with the potential Pareto criterion. To the contrary, Hanemann (1994) criticized that the mean is extremely sensitive to the right tail of the distribution; that is, to the responses of the higher bidders. He further suggests that, if the mean is to be used, a bounded influence approach is highly recommended for fitting the willingness-to-pay distribution. For this study case, considering the nature of the good being valued and the bidding mechanism (DBDC) used the mean WTP was used for aggregation of benefit.

Mean willingness to pay can be calculated either by using the results from the first bid response or using the second follow-up bid response. However, Haab and McConnel (2002) recommended that the researcher must decide which estimates from the double bounded question to use. They justified that parameter estimates from the first response are most commonly used in computing mean WTP. The reason behind this argument is that the second equation parameters are likely to contain more disturbances in terms of anchoring bias. Scarpa and Bateman (2000) also recommend using the first bid it is because the respondent is assumed to take the clue from the first bid while forming his WTP for the second response.

Moreover, incentive incompatibility bias is likely to exist in the follow-up bid response. To avoid these criticisms, in DBDC format the estimate of mean willingness to pay is based on the first bid response. The follow-up responses are utilized to estimate the extent of bias in the follow up responses (Whitehead, 2002; Herriges and Shogren, 1996). Some CV researchers in Ethiopia, adopted this procedure and calculated the mean WTP from the initial bid response (Gebrelibanous, 2012; Ayalneh and Birhanu, 2012; Musa *et al*., 2015; Meseret and Endrias, 2016). Therefore for the present study, the researcher followed the same procedure and used the first bid response in order to calculate the mean WTP from the DBDC format.

3.6. Definition, Measurement of Variables and Working Hypothesis

Dependent Variable of the Model: It is a dummy variable in which the individual's willingness to pay an existing bid or/and higher/lower bid (Initial and second bids**):** for improved communal land soil conservation program. Farmers, who are willing to pay the stated bid say **'**yes' and say 'no' otherwise, then they were asked another higher or lower bid depending on their first response. They were represented in the model by 1 for willing households and by 0 for non-willing households.

Explanatory variables of the model: The independent variables of the study were those factors, which were hypothesized to have an association with the willingness to pay for soil conservation measures. According to past findings, the prevailing theoretical explanations, and the researchers' personal judgment, fourteen explanatory variables make up the working hypotheses.

Sex of the household head (SEX): This is a dummy variable with a value 1 for male-headed households and 0 for female-headed households. It was included in the analysis to find out the difference between males and females in their WTP for communal land soil conservation. From previous findings, male-headed households were found to be willing to pay more for soil conservation practices than female-headed households (Mesfin *et al*., 2011; Ayalneh and Berhanu, 2012; Almansa, *et al*., 2012). The reason could be due to lack of resource possession and cultural constraints of male-headed households. Consequently, in this study, the effect of sex was hypothesized to have positive effect.

Age of the household head (AGE): This is a continuous variable indicating the age of the household head in years. From past studies, the effect of a farmer's age can be taken as a combination of the effect of farming experience and planning horizon. Older farmers may have longer farming experience; as a result, it has a positive effect on WTP (Abera and Desale, 2016). On the other hand, young farmers may have longer planning horizon and hence, they may be more likely willing to invest their labor time in soil conservation than the older ones (Almansa *et al*., 2012; Gebrelibanos *et al*., 2013; Bamlaku and Yirdaw.,2015; Wolde *et al*., 2015; Dagninet *et al.*, 2016). Considering the two different effects of age of the farmers on WTP, in this study the effect of this variable was hypothesized to have indeterminate effect.

Literacy status of household head (LITERACY): This is a dummy variable which takes a value 1 if a household is literate (able to read and write), and 0 otherwise (not able to read write). Education is one of the very crucial things for household's participation in environmental conservation as literate households are expected to have a better skill and awareness on effects of soil erosion on peoples livelihood. A positive relationship between education and willingness to pay is one of the most consistent findings of previous studies (Paulos *et al*., 2004; Tao *et al*., 2012; Gebrelibanos, 2012; Bamlaku and Yirdaw, 2015; Yibeltal, 2015; Musa *et al*., 2015; Gemechisa, 2017). Therefore, in this study, it was hypothesized that literacy statuses of the households have positive effect on WTP.

Dependency ratio (DPR): This is a continuous variable measured as inactive labor force (<15 years, disabled members and elders above 65 years) divided by the number of the active labor force (15-64 years). The presence of dependent household members tends to create pressure on active labor force both in cash requirement and labor to support them. The more dependency ratio of the household, the less time the household will have for soil conservation and rehabilitation of the degraded land (Gulati and Rai, 2015). So, it was negatively hypothesized with WTP.

Livestock holding (LIVES): This variable measures the total number of livestock holding in Tropical Livestock Units (TLU). As conserved communal lands would help households' for better grazing lands and access to fodders so that households with more number of livestock would be likely to be willing to contribute labor.

Besides, livestock is one source of income so that household who have more number of livestock may relax his/her cash constraints and he/she might contribute more for the conservation of the soils (Anemut, 2006; Gebrelibanos *et al*., 2013; Bamlaku and Yirdaw., 2015; Dagninet *et al.*, 2017). As a result, the effect of livestock holding on WTP for communal land soil conservation was hypothesized to have positive effect.

Annual farm income of the household (AFIHH): It is a continuous variable measured by the amount of Ethiopian birr a household earned annually from agricultural activities (crop production, livestock selling). When a household earned more agricultural income, he /she will be more willing to contribute for soil conservation. The reason for this may be when a farmer's income is sourced mainly from selling crops, livestock and livestock product selling, communal land soil environmental quality improvements are likely to be more beneficial to farmers, and therefore, such farmers are more willing to compensate the environment. Besides, cash might relax households to buy a material that needs for conservation activities. According to previous studies, the income of households has a positive impact on the willingness of respondents to invest on soil conservation activities (Kong *et al*., 2014; Yibeltal, 2015; Bamlaku and Yirdaw, 2015; Musa *et al*., 2015; Gemechisa, 2017). Therefore, annual farm income of the household was hypothesized to affect WTP positively in this study.

Off-farm income participation (OFPART): This is a dummy variable that measures the participation of sampled respondents in off-farm income earning activity during the production year. In some studies, this variable was found to have a positive influence on soil and water conservation and adoption decision (Pender and Kerr, 1998). The assumption was that diversified out of agriculture (involvement in off-farm activities) would help households to earn income in that way easing the liquidity needed for soil conservation investments. On the other hand, if farming is not the major income earning activity, off-farm income earners may decide not to invest their labor time or financial resources in soil conservation activities. Some researchers have found a negative effect of off farm participation on WTP on soil conservation (Berhanu and Swinton, 2003; Gulati and Rai, 2015; Abera and Desale, 2016). As empirical studies reported both positive and negative effects, in this study the effect of this variable was considered as indeterminate.

Perception of communal land soil erosion problem (PERCEPTION): This is a dummy variable which takes 1 if the household head perceives the problem of communal land soil erosion, 0 otherwise. Farmers' perception of the soil erosion problem can be hypothesized as a precondition to undertaking remedial action on the erosion problem. Therefore, farmers who have already perceived the problem of soil erosion are more likely to be willing to pay than their counterparts. Previous researchers found a positive effect of this variable on households WTP decisions (Paulos *et al*., 2004; Gebrelibanos, 2012; Bamlaku and Yirdaw, 2015; Abera and Desale, 2016). Similarly, in the current study this variable was also expected to be positively associated with farmers' willingness to pay for soil conservation practices on communal lands.

Frequency of extension contact (FEXTC): It is a continuous variable indicating the number of visits the farmer obtain from extension agent on the issue of natural resource conservation. Extension service amplifies the farmer knowledge and skills about soil conservation activities and the adoption of other agricultural technologies that can be used to combat soil erosion. Previous researchers have found a positive effect of extension contact on WTP (Paulos, 2002; Abera and Desale, 2016). Hence, the effect of this explanatory variable was hypothesized to have a positive relation with willingness to pay in this study.

Credit utilization (CREDITU): It is dummy variable which takes the value 1, if the household has used credit (either from formal or informal creditors) and 0 otherwise**.** Credit in cash or in-kind will improve the financial capacity of farmers since it would enable them to overcome the input constraints. When a farmer gets credit at a time when he/she needs, they would be willing to invest their time or financial resource for soil conservation. A positive relationship of credit use and WTP was found in previous findings (Desalegn, 2015; Gemechisa, 2017). In this study, it was hypothesized that there would be a positive relationship between credit utilization and WTP.

Size of farm land near to communal land (FSNCL): This is a continuous variable that stands for the total area of the farmland (in hectare) which is near to the communal land owned by the sample respondents at the time of the survey. Conserved communal lands have huge importance to reduce off-site soil erosion effects that will occur on the farmlands.

Large farm holders are more willing to conservation and it is true from many empirical findings **(**Paulos *et al.*, 2002; Abera and Desale, 2016**)**. Therefore, in this study, it was hypothesized that size of the farmland near to communal land is positively related with the willingness to pay for soil conservation activity on communal lands.

Distance of communal land from home (DOCLFH): This is a continuous variable which refers to the amount of distance in kilometer it takes from a farmer's home to communal land. Farmers who are living further away from the resource proposed to be conserved are willing to pay less than those who are closer to it (Alemu, 2000; Belay, 2015). Farmers who are living at near distance from the communal land might easily get the benefit (better grass for livestock and other farm equipment) from the communal land conservation more than those who are living in a more distant area. For the current study, the distance of communal land was expected to have a negative correlation with willingness to pay.

Initial offered bid (BID1): This is the pre-specified bid price (labor days) offered to the respondents. Empirical studies have shown that this variable has been negatively correlated with the willingness of soil conservation effort. The probability of a yes response to the initial bid increases with a decrease in the offered initial bid. Which indicates that the possibility of accepting an offered bid amount increases as the bid amount goes down and vice versa which is consistent with the economic theory (Mesfin *et al.*, 2011; Gebrelibanos, 2012; Yibeltal, 2015; Musa *et al.*, 2015; Bamlaku and Yirdaw, 2015; Gemechisa, 2017). For this study, the initial bid price (in terms of labor contribution) was expected to influence the willingness to pay of the respondents negatively.

Migration (MIG): It is a continuous variable measured in the number of migrant person in the household. In rural areas of developing countries where market imperfections are a common phenomenon, migration may reduce the incentives for land conservation as land conservation activities are mostly labor intensive (Aryal, 2005). There is not any empirical research in Ethiopia that has seen the impacts of migration on soil conservation activities. However, in this study the researcher had given attention to migration as a threat to soil conservation.

The area is being affected by a server migration problem and that has greater implication either for labor shortage or on the farmers' attitude (as it makes farmers lack having long-term plan on agriculture). Hence, it was hypnotized that there would be a negative relationship between migration and soil conservation.

Table 2. Definition of hypothesized variables included the model

Description of Variable			Sign
Dependent variables: Initial bid (WTP1), Second bid (WTP2)			
	Types	Unit of Measurement	
Age of the household head	Continuous	Years	+/-
Sex of the household head	Dummy	1,for male, 0 otherwise	+
Literacy status of HHs	Dummy	1,for literate, 0 otherwise	+
Dependency ratio	Continuous	Inactive to active members of HHs	-
Farm size near to communal land	Continuous	Hectare	+
Distance of communal land from home	Continuous	Kilometer	-
Livestock holding	Continuous	Total livestock owned in TLU	+
Annual farm income	Continuous	Birr	+
Off farm participation	Dummy	1,if participate in off farm, 0otherwise	-/+
Credit utilization	Dummy	1,if a household received, 0, otherwise	+
Frequency of extension contact	Continuous	The number of contact within a year	+
Perception of soil erosion problems	Dummy	1, if HHs perceive ,0 otherwise	+
Migration	Continuous	The number of migrant person	-
Initial bid	Continuous	Man day	-

Source: Own survey result, 2018

4. RESULTS AND DISCUSSION

This chapter contains three main sections in which the main result and finding of the study are presented and discussed. Accordingly, the chapter is organized as follows. The first section deals with the result of descriptive statistics about the demographic, socioeconomic and institutional characteristics of sampled respondents related to the first willingness to pay. The second section deals with the econometric analysis of determinants of respondents' willingness to pay for improved communal land conservation practices. The last section presents mean willingness to pay and aggregate welfare gain of the proposed program.

4.1. Descriptive Results

This sub-section presents the demographic, socioeconomic and institutional characteristics of sampled respondents related to the initial bid equation (WTP1). Knowing the characteristics of respondents is vital in order to identify variables that can hinder or help willingness of households on communal lands soil conservation. The characteristics of sample households were summarized under each sub-section by descriptive (mean and percentage) and inferential statistics (chi-square and t-test). For this study, data were collected from 245 randomly selected households. However, data from 234 respondents were utilized for the analysis since 11 respondents were found to be a protest zero bidders. Meanwhile, out of the total 234 sampled households that were included in the analysis, 197 (84.19%) were willing to take and contribute labor for the initial offered bid (WTP1) and the remaining 37 (15.8%) were not willing to contribute any labor day.

4.1.1. Descriptive statistics for dummy variables

Sex of the household head (SEX): Out of the 37 (15.81%) non-willing households, 20 (54.05%) of them were female-headed and 17 (45.95%) were male-headed households. On the other hand, out of the total 197 (84.2%) willing households, 58 (29.45%) were female-headed and the remaining 139 (70.55%) were male-heads households. In addition, among the total 234 sampled households taken 156 (66.67%) were male-headed households whereas 78 (33.33%) were female-headed households (Table 3).

The occurrence of large number of female-headed households in the study area is not surprising. As justified by the focus group discussants and informant interviewers, it is common in the study area that after marriage the male head of households migrated to somewhere out of the village especially to Arabian countries. The result of chi-square test result ($\chi 2$=8.48) in Table 3 revealed that there is a strong relationship between sex of the household head and willingness to pay status to accept the initial bid, which is significant at 1% probability level. This indicates that, consideration of sex difference is an important component in communal land soil conservation WTP decision.

Literacy status of household heads (LITERACY): From the total 37 (15.81%) non-willing households, 27 (72.97%) were not able to read and write whereas the reaming 10 (27.03%) were able to read and write. In addition, from the total 197 willing households, 108 (54.82%) were not able to read and write but the reaming 89 (45.18%) were able to read and write. Among the total 234 households, 135 (57.69%) were not able to read and write whereas the remaining 99 (42.31%) were able to read and write. The Pearson chi-square results in Table 3 shows that there is statistically significant difference between willing and non-willing households in terms of their literacy status. Therefore, it indicates that literacy status increases willingness to pay for communal land soil conservation.

Perception of communal land soil erosion problem (PERCEPTION): When a farmer is aware of the existence of erosion and believe it as a threat for his/her livelihood, he/she may be willing to participate in conservation programs more importantly than their counterparts. Out of the 234 sampled households, 49 (20.94%) did not perceived the existence of communal land soil erosion problem; whereas the remaining 185 (79.06%) perceive the communal land erosion problem that exist in the communal lands of the study area. Among the 37 non-willing households, 12 (32.43%) did not perceive the existence of communal land soil erosion problem in their area; whereas the remaining 25 (67.57%) non-willing households perceive the occurrence of communal land soil erosion problem in their villages. Out of the total 197 willing households, 160 (81.02%) perceived the existence of communal land soil erosion problems; whereas the rest 37 (18.37%) households willing households were not aware of the existence of erosion problem (Table 3).

The willingness of those non perceived respondents showed that they did not observe the current soil erosion problems rather they are ready taking a pre-action against the occurrence of future communal land erosion. The chi-square result in Table 5 shows that there is a statistically significant relationship between willingness to pay status and perception of communal land soil erosion problem at 10% probability level. Hence, it shows that perception of soil erosion problem by households increases their willingness to accept for the initial offered bid amount. The respondents who perceived the existence of communal land soil erosion problems frequently mentioned features of soil erosion such as a decrease in forests, a decrease in agricultural yield, and lack of grass for livestock, destruction of habitats, climate change and drought as indicators of the degradation of communal lands. Hence, this indicates that the problem of communal land soil erosion problem is well perceived in the study area and there is a need to take action against the erosion hazards. The focus group discussants highlighted that they are aware of the problems of communal land soil erosion in their respective *kebeles*. The extent of communal land degradation in the study area was found to be high. They noted that the majority of communal lands have gone out of use mainly due to soil erosion. Rills and gullies are commonly observed. They suggested there must be an urgent intervention to tackle the problem with free participation of the community.

Off-farm income participation (OFPART): Apart from farm and non-farm incomes, sources including sale of charcoal and firewood, daily laborer, pity trade and sale forest product for construction are found to be additional sources of off-farm income for the survey households. As indicated in Table 3, from the total 37 non-willing households' about 21 (56.75%) households were participating in off-farm income source activities. Out of the total 197 willing households, only, 59 (29.95%) households participated in 2017/2018 production year in off–farm activities. Among the 234 households, 154 (65.81%) do not participate in off-farm activities. The chi-square result shows that there was a statistically significant difference between willingness to pay for communal land soil conservation and off-farm participation.

Credit use (CREDITU): Both formal and informal lending institutions provide credit in the study area. Out of the 234 sampled households about 120 (51.28%) of the household have got credit from formal and or informal sources for the 2017/18 production period.

Among the 197 willing households, 100 (50.76%) of them have got credit. Out of the total 37 non-willing households, 20 (54.06%) have got credit (Table 3). Amhara Credit and Savings Institution (ACSI) was the major source of formal credit providers whilst neighbors and relatives were among the informal sources of credit. However, during the focus group discussions the focus group discussants indicated that farmers cannot get credit easily from these institutions due to the collateral requirement criteria of the formal credit lenders which did not consider farmers ability. The focus group discussants also raised fears to repay loans as obstacles of borrowing from formal credit. As forwarded by them, ASCI expect farmers to form a group of ten to acquire credit. The rule of the institution forces the remaining group members to repay the total if any of the group members fail to pay back by any circumstances. As a result, the farmers prefer to abstain from taking credit. The statistical analysis of chi-square test results was insignificant, denoting no significant difference between willing and non-willing respondents in terms of credit use.

Table 3. Descriptive statistics for dummy variables

Variable	Non Willing (N=37)		Willing (N=197)		Total (N=234)		χ^2
	No	Percentage	No	Percentage	No	Percentage	
SEX							
Female	20	54.05	58	29.45	78	33.33	8.48***
Male	17	45.95	139	70.55	156	66.67	
LITERACY							
Illiterate	27	72.97	108	54.82	135	57.69	4.20**
Literate	10	27.03	89	45.18	99	42.31	
PERCEPTION							
No	12	32.43	37	18.78	49	20.94	3.5 *
Yes	25	67.57	160	81.02	185	79.06	
OFPART							
No	16	43.25	138	70.05	154	65.81	9.95***
Yes	21	56.75	59	29.95	80	34.19	
CREDITU							
No	17	45.94	97	49.24	114	48.72	0.14
Yes	20	54.06	100	50.76	120	51.28	

Note: The symbol *, ** and *** shows statistically significant difference at 10%, 5% and 1% probability level, respectively.

Source: Own survey result, 2018

4.1.2. Descriptive statistics for continuous variables

Age of the household head (AGE): The total sampled households have a mean age of 44.67 years. The mean age of the willing and non-willing households were 44 and 48.24 ages, respectively, and this difference is statistically significant at 5% significance level (Table 4) indicating that there was statistically significant difference in the mean age between the willing and non-willing respondents. This t-test result justifies that younger households were willing than their older counterparts. The inferential statistics result suggests there was a strong relationship between age and willingness to pay for the initial bid. Thus, consideration of age difference should be one of the important issues in willingness to pay decision of communal land soil conservation in the study area.

Dependency ratio (DPR): As indicated in Table 4, the average dependency ratio for the 234 households' were about 1.19 indicating that every economically active family member of the respondents support a minimum of about one economically inactive family members. The average dependency ratio for the non-willing households and willing households were found to be 1.84 and 1.03, respectively. Hence, the dependency ratio for non-willing households was greater than the dependency ratio for willing households. The t-test result indicated that there was a statistically significant difference in the means of dependency ratio between the willing and non-willing households for the initially offered bid at less than 1% level.

Migration (MIG): Migration has a dual negative effect on environmental conservation on households WTP in the study area. In a country like Ethiopia where the labor market is imperfect, the increased involvement of the household members in internal and the international migration activities can affect the agricultural production as well as other activities of the households. It creates a shortage of labor for the households whose families have migrated to somewhere out of their resident village. For instance, out of the 234 sampled households, for 76 households their economically active family members are participating in migration and out of these, 65 of them have a shortage of labor.

Alternatively, out of the total 102 households who have labor shortage, 76 of them are because of migration of their adults to somewhere out of their resident village particularly to Saudi Arabia (Appendix Table 1). The remittance earnings increase household income and the households can use it for several purposes and the households' can increase its level of welfare via increased consumption of both food and non-food commodities. On the other side, the remittance earning from migration may lead migrant families in order not to have a long term plan on their agricultural activity. In the study area they are more likely to invest their remittance income for the purchase of cars and construction of houses on the nearby towns. Through this, they might ignore the agricultural sector and their willingness to contribute a labor day for the conservation of the communal land will be low or totally unwilling to participate in any conservation program voluntarily. As it can be deduced from Table 4, the average migrant persons for the 234 households were about one person. Besides, the average migrant persons for the non-willing and willing households were found to be one or more and a maximum of one, respectively. The t-test result indicates that there is a significant mean difference (at 1% level) between willing and non-willing respondents with regard to migration status of households.

Annual farm income (AFIHH): Income from agricultural activities was one of the main income sources for the sampled households. As indicated in Table 4, the mean gross annual income from agricultural sources for the willing and non-willing respondents was about birr 8403 and 8699, respectively. The mean gross annual income for the total sampled households was about 8449.9 birr. Based on the t-test result, the mean average income between willing and non-willing farmers to contribute labor for communal land soil conservation was significant at 5% probability level indicating agricultural income increases willingness to pay for soil conservation.

Farm size near to communal land (FSNCL): As indicated in Table 4, the mean farm size for the 197 willing households was about 0.74 hectare and for the 37 non-willing respondents it was about 0.50 hectare. Meanwhile, the mean farm size of the total 234 sampled households was about 0.70 hectare. The statistical t–test result indicated that there was a significant mean difference (at 1% level) between willing and non-willing respondents for the initial offered bid in terms of their farm size near to communal land.

This is probably due to the fact that conserved and protected communal lands have a crucial role to reduce the off-site soil erosion effects that will be occurred on the farmlands that found near to the communal lands. Thus, farmers who have larger hectares of farmland near to communal land would be much more willing than those who have smaller hectares (or totally not have farmlands near to communal lands).

Distance of communal land from home (DOCLCH): The distance of communal land from home was included in the analysis with the expectation that those farmers whose homes are near to communal lands will observe the communal land erosion problem so that they will be willing than those whose homes are far. However, the t-test result shows that there was no a significant mean difference between willing and non-willing households with regard to distance of communal land from home (Table 4). For the 37 non-willing and the 197 willing households, the average distance from their home to communal lands was about 2.30 and 2.47 kilometers, respectively. Besides, the average distance of communal land from their home for the 234 sampled households was about 2.44 kilometers.

Livestock holding (LIVES): For rural farm households, livestock are an important source of cash income, food, manure and source of power for cultivation (Gelan *et al*., 2012). Holding a larger amount of livestock is an indication of wealth. The same is true in the study area where the majority of the farmers' income is dependent on livestock. Based on Storck *et al*. (1991) standard conversion factors (Appendix Table 2) the livestock owned by household head was converted into Tropical Livestock Unit (TLU). Accordingly, as indicated in Table 4, the mean TLU for the 37 non-willing and 197 willing households were about 3.39 and 7.23, respectively. Meanwhile, the mean TLU for the 234 sampled households was about 6.62. The mean difference for total livestock holding was statistically significant for the initial bid offered. This shows that possessing more number of livestock is related with willingness of communal land soil conservation. However, according to focus group discussants, possessing a large number of livestock become difficult because of the shortage of livestock feed resulted from severe erosion on the communal lands.

On the other hand, key informants noted that, a greater number of livestock are a treat to communal lands soil conservation. They asserted that, those farmers with a greater number of livestock are not willing to feed their livestock on cut and carry system. They rather preferred free grazing which practically accelerates soil erosion on communal lands even after conservation structures are built. Thus, focusing on ways of increasing livestock productivity than number is important.

Frequency of extension contact (FEXTC): It is expected that extension agent's contact with farmers regarding natural resource conservation has a potential to accelerate farmers' perception about effects of erosion and advantage of soil conservation on their livelihoods. As indicated in Table 4, on average, the 234 sampled households made 23.72 times per year contact with extension agents specifically on natural resource conservation issues. On average, the willing households made more contact with development agents (24.86 times per year) compared to the non-willing participants who made about 17.68 times per year on average. There was a statistically significant mean difference in the frequency of extension contact between willing and non-willing respondents at less than 1% significance level. However, a focus group discussants and informant interview with the extension agents indicate that the habit of farmers to come in the office of extension agents is too weak as farmers expect that extension agents have to come to their home and in watershed conservation programs for advice.

Table 4. Descriptive statistics for continuous variables

Variable	Non Willing (N=37)		Willing (N=197)		Total (N=234)		t-test
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	
AGE	48.24	11.49	44	9.98	44.67	10.31	2.32**
DPR	1.84	1.63	1.03	1.01	1.19	1.15	3.92***
MIG	1.03	0.98	0.47	0.34	0.55	0.47	3.3620***
AFIHH	8699	7677	8403	7958	8449	8348.1	0.1203
FSNCL	0.50	0.34	0.74	0.46	0.70	0.45	-3.0548***
DOCLCH	2.30	1.38	2.47	1.70	2.44	1.65	-0.5597
LIVES	3.39	4.41	7.23	5.35	6.62	5.39	-4.099***
FEXTC	17.68	9.92	24.86	11.83	23.72	11.83	-3.47***

Note: **'***'** and **'**'** shows statistically significant difference at 1% and 10% probability level, respectively

Source: Own survey result, 2018

4.2. The Contingent Valuation Survey Result

4.2.1. Results of the dichotomous responses

During the pilot survey, respondents were openly asked to state their maximum willingness to pay either in labour or monetary contribution for the proposed communal land soil conservation program per year that will last for five years. However, almost all of the respondents in the pilot survey were willing only via labor contribution. The range of response varied between 0 and 130 labor-days per year. However, the most frequent responses were 24, 36 and 48 labor days per year. The focus group discussants also preferred a labor contribution through these bid values. Accordingly, these three sets of bids were selected for the final survey via their frequency of occurrence. Therefore, in the final survey the total sampled households were divided randomly into three equal groups which were about 78 households (excluding 11 protest bidders).

Therefore, among these three set of bids a random initial bid were offered to the respondent and if the respondents agreed to pay the pre-specified offered bid the follow up bid were doubled and in case of a no response the respondents were offered a bid that was half of its initial value. Finally depending on the respondents follow up bid response, “what maximum or minimum number of labor-day are you willing to contribute?” was followed and the bidding completed. Some valuation researchers in Ethiopia have applied this procedure (Gebrelibanous *et al.,* 2013; Belay, 2015; Musa *et al.,* 2015*;* Bamlaku *et al.,* 2015; Dagninet *et al.,* 2016; Dagninet *et al.,* 2017; Gemechisa, 2017).

As indicated in Table 5, out of 78 respondents who were asked 24 labor-days per year as starting bid about 60.26% respondents accepted both the first and the follow up higher bid, 37.18% accepted the starting bid but rejected to pay for the higher follow up bid, and 2.56% of the respondents rejected both the starting bid and the second lower bid. From the total of 78 respondents who were asked 36 labor days as an initial starting bid, 38.46% accepted both the first and the follow up bid, 43.59% accepted the initial starting bid and refused to pay for the higher follow up bid. Meanwhile, out of these respondents who were asked 36 as an initial bid, 2.56% rejected the first starting bid but accepted the second lower follow up bid and, 15.38% rejected both the first and second follow up bid. Similarly, from 78 respondents to whom 48 labor-days per year were offered as initial bid, 29.49% of them accepted both the initial and the second higher bid. And 43.59% accepted the first bid and rejected the next higher bid, 3.85% rejected the first bid and accepted the follow up lower bid amount and 23.08% rejected both the first and the second lower bid.

Table 5. Distribution of responses to the double bounded WTP question across bids[2]

Set of bids	Yes-Yes		Yes- No		No-Yes		No-No		Total	
	N	%	N	%	N	%	N	%	N	%
(24,48,12)	47	60.26	29	37.18	0	0	2	2.56	78	100
(36,72,18)	30	38.46	34	43.59	2	2.56	12	15.38	78	100
(48,96,24)	23	29.49	34	43.59	3	3.85	18	23.08	78	100

Source: Own survey result, 2018

As it has been indicated in Table 5, from the total 234 respondents which were included in the analysis, 100 (42.74%) of them accepted both the first and the second higher follow up bid (yes-yes), 97 (41.45%) accepted the first offered bid but rejected the second higher follow up bid (yes-no), 5 (2.14%) of the respondents rejected the first bid but accepted the second lower follow up bid (no-yes) and the remaining 32 (13.68%) rejected both the first and the second lower follow up bid (no-no). The other notable result here is, 42.74% of the respondents who accepted the first bid gave a similar response for the second follow up bid and 13.68% of the respondents who rejected the first bid also rejected the second follow up bid. This could justify the presence of the first response effect on the follow up question (Cameron and Quiggin, 1994). It is also consistent with a study done by Ayalneh and Berhanu (2012).

4.2.2. Analysis of results of open ended format

After the respondents were asked trough the double bounded WTP question, they were also asked an open ended WTP question. In the open ended question, respondents were asked to state freely the maximum or minimum amount of labor-day they will contribute for the proposed communal land soil conservation. As it is shown in Table 6, the maximum amount of labor-day contribution of respondents for the proposed improved communal land soil conservation ranges from 0 to 130 labor days per household per year for consecutive five years.

[2] If the respondent's response is "yes" for the first offered bid, then the respondent would be asked a second question which is double of the first bid; but, if the respondent's response is "no" for the first offered bid, then the respondent would be asked a second question which is half of the first bid.

As it is shown in the table the number of willing respondents gets lower when the bids amount gets higher which conform to the economic theory that quantity demand decrease when price of the good increases.

Table 6. Frequency distribution of the open ended questionnaire format

Number of labor days to contribute	Number of respondents	Percent
0	22	9.4
5-25	38	16.24
26-46	39	16.67
47-67	47	20.09
68-88	45	19.23
89-109	31	13.25
110-130	12	5.13
Total observation	234	
Mean	45.66	
Standard deviation	1.78	
Maximum	130	
Minimum	0	

Source: Own survey result, 2018

The result from the follow up open-ended question would basically help for two issues. Firstly, to compare the mean willingness to pay value that was computed from the double bounded bivariate probit estimation result. The arithmetic mean value from the open-ended result was found to be 45.66 labor days per household per year which will last for five years. This value is considered as the average numbers of labor-days households were willing to contribute for the proposed communal land soil conservation program that would happen if results from open-ended question were used as a biding mechanism for the implementation of the proposed conservation program. Secondly, the result from the open ended format might help to sketch the frequency (aggregate demand) curve for the proposed hypothetical program. As Hanemann (1994) and Brookshire *et al.* (1980) indicated one of the advantages of contingent valuation result is to draw the aggregate demand or latent demand curve by inferring respondents WTP for a hypothetical commodity. For this study, the open-ended CV data were used to estimate the latent aggregate demand curve for the proposed improved communal land soil conservation program (Appendix Figure 1).

However, the figure did not look exact demand curve unlike the traded goods in which price of the good act as the marginal value of the good and which is consistent across individuals. For non-marketed environmental goods value of the resource depends on the peoples affected so that WTP responses are likely to vary with individual characteristics so that aggregate demand curve deviates from the usual aggregate demand curve.

4.2.3. Reasons for maximum willingness to pay

After respondents have stated their maximum WTP through the open ended question, they were also asked to point out their major reasons for not willing to contribute more than what they described as their maximum capacity. Examining their reason will help to know the WTP characteristics of respondents. Of the total 245 sampled households, 212 of the households state their reason for maximum willingness to pay. The rest 33 of the sampled households were missing because they were not willing to pay any amount of labor days.

The 212 respondents' main reason for their maximum willingness to contribute labor days are presented in Table 7. From the total 212 willing households, 83 (39.15%) of them said that "I think it is worth that amount" as their basic reason to state their maximum labor-day contribution. The households with a positive willingness to pay who revealed "others should contribute" were about 15 (7.08%) and the remaining 114 (53.77) households stated their reason as "I could not afford more'' as their basic reason for their maximum willingness to pay. Hence, it can be concluded that labour shortage (I could not afford more) was one of the major factors that limit the respondents' maximum willingness to pay for the proposed communal land soil conservation program.

Table 7. Reasons for maximum willingness to pay

Reasons for maximum willingness to pay	Number of respondent	Frequency
I think it is worth that amount	83	39.15
Others should contribute	15	7.08
I could not afford more	114	53.77
Total	212	100

Source: Own survey result, 2018

4.2.4. Reasons for not willing to pay

Although motives usually do not matter in economic analysis, CV is an exception. For public goods provision motives for negative or zero bid matter because they determine how the value estimate should be interpreted and used in decision making (Stevens, 1994). Even though there are different types of protest bias (outliers), protest zero are quite common in dichotomous choice CV studies (Halstead *et al.*, 1989). Based on the motives in which the farmers are not willing to contribute any amount of labor-day, it is possible to know those who had a zero valuation of the communal land soil or the protest zero bidders. The selection of protest zero bids (invalid zero response) and true zero respondents in this study was done based on the respondents' response to a follow-up question. If protest zero bids are not identified, they might be misinterpreted as indicating a zero value for a resource being valued.

In the valuation question respondents were asked the reasons why they are not willing-to-pay any amount of labor-day. As it has been indicated in Table 8, among the total non-willing households (households who have a zero WTP), 22 (66.67%) of them revealed their reason as 'I do not have enough labor'. These unwilling respondents are said to be true (legitimate) zero respondents. This is because they indicated their willingness to participate in the proposed conservation program, but they couldn't afford any labor day for the conservation program due to a shortage of labor. This kind of response signpost that although people could be willing to pay, their ability to work prohibits them from expressing their willingness. On the other hand, out of the total 33 non-willing respondents, 24.24% and 9.09% of them stated their reason for not willing to pay as "the government should pay for it" and "I do not trust in the proposed conservation program" respectively. These kinds of respondents are said to be protest bidders[3].

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

Labao *et al.* (2008) suggested that in the CV literature, reasons other than financial constraint (labor shortage) and the good having no value to the respondent are considered as protest responses. For this study, those non-wiling households who refused to participate and contribute labor for the proposed conservation program (except due to a shortage of labor) are categorized as protest bidders. Consequently, among the total 33 non-wiling households 11 (33.33%) were found to be protest zero bidders. The issue of treating protest zero bidders is critical as it have a significant effect in aggregation of value. As stated by (Halstead *et al.* (1992) conventionally there are three principal means of dealing with protest zero bids: (a) drop them from the data set; (b) treat the protest bids as legitimate zero bids and include them in the data set; or (3) assign protest bidders mean WTP values based upon their socio demographic characteristics relative to the rest of the sample group. However, the NOAA panel guideline prepared for CV studies reported by Arraw *et al*. (1993) recommends the exclusion of protest responses from further analysis in order not to make biased aggregate value of the resource being valued. Many CV studies have applied this procedure (for instance, Stevens, 1994, Alemu, 2000; Gebrelibanos, 2012; Musa *et al*., 2015). Therefore, in this study; the protest bidders were not included in the analysis so that whole analysis considers only the 234 willing households (212 positive bidders' and 22 legitimate zero respondents).

Table 8. Reasons for not willing to participate for communal land soil conservation

Reasons for not willingness to pay	Number of respondent	Frequency
I do not have enough labor	22	66.67
The government should pay for it	8	24.24
I do not trust in the rehabilitation program	3	9.09
Total	33	100

Source: Own survey result, 2018

4.3. Soil Conservation Strategies Preferred by Sampled Households

Empirical reviews on soil and water conservation indicated that lack of consideration given to farmers' knowledge and perceptions towards soil and water conservation methods is a major factor responsible for the failure of past conservation programs in Ethiopia. Hence, it indicates that identification of farmers' preferred conservation strategies is one of the most important issues for better achievements in soil conservation programs. Following this, after the respondents have decided their willingness, they were asked to choose their own preferred conservation strategies. The response was included in the analysis in order to make the choices of conservation strategies participatory regarding the decision of conservation structure selection by farmers.

Accordingly, the 212 willing respondents (positive bidders) were asked to give their preferred soil conservation strategies for the conservation program. Although there are lots of soil conservation strategies, which can be used in communal lands, six conservation strategies were preferred by respondents. These include hillside terracing, hillside terrace plus trench, check dams (in the study area traditionally called *kitir*), tree plantation, area closure and half-moon. As presented in Figure 3, out of 212 willing households the majority of the respondents which are 178 (83.96%) households preferred hillside terrace. The reason could be due to the fact that the majority of the communal lands are mountainous (steep slope) so that this kind of strategy will be better to conserve the soil as well as the water. Similarly, from 212 willing households, 22 (10.38%), 84 (39.62%), 48 (22.64%), 60 (28.3%) and 58 (27.36%) households' preferred hillside terrace plus trench, check dam, tree plantation, area closure and half-moon respectively.

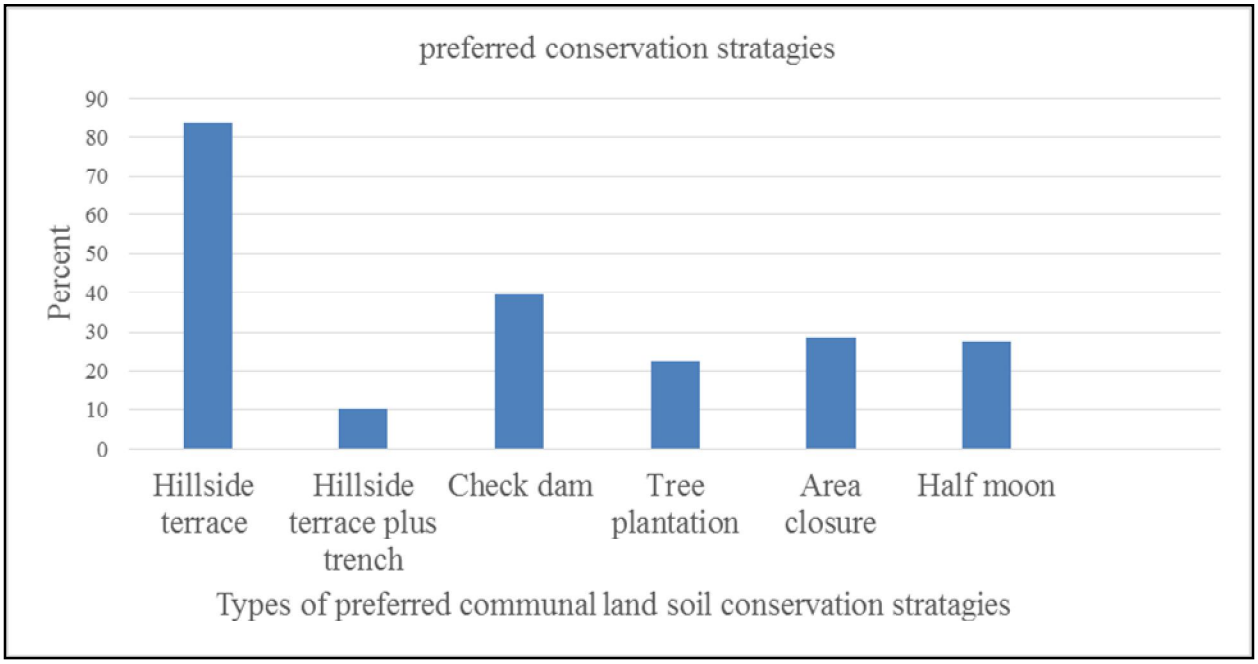

Figure 3. Soil conservation strategies' preferred by sampled households'

Source: Own survey, 2018

Moreover, the 2012 positive bidders were also asked to rate the approval of proposed hypothetical conservation program as "very necessary", "necessary" "not as such necessary and not necessary". From 212 willing households, 119 (54.14%); 89 (41.98%) and 4 (1.88%) rate the program as "very necessary", "necessary" and "not as such necessary" respectively (Appendix Table 3). The majority of the willing households rate the program approval as very necessary. Therefore, it can be assured from this result that respondents were aware of the communal land soil erosion problem and their concern for the need for environmental restoration as well as their need for the real implementation of the program.

4.4. Econometric Results

In addition to the descriptive statistics, a bivariate probit econometric model was used to analyze the effects of the hypothesized explanatory variables on WTP. However, before the bivariate econometric model was estimated, Variance Inflation Factor (VIF) and Contingency Coefficients (CC) were computed to check the existence of serious multicollinearity problem among continuous variables and correlation between discrete explanatory variables, respectively. As a rule of thumb, if the value of VIF and CC of a variable exceeds 10 and 0.75, there is a multicollinearity and correlation problem respectively. However, for this study the VIF result for all continuous variables was found to be less than 1.26 (Appendix Table 4), which confirms that the explanatory variables did not have severe problem of multicollinearity. The result of CC was also found to be less than 0.75 (Appendix Table 5), which indicates there is no correlation between the discrete variables. In addition, in order to control a potential bias due to non-normality and outliers, the robust estimator was used as a means to control the potential bias from this source (Mitchel and Carson, 1989; Haneman *et.al*., 1991; Wooldridge, 2005). For this reason, fourteen explanatory (9 continuous and 5 dummy) variables that were hypothesized to affect the willingness to pay for the communal land soil conservation were maintained.

4.4.1. Determinants of willingness to pay for communal land soil conservation practice

Before coefficient and marginal effect results of the bivariate probit model were interpreted, a decision was made whether the data is appropriate for independent probit/ logit, bivariate probit interval data model, random effect model and recursive probit. This crucial decision regarding the selection of the appropriate econometric model for the double bounded CV data was decided based on correlation coefficient test against the null hypothesis. The test against the null hypothesis is based on the criteria illuminated by Haab and McConnell (2002). The first assumption is that, when the correlation between the two error terms in the two dependent variables is zero, then the two dummy dependent variables (WTP1 and WTP2) can be independently estimated so that independent probit is the appropriate econometric model.

The second assumption is when the correlation between the two disturbances term is different from zero but not equal to one and statistically significant, bivariate probit is appropriate so that the two dummy dependent variables (WTP1 and WTP2) can be estimated jointly. On the other hand, when the correlation coefficient between the two error terms is exactly one (when there is a perfect correlation), interval data probit model is appropriate. All the three critical decision criteria can be checked by looking at the correlation coefficient result (rho) from the bivariate probit estimation results. As it is shown in table 9, the correlation coefficient result is 0.314 which is different from zero and significant at 5 % level of significance. It implies that there is a positive correlation between the two WTP responses. Therefore, the two dummy dependent variables can be estimated simultaneously. Hence, bivariate probit model was found to be the most appropriate model for this double bounded CV data.

The Wald chi-square test was used as the measure of the overall significance of a model in bivariate probit model estimation. The result of the bivariate probit model shows that the probability of the chi-square distributions (136.49) at 28 degrees of freedom is 0.0000, which is significant at less than 1% probability level. Hence, this shows that the variables included in the model in explaining the willingness to pay both for the first and the second bid equation fits the bivariate probit model at less than 1% probability level. Therefore, the parameters included in the model taken together are significantly different from zero at 1% probability level so that the null hypothesis which says 'the coefficients of all explanatory variables included in the model were zero' should be rejected.

Most of the explanatory variables used in this model had signs that confirm the researcher's prior expectation. As indicated in Table 9, the bivariate probit model estimate result revealed that, out of the total fourteen explanatory variables which were hypothesized, nine explanatory variables were found to have a statistically significant effect for the first bid equation. Out of these variable, five variables namely; sex of the household head (SEX), farm size near to communal land (FSNC), livestock holding (LIVES), frequency of extension contact (FEXTC) and perception of communal land soil erosion problem (PERCEPTION) were positively and significantly related with the probability of accepting and responding a 'yes answer to the initial offered bid.

On the other hand, the remaining four variable, age of the household (AGE), dependency ratio (DPR), migration (MIG), and initial bid (BID1) had negative and significant effects on the probability of accepting the initially offered bid. In addition, out of the fourteen hypothesized explanatory variables, seven variables were found to have a statistically significant effect on the follow up bid response (WTP2). Out these seven significant variables, three of them namely; dependency ratio (DPR), initial offered bid (BID1) and off-farm participation (OFPART) had a negative effects on the follow up bids, whereas the remaining four exogenous variables namely; farm size near to communal land (FSNCL), livestock holding (LIVES), credit utilization (CREDITU) and frequency of extension contact (FEXTC) had a positive effect on probability of accepting the follow up bid level. Additionally, the common underlying factors which affects both equations (WTP1and WTP2) are found to be DPR, LIVES, FSNCL, FEXTC and BID1.

Table 9. Bivariate probit regression results

	WTP1		WTP2		Marginal effect (Joint)	
Variables	Coef	Robust Std. Err	Coef.	Robust Std. Err	dy/dx	Std. Err
SEX	0.492**	0.251	0.034	0.21	0.029	0.08
AGE	-0.026**	0.013	-0.003	0.009	-0.002	0.004
DPR	-0.304***	0.092	-0.215***	0.068	-0.089	0.026
LITERACY	0.176	0.25	0.29	0.187	0.114	0.072
MIG	-0.201*	0.105	-0.045	0.099	-0.022	0.037
OFPART	-0.214	0.242	-0.429**	0.198	-0.164	0.071
*ln*AFIHH	0.001	0.073	0.06	0.045	0.023	0.018
FSNCL	0.734***	0.258	0.436**	0.208	0.184	0.08
DOCLFH	-0.006	0.073	0.068	0.056	0.025	0.022
LIVES	0.073*	0.039	0.067***	0.02	0.027	0.008
CREDITU	0.043	0.231	0.477**	0.198	0.179	0.073
FEXTC	0.037***	0.013	0.016*	0.008	0.007	0.003
PERCEPTION	0.617**	0.282	0.086	0.24	0.055	0.091
Bid1	-0.038***	0.011	-0.017*	0.01	-0.007	0.004
Cons	1.806	1.112	1.253	0.779		

Number of observation = 234

Log pseudo likelihood = -191.489

Wald chi2 (28) = 136.49

Prob > chi2 = 0.0000

Rho = 0.314

Wald test of rho=0: chi2 (1) = 3.72

Prob > chi2 = 0.054

y = Pr (WTP1=1, WTP2=1) (predict, p11) = 0 .421

Note: ***, ** and * shows significant variables at 1%, 5% and 10% probability levels, respectively

Source: Own survey result, 2018

Sex of the household head (SEX): As hypothesized, sex of the respondent is statistically significant and had a positive effect at 5% probability level for the first bid equation. This indicates male household heads are more likely to accept the first offered bid than their female counterparts. This could be due to the fact that physical soil conservation practices are challenging for female households since most of the soil and water conservation structures require digging the soil in which females are unfamiliar particularly in the study area. In addition, in rural areas women are commonly busy in household activities and their prime responsibility is usually child rearing so that they might not have extra time for soil conservation activities. As well, female-headed households are prone to fewer resources possession endowment and also some cultural constraints than male headed households. Due to these reasons male headed households would be more willing than female headed households. The results of the marginal effect result revealed that, keeping other factors constant at their mean values, being male will increase the probability of willing to pay for improved communal land soil conservation by 2.9%. The result of this study is found to be similar with some researchers who tried to examine the effect of sex on willingness to pay (Mesfin *et al*., 2011; Ayalneh and Berhanu, 2012; Almansa *et al*., 2012).

Age of the household head (AGE): The bivariate probit result has revealed a negative effect of age of the household head on the households' willingness to pay for the first bid equation at 5% probability level. The negative and significant effect between ages of the farmers on their willingness to pay could be mainly due to the several basic reasons. Older farmers have a short planning horizon as they have shorter life expectancy compared to the younger farmers so that they may not worry about the option value that will obtained from the improved communal land soil. Besides, the older farmers may face with a shortage of labor as their family members live a separate life through marriage. Consequently, older farmers who are lacking the labor necessary for the conservation of communal lands might prefer to be less willing than the younger farmers. As well, the nature of physical soil conservation work requires physical strength as it demands to dig the soil and carry stones for the construction of check dams, hillside trace and other physical conservation structure. During the focus group discussion, older farmers were giving a reason, like the difficulty of the physical conservation works on the mountainous communal areas for their reason for not opting to participate in the program.

Hence, in this regard, except health problem, younger households could have a physical strength that intern enhances their willingness for communal land soil conservation. The marginal effect result revealed that keeping the other factors constant at their mean value, an increase in age of respondent by one year will decrease the probability of willing to contribute labor for communal land soil conservation by 0.2%, This result is in line with the findings of some studies (Almansa *et al*., 2012; Gebrlibanos *et al*., 2013; Bamlaku and Yirdaw, 2015). However, this finding contradicts the results of Abera and Desale (2016) who have got older farmers are more willing than the younger farmers. They justified that older farmers may have longer farming experience so that they would be more willing than their younger counterparts.

Dependency ratio (DPR): The coefficient of dependency ratio had a negative effect as expected. It had a negative sign on both the pre specified initial bid and on the follow up bid at 1% probability level. The marginal effect of this variable indicates that, keeping other factors constant at their mean values, a one unit of an additional dependency ratio will decrease the probability to agree with the first and follow up offered bids by 8.9%. This suggests that households with a large number of economically inactive persons are less willing than those households with a lesser number of economically inactive persons. This could be due to the fact that a larger presence of economically inactive persons tends to create pressure on the active labor force. As a result, a household with more inactive numbers of household allocate less time for the conservation and rehabilitation of the degraded communal lands. In subsistence farming, households with large dependent families may perceive a higher risk of starvation than those with smaller families. It also may increase the personal rate of time preference (Bekele and Holden, 1998). Therefore; Households with more number of economically inactive persons may prefer to invest their time in any work that can provide them with some amount of income instead of giving a free labor time contribution. This result is in line with the research output done by Gulati and Rai (2015).

Migration (MIG): It had a negative effect on the initially offered bid at 10 % probability level. Migration in this context may have two possible negative effects. One of these possible effects can be seen from the labor market perspective. As indicated by Aryal (2005) in developing countries of rural areas where market imperfections are common phenomenon, migration may reduce the incentives for land conservation as land conservation activities are mostly labor intensive. It is because the family labor and the hired labor are not close substitutes. In the study area, one of the crucial issues for communal land soil conservation activity includes labor to construct and manage the hillside terrace, check dams and to constantly manage waterways in order to prevent the communal land from erosion as well as to protect the farmlands and road damages through off-site effects. Hence, migration makes harder to perform these activities effectively once the active individuals are migrated as it leads to labor shortage in the family. The other effects of migration in the study area can be seen from liquidity aspects. As stated by Aryal (2005) remittance incomes from migration may reduce farm households' dependency on agricultural income and thus possibly decrease investment on soil conservation. Through this, it may lead the farmer not to have a long-term plan on the agricultural sector so that they will not be willing to contribute their labor time on soil conservation activity. The result of the marginal effect of the variable shows that keeping the influence of other factors constant, farmer WTP to contribute labor for communal land soil conservation will decrease by 2.2% as the migration in the household members are increased by 1 person.

Off-farm participation (OFPART): Participation of households in off-farm activity had a negative effect at 5% probability level on the second bid response. When farmers are not able to survive in farming income, they are forced to look for a supplementary source of income to satisfy at least the basic needs of their family. Consequently, they will have lesser time for conservation activities. This is evident when it is considered that those farmers who participate in off-farm activities need to move to urban centers, and are not therefore in their village during much of the slack season when conservation activities are undertaken Meanwhile, the proposed conservation activities provided to the respondents in the CV scenario were planned to be done during the off seasons (it was decided based on the pre-test result) so that it overlaps with the off-farm working times. Therefore, it makes those off-farm participant households' to be less willing than their counterparts.

The marginal effect result indicates that keeping others factors constant at their mean value, the participation of household in off-farm activity will make the farmer less likely to be willing to contribute labor for communal land soil conservation for the proposed bids by 16.4%. Similar effects of this variable have been found in earlier studies by Berhanu and Swinton (2003); Gulati and Rai (2015) and Abera and Desale (2016).

Size of farmland near to communal land (FSNCL): Size of farmland which is near to communal lands was found to have positive effect on WTP as expected. It were found to have a positive and statistically significant effect both on the initial and the second bid equation at 1% and 5% probability levels, respectively. The result of the marginal effect of the variable shows that a one-hectare increase in farmers' farmland size which is near to the communal land, the farmers probability to agree with the first and second bid values proposed for communal land soil conservation will be increased by 18.4%, *ceteris paribus*. When a farmers have a large farmland which is near to communal land, the more his farmland will be in a high risk due to off-site erosion effects that will come from the degraded/eroded communal land. Thus, the conserved communal land has a huge opportunity for large farmland holders (through their income from the farmland) and for this reason, farmers might be more willing to pay their labor time for conserving communal land. On the contrary, those farmers who have fewer farmlands near–to communal land are less willing to participate in the proposed communal land soil conservation program since the degraded communal land have less direct or indirect effect on their farming income. This finding is in line with the result of Dagninet *et al*. (2016). They have got a positive relationship between owning farmland adjacent to church forests and willingness to pay for the conservation of church forests.

Livestock holding (LIVES): As hypothesized, livestock holding has positive and statistically significant effect at 10% and 1% probability level on both the respondents' initial and subsequent decision, respectively. The marginal effect result of this variable revealed that holding other things constant, an increase in one unit livestock holding in TLU leads to increase the probability of accepting the proposed bids for both the first and second bids by 2.7%. For rural farmers, livestock could be a proxy for wealth. Therefore, household who have large amount of livestock will contribute more of their labor time for environmental conservation than their counterparts.

Moreover, one of the very primary roles of communal lands in the study area is for livestock grazing. Hence, the more the communal land soil quality is improved, the higher will be the grass and other fodders. Consequently, farmers who have large number of livestock may expect higher benefits (grass) from the improved communal land; as a result, their WTP for improved communal land soil conservation will be higher than their counterparts. The finding supports the idea of Dietz *et al*. (2003) which is done on collective action for communal resources management. They suggest that the resource must be salient enough to the users that they are willing to invest time and energy to create new institutions. However, those farmers who have lesser number of livestock are not highly dependent on communal lands (for grazing purpose). Hence, as rational thinkers (in economics), they are reluctant to invest in communal lands on which they are less dependent for their livelihood. Therefore, the significant contribution of labor days from households that have higher TLU indicates not directly their aim to rehabilitate the eroded communal land area but rather also indicates their plan to get grass and fodder from the proposed communal land soil conservation program. Similar positive and significant results of livestock holding result were also achieved by other researcher (Gebrelibanos *et al*., 2013; Bamlaku and Yirdaw, 2015; Dagninet *et al.,* 2017).

Credit utilization (CREDITU): Credit utilization was found to have a positive and significant effect on the follow-up bid equation at 5% probability level. Credit may relax farmers' cash constraints. When the farmers are able to get credit, they may be able to buy livestock for fattening or production purpose thereby their demand for communal land (for grazing purpose) will be increased so that they will be willing to conserve the communal lands. Moreover, the positive relationship between credit and willingness to contribute labor may be related to the positive attitude developed through the awareness creation during accessing credit from formal credit givers. This due to the fact that in rural areas credit service are the major source of information and finance to those farmers who need to use improved agricultural technologies.

The marginal effect for this explanatory variable showed that households that has used credit was more willing to pay for communal land soil conservation than those who did not use credit by the amount of 17.9%, keeping other effects constant at their mean. The justification is also supported with the research done by Gemechisa (2017), on the study of farmers' willingness to pay for soil conservation practices in Gobuseyo district, eastern Wollega zone and by Desalegn (2015) on WTP study of smallholder farmers' for improved forage seeds in eastern Tigray.

Frequency of extension contact (FEXTC): As per expected, the frequency of extension contact by households had a positive relationship with WTP and it is statistically significant at a 1% and 10% for the first and the follow-up bids, respectively. The marginal effect shows that, for each additional contact days taking with extension agents other factors kept constant, the farmer would be 0.7% more likely willing to pay for both the first and second bid values. Extension service is assumed to improve and amplify farmer knowledge and skills about soil conservation activities and diffusion of information on available technological options for abating soil erosion. As a result, farmers with a more frequent contact with extension agents are able to get advice and training on impacts of erosion and the livelihood benefits from conservation. For this reasons, farmers who have frequent extension contact might be more likely willing to pay for the improved communal land soil conservation than their counterparts. The result is supported by Dagninet *et al*. (2016) and Abera and Desale (2016).

Perception of communal land soil erosion problem (PERCEPTION): Perception of communal land soil erosion problem was positively related with willingness to pay as expected and it is statistically significant at 5% for the first offered bid equation. The possible explanation is that knowing and observing the real communal land soil erosion problem is one of the preconditions for willing of farmers to participate in soil conservation programs. Farmers who observed the communal land soil erosion problem have more preference and will be willing to pay for improved communal land soil conservation practice than their counterparts. This suggests that perception of soil erosion problem plays an important role in WTP decision of communal land soil conservation.

The marginal effect result of the variable showed that households who perceived the existence of communal land soil erosion problem are willing to pay more than those who did not perceived communal land soil erosion problem by an amount 5.5%, *ceteris paribus*. Some empirical studies confirmed this finding (Gebrelibanos, 2012; Bamlaku and Yirdaw, 2015; Abera and Desale, 2016).

Initial offered bids (BID1): The bivariate probit model has revealed negative and significant effect of the initial bid at 1% and 10% level of significance for both the first and second follow up bid equation, respectively. This tells the possibility of accepting an offered bid amount increases as the bid amount goes down and vice versa. The result is consistent with the economic theory of the law of demand which says that quantity demand for goods decrease as an increased price. The marginal analysis indicated that as the starting bid prices increases by one unit, the probability of a household' WTP the proposed bids both in the first and second bid question will decrease by 0.7%, *ceteris paribus*. This result is in conformity with the findings of many studies (Gebrelibanos, 2012; Yibeltal, 2015; Musa *et al*., 2015; Bamlaku and Yirdaw, 2015; Gemechisa, 2017).

4.4.2. Mean willingness to pay and aggregation of benefits

The ultimate aim of fitting a statistical model to CV responses is to derive a summary measure of the WTP distribution (mean WTP) and to estimate the welfare change to society due to the improvement in a particular program as stated in (Hanemann *et al*., 1991). For the current study, the mean willingness to pay of the respondents that was captured from the double bounded data was calculated using the formula developed by Haab and McConnel (2002) which is specified and discussed on the methodology part. The researcher preferred to compute the mean willingness to pay from the parameter results of the first bid equation as in most cases there is anchoring bias in the follow up bid equation. Therefore, using the coefficient (-0.038) and constant (1.806) of the initial bid in the first equation (WTP1) which was estimated from the bivariate probit model (Table 9) the mean WTP for the proposed communal land soil conservation program were estimated to be 47.526 labor-days per year per household for five consecutive years. From an economic policy perspective, this mean WTP indicates that average farm households are willing to pay 47.526 of their annual working labor days for the improved communal land soil conservation program.

In addition, a central issue related to the measurement of welfare using willingness to pay is the aggregation of benefit from the hypothetical program. The mean WTP value that was computed from the double bounded format was used to estimate the aggregate benefit of the proposed communal land soil conservation program. After mean willingness to pay were calculated from the sampled households, proportion of protest zeros from each of the sampled *kebeles* as well as from the total households in the study area were excluded. Thus, the aggregate WTP were calculated by multiplying the mean WTP by the total number of households who are expected to have a valid WTP response (Table 10). Besides, for comparison purpose the aggregate benefits were also computed from the open ended CV data.

Table 10. Welfare measures and aggregate benefits through *kebeles*

Name of *Kebele*	Total number of HHs	Number of sampled HHs	Number of HHs accounted for protest zero	Proportion of protest zero	Expected protest zero	HHs withvalid response	Mean WTP	Total WTP by *Kebele*
Tekuleshi	1412	64	59	0.078	110.14	1301.86	47.526	61872.20
Zobile	1288	59	57	0.034	43.79	1244.21	47.526	59132.32
Rama	1425	65	61	0.063	89.78	1335.22	47.526	63457.67
Amaya	1254	57	57	0	0.00	1254	47.526	59597.60
Total	5379	245	234		243.71	5135.29		244059.79

Source: Own survey result, 2018

As shown in the table, the total WTP for the communal land soil conservation in terms of labor days for the four sampled *kebeles* was estimated to be 244,059.79 labor days per year. The total WTP for the four sampled *kebeles* in terms of money can be calculated by multiplying the total WTP in terms of labor days by the current minimum wage[4] rate in the study area. Accordingly, the total aggregate benefit of the proposed program based on the double bounded CV data for the four sampled *kebeles* was computed to be 14,643,587.4 birr per year.

[4]The minimum wage rate in the study area at the time of survey is 60 birr per labor.

Moreover, the total aggregate benefit from the open ended data for the four sampled *kebeles* were computed to be 234,477.34 labor days and 14,068,640.4 birr per year. Consequently, the aggregate benefit of the program based on double bounded and open-ended mean WTP for the four sampled *kebeles* for five years was estimated to be 1,220,298.95 labor days (73,217,937 birr) and 1,172,386.7 labor days (70,343,202 birr), respectively. It is also possible to calculate the total aggregate benefit of the program for the whole woreda. In Raya Kobo Woreda there are 49,841 rural households. After deducting the protest zeros (2237.86)[5] the expected total households with valid responses are 47,603.14 households. The total willingness to pay in the whole study area (Raya Kobo Woreda) is simply the multiplication of the mean WTP and the number of expected households to have valid responses. Therefore, the aggregate value of communal land soil conservation in the study area from the double bounded and open-ended formats are computed to be 2,262,386.83 labor days (135,743,209.8 birr) and 2,173,559.37 labor days (130,413,562.2 birr) per year for five years, respectively.

[5]Those are households that are expected to protest against the proposed communal land soil conservation program in the whole study area. It was calculated by the multiplying the percentage of protest sampled households (4.49%) by the total number of households in the study area (49,841). Thus, 4.49%*49,841 = 2237.86 and this number was deducted from the total number of households in the study area for welfare analysis.

5. SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter consists of summary, conclusion and recommendations on WTP for communal land soil conservation. The summary of the study which consists of the main purpose of this study to be carried on, the main step followed to achieve the objectives and gives a brief summary on the research finding. While the conclusion and recommendations point out the major activities, and strategies that have to be done by the responsible stakeholder, so as to create a sound and better communal land soil conservation activities on the study area.

5.1. Summary

In Ethiopia, soil is a valuable resource for the livelihoods of rural households. However, this valuable resource is currently facing an increasing degradation due to erosion particularly in the communal lands. Therefore, conserving communal lands soil is a crucial decision to hasten the improvement of the rural farmers' livelihoods through livestock production and other livelihood options. Participating local community at all phases (inception to implementation) of the conservation program is necessary for sustainable soil conservation practice in communal lands.

This study was undertaken to identify factors determining households' willingness to pay for soil conservation on communal lands and estimating the aggregate welfare gain of the proposed conservation program in Raya Kobo *woreda*. The major sources of data were obtained from cross-sectional contingent valuation survey of 234 sampled respondents using multi-stage sampling technique with structured questionnaire with trained enumerators. Double bounded dichotomous choice format with a follow up open-ended question was employed to elicit households' willingness to pay. Before the final survey was conducted through DBDC format with an open ended follow up question, a pilot survey was conducted from 30 randomly selected households through open ended format. The most frequent results from the pilot survey result were used as a starting bid for the final survey. Following this, a labor day of 24, 36 and 48 was used as starting bid in the final survey.

The data were analyzed using descriptive statistics, inferential statistics and econometric model. Descriptive statistics like average, frequency, standard deviation and percentage were used to describe demographic, socioeconomic and institutional characteristics of the sampled respondents. Inferential statistics such as chi-square and t-test were used to see the existence of significant mean or percentage difference between willing and non-willing households in terms of the hypothesized independent variables on the initial offered bid.

The result of descriptive statistics result from the 234 sampled households showed that 197 (84.19%) households were willing to accept the initial offered bid whereas the remaining 37 (15.81%) households were not willing. However, out of these 234 households, 212 (90.6%) respondents were willing to contribute some amount of labour for the proposed communal land soil conservation practices. Furthermore, the inferential statistical result of t-test and chi-square test revealed that there was a significant mean/percentage difference between willing and non-willing households for hypothesized variables, except for some variables like, annual farm income, and distance from home to communal land and credit use of sampled respondents.

A bivariate probit model was employed to analyze the influence of the hypothesized explanatory variables on farmers' willingness to pay for communal land soil conservation However, before the models were estimated and the marginal effects were interpreted the problem of sever multicollinearity among continuous variables and correlation problem among discrete variables were checked by using VIF and CC, respectively. The bivariate probit result showed that households' WTP decisions for communal land soil conservation are shaped by a host of factors. Five of the 14 variables used in the model namely; sex of the household head, size of farmland near to communal land, livestock holding, frequency of extension contact, and perception of communal land soil erosion problem displayed a statistically significant and positive effect on the respondents' first bid response (WTP1). On the contrary, age of the household head, dependency ratio, migration and the pre-specified initial bid exhibited a statistically significant and negative effect on the respondents' first bid response (WTP1).

Furthermore, four variables which are size of farmland near to the communal land, livestock holding, credit utilization and frequency of extension contact are found to have a positive and significant effect on the second follow-up bid response (WTP2). On the other hand, factors like dependency ratio, off-farm income participation, and the pre-specified initial bid unveiled negative and significant effect on respondents follow-up bid response (WTP2).

In addition, the bivariate probit model was also used to calculate the mean WTP from the double bounded dichotomous choice format. Meanwhile, mean WTP from the open ended format were also computed for comparison purpose. Consequently, the mean WTP from the double bounded dichotomous choice format and open ended format were estimated to be 47.526 and 45.66 labor days per household per year, respectively. The result revealed that the farmers are willing to pay the proposed program. The aggregate welfare gain from the proposed communal land soil conservation program in the study area based on the double bounded dichotomous choice format and open ended format was computed to be 2,262,386.83 labor days (135,743,209.8 birr) and 2,173,559.37 labor days (130,413,562.2 birr) per year for five years, respectively. The study revealed that the value of communal land soil conservation from double bounded format was marginally better as compared to the open ended format. Therefore, in examining the value of non-marketed environmental goods and services employing contingent valuation method in the form of double bounded dichotomous choice format is better than the open ended format. Above all, the study found a very high level of welfare gain from the proposed communal soil conservation program on the study area.

5.2. Conclusion and Recommendations

The result of study showed that demographic and, socio-economic characteristics, and institutional factors contribute for households' willingness to pay on communal land soil conservation practice in the study area. Hence, government policy and programs designed to combat communal land soil erosion problem in the study area have to consider these factors for sustainable and better achievements. Based on the study, the following points should be given emphasis to implement policies that enhance farmers' participation in the planning and implementation of communal land soil conservation activities.

Farmers of the study area were found to be willing through labor contribution as opposed to monetary contribution. Hence, in order to achieve sustainable communal land soil conservation, the farmers WTP payment should be through labor contribution.

The result shows that sex of the household head affected WTP decision positively; entailing male-headed households were willing to participate more for communal land soil conservation than female-headed households. This is due to the fact that male-headed households have a better access to resources such as land, capital and information than their female counterparts. Besides, there is a cultural constraint that limits female headed households to participate in any activities like soil conservation. Therefore, the policies should aim to empower women through self-help groups and support them by creating awareness on cultural constraints and enhance their resource possession so that they can take their part in soil conservation.

The results of this study also showed that credit is positively and significantly related to the probability of households' willingness to pay. Hence, policymakers have to increase the coverage of capital markets in the study area with flexible collateral requirement that will consider the local farmers' ability.

The result of the study implies more frequent contact between the farmers and development agents could enhance farmers understanding of the communal land soil erosion problems as well as the benefits from its conservation. Therefore, there should be further effort on awareness creation of farmers to increasing their contact and also quality of services given by agricultural extension workers especially with a particular focus on natural resource conservation technical skills.

The result also implies that households with more number of migrant family members are unlikely to be willing for communal land soil conservation than those who have less numbers. Besides, from the model result, young farmers are found to be more likely to be willing than older farmers. It implies that losing the young farmers through migration has a huge adverse impact on soil conservation. Therefore, there must be further study which could identify the factors which contributes for the migration of economically productive younger farmers so that will be possible to find alternative solutions.

Moreover, households of the study area were found to have their own preferred conservation strategy in which they are going to invest their labor time for the communal land soil conservation. Hence, it indicates that farmers should be the best judge for the selection of the conservation strategies.

Therefore, policymakers have to take in to account farmers' preference of conservation strategies rather than ordering them to adopt and practice what they do not believe in its worthiness. This should be one of the most important measures for the implementation of the proposed communal land soil conservation program in the study area.

Finally, from the result, the laissez-faire approach of communal land soil conservation is recommended, since the approach is primarily demand driven, dependable on market forces and voluntary choices of the local communities, and is very likely to induce sufficient investment in soil conservation of communal lands. However, such studies should also be complemented by other cost based studies that can examine the cost of conservation activities since the current study analyses only the demand side information for communal land soil conservation.

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7. APPENDICES

7.1. Appendix I. List of Tables in the Appendices

Appendix Table 1. Joint response for occurrence of migration and shortage of labor

Response(occurrence of migration and labor shortage in the household)	Frequency	Percentage
Migration-Labor shortage	65	27.78
Migration-No labor shortage	11	4.7
No Migration-Labor shortage	37	15.81
No migration-No labor shortage	121	51.7
Total	234	100

Source: Own survey result, 2018

Appendix Table 2. Conversion factor used to estimate Tropical Livestock Unit (TLU)

Animal category	Conversion factor
Calf	0.25
Weaned Calf	0.34
Donkey (Young)	0.35
Donkey (adult)	0.70
Camel	1.25
Heifer	0.75
Sheep and Goat (adult)	0.13
Caw and Ox	1.00
Sheep and Goat young	0.06
Horse	1.10
Chicken	0.013
Calf	0.25

Source: Storck, *et al*. (1991)

Appendix Table 3. Rate of approval of the communal land soil conservation program

Rate of approval of the program	Number of respondent	Frequency
Necessary	89	41.98
Very necessary	119	56.14
Not as such necessary	4	1.88
Total	212	100

Source: survey result, 2018

Appendix Table 4. Variance inflation factor for continuous variables

Variable	TLU	Bid1	AGE	MIG	FSNCL	AFIHH	DOCLFH	DR	FEXTC
VIF	1.26	1.25	1.13	1.10	1.10	1.09	1.09	1.07	1.06
1/VIF	0.79	0.80	0.88	0.91	0.91	0.92	0.92	0.94	0.94
Mean VIF					1.13				

Where, TLU= Size of total livestock in tropical units, Bid= bid, AGE= Age of the household, MIG = Migration, FSNCL= Farm size near to communal land, AFIHH = Annual income of households, DOCLFH = Distance of communal land from home, DR= Dependency ratio, FEXTC= Frequency of extension contact

Source: Own survey result, 2018

Appendix Table 5. Contingency coefficient for dummy variables

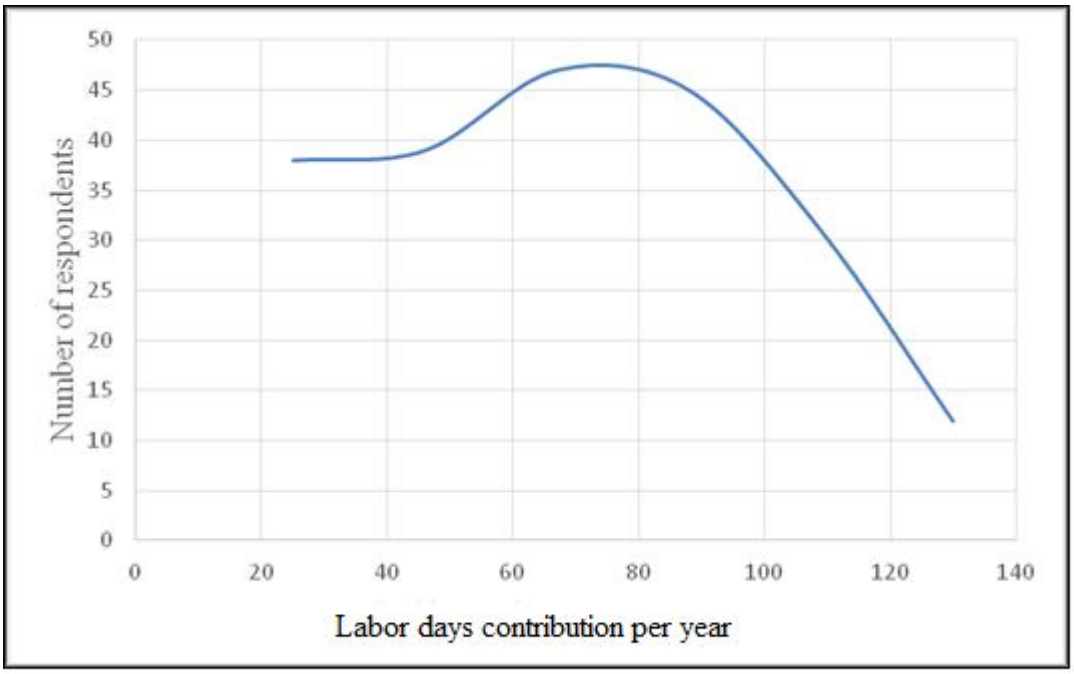
	SEX	LITERACY	OFPART	CREDITU	PERCEPN
SEX	1.0000				
LITERACY	0.2018	1.0000			
OFPART	-0.1593	-0.0519	1.0000		
CREDITU	-0.2176	0.0732	0.0536	1.0000	
PERCEPTION	-0.0297	0.0793	-0.0055	-0.0183	1.0000

Where, SEX= Sex of the household head, LITERACY= Literacy status of the household head, OFPART=of participation of household, CREDITU= Credit utilization of the household, PERCEPTION= Perception of soil erosion problems

Source: Own survey, 2018

7.2. Appendix II. List of Figures in the Appendices

Appendix Figure 1. Frequency curve for communal land soil conservation from open ended CV data



7.2. Appendix III. Farm households interview schedule

General information

Name of enumerator _____ Sign_____

Name of the Keble_____

Name of the village _____ Date of interview_____

Dear respondents,

The purpose of this questionnaire is to collect data for the master thesis research entitled with" **Determinant of Households' Willingness to Pay for Soil Conservation on Communal Lands in Raya Kobo Woreda, North Wollo Zone, Ethiopia"**. Your response to this questionnaire will be an input for the success of the study.

The investigator wants to make sure that your participation is totally voluntary and information collected through this questionnaire will be used only for academic purpose and will be kept confidential. Therefore, you are kindly requested to give genuine response freely.

Thank you in advance for your cooperation

1. RESPONDENT GENERAL INFORMATION

1.1 . Respondent's ID number: _____

1.2. Age of the household head: _____

1.3 . Sex of household head: 1.Male 0. Female

1.4 . Literacy Status: 1. Read and write 0. Not read and write

1.5 . If you can read and write, years of schooling (in years completed)_____

1.6 . Marital status (please tick one): 1. Single 2. Married 3. Divorced 4. Widowed

1.7 Religion: 1. Orthodox 2. Muslim 3 Protestant 4. Catholic 5. Others_____

1.8 Occupation____ 1. Farmer 2. Merchant 3. Other_____

1 .9.Ethinicity:_____ 1.Amhara 2. Oromo 3. Tigri 4. others_____

1.10. Year of occupancy in this Kebele_____

1.11. Household composition by age group

Age category	Number	
	Male	Female
Inactive (1-14)		
Active (15-64)		
Inactive (>65)		
Total		

1.12. Did your active household members participate in farming work? 1. Yes 0. No

1.13. If yes, how many of them participated,

Male_____ Female_____ Total _____

2. LAND SIZE AND HOUSEHOLD'S LAND USE

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

2.2.. If you said yes (own ___timad__hectare, rented in_____timad___hectare and share crop_____timad___ hectare

2.2.1. For grazing_____timad___ hectare

2.2.2. Fallowed in 2009 _____timad___ hectare

2.2.3. For forest_____timad___ hectare

2.2.4.. Homestead_____timad___ hectare

2.2.5. Others in timad_____ hectare

2.3. How many years since you started farming (Farming experiences) _____ years?

2.4. Slope of communal land (as perceived by the farmer): 1.Very steep 2. Steep 3. Gentle slope 4. Flat 5. Others specify

2.5. . Do you have farmland near to the communal land? 1. Yes 0. No

2.6. If yes(own_____timad, rented in_____timad, share crop_____timad)

2.7. How far is the nearest farmland to the communal land?_____in k.m_____in minute_____

2.8. Average slope of your farm land which is near to the communal land (as perceived by the farmer): 1.Very steep Steep 2. Gentle slope 3. Flat 4.Gentele slope 5. Others specify

2.9. How far is the nearest market from your home in Km_____ in minute_____?

2.10. What is the distance between the communally lands to your home in Km_____in minute_____?

2.11. For what purpose you are using the communal lands right now? 1. for grazing livestock's 2. For collecting fire wood and guarding 3. Recreational 4. Others_____

3. LIVESTOCK OWNERSHIP AND CROP PRODUCTION

3.1. Do you own livestock? 1. Yes 2. No

3.2. If ***yes***, please describe the livestock you own.

S/N	Type of livestock	Number of livestock	Did your sale livestock last year and this year? 1. Yes 2. No	If yes, Income obtained in this year (2010)	If yes income obtained in last year (2009)
1	Oxen				
2	Cow				
3	Sheep				
4	Mule				
5	Horse				
6	Donkey				
7	Goat				
8	Poultry				
9	Bull				
10	Heifer				
11	Camel				
12	Calves				
13	Other (Specify)				
Total					

3.3. CROP PRODUCTION

Crop	**Yield**	**Did you sale the crop last production season? 1. Yes 2. No**	**If yes, Amount of income obtained**	**If no, what is the reason**
4.1 Annual crops				
Barely				
Wheat				
Teff				
Sorghum				
Maize				
Rice				
Bean				
Pea				
Castor bean				
Finger				

Crop	**Yield**	**Did you sale the crop last production season? 1. Yes 2. No**	**If yes, Amount of income obtained**	**If no, what is the reason**
Millet				
Others				
4.2 Vegetables				
Tomato				
Onion				
Potato				
Carrot				
Lettuce				
Cabbage				
Beetroot				
Pepper				
Other				
4.3 Fruits				
Avocado				
Banana				
Mango				
Papaya				
Orange				
Lemon				
Other				
4.4 Perennials				
Khat				
Coffee				
Eucalyptus				
Gesho				
Other				
Total				

4. **INCOME SOURCE OF HOUSEHOLD**

4.1 What are your main sources of income?

1. Crop sale 2.Livestock sale 3. Off -farm income 4. Non-farm

4.2 Have you earned income from the following sources? Indicate in the table below

No	**Income source**	**Yes**	**No**	**Annual income in Birr in 2009**

No	Income source	Yes	No	Annual income in Birr in 2009
1	**Farm income**			
1.1	Sale of crop, fruit, vegetable produce			
1.2	**Sale of livestock**			
1.2.1	Meat			
1.2.2	Milk			
1.2.3	Butter			
1.2.4	Cheese			
1.2.5	Egg			
1.2.6	Honey			
1.2.7	Hides/skin			
1.2.8	Others			
2.	**Off farm**			
2.1	Daily laborer			
2.2	Sale of Charcoal and Fire wood			
2.3	Sale of forest products for construction			
2.4	Rent of land			
2.5	Rent of pack animals			
3	**Non-farm**			
3.1	Weaving			
3.2	Pottery			
3.3	Construction work			
3.4	Petty trade			
3.5	Sale of local drink and food			
3.6	Formal salary			
3.7	Carpenter			
3.8	**Remittance**			
3.9	Leather work			
4.	Other			
	Total			

5. **CREDIT UTILIZATION**

5.1. Do you have formal or in formal credit access whenever you want to borrow?

1. Yes 0. No

5.2. If no to Q5.1, why? _____

5.3. Have you got credit in the last year (2009 E.C)? 1. Yes 0. No

5.4. If yes, Q5.3, where do you get the sources? 1. Banks 2. Service cooperatives 3 Neighbors and relatives 4.Micro finance institutes 5.Other (specify) _____

5.4. If yes, Q 5.3, how much you borrowed in last year (2009)? (Use the table below)

Banks (birr)	ACSI (birr)	Cooperatives(birr)	Neighbors and relatives (birr)	Micro finance institutes	others	Total

5.5. If yes to Q5.1 for what purpose did you spend? 1. Purchase of farm inputs 2. Household consumption 3. To pays tax and debts 4. Purchase of livestock 5. To pay expenses related communal land conservation. 6. Others (specify) _____

6. INSTITUTIONAL CONTACT AND AVAILABILITY OF ASSISTANCE

6.1 Is there farmers training center (FTC) in your kebele? 0. No 1. Yes

6.2 How far is the FTC from your home _____ in Km?

6.3 Do you contact with DA's related to Soil and water conservation? 1. Yes 0. No

6.4 If yes, how many times do you contact with them _____ times per year?

6.5 Have you received extension advice on soil conservation practices so far?

1. Yes 0. No

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

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

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

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

6.9 Have you attend any soil conservation training in the past?

1. Yes 0. No

6.10 Do you think that assistant is necessary to protect communal land / natural resources from degradation? 1. Yes 0. No

7 AWARENESS TOWARDS EROSION AND EROSION HAZARDS

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

7.2 What is your opinion about the communally used land soil erosion from time to time?

1. Increasing 2.Decreasing 3. No change 4.others

7.3 Do you think that soil erosion that needs to be redressed by extra efforts? 1. Yes 0 No

7.4 How do you rate the important of reducing soil erosion in the future? 1. important 2.very Important

7.5 Do you feel responsible when communal land are degraded? 1. Yes, I fell 0. No I don't fell

7.6 How do you observe the following effects of soil erosion in your area?

	Erosion effects	Write 1=If you observe ,otherwise write zero If you did not observe
1	Decrease in soil infiltration	
2	Decrease in forests	
3	Deterioration in recreational value of the environment	
4	Decrease in agricultural yield	
5	Distraction of habitants	
6	Climate change	
7	Dryness of stream	
8	Road damage	
9	Affects animal health (negatively)	
10	Shortage of grazing/farmland	
11	Drought	
12	Others	

7.7 . Based on your judgment, do you think that erosion will severe in the future if situations remain unchecked? 1. Yes 2. No 3. I do not know

7.8 If yes, what negative changes do you expect in the overall environment? 1. Shortage of crop production 2. Rising of temperature (increment of co_2) 3. Loss of livelihood options 4. Biodiversity loss 5. Shortage of rainfall 6. Road damage 7. Others (specify)_____

7.9 What are the possible reasons for degradation of the communal lands (multiple responses possible)?

1. Livestock grazing 2. Lack of property right 3. Expansion of farm lands 4. Cutting trees for fire wood, construction, and sale 5. Poor communal land conservation habit of the community 6. Limited income source of the farmers 7. Governments top down policy that did not consider farmers cultural knowledge 8. Others (specify) _____

7.10 Are you aware of the off-site effects of soil erosion? _____ 1. Yes 0. No

7.11 What do you think is the main causes of off-site soil erosion problem in yourarea?

1. Lack of conservation structures
2. Steep land without conservation structures
3. Damaged conservation structures
4. Deforestation and in appropriate farming practices
5. Others _____

7.12 Do you participate in conservation programs like FFW/ CFW or others that undertake soil conservation activities? A) Yes B) No

7.13 If yes, what is the reason for deciding to participate?

1. Because I know that soil erosion is a serious environmental threat
2. I need the reward (money or food) that I get from participation in such program
3. It is because others in my area participated so that I have to participate
4. It is the government's plan so that I have to undertake it
4. others_____

8. MIGRATION

8.1 Do you have migrant persons in your family? 1. Yes 0. No

8.1.1 If yes, answer the question on the table bellow

No	Sex of migrants	Age of migrants	Migrants years of Education
1			
2			
3			
4			
5			

8.2 Have you ever used your income from migrate family for conservation expenses?

1. Yes 0. No

8.2.1 If no, for what purpose you are you using?_____

8.3 Do you think migration has negative impact for soil and water conservation?

1. Yes 0. No

8.3.1 If yes, how? _____

8.4 Do you think that migration leads the young farmers to not have long term plan on agriculture?

1. Yes 2. No

9. AVAILABILITY OF LABOR

9.1. Do you currently have labor shortage for crop and livestock production?

1. Yes 0. No

9.2 If yes to 9.1, how do you solve labour shortage?

1. Hiring labour 2. Use communal labour (Debo,Jiga) 3. Other (specify)----------

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

1. Permanent 2. Casual 3. Both =3

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

9.5. If casual, 9.3. How much is the cost of labor during peak and slack working periods of the year in your area?

1. Peak season _____Birr/person/ Labor Day,

2. Slack season _____ Birr/person/ Labor Day.

9.6Can you get labour to hire when you are in need?

Yes =1 no =0

10. Communally used land Rules and Enforcement

10.1 Would you agree on community responsibility of communally used land management?

1. Agree 2. Disagree

10.2 If you do not disagree, who is responsible to protect the communal land from degradation?

1. The community who are benefited from the communal land 2. Government 3. NGOs 4. Others (specify) _____

10.3 If there are peoples who are cutting indigenous trees on the degraded communal lands for fire wood and **ATIR**, in a carless manner, etc. so that they are enhancing erosion. How can you stop these peoples from this activity?

1. Advice 2. Money punishment 3. Labor punishment 4. Social sanction 5 Jail 6. Others _____

11. Social organization and leadership

11.1 Do you have social position in the community? 1. Yes 2. No

11.2 Fill in which of the following organization are you member and leader and why you join the organizations?

SN	Organization/Institution	Responsibility			Purpose			
		Member	Leader	Committee	Self-help	Voluntary service	Political	Others
1	Agricultural cooperatives							
2	School council							
3	PA council							
4	Saving and credit union							
5	Natural resource conservation team							
6	Mahiber/senbete							
7	1to5 leader							
8	Church/Mosque/ administrator							
9	Others (Specify)							

11.2. Do your organizations discuss the need to protect and conserve communal lands?

1. Yes 2. No

12. SOCIAL CEREMONY AND HOLIDAYS

12.1 Do you have a social ceremony festivity on, Senbetie, Mahiber, Tezikar, Kristina,Serg, Sedeka,? 1. Yes 0. No

12.2. If yes to Q 14.1, how many days you spent on them within a year?_____

13. TENURE OR PROPERTY RIGHT

13.1 For how long have you been with your communal land? ----------

13.2 Do you feel secure your farmland belongs to you at least in your lifetime?

1. Yes 0. No

13.3 If no, what are the reasons? ----------

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

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

13.5 Do you think that giving farmland for the newly married household members have accelerate soil erosion? 1. Yes 0. No

14. WILLINGNESS TO PARTICIPATE IN COMMUNAL LAND SOIL CONSERVATION PRACTICES (Enumerator read the CV scenario)

14.1. Are you willing to participate in the conservation program?

1. Yes 0. No

14.2. If yes, by what means you are willing to participate (multiple answers possible)?

1. Cash Payment 2. Labor contribution 3. Both 4. Others

14.3. If you are willing to contribute labor days, at which period you are willing to contribute?

1. At a time where there is not agricultural production 0. At any time where conservation is needed

14.4. If you are willing to contribute cash**,** at which period you are willing to contribute?

1. After the harvest Season 0. At any time where money for conservation is needed

14.5. If your answer for Q15.1 is cash or labor or both, answer the question below.

Payments	a. Starting Price (Birr)/ Man days 24/36/48	b. Would you be willing to pay 24/36/48 labor days for communally used conservation? If Yes → d If No → e	c. Increment (Birr/man-days) (a/2 for no answer and 2*a for yes answer	d. Would you be willing to pay 48/72/96 labor days? If Yes→ • f	e. Would you be willing to pay 12/18/24 labor days? If→No • g	f. What is the maximum amount you would be willing to pay? .	g. What is the minimum amount you would be willing to pay? Write **0** if respondent unwilling to pay	If your answer is yes-no/ no-yes, please state your willingness to pay.
Cash								
Labor								

14.6. What is the main reason for your maximum willingness to contribute labor days in Q14.5 above?

14.7. 1. I think it is worth that amount

2. Others should pay

3. I could not afford more

4. Other reason(specify)_____

14.7. How would you rate the overall approval of the program?

1. Important 2.Very important 3. Not as such important 4. Not important

14.8. If you refuse to pay any amount/ not willing to participate in the conservation practice of communal lands, please explain your reasons why.

1. Do not trust in rehabilitation

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

3. The government should pay for it

4. I do not observe the problem of soil erosion

5. Other (specify, if any) _____

14.9. As you are informed in the scenario (Appendix IV), one of the main objective of this program is to know your preferred conservation intervention strategy for the proposed program based on your preference. We believe that you have a very good knowledge and skill regarding what must be done on your communal lands and also you are the only person who will decide what must be done on your communal lands. In the past soil and water conservation in this area were not succeeded as desires that may be the implementation of conservation practice with prior participation. Government should not have to order you to do a certain conservation practice without considering you preference in the planning process rather the government should have to identify and examine your preference for conservation practice that has to be done on the communal lands before the implementation the conservation programs. Now, we are here to identify and examine your indigenous and modern conservation practices that have to be done for the coming five years for the proposed program. Accordingly, we will recommend the policy makers to supply necessary assistance for each conservation practice you choose. Thus, use the following table and please identify your preferred conservation strategies and give your critical reasons why you preferred these conservation methods

No	Lists of your preferred conservation strategies	Your reason for preferring it
1		
2		
3		
4		
5		
6		
7		
8		

7.3. Appendix IV. CONTINGENT VALUATION SCENARIO

As you might notice it by yourself through time or heard about it, the communal lands of these Keble's were very green, conserved, full of forests and also the streams and the rivers were also high. However, as you are observing through time, these valuable lands are being degraded because of soil erosion and related factors so that it is affecting the farming income and livestock income. Moreover, as you know that the soil erosion in the communal lands in this *kebeles* is not limited to the communal land but also it has off-site effects like landscape degradation; damage on rural road; downstream sedimentation of reservoirs and water channels; crop burial by sediment and deterioration of recreation & amenity values and visual detraction. Hence, to minimize the onsite and off-site effects of soil erosion, the best option will be to conserve the communal land. Additionally, it is the community's morality responsibility to transfer a healthy farming and communal land to the coming generations. Thus, to provide a safe communal land to the coming farming community, you must care for the communal lands from soil erosion by taking immediate conservation mechanism. Although, the past and the current 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 by water due to a budget constraint and its top down approach .We believe that one of the main reason the governments and other NGOs conservation programmes to fail might be because of the top down approach that did not consider the farmers indigenous conservation knowledge and preference for different adopted conservation interventions.

To overcome this problem, it is not an easy task, but possible to stop and reverse the degradation problem by conservation works by considering the farmers indigenous knowledge in the planning process. The conservation work includes rehabilitation of the soil via physical and biological conservation practice based on your preference and thoughts that will be appropriate for the area. Such conservation practice need initial investment cost, running cost and labor starting from the inception of the project to the end. Now we are planning to invest a program that aims at improving the communal land soil through your free contribution so that the improved soil in the communal lands will benefit you in return.

But, bear in mind that your participation in the conservation program will decrease your labour budget or cash which you are going to spend on other activities. This will be done if and only if you as the owner and beneficiary of the communal lands of this area willing to participate. The payment will be in the form of labor and/or 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 agricultural production) or it can be collected at any time based on your choice so as to tackle the erosion problem. Therefore, we want to know the amount of days/money/ you are willing to spend on such activities for the coming five years. Bear in your mind that the project will be realized only if the overall money/labor the farmers are willing to contribute to that fund covers that part of the cost that cannot be borne by government alone. 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 for the coming five years. 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.

Appendix V. Open Ended Question

Open ended questions that was used during the pre –Test in order to know starting pint bids

After opening statement

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

Check list for focus group discussion

- Please list all problems associated with communal lands soil erosion in your village or kebeles.
- What are the major causes of communal land degradation?
- What kinds of communal land management practice have been practicing in your kebele?
- What interventions must be made for better implementation of the proposed conservation program in your area?
- What will be the challenges and opportunities of the proposed communal soil conservation in your village?
- **Check list for informant interview**
- Do you think that communal land soil conservation practices based on farmer willingness will lead sustainable soil conservation?
- Do you think this bottom-up approach is better than the old top down app that has been done so far?
- How do you see the role of conserved natural resources for growth and development of our country Ethiopia?