EFFECT OF PHYSICAL STRUCTURE ON SOIL AND WATER CONSERVATION IN ETHIOPIA: THE CASE OF SMALLHOLDER FARMERS IN GUBALAFTO DISTRICT OF NORTH WOLLO ZONE.

BY

Ketsella Negussie Gebretsadik

A THESIS SUBMITTED TO DEPARTMENT OF RURAL DEVELOPMENT OF INDIRA GANDHI NATIONAL OPEN UNVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR MASTER OF ART (MA) DEGREE IN RURAL DEVELOPMENT

March, 2013

Addis Ababa, Ethiopia

DEDICATION

To my mother W/o Huluagersh Agonafer and my father Priest Negussie Gebretsadik who fostered and shaped me from childhood and made me reach to this level.

DECLARATION

I hereby declare that the Dissertation entitled ***EFFECT OF PHYSICAL STRUCTURE ON SOIL AND WATER CONSERVATION IN ETHIOPIA: THE CASE OF SMALLHOLDER FARMERS IN GUBALAFTO DISTRICT OF NORTH WOLLO ZONE*** submitted by me for the partial fulfillment of the M.A. in Rural Development to Indira Gandhi National Open University, (IGNOU) New Delhi is my own original work and has not been submitted earlier either to IGNOU or to any other institution for the fulfillment of the requirement for any course of study. I also declare that no chapter of this manuscript in whole or in part is lifted and incorporated in this report from any earlier work done by me or others.

Place: ADDIS ABABA (ETHIOPIA) Signature…………………….

Date: December 2012 Enrolment No. 109100688

Name: Ketsella Negussie Gebretsadik

Place: ADDIS ABABA (ETHIOPIA)

CERTIFICATE

This is to certify that Mr. Ketsella Negussie Gebretsadik

Student of M.A. (RD) from Indira Gandhi Open University, New Delhi was working under supervision and guidance for his project work for the Course MRDP-001 His Project Work entitled ***EFFECT OF PHYSICAL STRUCTURE ON SOIL AND WATER CONSERVATION IN ETHIOPIA: THE CASE OF SMALLHOLDER FARMERS IN GUBALAFTO DISTRICT OF NORTH WOLLO ZONE*** which he is submitting, his genuine and original work.

Place: ADDIS ABABA (Ethiopia) Signature………………………..

Date:- March , 2013 Name Eylachew Zewudie (PhD)

Address: St. Mary's University College,
School of Graduate Studies
Institute of Agriculture and Development Studies.

ACKNOWLEDGEMENTS

I wish to list of individuals and institution that contributed, in one way or another, to the successful completion of my study. But they are too many to mention all. First of all, I would like to express my deepest gratitude to my research advisor Dr..Eylachew Zewudie, for his support and guidance from the inception up until the completion of this study.

My special thanks are also due to Temesgen Kassa for his constructive comments and advice during my thesis work. I am also grateful to my wife Alemtsehay Molla for her warm and friendly comments and support of my work during the study period. I would like to thanks North Wollo Department of Agriculture staff for giving all rounded technical support, moral support and advice they gave me during my study.

I thank and appreciate the staff of Gubalafto Woreda Office of Agriculture for their cooperation and assistance during data collection. It would have been impossible to collect data without the assistance of the development agent (as enumerators) and other staff members in the two offices. Last but not least, I would like to express my heart-felt gratitude to my parents' and friends for their love and encouragement since my childhood and offering me the opportunity of education they never had.

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

ANNEXES

Page

ACRONYMS

BPEDAR	Bureau of Planning and Economic Development for Amhara Region
CARE	Cooperative Assistance and Relief Everywhere
CSA	Central Statistical Authority
EARO	Ethiopian Agricultural Research Organization
FAO	Food and Agriculture Organization
FaWCDA	Forest and Wildlife Conservation and Development Authority
FFW	Food for Work
GDP	Gross Domestic Product
GWOANR	Gubalafto Woreda Office of Agriculture and Natural Resource
Masl	meters above sea level
MfM	Menschen fur Menschen
MOA	Ministry of Agriculture
NBE	National Bank of Ethiopia
NGO	Non-governmental organization
SWC	Soil and Water Conservation
WFP	World Food Program

ABSTRACT

EFFECT OF PHYSICAL STRUCTURE ON SOIL AND WATER CONSERVATION IN ETHIOPIA: THE CASE OF SMALLHOLDERS FARMERS IN GUBALAFTO DISTRICT OF NORTH WOLLO ZONE.

By: Ketsella Negussie Gebretsadik (B.Sc.)

Soil erosion in most part of Ethiopian highlands has reached the point where it will become increasingly difficult even to maintain the present day of agricultural production of basic food which is already insufficient in many regions of country. Currently, in response to the extensive land degradation, Ethiopia, through the ministry of agriculture, is undertaking efforts to reduce the problem in degraded areas including Gubalafto district of North Wollo Zone.

The objective of this study was to examine how small holder farmers in the study area are trying to reduce the challenges and impacts of soil erosion and what parameters considered to undertake conservation investment which enhance sustainable productivity of land. The primary data were collected from 101 sample households possessing 204 farm plots from 2 kebeles proportionately and randomly. SPSS model analysis at household level was used to estimate physical, Socioeconomic and institutional factors that affect the use of soil conservation measures. In addition descriptive statistics were also used as deemed necessary.

The result of this study indicated that famers' conservation decision and the extent of use of both improved and traditional soil and water conservation measures were influenced by physical, social, Economic and institutional factors. Area of cultivated land increased the probability of using improved soil and water conservation measures especially improved soil bund and cut off drain. Farmers' age decreased the use of improved soil conservation structures while education level of head of households has positive impact on soil and water conservation. Extension education had a substantial contribution to motivate the use of improved soil conservation measures but it had no effect on the use of traditional soil conservation practices. Land to labor ratio affected the use of both traditional and improved soil and water conservation practices.

Natural resource conservation policies should account for inter plot variation and the importance of physical factors in the design and promotion of conservation technologies. The need for policies which are likely to influence the awareness of individual farmers through extension service towards the effect of soil conservation and policy makers and development agencies should target soil conservation technologies. Soil and water conserving technologies particularly to areas relatively having greater arable land and to areas having smaller area of cultivated land; integrating of indigenous soil conservation practices with improved ones are crucial to increases sustainability and modern natural resource conservation system.

***Key Words**: -Ethiopia, Land degraded, Soil Conservation, policy maker*

1. INTRODUCTION

1.1. Background and Justification of the Study

Ethiopia is one of the heavily populated least developed countries in the world with an area of 1.14 million square kilometer and a human population of about 81 million which grows at a rate of about 2.7% annually (NBE, 2003). The Ethiopian economy has largely remained dependent on agriculture; this provides about 44% of the GDP, over 80% of the export revenue and employment for about 80% of the population (NBE, 2003). About 46% of the land mass lies in what is called the highlands, which constitutes areas above 1500 meters above sea level (masl). The highlands harbor about 88% of the country's population, over 95% of the regularly cultivated lands and about 75% of the livestock population (FAO, 1986).

In spite of the importance of agriculture in the Ethiopian economy, the level of food production has been low and the country is dependent on food aid. Increasingly, many farmers in Ethiopia are incapable of producing enough food to satisfy household consumption. The direct consequences are the occurrences of famines and reduced productivity of land (Siferaw and Holden, 1998). Ethiopia had food security until 1960s, but since the drought of 1975, food production has been very poor and lagged behind the population growth. As a result, significant amount of food (mainly as aid) has been received every year (Seyoum Et al., 1998).

The living conditions of the rural poor in Ethiopia have been worsened because of drought and increasing deterioration of the quality and quantity of natural resources, which are the main basis of subsistence agriculture. At present Ethiopia is facing greater land degradation problem. Some studies indicated that soil erosion and deforestation are two of the most important environmental problems in Ethiopia. For example the Ethiopian Highlands Reclamation Study (EHRS), Which contains one of the earliest major studies of land degradation in Ethiopia put the Total crop production loss due to erosion at 120,000 tons per annum in 1985(FAO,1986). According to the result of this study, one-half of the highland area was significantly eroded and over one fourth was seriously eroded, and over 2,000 km2 of farmlands have reached the point of no return.

Bojo and Cassells (1995) reassessed land degradation and indicated that the immediate gross financial losses due to land degradation in the Ethiopian highlands were about USD 102 million per annum which was about 3% of the country's GDP. The study also showed that virtually all of the losses were due to nutrient losses resulting from the removal of dung and crop residues from cropland, while the remaining was mainly due to soil erosion.

In the highlands of Ethiopia, deforestation has reduced tree cover to 2.7% of the surface area, 50-60% of the rainfall is estimated to be lost as runoff, carrying 2-3 billion tones of the top soil away annually (Hurni, 1988). In many areas, soil loss rates are much higher than soil formation rates, due to over cultivation. Estimated rate of soil formation in Ethiopia vary between 2 and 22 tons per hectare per year, while soil loss rates range from 51 to200tons per hectare per year in most highlands of the country (Tefera et al., 2000). The degradation of a large part of the Ethiopian highlands has reached where it will become increasingly difficult even to maintain the present day production of basic food which is already insufficient in many regions of the country (Atnafie, 1995, cited in Demeke, 1998).

Traditional cereal farming in Ethiopia is not only low yielding but also results in the mining of plant nutrients from the soil. After harvest, farmers remove the stalks and leaves for feed, fuel and building materials, which leave no crop residue to restore soil nutrients and organic matters (Seyoum et al., 1998). Due to decrease in the degree of vegetation cover, increased tillage that leave the surface smooth, the larger number of livestock and their frequent trekking for water and grass and poorly constructed roads, both water and wind erosion are becoming serious problems in Ethiopia.

All these factors are important in influencing the natural resource base of North Wollo Zone. While soil erosion is a problem in North Wollo zone, it is particularly series in Gubalafto district because of the rugged and rolling topography of the district. The purpose of this study is therefore; to investigate the physical, socioeconomic and institutional factors that influence farm level conservation efforts in Gubalafto district, North Wollo Zone.

1.2. Statement of the Problem

Agricultural development in Ethiopia is hampered by many factors among which land degradation is the major one, which is threatening the overall sustainability of agricultural production of the country. Most of the highland terrain has slopes of more than 16%, and only a fifth is considered free from erosion hazard. Most of the productive topsoil in the highlands has been degraded resulting in chronic food shortages and persistent poverty (Hans-Joachim et al, 1996).

Problems of poverty, land scarcity and soil degradation are prevalent in Ethiopia. Small holders are still poor, degradation has continued, and food insecurity is a great problem. Serious soil erosion is estimated to have affected 25% of the area of the highlands is now seriously eroded that they will not be economically productive again in the foreseeable future. The capacity of highland farming communities to sustain production is, therefore, under serious pressure (Hans-Joachim et al., 1996).

The complex inter-linkages between poverty, population growth and environmental degradation offer another dimension to the degradation to the land degradation problems. In recent years, rapid population growth has brought several changes: farm holdings have become smaller due to constraints in land availability; holdings are more fragmented; farmers cultivate fragile margins on steep slopes previously held in pasture and wood lots; many households particularly those owning little land or with large families are in great problem, fallow periods have become shorter, with longer cultivation periods. Consequences of more intensive farming and faming on steep slopes are declining fertility and increasing the high incidence of soil loss due to erosion (Shiferaw and Holden 1998). The use of external yield increasing inputs in Ethiopia is rudimentary and agricultural production relies heavily on technologies largely unchanged of feed for livestock, accompanied by high population pressure and a decline in land-man ratios, have made the traditional systems of regenerating soil fertility through fallowing and use of manure and crop residues increasingly difficult. Intensification of cropping on slopping lands without suitable amendments to replenish lost nutrients has thus led to wide spread degradation of land (FAO, 1986).

In response to the extensive degradation of its resource base, Ethiopia has taken some efforts to mitigate the problem of soil erosion and enhance or maintain the production potential of agricultural land. New soil and water conservation technologies were introduced in some degraded and food deficit area of the highlands, mainly through food-for- work incentives since the early 1980s. Even though, soil and water conservation technologies were promoted through the ministry of Agriculture in Ethiopian highlands including the study area, the farmers' perception to the problem of soil erosion and their responses to soil and water conservation practices have not been well studied. Moreover the factors influencing the use of soil conservation measures were not clearly identified (Shiferaw and Holden 1998).

Given this state of conditions, analysis of the issue of what specifically determines the decision taken by smallholder farmers to invest in soil and water conservation measures to maintain sustainable agricultural production and conserving the natural resource base of the country is not only an important and realistic option but it is also a means to sustain and improve the livelihood of the population.

1.3. Objectives of the Study

The general objectives of this study is, therefore, to examine how smallholders are trying to meet the effect of different types of soil and water conservation structure which enhance sustainable productivity of farming.

The specific objectives are:

- To identify and describe the most commonly used traditional (indigenous) and improved soil and water conservation methods.
- To identify physical and socio economic factors which affect farmers to use soil and water conservation measures.
- To assess the effect of practicing soil and water conservation measures on farm production and productivity in the study area.

1.4. Significance of the study

The importance of soil erosion and its consequence in Ethiopia has been emphasized repeatedly. For a long time concern had been raised on the alarming degradation of the natural resource in general and soil erosion in particular in the country. Different stake-holders (Government and NGOs) involved in rural development are highly concerned with this problem and they have been taking considerable measures to increase agricultural production and to improve or maintain the existing natural resource base of the country. Thus, extension agents, researchers, nongovernmental organizations (NGOs), and policy makers need to understand the small farmers' investment behavior in soil conservation measures to develop appropriate technologies and design effective policies and strategies that promote resource conserving and productive land use. Therefore the findings if this study would help different governmental and non-governmental organizations, and policy makers to design and develop effective soil conservation strategies.

1.5. Scope and Limitations of the Study

This study was carried out in Amhara National Regional State, North Wollo Zone Gubalafto district. Due to lake of sufficient cooperation from government bureaus or offices and lack of clear and truthful information getting from farmer, the study was carried out only in two kebeles and 101 samples households. Moreover, the study was mainly focused on widely introduced improved soil conservation technologies and most commonly used indigenous physical soil and water conservation measures. In addition, since the information was gathered through structured survey questionnaire, the quality of the information depends on the willingness, knowledge and recall capacity of respondents. Thus the information obtained may have some errors. Although, these were some of the expected limitation of the study, still the results can be used to develop appropriate soil and water conservation strategies for the study area and for other similar parts of the region.

1.6. Organization of the Thesis.

This thesis is organized in to six major parts. Part one constituted the introduction, which focuses mainly on the background, statement of the problem, objectives, significance and scope of the study. Part two deals with reviews of different literatures about the problems, causes and consequences of soil erosion and theoretical and empirical aspects on the study of soil and water conservation. Part three contains a brief description of the study area. Part four describes data collection procedures and analytical techniques. Part five contains discussion of results. Part six constituted summary and conclusion of the study.

2. REVIEW OF LITERATURE

2.1. Concepts and Theoretical Framework

Soil is a natural resource, which generates every year through the natural process. Soil erosion is interchangeably used with land degradation; however, soil erosion is only one form of land degradation. The term land degradation can be defined in various ways in relation to soil erosion to describe its negative impacts on land productivity (Hudson, 1992).

Land degradation can be defined as a process that lowers the current and future capacity of the land to support human life (Pagiola, 1994 cited in Demeke, 1998). Allan (1949), described land degradation as a process which results in a radical change in the complete character of the land due to the loss of mineral plant nutrition, the oxidation and disappearance of organic matter, the breakdown of soil structures, the degeneration of vegetation and setting up of a new terrain of land and water relationship. Land degradation is also defined as the temporary or permanent lowering of the productive capacity of land (FAO, 1994).

Soil erosion accounts for the major forms of land degradation in developing countries, and at the same time, it is difficult to isolate and measure its impact on productivity even when the means and resources are available (Ayalneh, 2002). Soil conservation includes all forms of human actions to prevent and treat soil degradation (Grohs, 1994 cited in Demeke, 1998). The amount of soil erosion, which occurs under a given condition, is influenced not only by the nature of the soil itself but also by the treatment or management it receives. The difference in erosion caused by different management of the same soil is very much greater than the difference in erosion from different soils given the same management (Hudsen, 1992). According to Hudsen, the best land management might be defined as the most intensive and productive use of which the land is capable without causing any degradation.

The application of sustainable soil and water conservation (SWC) managements is largely determined by economic status, public awareness, and educational level of the stakeholders and the main prerequisite for attaining sustainable agricultural development is the formulation of appropriate resource management policies which are supported by the farming community to which they are willing and able to respond (Strock, 1995, in Ayalneh, 2002). In many agricultural based developing countries, environmental degradation takes the form of soil nutrient depletion and loss of food production potential. Reversal of the erosion induced productivity decline and ensuring adequate food supplies to the fast growing population in these countries posit a formidable challenge (Shiferaw and Holden, 1998).

Sustainable economic growth depends on a stable and resilient agricultural sector. Continued land degradation means lower rural income and economic decline. Controlling soil erosion and improving soil fertility are the keys to this economic growth. Today soil degradation is almost universally recognized as a serious threat to the well being of human being and this is shown by the fact that most governments give active support to programs of soil conservation.

2.2. Problems of Land Degradation

Ethiopia is one of the sub Saharan African countries where soil degradation has reached a severe stage. Land degradation mainly due to soil erosion and nutrient depletion, has become the most important environmental problems in the country. Coupled with poverty, fast growing population, policy failures and social unrest, land degradation poses a serious threat to national and household food security (Shiferaw and Holden, 1999).

A major survey undertaken around the early 1980s concluded that 50% of the highland region, roughly 270,000 km2 had already totally lost its productive capacity (Hurni, 1988). Constable (1984) has indicated that in addition to soil degradation, which is extensive, current rates of soil erosion are very high and the estimates of soil loss from the highlands vary widely from less than a billion tons up to three billion tons per year. Moreover, Land Use and Regulatory Department of Ministry of Agriculture estimated the gross soil loss from the highlands at up to 1,900 million ton per year, of which 80% (1520 million tons) is from croplands constituting only 22% of the highland areas. In general, the rate of soil loss in the country as a whole is estimated to be extremely high where its soil loss varies by type of land cover (Hurni, 1988).

According to Hurni (1983), the rates of soil formation in Ethiopia vary between 2 and 22 tons/ hectare/ year, which is much lower than the rate of soil erosion. The average soil loss rate is six times greater than the rate of soil formation and it causes an annual reduction of 4 mm in soil depth (Tsigie, 1995). According to Ayalneh (2002), extensive land degradation in the highlands of Ethiopia is often a direct outcome of individuals' and governments' failures not fully recognize and integrate environmental values into the decision making process. The problem is only identified after the situation has already become serious, usually by the time, much of the topsoil has been lost, and the productivity of the land seriously impaired. Even then, plans are prepared with emphasis on physically keeping the soil in place, and with planners seldom giving attention to the problems of faulty land use and management, of which excessive run-off and soil loss are only the symptoms. Often contact between planners and the stakeholders used to be minimal.

Finally framers are directly or indirectly or indirectly persuaded, even some times forced to implement the plans. Such strategies have seriously undermined the incentives for land users to involve themselves in the implementation of plans and the conservation programs have generally been far from success. According to Ayalneh (2002), often, resource users have been blamed for the failure of the plans without any attempt being made to analyze their circumstances. Nevertheless, it appears that various soil and water conservation strategies have been known and practiced in different places for hundreds of years. The reason that introduced soil and water conservation have been unsuccessful should be traced in terms of the faulty approaches they have adopted. Now a days, there is growing commences that soil and water conservation strategies need to be based on an approach that will ensure the participation of rural people in conservation because of the benefits that conservation brings. For the soil and water conservation to take place and remain sustainable, it must be the land users themselves who should carry out and maintain the necessary measures. The role of the government and NGOs should change from that of implementers of conservation projects to that of facilitators, who help to identify the problem, develop suitable conservation measures and to encourage and assist the land users. Therefore, we can conclude that soil degradation is one of the major bottlenecks of agricultural development in Ethiopia. If proper measures are not taken, the present extent and rates of soil erosion will continue to be even more serious in the future.

2.3. Causes of Land Degradation

Both environmental and socio-political factors have contributed to the poor performance of Ethiopian agriculture. Environmental factors include the dissected terrain, the cultivation of steeper slopes, erratic and erosive rainfall, and so on (Hurni, 1988). Socio-political factors include the top down approach adopted by bodies intervening to improve soil and water conservation. Farmers have been minimally involved in soil and water conservation activities and indigenous knowledge has been undermined within planning, Design, and implementation process. As a result, soil and water conservation programs have to date proved to be highly unpopular among farmers. Government policies concerning landholding, marketing pricing credit and resettlement have discouraged long-term investment and exacerbated these deficiencies (Hans-Joachim et al., 1996).

Today, the severity of soil erosion is attributed to human activities. Human population is increasing at alarming rate and the productive capacity of soil resource necessary to sustain that population is steadily decreasing because of land degradation. For example, results compiled by the Global Assessment of Soil Degradation (GLASD 1990) showed that about 2 billion hectares of land are affected by human induced soil degradation, where water erosion is responsible for the biggest share of this degradation that is estimated at about 58-60%. Moreover, Hurni (1994) has indicated that many types of processes are responsible for soil degradation, such as water erosion, wind erosion, deforestation, where the most important is soil erosion by water and wind which accounts for 84% of all damages. Hurni also indicated that, according to world map, 28% of all types of land degradation at the level are caused by agriculture, and 35% by over grazing and 29% are related to deforestation. Thus, soil degradation is caused, in more than 92% of all the cases by a variety of agricultural uses. The problems of degradation of land resources may be attributed partly to the failure of the rural population to take due care of these resources while remaining unaware of the tragic consequences. But, there were and still are more fundamental natural and socio economic factors responsible for the degradation of land resources including soils (Mesfin, 1984) and Fassil (1993) has also shown that due to the high concentration of both human and livestock population in the highlands of Ethiopia, the continued intensive cultivation of these regions exacerbated by the pressure of population growth, inappropriate of land use practices, a stagnant productive technology, and other factors have culminated in the present conditions of near ecological disaster..

Productivity in agriculture sector has been hampered mainly by, among others, resource degradation, unfavorable weather condition and misguiding polices (Ayalneh, 2002). According to FAO (1996), the other and recent cause of land degradation in developing countries is attributed to Structural Adjustment programs. Structural adjustment loans are intended to create the conditions for growth. However, they have been criticized for doing the opposite, by undermining the opposite, by undermining the environmental resource base upon which developing countries depend. Perhaps the most important element in this resource base is the soil.

The World Bank's development report (1997) lays the blame for the performance of agriculture in low-income countries on macroeconomic and spectral policies like overvalued exchange rates and agricultural output taxes, which alter the incentives facing farmers. According to the World Bank's development report (1997), protection of the environment is task that has recently attracted much attention, especially because of the erosion of arable land in sub-Saharan Africa. Although, it is not realized, the pricing policies that developing countries follow can be important from this point of view. When farming becomes profitable, farmers loose the incentive to care for their land.

Literature offers two views about the relationship between output prices and soil conservation. The first view maintains that low output prices have encouraged soil deflection. For example, Repetto (1987) as cited in Barrett (1996) has argued that as consequence of keeping agricultural output prices artificially low in developing countries, return on investment in farm land development and conservation are depressed. Farmers are discouraged from leveling, terracing, draining, irrigating or otherwise improving their land. The loss of land productivity through erosion, Stalinization .or nutrient depletion is less costly relative to other vales in the economy. In general, depressing agricultural prices depresses farmers' incentives for soil conservation. The other view, articulated by Hipton (1987) as cited in Barrett (1996) argues that higher prices will encourage yet more depletion. The environment responds badly to the normally advised, and otherwise often desirable, price performs. Better farm prices now, if they work as will encourage soil mining for quick, big crops. In general, policy reforms could improve conservation, worsen it, or have no effect at all. According to FAO (1996), macroeconomic and sector policies, like policies intended to promote industrial growth and overvalued exchange rates can alter the incentive facing farmers to conserve soil by altering prices farmers receive for outputs and pay for inputs, the latter including the cost of money invested in the farming enterprise.

Policies intended promote industrial growth have both direct and indirect effects on the prices of farm inputs. The direct effect is to increase the cost farm inputs. The indirect is to change the internal terms of trade in favor of industry. As consequence labor is attracted away from agriculture and the real wage of labor increases. Both of these effects tend to increase input prices. Overvalued exchange rates, sustained by exchange controls and quotas protecting industry, lower the prices of agricultural exports and import substitutes. Imported farm inputs may become cheaper, but migration of labor out of agriculture will raise real labor cost. World Bank (2000) argues that in sub-Saharan Africa the effect of macroeconomic policies on inputs would exacerbate the effect on output prices alone. Hence, for sub Sahara Africa the effect of exchange rate policies on input prices is positive.

The control of represents a classic problem of balancing the immediate gains of an action with the associated long –term losses. Soil depth has appositive effect on output because; in deeper soil there is more room for plant growth. But conservation of soil and water nearly always requires sacrifices in output in the short run (FAO, 1996). Empirical evidence indicates that substantial switching of crop mix dose occurs as a result of price changes of crops. According to the World Bank (1997) pricing policies can worsen soil erosion by encouraging farmers to plant less environmentally benign crops. Different crops have different effects on soil conservation and pricing policies may exacerbate soil erosion by inducing farmers to choose the wrong crops i.e. crops entailing more erosion or farmers will blindly switch crops without considering the implication of such a change for soil conservation. If farmers switch to a crop that is more distractive to the soil, then the relation governing optimal soil conservation will have to be recomputed, but it will not be forgotten. The alterative crop may demand less soil conservation in the steady state. But this will cause no loss in efficiency provided the prices of both crops reflect their true opportunity costs (World Bank, 1997).

According to World Bank, (1997), the practical of returning cropland to fallow, or shifting cultivation is ecologically stable provided that the productivity of the soil can be maintained .But under the pressure of rising human populations, fallow periods have grown shorter, and fertilizers have not been used to an extent necessary to prevent productivity declines. As a consequence, soil fertility has decreased. Three predominant human activities' could be in invariable identified as contributing to the vicious cycle of resource degradation, drought and famine in Ethiopia. These are overgrazing, over cultivation and deforestation (Ayalneh, 2002). Extensive land use as a means of enhancing sustainability is not an option in densely populated areas. Land use needs to be intensified to feed the increasing population. The effect of intensification on soil and water conservation depends on the structure of property rights, the level of development land and capital markets, access to technology and information, and development of the non-farm sector. Security of tenure is a critical variable determining incentives to conserve land quality. If property rights to land are well defined enforceable, farmers will incentives to conserve soil, as future benefits from soil conservation will accrue to the farmer who makes the investment. Security of tenure will lengthen the planning horizon or lower the effective discount rate. On the other hand, if property rights are ill defined or are not enforceable, a mining strategy based on rapid exhaustion of soil fertility will be adopted (Lapar and pandey, 1999).

The possession of legal title to land is not, however, necessary for ensuring the security of land tenure. Empirical evidences in other countries indicate that farmers who do not have legal titles have often invested in soil and water conservation while others with legal titles have not always so (Lapar and Pandey, 1999). The existence of well defined and enforceable property rights to land is, therefore, a necessary but not a sufficient condition to use soil & water conservation technologies. There for, the use of these technologies is dependent on the existence of several additional factors. A poorly developed land market may fail to internalize land quality improvement in land values, thus discouraging investment on soil conservation practices. Similarly, a poorly developed capital market may constrain soil conservation investment by limiting funds available for such investment (Lapar and Pandey, 1999).

In general, sustainable intensification can be achieved with the right mix of policy and institutional intervention. The Machakos's experience in Kenya is a case in point. Despite a five-fold increase in population, Machako's residents were able to increase per capita agricultural output through a correct mix of institution and technological innovations and improved linking with the non- farm economy (English et al, 1994 cited Lapar and pandey, 1999). Although the Machako's experience may not be replicable in many parts of the other countries (Africa), it highlights the importance of various policies and institution option in encouraging the sustainable practice of soil and water conservation investment.

According to Holden and Shanmugaratnam (1995), as cited in Shiferaw and Holden (1998), research in to the determinant of conservation investment has been limited. Poverty and market imperfections may create disincentive for conservation investment. Innovations that enhance or conserve the recourse base may not also provide immediate benefits to land users. Thus a different set of policies and targeting strategies may be required to promote such investments. Investment in soil conservation may be conditioned by a number of factors that may in turn depend on the nature of the rural markets. The decision to invest in land conservation may depend on perception of the erosion problem, household characteristics, technology, land and farm attributes and exogenous factors (Shiferaw and Holden (1998). Kim et al. (2001) explained that the possibility of long–term soil productivity decline has potentially significant implications for economic welfare and understanding soil productivity dynamics, thus has economic value, both as a tool for agriculture decision making as an input to ex-ante and ex-post analysis of the benefits and cost of intervention such as agricultural policies for research and development investment that alters the value of crops, the use of land, or cultivation practices.

2.4. Consequence of Land Degradation

Degradation of soil has become an alarming global environmental problem threatening sustainable development in most developing countries. Barrett (1996) stated that the depletion of oil reserve, and its effect on world oil prices, is the most immediate threat to world economic stability, but the depletion of soil resources by erosion might be the most series long term threat. The unprecedented doubling of world food supplies over the last generation was achieved in part by adopting agricultural practices that led to the excessive soil erosion, erosion that is draining the productivity of land. Developing countries have lower income and the agriculture share of income is much greater. For example, about 44 % of gross output in Ethiopia is generated from Agriculture (NBE, 2003). Degradation of agricultural soil resource in Ethiopia is seriously limiting production. In economic terms, the annual rate of land degradation results in the reduction of agricultural production by about 2 % per year (Hurni, 1988). According to FAO (1986), available estimates on economic impact of soil and water conservation for three agro ecological zones in Ethiopia indicated an annual on site productivity loss of 2.2% from the 1985 yield level.

Constable (1984) has also indicated that if proper measures are not taken and the present (1983/84) rates of soil erosion be allowed to continue, the national cost of soil degradation in the highlands alone would amount to about 15,261 million Ethiopia birr by 2010, of which, 77.8 % would be due to decrease in crop production and 22.2 % to decreased livestock production.

Similarly ,Wood (1989) argues that unless land use change are made so that erosion is slowed 10 million hectares (10 % of the crop lands) will be taken out of cultivation by 2010, which will affect the lives of about 10 million people.

2.5. Soil Conservation Efforts in Ethiopia

Despite the increase pace of degradation sand consistent with the old development thinking, which down played the role of agriculture, prior to 1974, the issue of conserving an agricultural land was largely neglected (Shiferaw and Holden, 1998). The political and socio economic system, which characterized most of Ethiopia's past, resulted in the neglect of conservation of natural resources, and not enough has been done to combat the problem of land degradation in Ethiopia because of limited understanding of the problem, lack of recourse, lack of motivation, conflicting policies and inefficient organization arrangements. As most degradation occurs gradually and subtly, until 1970s policy makers overlooked its effects (Ayalneh, 2002). The Ethiopian government first recognized severity of the degradation problem following the 1973/74 famines in Wollo .the 1973/74 droughts drew also the attention of external donors to land degradation problem and soon conservation become apriority (Berhanu and Swinton, 2003).

According to Berhanu and Swinton, (2003), after the early 1970s, national efforts to conserve land intensified. These interventions largely relied on mobilization of farm households and food for work (FFW) projects to conserve degraded lands through the construction of soil bunds, stone terraces and a forestation. The attention given by the Ethiopian government to the expansion of conservation activities since the early 1970s is an indication of increasing awareness of the problem but true understanding of the processes and solutions to land degradation and severity are still lacking.

With heavy external support, the government initiated a massive program of soil conservation and rehabilitation in most highland degraded area of the country following the 1975 land reform and establishment of the peasant association (Pas), which were instrumental in mobilizing labor and assignment of local responsibly. This involved over 30 million peasant workdays per year (Hurni, 1988). Reports indicate that between 1975 and 1989 terraces were built on 980,000 ha of cropland; 280.000 ha of hillside terraces were built, 310,000 ha of highly denuded land were revalidated (Hans-Joachim et, al., 1996). This was further expanded with involvement of mainly the world food program (WFP) since the early 1980s, which provided incentives for conservation activities. On cropland measures, mainly soil and stone bunds were built uniformly across regions with FFW incentives in food deficit areas of the highlands of Ethiopia. Conservation activities were mainly undertaken in a campaign often without the involvement of the land users. Peasants were not allowed to remove the structures once built but maintenance was often carried out through FFW incentives .Even if considerable areas of erodible land have been treated; maintenance of the structures has become a cause for concern to the implementing agencies (Shiferaw and Holden, 1998).

The introduction of economic reform program in 1990 and subsequent liberalization of the economy also brought more freedom and hence conservation structures might be removed if the land user so wishes. Yet these achievements fall far below expectation and despite considerable efforts, the country is annually loosing an incredible amount of precious top soil (Shiferaw and Holden, 1998). These activities were concentrated in the drought prone, food deficit highland and were further promoted to other areas through the assistance made by world food program (WFP). The quantity of labor employed for conservation both through voluntary labor and FFW program had increased almost four fold between 1976 and 1982 from less than 10 million man days to 38 million man days a year and it was estimated that more than U.S. $256 million had been spent on the program between 1978 and 1983 (Constable 1984).

In order to better organize and supervise the increasing FFW conservation activities, the Ministry of Agriculture (MOA) reorganized its structure in to a Community Soil and Water Conservation Department (SWCD) and a Forest and Wildlife Conservation and Development Authority (FaWCDA). The main activities of SECD concentrated in creating awareness, planning, executing, supervision and monitoring the conservation and rehabilitation of degraded lands and establishment of small-scale village (community) wood lots by the application of suitable techniques within an integrated approach towards agricultural development. It was also responsible for organizing training of farmers and development agents. FaWCDA's conservation has been generally confined to hillside terracing with a forestation and area closure.

Although the peasant association, in conjunction with SWCD and FaWCDA, undertook most of the field level conservation activities in the highlands of Ethiopia, there were a number of other agencies which involved in conservation activities including Relief and Rehabilitation

Commission (RRC), and a number of NGOs, such as OXFAM, CARE, etc. However, there is no centralized information available to date on the scope of activities of NGOs and their conservation activities were location specific and relatively insignificant in terms of total area coverage.

2.6. Indigenous Soil Conservation Measures

Indigenous agricultural practices refers to the practices, skills and techniques that were developed by farmers over generations as opposed to the global agricultural technologies generated by the modern net work of research institutes in the last hundred years (Zenebe, 2000). Alemayehu (2001) described the term indigenous practices as the local practices or techniques, which have been adapted by the farmers since long time ago as distinct from the newly introduced or modern techniques imposed from outside. Indigenous practices are dynamic in the sense that they are productive and stable; they can therefore maintain a considerable degree of sustainability (Radcliff, 1987 cited in Zenebe, 2000). Indigenous practices have a considerable degree of sustainability because they have been developed in line with the laws of natural ecological systems and within the limits of farmers' acquired or inherited culture and knowledge (Zenebe, 2000).

Indigenous soil conservation measures are the results of gradual learning process and emerge from a knowledge base accumulated by rural people through observation. Indigenous conservation practices are shaped by and emerge from detailed understanding of local conditions. They are modified in response to changing Socio-economic, political, and ecological conditions. Thus, integrating indigenous agricultural practices with modern technologies increases the sustainability of modern agricultural management system. Lack of appreciations of these conditions, the skills and knowledge smallholders acquire and failures to understand livelihood strategies and risk faced by them have contributed towards the poor success of soil and water conservation projects in Ethiopia. To reverse the situation, identifying successful measures, analysis of their role in the context of the rural communities and scrutinizing the potentials and limitations of such technologies are inseparable.

There is an intensive debate, however, which ones of these are indigenous and which ones are introduced. Part of the problem lies with the fact that there is no clear demarcation between the two. For the purpose of this study, indigenous soil conservation measures are farming practices that have evolved over the course of time, without any known outside institutional intervention and which have some conservation effects.

2.7. Approaches and Techniques of Analysis of Soil & water Conservation Studies

A farm level approach in the study of use of soil conservation is more appropriate for incorporating site-specific events than society level approaches requiring aggregation of heterogeneous variables to examine the value of soil & water conservation in maintaining and enhancing agricultural productivity (Subhrendu and Mercer, 1997). Because, since the farmer is the primary soil conservation decision maker, only a tyrannical state or a massive subsidy program could induce soil conservation in the absence of substantial economic benefits for the farmer. Second, land use problems are generally dependent on site-specific biophysical characteristics which often vary significantly even with in small areas (Kim et al., 2001).

On site benefits to farmers may not be the largest benefit of soil conservation (Brooks et al., 1992 cited in Suborned and Mercer, 1997); however, given the central role of farmers in conserving soil, on site benefits are likely to be the most crucial, especially in least developed countries. In any case, the market value of the preserved agricultural productivity provides a lower bound of the soil conservation. Estimates of this value help policy makers determine the appropriate level of support for different soil and water conservation measures. Economic analysis of soil & water conservation from different land uses is not common. Few empirical studies have estimated the value of soil conservation.

According to Subhrendu and Mercer (1997), economic analysis of soil & water conservation has primarily been of four types. The first type uses dynamic control theory to determine the set of conditions under which individuals and society chose optimum levels of soil & water conservation. Second, programming models have been used to evaluate public support for soil and water conservation. The third set includes adoption studies of soil & water conservation technologies. Finally resource accounting studies of soil erosion have used benefit transfer techniques in which parametric values associated with natural assets are transferred to similar settings.

In analyzing the decision behavior of farmers, different researchers have been using different techniques to relate the decision to use and level of use to factors affecting it. These techniques range from the use of descriptive statistics such as mean, percentage, and Chi-square test to the use of SPSS models, which give greater reliability, with more sophisticated statistical techniques. The disadvantage of using descriptive statistics is that they fail to predict the combined effect of explanatory variables on the dependent variables. Moreover, these techniques do not separate the influence of other variables (Feder et al., 1985).

Analytical models widely used to assess the probability of using or not using soil & water conservation technologies include SPSS models (EX: Shiferaw and Holden, 1998; Lapar and pandy, 1999; Wegayehu, 2003). However, Lynne et al., (1988) as cited in Baidu-Forson (1999), Pointed out that possible loss of information may occur if a binary variable is used as the dependent variable, Knowledge of whether a farmer is using or not using a given soil & water conservation technology may not provide sufficient information about the farmer’s behavior because, he/she may apply fully or partly the technologies on his farm. Therefore, a strictly dichotomous variable often is not sufficient for examining the extent and intensity of use of technologies (Feder et al., 1985).

Lynne et al., (1988), as cited in Baidu-Forson (1999), proposed the use of SPSS estimation method. This accounts for a dependent variable that has zero limit and measurement error peculiarly associated with the choice of a number of practices as a proxy for conservation efforts in the absence of data on expenditure. The SPSS model is relevant in predicting the use rates by technology users when the dependent variable is continuous. When the dependent variable is truncated, it will continuous between to certain lower and upper limit. The extra advantage of this model as compared to the SPSS model is that it reveals both the probability and intensity of using a technology or practice.

2.8. Empirical studies on the effects of Soil and Water Conservation

Studies on the Effects of soil and water conservation decision behavior of farmers in Ethiopia have been limited. Generally the past approach to soil conservation study emphasized technical solution to soil erosion problems to the neglect of socioeconomic constraints (Shiferaw and Holden, 1998). For decades it was believed that technological innovations combined with scientific methods were the answers to soil erosion problems. However, regardless of advances in the development and promotion of technologies, the soil erosion problem persisted, forcing changes in attitudes to the way to tackle the problem. This led to the realization that soil and water conservation is not only a technical problem bout also a socio economic problem, which directed attention to socioeconomic and behavioral factors influencing soil and water conservation decision making. This is evident from the ever-increasing literature on this area (Wegayehu, 2003). Here, some literatures were reviewed to come up with some general idea concerning issues on a range of agro-climatic and socio-economic factors influencing farmers' soil and water conservation decision behavior and related topics.

In the study of resource degradation and adoption of land conservation technologies by smallholders in the Ethiopian highlands, Shiferaw and Holden (1998), found out the importance of perception of soil erosion problems, household, and farm characteristics, farmers' perception of technology specific attributes and land quality differentials in shaping conservation decisions. Berhanu and Swinton (2003), using a double hurdle model, identified causal factors for soil conservation adoption versus intensity of use. Farmers' reason for adopting soil & water conservation measures vary sharply between stone terraces and soil bunds. Longs-term investments in stone terraces were associated with secure land tenure, labor availability, proximity to the farm stead and learning opportunities via extension and the existence local food for work (FFW) projects. By contrast, short term investment in soil bunds were strongly linked to insecure land tenure and the absence of local food for work projects.

According to Badu-Forson (1999), factors that motivate level and intensity of specific soil and water management technologies include: higher percentage of degraded farm land, extension education, lower risk aversion and the availability of short term benefit. This result shows that technologies should be targeted to locations that have large percentages of degraded farm land and there is a need to provide extension education that demonstrates risk reduction capacities of conservation techniques.

A case study by Lapar and Pandey (1999) on the adoption of contour hedgerow as soil and water conservation practice in Philippine uplands used a SPSS model and found out that age of the farmers, level of education, land ownership, access to markets, membership in a local organization of farmers with labor exchange arrangements among members and slopes were the significant factors affecting use of conservation. According to this study, ownership of land is not always a necessary condition for having security of tenure that would lead to investment. The result obtained in one of the study sites showed that 72% of the fields with contour hedgerows were rented while 28% was owned.

A study conducted by Anim (1999) on soil and water conservation measures in South Africa attempted to expand the range of explanatory variables used in the use of soil conservation studies. The result of this study suggested that awareness of soil erosion problems and increases in long-term profit are significant indicators of the probability of adopting silt traps and contour ploughing as methods of soil conservation. Factors such as age, security of land tenure, informal communication, size of land holding and difficulty of adopting a particular technology. Do not appear to be significant determinants of the adoption of soil conservation measures.

A study by more (1996) Showed that perceived property rights among Zimbabwean small farmer sectors were more important than the factor property rights in investment decisions of small scale farmers. These findings seem to explain the possible effects of secure property rights and soil & water conservation measures. These findings can also be used to predict consequences from secure property rights in land tenure reform programs in South Africa and elsewhere from the perspective of small –scale farmers and soil and water conservation policies. Araya and Asafu-Adjhaye (2001) used SPSS analysis to examine factors affecting use of soil & water conservation technologies in Eritrea using the total number of days spent on soil & water conservation as a proxy measure of soil conservation effort. The result indicated that significant variables affecting soil & water conservation efforts in the highlands of Eritrea include; family size, perceptions about the effect of soil erosion on yield, perceptions about the profitability of soil & water conservation measures, off farm employment and the system of land ownership. This result explains that the importance of farmers training and education programs on aspects of soil & water conservation, initiating programs that will raise the farm income of farmers, inclusion of materials on degradation in the education of primary school curriculum.

A study on soil and water conservation decision behavior of subsistence farmers in the eastern highlands of Ethiopia by Wegayehu (2003) using multinomial log it analysis showed that plot level adoption of conservation measures was positively related to access to information, support programs for initial investment, slope area of the plot.

The landholding per economically active persons in the family was found to have a negative influence on conservation decisions. Participation of women in field work activities, farmer's age group, uses duration of a plot, credit for fertilizer and food, livestock holding, type of crop grown, and plot soil type did not influence plot level conservation decisions by farmers.

3. METHODOLOGY

3.1. Description of the Study Area

The performance of any development program is influenced by the quality and quality of the resources available, the efforts made to make best use of them and the socio economic conditions of the area in which it is undertaken.

3.2. Location, Relief and Climate

3.2.1. Location

North Wollo Zone is located in the North Eastern part of Ethiopia it is bordered by South Gonder Zone to the West, Wag-Humera Zone to the North West, Tigriye Region to the North, Afar Region to East and South Wollo to the South. Its absolute location extends between the co-ordinates of 11^0:21' - 12^0:24' N latitude and 38^0:27' - 39^0:57'E longitude (BPEDAR, 2010).

According to BPEDAR (2010), the total area of North Wollo Zone is 12,706 km2. There are 13 Woredas separated from others by natural demarcations such as rivers, mountain chains, and/or randomly designated marks.

Gubalafto is one of the thirteen districts of North Wollo Zone and it is located in the South Western part of North Wollo Zone. The district shares its boundaries with Habru district to the East and south East, Kobo district to the North. Meket and Wadlla districts to the West and South-West. It's absolute location is marked as 11^0:36'-11^0:59N latitude and 39^0:12'-39^0:49 E longitude (GWOANR, 2011). The total geographical area of the district is about 1042 km2 with 34% Dega, 46% Weyna Dega, and 18% kola, which are divided into 43 rural Kebeles and two Urban kebele, Woldya is the capital city of Gubalafto district and as the time it is the capital city of North Wollo Zone.

3.2.2 Relief

According to the BPEDAR (2010), the relief of North Wollo Zone generally reveals a decreasing altitude from west to east and northwards. Altitude ranges between 880 meters at the lowest to 3360 meters at the highest. The lowest altitude in the zone is the area along the Kobo-Girranna valet and the highest is along the Abuneyosef Mountains in Northern East of Lasta Woreda. In general the physical feature of the depicts is dissected and undulating plane.

This zone is the origin of permanent rivers like Layalewuha, Gimborra, Golinna, Tekeaze, Beshilo, etc. and various smaller rivers and streams forming a dendrite pattern over the zone. These water bodies make the zone potentially rich for both irrigation and hydroelectric power production. These rivers are classified into two-river basins- the Awash and Abay basin.

The major mountains and mountain chains are Abuneyosef, Dilbe, Zoble, Gubarja and Gebrale, Ezate, Maso-dengolla and the Jemdo-Mariam mountains are some of the mountain. The Raya, Alewuha, Terrae, Dawunt, Wadlla and Girrana are relatively with a plain landscape. Kobo-Girrana form valleys in North Wollo Zone. The major rivers found in Gubalafto district are Alewuha, Beshilo and Gimborra, small streams include Cherti, Shellea, Abakolsha and Abakalu are some of them.

3.2.3 Climate

North Wollo Zone has a tropical, highland, climate; characterized by heavy rainfall, warm temperature and long wet period. The mean annual rainfall of the zone ranges between 1200 mm and 2800mm with a mean temperature of 20^0 c - 25^0c. The rainy season extends from February up to the end of November (BPEDAR,2010) .The mean annual rainfall and temperature for Gubalafto district is 1700 mm and 21^0 c respectively, Rainfall is bi-modal and the short rainy season stares in January and extends to May. The long rainy season starts in June and extends to September.

3.3. Demographic Characteristics

According to the 2010 population and housing census data, the projected population of the Zone for the year 2013 is estimated to be 2263861 out which, 1133151 (50.05%) are female. It is about 10.5% the total population of the region. The rural population size constitutes 2021418 of which 10111002 (50.01%) are male and 1010316 (49.9%) are female (BPEDAR, 2010).

The young population (0-14), the economically active of working population (15-64) and the old population (65 and above) constituted 44.2%.,52.7 % and 3.1 % of the population respectively GWOANR(2011) indicted that total population of Gubalafto district was 255420 out of which

97.8% live in rural areas. It has a young population of 49 % economically active population 48% and aged population of 3 %. It is one of the densely populated areas of region with 171 persons per sq.km this created the problem of deforestation and intensive cultivation including sloppy lands that aggravated the problem of soil erosion.

3.4. Research Design

The research sites, Gubalafto Woreda, and dega (Baba-seat Kebele) and woyna dega (Gashober kebele) within the Woreda were selected using purposive sampling method because soil degradation is a serious challenge of the area and needs immediate conservation measure to save the natural resources for future wellbeing of the citizens of the area. Based on the presence of soil and water conservation activity 2 kebeles (one from dega and one from weyandega rural kebeles in the district.) will be purposely select Reconnaissance survey will be conducted to delineate the study site on the base of watershed concept. The households will be stratified based on wealth and other factors (sex, age, education, marital and etc) and, then from each group sample will be drown using random sample method. The sample sizes will be 45% of farm households of the study site.

Both relevant qualitative and quantitative data were collected from primary and secondary source. The primary data were collected from 101 individual households possessing 204 farm plots in Gubalafto district using formal sample survey. Some of the general information collected from this source include: household characteristics, land holding and farm characteristics, availability of labor farmers` awareness and perception about soil erosion problems, soil & water conservation technologies and farmers` attitude, tenure arrangement, institutional support and wealth status of sample households. The secondary data were collected from published and unpublished documents from different organizations.

3.5. Sampling techniques and Methods of data collection tools

The primary data required for this study were generated from the sample households by conducting formal survey using a structured questionnaire in August and September 2012. Before starting the actual formal survey, a reconnaissance survey was conducted and some general or back ground information was collected about the study area and the farming system. Eight enumerators were recruited and trained for two days on the method of data collections and related topics. Then a structured questionnaire was developed and pretested before conducting the formal survey (see appendix 5). Data were collected at household and plot level. Enumerators from observation, measurement and interviews generated the data with sample farm households under the supervision of the researcher. Considering the presence (diffusion) of soil and water conservation technologies 2 Kebeles were selected first from the total number of rural Kebeles in the district. Because the diffusion and implementation of improved soil conservation technologies were undertaken only in dega and woyna dega climatic zone, the selected Kebeles are found in the two climatic zones. The selected Kebeles were purposely selected, dega (1) and woyna dega (1) climatic zone. Then, considering the total numbers of households in each Kebele, a total of 101 sample farm households were selected proportionately and randomly.

3.6. Methods of Data Analysis

3.6.1. Specification of the Model

It is difficult to generalize about the factors affecting use of soil and water conservation technologies in different parts of the world or even in different regions of a country because of differences in agro-ecological and socioeconomic settings under which farmers operate (Bekele, 2003). According to Bekele (2003), though the basic assumption that the utility maximizing objective of farmers is the same, the specific attributes influencing the utility of farmers and adoption are far from being uniform and use of soil and water conservation practices depends up on this difference in attributes, some of which are specific to particular region, farm or plot.

Farmers in Gubalafto district, like other Ethiopian farmers, usually cultivate or manage more than one plot located at different places, having different soil color and distance from home etc. As a result, farm households may have different soil and water conservation decision for different plots depending on specific circumstances of a plot and the importance of the households.

Farm households in Gubalafto district the proportion of cultivated land on which different types of physical soil and water conservation structures are used. There are non–users of these improved and traditional soil and water conservation measures even in the areas of diffusion of these technologies. Therefore, there is a cluster of households with zero level of use of soil and water conservation measures at the limit. The application of SPSS analysis is preferred in such cases because it uses data at the limit as well as those above the limit to estimate regression. Therefore, a direct application of SPSS estimation sufficiently provides the needed information on the probability and intensity of using soil and water conservation measures.

3.7. Definition and Hypothesis of Variables

Using the literature reviewed as a base, formation of the above model was influenced by a number of working hypotheses. It is hypothesized that a farmer`s decision to either use and the extent of use of soil and water conservation measure at any time is influenced by the combined effect of a number of factors related to farmer` objectives and constraints. The variable can be grouped into personal, economic and institution factors. The variables in the model were hypothesized to influence the use of soil and water conservation measures positively (+) negatively (-) of both positively and negatively (+/-). Based of literature reviewed, a total of 12 variables ware hypothesized. The definition and explanation of the dependent and explanatory variables are presented below.

The dependent (Y1, Y2, Y3, and Y4) represented improved soil bund, improved cut off drain. Fanyajuu and trash lines constructed (meter per hectare) respectively. Area of cultivated land: Soil & water conservation structures may take some area that would have been used for cultivated (growing of crops). Farmers who operate on lager farms can allocate some part of the land than those who have small farms. Therefore, it is anticipated that farm size and the likelihood of using soil-conserving technologies are positively correlated.

Land to labor ratio: Land to labor ratio measured as the ratio of the area operated to the number of family members engaged in farming is used as an indicator of the population pressure. Households with lower land to labor ration may have incentives to invest in soil & water conservation. On the other hand, the potential loss of land to soil and water conserving structures may discourage use of soil and water conserving structures.

For households with more land per unit of labor, this potential loss of land and the subsequent reduction in cropping area may be less of a constraint relative to those with little land .Hence households with higher land to labor ratio may be more likely to use soil water conservation structures. The effect of land to labor ratio is, therefore, indeterminate a priori.

Age of the household head: This is a continuous independent variable indicating the farming experience of the household head in years. Through experience, experience, farmers may perceive and analyze the problem of soil erosion and to develop confidence to use soil-conserving measures. Thus more experienced farmers in farming are more likely use soil conserving technologies than less experienced farmers.

Education: Refers to the number of years of formal education completed by the head of the household. Educated farmers can understand, analyze, and interpret the advantage of different technologies more easily than uneducated and training once.

Slope of the land: The land surface configuration that relates to topography is described in terms of slope. The slope of the land affects soil development both directly and indirectly. Steep slopes are subjected to more rapid runoff surface water. Therefore, the high erosion potential of the farm forces the farmers to use soil and water conservation measures. Thus, the slope of the cultivated land is hypothesized to affect use of soil and water conservation positively.

Distance of the farm: It refers to the average distance of the farm from residence .Farmers whose farms are nearer to their residence use soil-conserving technologies because the time and energy they spend is lesser for nearer farms than distant farms. Therefore, distance from residence more likely affects conservation practices negatively.

Extension service: It indicates whether the household head gets extension service from development agents (DAs) or not. Extension service provides the necessary information to acquire new skills and knowledge to farmers to improve soil and water conservation efforts. It is, therefore, expected that access to extension education to farmers and using soil and water conserving practices or technologies be positively correlated.

Livestock holding: This variable represents the livestock holding of the household in tropical livestock unit. It is used as an indicator of wealth. More specialization into livestock away from cropping may reduce the economic impact of soil erosion and lower the need for soil and water conservation. On the other hand, those farmers who have large number of livestock may have more capital to invest in soil and water conservation practices. This affects the use of soil and water conservation measures positively. However, in the case of the study area, conservation technologies are more labor intensive and require less capital. Therefore, the size of livestock holding is hypothesized to affect conservation investment negatively

Security of land: An indicator of security of land tenure of confidence in the long term. It is expected that farmer makes fewer long-term land improvements if they feel that government in the future will redistribute land .The presence of tenure security may increase land improvement practices. Therefore, it is hypothesized that long term land ownership confidence (land security) and soil & water conservation efforts are positively correlated.

Off farm income: The hypothesis about the effect of return to off –farm activity is ambiguous. On the one hand, better returns to off farm activity mean competition with on- farm investment. On the other hand, greater off-farm income means more cash available to the household to invest on farm. But labor and cash diverted to off-farm uses might also reduce the pressure on the land. It would provide cash to buy food, and might encourage the household to use land in a less labor demanding ways, such as perennial crops fallow and pasture ways that are also less mining of the soil.

Perception: It is hypothesized that farmers who perceive the problem of soil erosion are more likely to use soil and water conservation practices.

Social position in the kebele: It refers to the involvement of farmers in different administrative, religious and other matters in the community. Therefore, it is expected that farmers who involve in different position are more likely to use soil-conserving technologies as they exposed to different information and ideas.

4. RESULITS AND DISCUSSION

4.1. Descriptive Analysis

4.1.1. Demographic Characteristics

Population size and characteristics are directly related to the supply and demand conditions for basic human necessities such as food, shelter, health and educational facilities which in turn directly or indirectly influence the use of improved technologies and farming practices in a give farming system.

The average age of the sample household heads is 46.67 years with standard deviation of 11.42. The average family size of the sample households is 7.82 persons with a standard deviation of 0.25. The family size of the sample households ranges from 2 to 11 persons. The age structure the family members of the sample households is characterized by much higher proportion of young population (0-14 years) and low proportion of old age persons (>64 years), reflecting the prevailing high fertility. The young family members (<15 years), make up 49.9% of the total family members of the sample households and those at old age group (>64 years), constitute 2%. The proportion of the family members aged 15-64 constituted about 48.1% of the total family members (Table 4).

Table 1: Distribution of total family members of sample households by age group

Sex	Age group (Years)			
	0-14	15-64	> 64	All age
Male	204	193	9	406
Female	187	184	7	378
Total	391	377	16	784

The ratio of the dependent age group to those of the working age group provides a useful approximation to economic dependency burden. From table 4, the overall dependency ration of the sample household family members is 107.9 (i.e. for each 100 person in the productive age group, there are about 108 young and old dependents to be supported). The dependency burden for the study area is higher than that of the zone which is about 89.75.

Table 2: Distribution of sample households by family size

Family size	Users		Non-users		Total		T-value
	Number	%	Number	%	Number	%	
≤ 2	-	-	1	2.5	1	0.99	
3-5	11	18	7	17.5	18	17.83	
6-10	43	70.5	26	65	69	68.31	
>10	7	11.5	6	15	13	12.87	
Mean	7.9	-	7.77	7.82	-	-	**0.254**

As shown in table 6, the mean ages of users and non-users of improved soil conservation technologies are 45.9 and 47.85 years with standard devotion of 9.48 and 12.54 respectively. The average household family size of users and non-users was found to be 7.77 and 7.9 persons with standard deviation of 2.64 and 2.42 the statistical analysis showed no significant difference in the mean family size of users and non-users ($t=0.254$: $p<0.05$). About 50.8% of users and 47.5% of non users have age less than 46 years (table 6) and about 90% of the total household heads married (table 7).

Table 3: Distributions of sample households by age group

Age group	Users		Non-users		Total		T-value
	Number	%	Number	%	Number	%	
Up to 30	8	13.1	1	2.5	9	8.9	
31-45	23	37.7	18	45	41	4.6	
46-64	26	42.6	18	45	44	43.6	
>64	4	6.6	3	7.5	7	6.9	
Mean	**45.902**		**47.85**		**46.67**		**0.837**

Table 4: Distribution of sample household heads by marital status

Material status	Users		Non-users		Total	
	Number	**%**	**Number**	**%**	**Number**	**%**
Married	50	82	40	100	90	89.1
Single	4	6.6	-	-	4	3.9
Divorced	5	8.2	-	-	5	5
Window	2	3.2	-	-	2	2

4.1.2. Education Status of Sample Household Heads

Education level of farmers is assumed to increase the ability to obtain process and use information relevant to the use of improved agricultural technologies. Regarding the of education about 38.6% of the respondents are illiterate, while only 61.4% of the respondents have various education levels ranging from the ability to read and write and up to 12^{th} grade completion. Some of the respondents believe the education is very important and despite the labor intensive nature of agricultural activities in the area, especially during peak periods, they send their children to school.

As shown in table 8, from the total sample households about 32.78% of users and 47.5% of non users constitute group of farmer. The average years of education for the total sample households, users and non-users were 1.7, 2.02 and 1.23 years with a standard deviation of 2.37, 2.55 and 2.01, respectively, which results in significant difference between the two group ($t=1.653$; $P<0.05$).

Table 5: Distribution of sample household heads by education status

Education status	Users		Non-users		Total	
	Number	%	Number	%	Number	%
Illiterate	20	32.78	19	47.5	39	38.6
1-4 grade	34	55.7	18	45	52	51.5
5-8	4	66	3	7.5	7	6.9
> 8 grade	3	4.9			3	3

4.1.3. Labor availability

Labor together with land, capital and management, is one of the most important factors of production (input) in any kind of production of faming activity. The active part of the population, which is determined by the age and sex structures, comprises all those persons of both sexes who supply the work force or labor for different kinds of agricultural activities. The average available labor was estimated to be 3.66 man days per day sample households (3.39 man-days for users and 3.25 man-days per day for non-users). The statistical analysis showed significant difference in size of labor (man days) for users and non-users ($t=2.13$; $p<0.05$) (table 9).Both group reported that they face labor shortage during main crop seasons; however the use of hired causal (temporary) permanent labor was very low for both users and non-users of improved soil and water conservation technologies.

Table 6: distribution of sample household heads by size of labor (man days per day)

Labor (man day)	Users		Non-users		Total		T-value
	number	%	Number	%	Number	%	
Up to 2	7	11.4	6	15	13	12.9	
2.01-3	14	23	15	37.5	29	28.7	
3.01-4	14	23	10	25	24	23.8	
4.01-5	13	21.3	5	12.5	18	17.8	
>5	13	21	4	10	17	16.8	
Mean	**3.25**		**3.93**		**3.66**		**-2.13**

4.1.4. Land Holding and Farm Characteristics

4.1.4.1. Land size and Distribution

Land in the study area is scarce mainly due to population pressure and the farm size varies between 0.25 and 4.25 ha. The average landholding for the sample household is 2.042 ha. As a result fallow lands are not common and there is also shortage of grazing land.

The average farm size of users or improved soil conservation technologies (1.734 ha) is significantly larger than non- users (1.2647 ha) ($t=3.749$; $p<0.01$). Farm size most farmers (38%) fall between 0.25 and ha. Nearly 67% of farmers own 2 ha or less. Total cultivated area of users and non-users in 2012 was 124.6 and 50.58 ha, respectively (Table 10).

Table 7: Distribution of sample household heads by land holding

Farm size (ha)	Number of farmers	%
Up to 1	38	37.6
1.02-2	30	29.7
2.01- 3	19	18.8
3.01- 4	12	1.9
> 4	2	2

Table 8: Distribution of sample household heads by number of farm plots

Number of plots	**Users**		**Non-users**		**Total**	
	Number	**%**	**Number**	**%**	**Number**	**%**
1	14	23	19	47.5	33	32.7
2	29	47.5	12	30	41	40.6
3	15	24.6	5	10	7	19.8
4	3	4.9	4	10	7	6.9
Mean	**2.114**		**1.725**		**2.0099**	

The number of farm plots varies from 1 to 4 for sample households. Majority of the sample households (40.5%) have 2 plots.

4.1.4. 2. Slope, Fertility and Soil Type

The physical characteristics of farm plots are indicated in table 12. Respondents classified each farm plot into flat, slope steep and mountainous. Form the total plots only 3.4% are flat. This implies that about 95 of the farm plots need conservation of kind or another.

Table 9: Distribution of farm plots by slope category level, fertility and soil color

Description		Number of plots	%
		Frequency	
Slop category	Flat	7	3.4
	Gentle slope	85	41.70
	Steep and mountainous	112	54.90
Fertility	Low	28	13.70
	Medium	119	58.30
	High	57	27.94
Soil color	Red	57	27.90
	Black	78	38.20
	Brown	69	33.20

Respondents have also identified their plots fertility into three categories as fertile, medium and high. Based on this classification, from a total of 204 farm plot 13.7, 58.3 and 27.9 were considered as low fertile, medium and high, respectively. The color of soils for the farm plots of sample households were 27.9% red, 38.2% black and 33.2% brown. Farmers usually consider brown color soils as fertile in the study area. This may affect farmers' decision on soil conservation.

4.1.4. Perception and Attitude of Farmers

Farmers' understanding (awareness) about the existence causes and consequences of soil problem on their farm will increase the use of improved soil conservation measure. About 96% of the sample households perceive that soil erosion is a major problem to their farm plots and use at least one type of improved soil & water conservation structures. The difference showed that farm households who were aware of soil erosion problems did not have any improved soil and water conservation structures on their farm plots. According to the farmers, over cultivation and deforestation were the major causes of soil erosion (Table 13).

Table 10: Major causes of soil erosion and their ranks

Cause of soil degradation	Ranks and percentage of responses (n=101)						
	1st	2nd	3rd	4th	5th	6th	7th
Deforestation	22	23	14	15	5	8	2
Over grazing	1	6	21	23	17	12	81
Over cultivation	48	15	16	11	5	1	0
Poor age, practices	7	3	16	26	16	4	0
Cultivation of steep slopes	12	25	15	8	14	12	1
Excess rain fall	5	24	30	11	5	13	5
Poor government	1	0	2	0	2	7	45

4.1.5. Crop Production

The study area is characterized by mixed farming system. The agro-climatic condition is favorable for growing of diversified types of crops including both temporary and permanent crops. The major crops grown in the study area are sorghum, maize, teff, barley and wheat. You need to bring more information to keep the sub-title. You have given the same information in methodology.

4.1.6. Livestock Production

Another important component of the farming system in the study area, like in any other parts of Ethiopia is animal rearing. Farmers rear animals for various purposes, including milk, meat and eggs, draught power, transport and other purposes. The type and total number of livestock owned by the sample household is given in table 14.

The average size of livestock holding in tropical livestock unit found to be 4.04 for users and 4.2 for non-users .The average livestock holding for the total sample households 4.11 TLU. The difference between livestock holding by users and non-users of improved soil conservation is not statistically significant ($t=0.334$; $P>0.1$).

Table 11: Type and number of livestock owned by the sample household

Type of livestock	Number
Oxen	145
Cows	151
Calves	113
Heifer	104
Horses	23
Mule	27
Donkeys	13
Goats	27
Sheep	195
Chicken	181

Out of the total respondents, 8.9% did not have ox, 45% have one ox, 39.6% have two oxen and remaining 6% have more than two oxen. The main source of feed animals includes straw, Grass from the grazing land and maize stalk during vegetable stage of growing season. However, most farmers reported that there is shortage of feed for their animals especially during dry season.

Table12: Distribution of sample households by size of livestock holding (TLU)

Size of livestock holding	Uses		Non users		Total		T-value
	Number	%	number	%	number	%	
< 1	2	3.3	--	--	2	2	
1.01-2	8	13.1	4	10	12	11.8	
2.01-3	11	18	8	20	19	18.8	
3.01-4	10	16.4	8	20	18	17.9	
4.01-5	10	19.7	8	20	20	19.8	
>5	18	29.5	--	12	30.30	29.7	
Mean	**4.0419**	**--**	**4.1977**	**--**	**4.1036**	**--**	**-0.334**

4.1.7. Use of soil and Water conservation measures

Farmers in the study area used both improved and traditional soil and water conservation methods. Improved soil & water conservation practices include: improved soil bund, improved cut of drain and fanyajuu and other types of physical and biological conservation methods. Indigenous soil and water conservation methods include: traditional ditches, traditional stone bound, making trash lines leaving grass strips, etc. were also under use.

4.1.7.1. Improved soil and water conservation structures

This study indicated that different types of improved (modern) soil & water conservation practices were under taken in Gubalafto district. The most widely used improved soil and water conservation technologies were improved soil bund, improved cut of drain and fanyajuu .While other types of improved physical and biological conservation methods were promoted; their use were very limited due to various reasons (shortage of labor, technical problem, shortage of inputs for biological conservation and etc).

From total of 101 sample households, 61% used at least one type of improved soil conservation structure. The result indicated that 54.5%, 51.5% and 50.5% of the households used improved soil bund, improved cutoff drain, and fanyajuu on their farm plots, respectively. Out of the total of 204 farm plots possessed by the 101 households 60.4% used at less one type of improved conservation structures (Table 16).

Improved soil bund was the most widely and most intensively used soil conservation structures in the area. 54.5% of the sample households and 58.33% of the farm plots have improved soil bund.

Table13: Number of household and farm plots by type of improved soil and water conservation structures.

Types of structure	Households		Farm Plots	
	Number	%	Number	%
Improved soil bund	55	54.5	119	58.33
Improved cut of drain	52	51.5	91	44.60
Fanyajuu	51	50.5	104	50.98

4.1.7.2. Indigenous soil and water conservation practices

Farmers in the study area used indigenous (traditional) methods of soil conservation developed over generation. Based on the survey carried out, different types of traditional soil conservation practices were identified .These include traditional stone bound, traditional ditched, trash lines and un-ploughed strips, etc. They employed traditional systems with no technical specification, and hence much variability in application was observed. Most types of measures were adapted to cultivate land .The most widely used traditional soil and water conservation measures in the study area included traditional ditches and trash lines. Some farmers were also used traditional stone bund wherever there are stones on their farmland (Table 17). The use of un-ploughed strips on cultivated land was rarely used because of land shortage.

Table14: Number of household and farm plots by type of traditional soil conservation structures.

Types of structure	House holds		Farm plots	
	Number	%	Number	%
Traditional ditches	76	75.2	118	57.84
Trash lines	54	53.5	126	61.76

Traditional Ditches: Traditional ditches are constructed every cropping season and run diagonally over the cultivated land. Farmers make ditches using ox plough. Depending upon the slope gradient of farm plots farmers make ditches with certain interval. The distance between two consecutive ditches decreases with slope gradient. However, the distance is not based on scientific measurement and varies from plot to plot. The main purpose of traditional ditches was protecting soil from erosion. Sometimes farmers make ditches to drain water from flat fields during long growing season especially in teff and barley fields. The main advantage of traditional ditches is that it takes less time to construct and they can be made by oxen, therefore, it requires less time and labor.

Trash Lines: Normally trash lines are temporary structures made from crop residues mainly from sorghum and maize stock. The trash lines will be destroyed during next season and the residue of maize will be mixed with the soil. Trash lines are the most commonly used structures in teff field. The problem of constructing trash lines are that the crop residue mainly maize stock is limited. This limits the area coverage or intensity of application to significantly contribute in minimizing erosion problem.

Stone bund: Some farmers regardless of the difference in agro-climatic zones use stone bund or stone terrace. According to the respondents, stone bund construction is labor intensive and it is limited to areas where there is stone on the farm plot. Stone bund is constructed to capture the soil washed down by flood from steep and mountainous slopes where the use of other types of soil and water conservation technologies is not effective.

Un-ploughed strips: Farmers having relatively larger cultivate land deliberately leave un-ploughed strips within the farmland following the horizontal contour or at the boundary of their farmland for the purpose of mainly decreasing flood hazard coming from up lands.

The trapped soil over time developed on the strip will make the soil more fertile. This is suitable for growing of grass for their cattle. After some time, farmers plough some or all parts of the strips and leave another strip below or above the old once. The different parameters, length, width and distance between two strips vary from one plot to another. Obviously, this practice demand no labor input except that the farmers keep some part of the land out of cultivation, According to the farmers, this practice will not be possible in the future, because of land shortage.

4.2. Econometric Analysis

The major objective of this section is to identify important socio-economic variables, which affect smallholder farmers' decision to use and intensity of use of improved and traditional soil conservation structures. These variables were selected based on literature review.

Before taking these variables in to the analysis, it was necessary to check for the existence of multi-co-linearity among the continuous variables and verify the degree of association among discrete variables. Variance inflation factor and contingency coefficient were computed to detect multi-co-linearity for continuous variables and higher degree of association for discrete variables respectively (Appendices 3 and 4).

Finally, all the variables were considered in the analysis. Multi-co-linearity problem for continuous explanatory variables was also tested using a technique of Tolerance level (TOL),

Where, VIF (Xi) = (1-R2), TOL = (1-RI) = 1/VIFi

The larger is the value of VIF, the more troublesome is the multi-co-linearity or co-linear is the variable (Xi). If the VIF of a variable exceeds 10, (this will happen if R2 exceeds 0.90) that variable is said to be highly co-linear. Similarly, TOL approaches to 1 when the variable (Xi) is not correlated with other repressors.

From appendix 3 and 4, it is possible to conclude that there were no multi-co-linearity and association problems between a set of continuous and discrete variables as the respective coefficients were very low.

Definition and measurement of variables used in the model

<u>Variables Description and unit of Measurement</u>

Dependent variables

Y1 = ISOB Improved soil bund constructed (M/ha)

Y2 = ICOFD Improved cut-off drain constructed (m/ha)

Y3 = FAJU Fanyajuu constructed (m/ha)

Y4 = TRASH Trashline constructed (m/ha)

Explanatory variables

X1 = ACULTLND Area of total cultivated land (ha)

X2 = LNDLBR Ration of total land to total labor (hectare per man days)

X3 = AGEHH Age of the household head (Years)

X4 = EDUHH Education of head of household (Years); priest and sheik =3

X5 = DIST Walking distance to the farm plot from home (Minutes)

X6 = OFINCOM Off farm income (birr)

X7 = TLU Livestock holding of the household in tropical livestock unit (TLU)

X8 = SLOP Slope category of a plot: 1 flat; 0 otherwise

X9 = EXT Extension contact: 1 if the farmer gets extension contact, 0 otherwise

X10 = SOC Social position of the household head: 1 if the household head has social position in the kebele, 0 otherwise

X11 = PERCP Perception of the household head about soil erosion problem: 1 if the household head perceive soil erosion problem in his farm, o otherwise

X12 = LNDSECU Security of land tenure: 1 if the farmer considered that he/she will be able to use the plot at least during his/her life time, 0 other wise

5.2.1. Determinants of Use of Improved Soil and Water Conservation Technologies

SPSS analysis has been used to examine the determinants of use of soil conservation practices in Gubalafto district, North Wollo Zone using lengths of constructed improved and traditional soil and water conservation structures in meter per hectare as a proxy measure of conservation efforts. Results of the regression analysis for improved soil conservation measures are presented in Tables 19 and 20. The dependent variables were measured in meter per hectare for improved soil bund, improved cutoff drain, and fanyajuu.

Among the 12 hypothesized explanatory variables, only six variables were found to affect improved soil bund and improved cut-off drain significantly and five variables were found to affect the use of fanyajuu significantly. Table 19 shows the probability change among non-users of each type of conservation practices. The log likelihood ratio test for the three cases were significant at $P^{<}0.01$ level. This indicates that there exists useful information in the estimated of SPSS model.

The result indicated that the variables affecting use of improved soil conservation effort in the study area include; area of cultivated land (ACULTLND), land to labor ratio (LANDLBR), age of the household head (AGEHH), education level of the household head (EDUCHH), distance of the farm plot from home (DIST), slope of the farm plots (SLOP) and availability of extension services (EXT).

The coefficient estimated in all the variables except age, perception of soil problem and land security confirmed the prior expectations. However the coefficients of perception and land security did not support for the hypothesis. All variables except age of head of household have the expected. Land to Labor ratio (LNDLBR), education level of household head (EDUCHH), distance of the farm plot from residence (DIST), and slope of the farm plots (SLOP) have influenced the use of the three types of soil conservation measures significantly, i.e. improved soil bund, improved cut of drain and Fanyajuu.

Area of cultivated land significantly influenced the use of improved soil bund (ISOB) and improved cut off drain (ICOFD). Area of cultivated land increased the use of improved soil bund and improved cut off drain by 4.83% and 3.82%, respectively. This was true because farmers having larger farm size were allocating some part of the land to soil bund and improved cut of drain construction than those farmers who have small farms. This was contrary to the result that larger fields have fewer fields of terracing per hectare because of terrace indivisibility and diminishing marginal returns to terrace density (Berhanu et al., 1999)

Age decreased the probability of using improved soil bund by 0.34%. This result indicated that, as a farmer's age increases, the probability of using improved soil bund decreases. Younger farmers expend more effort on improved soil conservation methods especially improved soil bund compared to older ones and were motivated by the level of education. They, therefore, were more aware of the problems of erosion and the importance of soil conservation practices.

Although the overall level of education of the respondents was very low (Average of 1.7 years), it has influenced the use of improved soil bund, improved cut of drain and fanyajuu positively at 1% significant level. Education increased the probability of using improved soil bund, improved cut of drain and fanyajuu by 5.64, 10.02, and 10.38%, respectively. This means that the change in education level of the head of the household head by one year has increased the use of the three improved soil conservation technologies. This implied that better education levels enabled the farmers to get more information on conservation.

Land to labor ratio has negatively and significantly influenced the use of the three types of improved soil and water conservation technologies at 1% significant level. Land to labor ratio has decreased the use of improved soil bund, improved cut of drain and fanyajuu, respectively, by 12.19, 17.47, and 18.86%. This was because larger households were able to provide the required labor force for the implementation of soil conserving structures. Constructing soil-conserving structures is labor intensive. The negative relation between land and labor has supported the use of intensification as population grows (Boserup, 1965, in J. Baidu-Forson, 1999).

As population growth land scarcity became a major factor causing or intensifying the problem of land degradation in the study area. Family size was positively and significantly related to conservation effort. Although the results of the analysis showed that larger families spend more time on conservation activities than smaller families, larger families did not necessarily reduce soil erosion. While larger families have the supply of labor to undertake soil conservation activities, they also increased pressure on land and extended cultivation onto marginal areas that cannot support crop production even under extensive soil conservation measures. Moreover, as population increases, landholding per household gradually decreased which in turn have a negative impact on soil conservation.

Table 15: Maximum likelihood estimates of improved soil conservation measures

Dependent variables												
Parameters	Bi	St.err	T-value	(Change in probability	Bi	St.err	T-value	Change in probability	Bi	St. err	T-Value	Change in probability
Constants	-69.80	33.25	-2.009**	-------	-29.04	10.17	-2.85***	-------	-28.69	12.26	-2.340***	-------
ACULTLND	10.19	4.98	2.04**	0.0483	2.-16	1.50	2.86***	0.0382	3.05	1.82	1.676	0.0498
LNDLBR	-25.70	10.69	-2.404***	-0.1219	-9.87	3.24	-3.04***	-0.1747	-11.55	3.90	-2.960***	-0.1886
AGEHH	-0.73	0.30	-2.423***	-0.0034	-0.11	0.08	-1.32	-0.0019	-0.767	-11.55	3.90	-0.0125
EDUCHH	11.90	5.05	2.357***	0.0564	5.66	1.63	3.46***	0.1002	6.35	1.98	3.212***	0.1038
DIST	-1.61	0.44	-3.636***	-0.0076	-0.44	0.13	-3.28***	-0.0078	-0.52	0.16	-3.171***	-0.0084
OFFINCOM	-0.002	0.013	-.148	-0.0000	0.003	004	0.71	0.0000	0.002	0.005	-.376	0.00003
TLU	-1.29	1.37	-945	-0.0061	-0.03	0.42	-0.06	-0.001	-0.16	0.51	-322	-0.0028
SLOP	27.06	6.08	4.44**	0.1283	6.87	1.45	4.71***	0.1216	6.99	1.69	4.130***	0.1143
EXT	7.64	7.13	1.071	0.0362	5.39	2.42	2.23***	0.0954	6.23	2.92	2.134***	0.1017
SOC	1.27	0.82	1.24	0.0060	0.77	0.84	0.91	0.0136	1.15	1.02	1.25	0.0187
PERCEP	-7.64	18.09	-422	-0.0362	-0.63	5.32	-0.11	-0.0112	-0.11	6.44	-017	-0.0018
LNDSECU	-1.03	6.63	-155	-0.0049	-1.56	1.98	-0.78	-0.0276	-2.31	2.39	-967	-0.0378
λ	1760.36				1392.58				1214.34			
Z-score	1.42				1.32				1.26			
F(Z)	0.9220				0.9067				0.8960			
F (Z)	0.1476				0.1669				0.1804			
σ =sigma	31.1217				9.4287				11.0421			
Observations	204				204				204			

Note. ***,**, and * represent significance at less than 0.01, 0.05, and 0.1, probability levels respectively: λ = -2 log likely hood function; F(Z), f (Z) and Z- score respectively the cumulative normal distribution function unit normal density function and the Z score for the area under the normal curve.

Distance had negative significant effect on the use of improved soil bund, improved cut of drain and fanyajuu at 1% significant level. Distance decreased the use of these technologies by 0.76, 0.78 and 0.84%, respectively. Plots far away from home took more time and energy to construct soil conservation structures as well as other farming practices. The cost of soil conservation includes not only cash costs, but also transaction costs of travel to plots far away from homestead. Berhanu and Swinton (2003) in their study on the investment in soil conservation in Northern Ethiopia found that plots far away from homestead discouraged investment in soil conservation.

Degree of slope increased the use of the three types of improved soil & water conservation structures significantly (1%) significant level for all). It increased the use improved soil bund, improved cut of drain and fanyajuu by 12.83%, 12.16% and 11.43%, respectively. The significant positive relationship indicated that farmers were having inclination to invest in conservation practices if their farm plots are located on higher slopes.

Access to agricultural extension service increased the use of improved cut off drain and fanyajuu significantly (at 5% level). A visit of farmers by development agents increased the use of improved cut off drain and fanyajuu by 9.54% and 10.17%, respectively. This finding agreed with the finding of Baidu-Forson (1999) who indicated that availability of extension service has positively influenced level of use of 'tassa' and half-crescent shaped earthen mounds in the Shale (Niger). Extension service had a substantial contribution to motivate farmers to use soil & water conservation technology as a result of smooth flow of important information on the technology.

4.2.2. Extent of Use of Improved Soil and Water Conservation Technologies

The second part of the SPSS model had measured the extent of use with respect to a unit change of an independent variable among users and also it showed the marginal effect of an explanatory variable on the expected value (mean proportion) of the dependent variable. The truncated regression of improved soil conservation practices showed that the factors that influence the decision to use and intensity of use of improved soil and water conservation technologies were the same (Table 20). Table 20 presented the effect of marginal changes in explanatory variable on the intensity of use of improved soil and water conservation measures among users and among the whole sample. Area of cultivated land influenced level of use of improved soil bund and improved cut off drain positively. The marginal effect of area of cultivated land on improved soil bund and improved cut off drain were 9.39 and 1.96 and 7.61 and 1.56 among users of improved soil bund and improved cut of drain. On the average a change in the area of cultivated land by 1 hectare has increased the level of improved soil bund and cut off drain by 9.39 and 1.959 meter per hectare among the whole sample and by 7.61 and 1.56 meter per hectare among users of the two technologies.

The marginal effect of age on improved soil bund was -0.67 and -0.55 for the entire sample and among users of improved soil bund, respectively. On the average, a unit change in age of household heads (Year) has decreased the level of the use of improved soil bund measures by 0.67 m/ha among the whole sample and 0.55m/ha among users of improved soil bund.

Table16: Marginal effect of explanatory variables on the use of improved soil conservation technologies.

Parameters	Dependent Variable					
	Y1=ISOB		Y2=ICUTOFD		Y3=FANJU	
	(Change among Users)	Total Change	(Change Among Users)	Total Change	(change Among Users)	Total Change
ACULTLDN	7.61	9.39	1.56	1.958	2.15	2.73
LNDLBR	-19.20	-23.68	-7.14	-8.950	-8.15	-10.34
AGEHH	-0.55	-0.67	-0.08	-0.100	-0.54	-0.6872
EDUCHH	8.89	10.98	4.09	5.132	4.48	5.69
DISTA	-1.20	-1.49	-0.32	-0.399	-0.37	-0.46
OFFINCOM	0.00	-0.00	0.00	0.00	0.00	0.00
TLU	-0.96	-1.19	-0.02	-0.027	-0.12	-0.15
SLOP	20.22	24.95	4.97	6.230	4.94	6.27
EXT	5.71	7.04	3.90	4.888	4.40	5.58
SOC	0.95	1.27	0.56	0.698	0.81	1.03
PERCEP	-5.71	-7.04	-0.46	-0.571	-0.08	-0.10
LNDSECU	-0.77	-095	-1.13	-1.415	-1.63	-2.10

Similarly change in education level of head of household by one year, increased the intensity of use of improved soil bund, improved cut of drain and Fanyajuu by 10.98, 5.132 and 5.69 meter per hectare among the entre sample and 8.89, 4.09, and 4.48 meter per hectare among users of the three improved soil conservation structures respectively. The marginal effect of land to labor on improved soil bund, improved cut of drain and fanyajuu among the whole sample were -23.68, -8.95 and -10.34 meter per hectare and among users if respective measures were -19.20, -7.14 and -8.15, respectively. A unit change in the ratio of cultivated land to labor decreased the amount of improved soil bund, improved cut of drain and fanyajuu constructed by 19.20, 7.14 and 8.15 meters per hectare among users, respectively. Distance of a farm plot is another important variable, which affected the level of use of the three types of improved soil conservation structures significantly. An additional walking minute decreased the use of improved soil bund, improved cut off drain and fanyajuu by 1.49, 0.39 and 0.46 meter per hectare among the whole sample and by 1.20, 0.32 and 0.37 meter per hectare among users of the three technologies, respectively.

Degree of slope increased the extent of use of all the three types of improved soil conservation structures significantly. The marginal effect of slope on the extent of the use of improved soil bund, improved cut off drain and fanyajuu were 24.95, 6.23 and 6.27 among the 20.22, 4.97 and 4.94 among users of these technologies, respectively.

Access to extension service has positive effect on the extent of the use of improved cut of drain and fanyajuu. The marginal effect of extension visit by development agent in the study area on improved cut off drain and fanyajuu were 4.88 and 5.58 among the whole and 3.90 and 4.40 among users of the two technologies, respectively.

4.2.3. Determinants of Use and Intensity of Indigenous Soil Conservation Measure (trash lines)

The results of SPSS model on trash lines presented in Table 21 and 22. These results showed that all the variables, which affected the use trash lines. Among the 12 variables, only 4 variables were found to affect the use of trash lines significantly.

Land to labor ratio and distance of farm plots from residence has affected the use of trash lines positively. Land to labor ratio has decreased the use of trash lines by 4.96%. An increase in land to laborer ratio by one unit has a marginal effect of -25.23 meter per hectare on trash lines among the whole sample households and -22.67 meter per hectare among users of trash lines.

Table 17: Maximum likelihood Estimates of Trash lines

	Y4= TRASHLINs				
	Bi	**Bi**	**St.er**	**T-value**	**(change in probability)**
Constants	-145.95	-86.3	32.94	-2.62**	-------
ACULTLND	3.83	2.165	1.51	1.43	0.0041
LNDLBR	-55.95	-25.909	10.75	-2.41***	0.0496
AGEHH	-0.178	-0.109	0.08	-1.32	-0.0002
EDUCHH	25.20	11.040	7.94	1.39	0.0211
DIST	3.89	-1.676	0.45	-3.75***	0.0211
OFFINCOM	-0.005	0.002	0.01	0.13	0.0000
TLU	-2.88	-0.621	1.37	-0.452	0.0012
SLOP	61.41	28.215	6.15	4.59***	0.0540
EXT	17.09	7.930	7.08	1.12	0.0152
SOC	10.92	4.005	2.78	1.14	0.0077
PERCEP	-19.26	4.574	16.34	0.28	0.0088
LNDSECU	-7.07	-1.259	6.62	-0.19	-0.0024
λ	1436.59				
Z-score	1.94				
F (Z)	0.9740				
F (Z)	0.0608				
σ	31.78				
Observations	204				

*Note ***,**,and * represent significance at less than 0.01, 0.05, and 0.1 probability levels respectively; =-2 log likely hood function; F (Z); f (Z) and Z-score represent respectively the cumulative normal distribution function unit normal density function and the Z score for the are under the normal curve.*

Distance of a farm plot from homesteads obviously has a negative effect on the use trash lines. It affected the intensity of use of trash lines and decreased the use of trash lines by 0.32%. Similarly, the marginal effect of distance of trash line was -1.63 among the whole sample households and -1.47 among users.

Table 18: Marginal effect of explanatory variables on the use of traditional soil conservation measures

Variables	Y4=TRASHLINS	
	Change among users	(Total change)
ACULTLND	1.89	2.11
LNDLBR	-22.67	-25.23
AGEHH	-0.10	-0.11
EDUCHH	9.66	10.75
DIST	-1.47	-1.63
OFFINCOM	0.00	0.00
TLU	-0.54	-0.60
SLOP	24.69	27.48
EXT	6.94	7.72
SOC	3.50	3.90
PERCEP	4.00	4.45
LNDSECU	-1.10	-1.23

Slope has positive and significant effect on the use of trash lines (at 1% significant level). Slope increased the use of trash lines by 14.78 and 5.4%. The marginal effect of slope of the level of the use of trash lines 27.48 among the whole and 24.67 meter per hectare among users of the two practices.

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

Analysis of cross-sectional survey data based on 101 sample house hold farmers possessing 204 farm plots in Gubalafto district, North Wollo Zone in 2011 showed that farmers' conservation decision and extent of use of both improved and traditional soil and water conservation measures are influenced by a host of factors; social, economic, institutional and physical factors. Understanding of these factors would contribute to the design of appropriate strategies to achieve technical change in natural resource conservation process in the study area and other similar areas of the zone and the region. On the basis of the survey results and literature reviewed, the following points were made.

Natural resource conservation policies that fail to account for inter household and inter plot variation and the importance of physical factors behind the use of soil and water conservation measures of farmers are unlikely to be effective. Therefore, policies should consider differences in the above factors in the design and promotion of conservation technologies.

Investment in physical soil and water conserving technologies becomes more attractive as the area of cultivable land is larger; i.e. farmers make more soil and water conservation investment in holdings that are wider in area. This suggests a strategy of targeting diffusion of different (alternative) soil and water conserving technologies particularly to areas relatively having greater area of arable land and to areas having smaller area of cultivated land.

The level of formal education in the household and the extension visit were important variables affecting the probability and intensity of using improved soil and water conservation technologies. This underscores the importance of human capital development in increasing the probability and intensity of using soil and water conservation technologies.

Availability of extension services positively influenced the use of improved soil and water conservation measure. This underscores the need for policies aimed at improved soil and water conservation measures, which are likely to influence the awareness of individual farmers through extension service towards the effect of soil and water conservation.

Development agencies and policy makers should target conservation technologies on the basis of age. This is because older farmers have conservative outlook for new technologies and any policy or strategy related to natural resource conservation should target younger farmers.

Farmers in the study area use complementary and substitute traditional methods to improved soil and water conservation measures. One or a combination of these methods may be more suitable in a specific situation depending on the field condition and farmers' resources constraint. Promotion of these methods and improvement in their effectiveness will provide more choices to farmers so that they can select methods that they consider to be the most appropriate to their situations instead of narrowly targeting a specific technology and ignore other options that may be equally or more effective than the one being promoted.

According to the study area, the effectiveness of physical soil and water conservation was more productive than indigenous, the reason behind was that the improved one had quality and durable than the tradition. Thus, selected according to productivity and sustainability of the structure, and we also consider the structure quality and sustainability also the deposition of soil in the field and etc.

Indigenous conservation practices emerge from detail understanding of local conditions and they have a considerable degree of sustainability as they develop in line with farmers inherited culture and knowledge. Lack of appreciation of these conditions has contributed towards the poor success of soil and water conservation technologies in Ethiopia. Thus integrating of indigenous soil and water conservation practices with improved ones increases the sustainability of modern agricultural and natural resource conservation system.

The problems of soil erosion in Ethiopia in general and in the study area in particular have been identified after the situation has already become serious usually by the time much of the topsoil has been lost, and the productivity of the land has seriously impaired. This suggests a shift in emphasis by concerned organizations and government bodies involved in soil and water conservation to give greater attention in conserving soils and water before the land lost all the fertile soils rather than targeting on lands that has been already exhausted and degraded.

5.2. Recommendation

Agricultural development in Ethiopia is hampered by many factors among which land degradation is the major one, which is threatening the overall sustainability of agricultural production of the country. Soil erosion accounts for the major forms of land degradation in Ethiopia.

Environmental, socio- economic and political factors have contributed to the wide spread accelerated soil erosion in the country. The political and socio-economic systems which characterize most of Ethiopia's past, resulted in the neglect of conservation of natural resources, and not enough has been done to combat the problem of land degradation especially soil and forest resources, because of limited understanding of the problem, lack of resource, lack of motivation, conflicting policies and inefficient organizational arrangements. Because of these reasons, soil erosion in Ethiopia is seriously limiting agricultural production.

In response to the extensive degradation of land, Ethiopia has taken some efforts to mitigate the problem of soil erosion and enhance or at least to maintain the existing production potential of the land at different times. Improved soil and water conservation technologies were introduced and promoted in some degraded areas of the highlands of Ethiopia through the ministry of agriculture including the study area.

This study is conducted, therefore, to examine how smallholder farmers are trying to meet soil and water conservation problems and what determines to undertake both improved and traditional soil and water Conservation measures. To achieve the objectives of this study, SPSS model analysis using 101 sample household farmers selected from 2 kebeles in Gubalafto district, North Wollo zone were used in addition to secondary data collected from different institutions.

Farmers in Gubalafto district used both improved and traditional soil and water conservation measures. The most widely used improved soil and water conservation measures include: improved soil bund, improved cut of drain, and fanyajuu. While the most commonly used traditional soil and water conservation measures include: traditional ditches and trash lines.

Based on the result of this study, physical factors such as slope of farm plots and distance of the farm plots from residence significantly affected the probability and intensity of using both improved and traditional soil and water conservation measures. Whereas age, education level of the farmers, availability of extension service, and area of cultivated land significantly affected the use of improved soil and water conservation structures.

Area of cultivated land increased the probability of using improved soil and water conservation measures especially improved soil bund and fanyajuu. This may be due to the fact that farmers having larger farm size can allocate some part of the land to the construction of improved physical soil and water conservation structures.

In general it was recommended that:

- Government will be formulated soil and water conservation policy.
- All community will be trained about soil and water conservation in non-formal education system at class room level.
- Community will be settled their home near by each farm land.
- Government will give incentive for those who properly managed and keep farm land, forest land and grazing land.
- Government will give extension service closely to each farmer at grass root level.
- Government will stop campaign soil and water conservation activity, rather it was better to be practices communal activity at any time.
- Government will be facilitated biological conservation development at high land and lowland, with selecting appropriate species.
- Physical soil and water conservation activities must be combining with biological conservation activities.
- Incentive will be given for those who have good extension worker on soil and water conservation activities.
- It will be necessary up grading traditional soil and water conservation activities with integrated scientific soil and water conservation activities.
- Incentive will be given for those who have good technical support for extension worker on soil and water conservation activities.
- To solve the problem of soil and water lose it is important be practice integrated watershed development through the country.

6. REFERENCES

Allan, W. (1949). Studies in African Land Usage in North Rodehensia. Oxford University. Press, Cape Town.

Alemayehu, M. (2001). Indigenous Conservation Practices in North Showa Administrative Zone, Amhara Regional State. In: Zenebe, T.(ed). Environment and Development in Ethiopia. Proceedings of the Symposium of the Forum for Social Studies. Addis Ababa, 15-16,sep.2000.pp.87-99.

Amemiya, T. (1985). Advanced Econometrics. T.J. Press, Padstaw Ltd. Great Britain.

Araya, B. and Adjaye, J.A. (2001). 'Adoption of Farm Level Soil Conservation Practices in Eritrea'. Indian Journal of Agricultural Economics, 56: pp. 239-252.

Ayalneh, B. (2002). Land Degradation, Impoverishment and Livelihood Strategies of Rural Households in Ethiopia: Farmers' Perceptions and Policy Implications. PhD Dissertation, Umboldt University, Berlin, Germany.

Baidu-Forson, J. (1999). 'Factors Influencing Adoption of Land Enhancing Technology in the

Sahel: Lessons from a Case Study in Niger'.Agricultural Economics. The Journal of the International Association of Agricultural Economists (IAAE), Vol. 20, NO.3, pp.231-240.

Bekele, Shiferaw and Holden. S. T. (1998). 'Resource Degradation and Adoption of Land Conserving Technologies in the Ethiopian Highlands: A Case Study in Andit Tid, North Shewa'. Agricultural Economics. The Journal of the International Association of Agricultural Economists (IAAE), Vol.18, NO.3, pp.233-247.

Barrett, S. (1996). Economic Development and Environmental Policy. Agricultural and Economic Development Division. FAO Economic and Social Department.

Berhanu, G.; Swinton, S. M. and Tilahun, Y. (1999). 'Effects of Stone Terraces on Crop yields and Farm Profitability: Results of on Farm Research in Tigray, Northern Ethiopia'. The Journal of Soil and Water Conservation.Vol.54. No.3.

Berhanu, G. and Swinton, S. M. (2003).' Investment in Soil Conservation in Northern Ethiopia: The Role of Land Tenure Security and Public Programs'. Agricultural Economics.29:pp. 69-84

Bojo, J. and D. Cassells (1995). Land Degradation and Rehabilitation in Ethiopia: A Reassessment. AFTEA working paper, No.17. Washington Dc: World Bank, 1995.

BPEDOR (2002). Bureau of Planning and Economic Development for Oromia Region. The Office of Planning and Economic Development for Jimma Zone: Statistical Abstract (1996-2000)

CSA (1994). The 1994 Population and Housing Census of Ethiopia.

CSA (2002). Federal Democratic Republic of Ethiopia Central Agricultural Census Commission. Ethiopian Agricultural Sample Enumeration 2001/2002.

Constable, M. (1984). Degradation of the Ethiopian Highlands and Actions to Combat it:

Economic Implications, Costs and Benefits. FAO/MOA Joint Project, EHRS Report, Addis Ababa.

DWOA (2003). Annual Reports of 2002/2003 (unpublished). Sheki.

DWONR (2003). Annual Reports of 2002/2003 (unpublished). Sheki.

Demeke, B. (1998). Economics of Soil Erosion and Conservation. Review of Literature and a Dynamic Non-linear Optimization Model with Risks and Uncertainties: A Case Study for Ethiopia. M.Sc. Thesis in Environmental Economics. Wageningen Agricultural University

FAO (1986). Ethiopian Highland Reclamation Study, Final Report (Volume I and II). FAO.Rome

FAO (1994). Land Degradation in South East Asia: Its Severity, Causes and Effects up on the People, Rome of Land Degradation: World Map of the Status of Human Induced Soil FAO (1996). Economic Development and Environmental Policy. No. 138.

Fassil, G/Kiros (1993). The Subsistence Crisis in Africa: The Case of Ethiopia. Organization for Social Research in Eastern Africa

Feder, G.; Just, R. E.; and Zilberman, D. (1985). 'Adoption of Agricultural Innovations in Developing Countries'. Economic Development Cultural Change. 33: 255-298.

Francis, D. K. Anim (1999). A note on the Adoptin of Soil Conservation Measures in the North Province of South Africa.

GLASOD (1990). Global Assessment Degradation. UNEP/ISRIC, Nairobi and Wageningen, 3 maps and Explanatory Text. Pp.18

Hans-Joachim, K.; Berhanu, F.;Yohannes, G.; and Kefeni, K. (1996). Creating an Inventory of Indigenous Soil and Water Conservation Measures in Ethiopia. In: Sustaining Soil: Indigenous Soil and Water Conservation in Africa.

Hudson, N (1992). Soil Conservation. B T Bats Ford Limited. London.

Hurni, H. (1983). Soil Formation Rates in Ethiopia. FAO/MOA Joint Project, EHRS, Working Paper No.2, Addis Ababa.

_______ (1988). 'Degradation and Conservation of the Resources in the Ethiopian High Lands'. Mountain Research. Dev.8, 123-130.

_______ (1994). Achieving Sustainable Soil Management in Agriculture. In: SCRP, 1994. Planning Workshop, 28 February-4 March 1994, Nazareth, Ethiopia, pp.25-26

Johnston, J. and Dinardo,J. (1997).Econometrics Methods. Fourth Edition, The McGraw-Hill Companies, Inc, New York.

Kim, K.; Barham,B.L.; Coxhead,I. (2001). 'Measuring Soil Quality Dynamics. A Role for Economists and Implication for Economic Analysis'. Agricultural Economics. The Journal of the International Association of Agricultural Economists (IAAE), vol. 25, NO.1, pp.13-26.

Lapar, M. L. A. and Pandey, S. (1999). 'Adoption of Soil Conservation: The Case of Philippine Uplands'. Agricultural Economics. The Journal of the International Association of Agricultural Economists (IAAE), vol. 21, NO.3, pp.241-256.

Maddala, G. S. (1997). Limited Dependent and Quantitative Variables in Econometrics. Cambridge University Press.

More, G. M. (1996). Tenure Security and Productivity in Zimbabwean Small Farm Sector: Implication South Africa.

National Bank of Ethiopia (NBE) (2003). Quarterly Bulletin. Vol.18, No.1.

Nkonya, E.T. Schroeder, T. and Norman, D. (1997). 'Factors Affecting Adoption of Improved Maize Seed and Fertilizer in Northern Tanzania'. Journal of Agricultural Economics. 4:1-11

Seyoum, E.; Battase, G. E. and Fleming, E. M. (1998).'Technical Efficiency and Productivity of Maize Producers in Eastern Ethiopia. A Study of Farmers with in and outside the Sasakawa-Global 2000 project' Agricultural Economics. The Journal of the International Association of Agricultural Economists (IAAE), Vol. 19, NO. 3, pp. 341.

S. S. Pattanayak and D. Evan, Mercer (1997). 'Valuing Soil Conservation Benefits of Agro-Forestry: Contour Hedgerows in the Eastern Visayas, Philippines' Agricultural Economics. The

Journal of the International Association of Agricultural Economists (IAAE), vol.18, No.1, pp.31.

Strock, H.; Berhanu, Adnew; Bezabih, Emana; A., Borowiecki and Shimelis, W/Hawariat (1991). Farming Systems and Farm Management Practices of Smallholders in the Hararghe Highlands. Farming Systems and Resource Economics in the Tropics.Vol.II, Germany: Wissenschaftsverlag Vauk Kiel.

Tefera, B; Ayele,G; Dubale, P;and Jabbar, M. A.(2000). Nature and Causes of Land Degradation in the Oromia Region: A Review of Literature. In: Policies for Sustainable Land Management in the Highlands of Ethiopia. Summary of Papers and Proceedings of a Seminar held at the International Livestock Research Institute, Addis Ababa, Ethiopia, 22-23 may 2000.

Tsigie, Z.(1995). The Political Economy of Land Degradation in Ethiopia. North East African Studies, 2: 71_98.

Wegayehu, B. (2003). Economics of Soil and Water Conservation. Theory and Empirical Application to Subsistence Farming in the Eastern Ethiopian Highlands: A doctoral Thesis. Swedish University of Agricultural Sciences. Uppsala, 2003.

World Bank (1997). World Development Report. Washington DC: Oxford University Press.

World Bank (2000). Entering the 21st Century: World Development Report, Washington DC: Oxford University Press.

Wood, A. (1989). Natural Resource Management and Rural Development in Ethiopia. In Rural Development Options. Pausewang et al. (eds).

Zenebe,Tadesse (2000). Issues in Rural Development. Proceedings of the Inaugural Workshop of the Forum for Social Studies .18, sept. 1998, Addis Ababa.

7. ANNEXES

Annex 1: Conversion factors used to estimate tropical live stock units (TLU)

Animals	**TLU equivalent**
Calf	0.25
Heifer	0.75
Cows and Oxen	1.0
Horse	1.10
Donkey	0.70
Ship and Goat	0.13
Chicken	0.013

Source: stroke et al., (1991)

Annex 2: Conversion factors used to estimate labor equivalent (man days)

Age group (years)	**Gender**	
	Male	**Female**
Below 10	0	0
10-13	0.2	0.2
14-16	0.5	0.4
17-50	1.0	0.8
Over 50	0.7	0.5

Source: Stroke et al, (1991)

Annex 3: Contingency coefficients for discrete variables

Variable	Slop	Ext	Soc	Percep	Lndsecu
Slop	1.00	0.155	0.208	0.049	0.078
Ext		1.00	0.201	0.054	0.217
Soc			1.00	0.214	0.014
Percep				1.00	0.054
Lndsecu					1.00

Source; own computation

Annex 4: Variance inflation Factor (VIF) for continuous variable

Variable	VIF	Tolerance level
ACULTLND	2.232	0.448
LNDLBR	2.128	470
AGE	1.104	0.906
EDUC	1.101	0.908
DIST	1.029	0.972
OFFINCOM	1.041	0.961
TLU	1.040	0.961

Source: own computation

Annex 5: Project proposal

EFFECT OF PHYSICAL STRUCTURE ON SOIL AND WATER CONSERVATION IN ETHIOPIA: THE CASE OF SMALLHOLDERS IN GUBALAFTO DISTRICT OF NORTH WOLLO ZONE.

By

Ketsella Negussie Gebretsadik

A RESEARCH PROPOSAL SUBMITTED TO THE DEPARTMENT OF RURAL DEVELOPMENT, INDIRA GANDHI NATIONAL OPEN UNIVERSITY, IN PARTIAL FULLFILMENT FOR THE REQUIREMENTS OF MASTERS OF ART IN RURAL DEVELOPMENT.

July, 2012

Addis Ababa (Ethiopia)

PROFORMA FOR SUBMISSION OF M.A. (RD) PROPOSAL FOR APPROVAL

Signature: ……………………………………

Name & : Eylachew Zewdie (PhD)

Address of Guide: Addis Ababa (Ethiopia)

Name & address of student: ketsella Negussie Gebretsadik

Addisi Ababa (Ethipoia)

Enrolment No. 109100688

Date of submission: July 2012

Name of study center: Indria Gandhi National Open University school of Continuing Education,(Addis Ababa Ethiopia).

Name of guide: Eylachew Zewdie (PhD)

Title of The project: Effect of Physical Structure on Soil and Water Conservation in Ethiopia; The Case of Small Holders in Gubalafto District of North Wollo Zone.

Signature of the Student: ……………………….

Approved/Not Approved

Date:

TABLE OF CONTENTS

Page

ACRONYMS

BPEDAR	Bureau of Planning and Economic Development for Amhara Region
CARE	Cooperative Assistance and Relief Every Where
CSA	Central Statistical Authority
EARO	Ethiopian Agricultural Research Organization
FAO	Food and Agriculture Organization
FaWCDA	Forest and Wildlife Conservation and Development Authority
FFW	Food for Work
GDP	Gross Domestic Product
Masl	Meters above sea level
MfM	Menschen fur Menschen
MOA	Ministry of Agriculture
NBE	National Bank of Ethiopia
NGO	Non-Governmental Organization

1. INTRODUCTION

1.1. Background

Ethiopia is one of the heavily populated least developed countries in the world with an area of 1.14 million square kilometer and a human population of about 81 million (is this figure correct?) which grows at a rate of about 2.7% annually (NBE, 2003). The Ethiopian economy has largely remained dependent on agriculture, which provides about 44% of the GDP, over 80% of the export revenue and employment for about 80% of the population (NBE, 2003). About 46% of the land mass lies in what is called the highlands, which constitutes areas above 1500 meters above sea level (masl). The highlands harbor about 88% of the country's population, over 95% of the regularly cultivated lands and about 75% of the livestock population (FAO, 1986). In spite of the importance of agriculture in the Ethiopian economy, the level of food production has been low and the country is dependent on food aid. Increasingly, many farmers in Ethiopia are incapable of producing enough food to satisfy household consumption as direct consequences of famines and reduction of land productivity (Bekele,Siferaw and Holden,S.T. 1998).

Ethiopia had food security until 1960s, but since the drought of 1975, food production has been very poor and lagged behind the population growth. As a result, significant amount of food (mainly as aid) has been received every year (Seyoum et al., 1998).

The living conditions of the rural people in Ethiopia have been worsened because of drought and increasing deterioration of the quality and quantity of natural resources, which are the main basis of subsistence agriculture. At present, Ethiopia is facing greater land degradation problem. Some studies indicated that soil erosion and deforestation are two of the most important environmental problems in Ethiopia. For example the Ethiopian Highlands Reclamation Study (EHRS), which contains one of the earliest major studies of land degradation in Ethiopia, put the total crop production loss due to erosion at 120,000 tons per annum in 1985 (FAO, 1986). According to the result of this study, one-half of the highland area was significantly eroded and over one fourth was seriously eroded, and over 2,000 km2 of farm lands have reached the point of no return. Bojo and Cassells (1995) reassessed land degradation and indicated that the immediate gross financial losses due to land degradation in the Ethiopian highlands were about USD 102 million per annum which was about 3 % of the country's GDP. The study also showed that virtually all of the losses were due to nutrient losses resulting from the removal of dung and crop residues from cropland, while the remaining was mainly due to soil erosion. In the highlands of Ethiopia, deforestation has reduced tree cover to 2.7% of the surface area, 50-60% of the rainfall is estimated to be lost as runoff, carrying 2-3 billion tones of the top soil away annually (Hurni, 1988). In many areas, soil loss rates are much higher than soil formation rates, due to over cultivation. Estimated rate of soil formation in Ethiopia vary between 2 and 22 tons per hectare per year; while soil loss rates range from 51 to 200 tons per hectare per year in most highlands of the country (Tefera et al., 2000).

The degradation of a large part of the Ethiopian highlands has reached where it will become increasingly difficult even to maintain the present day production of basic food which is already insufficient in many regions of the country (cited in Demeke, 1998). Traditional cereal farming in Ethiopia is not only low yielding but also results in the mining of plant nutrients from the soil. After harvest, farmers remove the stalks and leaves for feed, fuel and building materials, which leave no crop residue to restore soil nutrients and organic matters (Seyoum et al., 1998). Due to decrease in the degree of vegetation cover, increased tillage that leave the surface smooth, the larger number of livestock and their frequent trekking for water and grass and poorly constructed roads, both water and wind erosion are becoming serious problems in Ethiopia.

The purpose of this study is therefore; to investigate the physical and socioeconomic factors that influence farm level soil and water conservation effect in Gubalafto district, North Wollo zone of Amhara Regional State.

1.2. Statement of the Problem

Agricultural development in Ethiopia is hampered by many factors among which land degradation is the major one, which is threatening the overall sustainability of agricultural production of the country. Most of the highland terrain has slopes of more than 16%, and only a fifth is considered free from erosion hazard. Most of the productive topsoil in the highlands has been degraded resulting in chronic food shortages and persistent poverty (Hans-Joachim et al., 1996). Problems of poverty, land scarcity and soil degradation are prevalent today in Ethiopia. Small holders are still poor, degradation has continued, and food insecurity is a great problem. Serious soil erosion is estimated to have affected 25% of the area of the highlands are now seriously eroded that they will not be economically productive again in the foreseeable future. The capacity of the highland farming communities to sustain production is, therefore, under serious pressure (Hans-Joachim et al., 1996).

The complex inter-linkages between poverty, population growth and environmental degradation offer another dimension to the land degradation problems. In recent years, rapid population growth has brought several changes: farm holdings have become smaller due to constraints in land availability; holdings are more fragmented; farmers cultivate fragile margins on steep slopes previously held in pasture and wood lots; many households particularly those owning little land or with large families are in great problem, fallow periods have become shorter, with longer cultivation periods. Consequences of more intensive farming and farming on steep slopes are declining fertility and increasing the high incidence of soil loss due to erosion (Shiferaw and Holden 1998).

The use of external yield increasing inputs in Ethiopia is rudimentary and agricultural production relies heavily on technologies largely unchanged for many years. Increasing demand for manure as a source of fire wood and crop residues as a source of feed for livestock, accompanied by high population pressure and a decline in land-man ratio, have made the traditional systems of regenerating soil fertility through fallowing and use of manure and crop residues increasingly difficult. Intensification of cropping on slopping lands without suitable amendments to replenish lost nutrients has thus led to wide spread degradation of land (FAO, 1986).

In response to the extensive degradation of its resource base, Ethiopia has taken some efforts to mitigate the problem of soil erosion and enhance or maintain the production potential of agricultural land. New soil conservation technologies were introduced in some degraded and food deficit area of the highlands, mainly through food- for- work incentives since the early 1980s. Even though, soil conservation technologies were promoted through the ministry of Agriculture in Ethiopian highlands. (Bekele,Siferaw and Holden,S.T. 1998).

Given this state of conditions, analysis of the issue of what specifically determines the decision taken by smallholder farmers to invest in soil conservation measures to maintain sustainable agricultural production and conserving the natural resource base of the country is not only an important and realistic option but it is also a means to sustain and improve the livelihood of the population.

1.3. Significant of the Study

Soil erosion is a problem in North Wollo zone and it is particularly serious problem in Gubalafto district because of the rugged and rolling topography of the district. Therefore it is important to know the strength and weakness of the household to practicing in physical soil and water conservation activities.

1.4. Hypothesis and research questions

1.4.1. The combine effect of soil and water conservation practices has impact on farmers' livelihood.

1.5. Objective of the Study

The general objectives of this study is, therefore, to examine how smallholders are trying to meet the effect of different types of soil and water conservation structure which enhance sustainable productivity of farming.

The specific objectives are:

1. To identify and describe the most commonly used traditional (indigenous) and improved soil and water conservation methods.

2. To identify physical and socio economic factors which affect farmers to use soil and water conservation measures.

3. To assess the effect of practicing soil and water conservation measures on farm production and productivity in the study area.

1.6 Scope and limitation of the study

- Lack of sufficient cooperation from government bureaus or offices.
- Lack of clear and truthful information getting from farmers.

2. REVIEW OF LITERATURE

2.1. Concepts and Theoretical Framework

Soil is a natural resource, which generates every year through the natural process. Soil erosion is interchangeably used with land degradation; however, soil erosion is only one form of land degradation. The term land degradation can be defined in various ways in relation to soil erosion to describe its negative impacts on land productivity (Hudson, 1992). Land degradation can be defined as a process that lowers the current and future capacity of the land to support human life (Pagiola, 1994 cited in Demeke, 1998). Allan (1949), described land degradation as a process which results in a radical change in the complete character of the land due to the loss of mineral plant nutrition, the oxidation and disappearance of organic matter, the breakdown of soil structures, the degeneration of vegetation and setting up of a new terrain of land and water relationship. Land degradation is also defined as the temporary or permanent lowering of the productive capacity of land (FAO, 1994).

Soil erosion accounts for the major forms of land degradation in developing countries, and at the same time, it is difficult to isolate and measure its impact on productivity even when the means and resources are available (Ayalneh, 2002). Soil conservation includes all forms of human actions to prevent and treat soil degradation (Grohs, 1994 cited in Demeke, 1998). The amount of soil erosion, which occurs under a given condition, is influenced not only by the nature of the soil itself but also by the treatment or management it receives. The difference in erosion caused by different management of the same soil is very much greater than the difference in erosion from different soils given the same management (Hudsen, 1992).

According to Hudsen, the best land management might be defined as the most intensive and productive use of which the land is capable without causing any degradation. The application of sustainable soil and water conservation (SWC) management is largely determined by economic status, public awareness, and educational level of the stakeholders and the main prerequisite for attaining sustainable agricultural development is the formulation of appropriate resource management policies which are supported by the farming community to which they are willing and able to respond (Strock, 1995, in Ayalneh, 2002). In many agricultural based developing countries, environmental degradation takes the form of soil nutrient depletion and loss of food production potential. Reversal of the erosion induced productivity decline and ensuring adequate food supplies to the fast growing population in these countries posit a formidable challenge (Shiferaw and Holden, 1998).

Sustainable economic growth depends on a stable and resilient agricultural sector. Continued land degradation means lower rural income and economic decline. Controlling soil erosion and improving soil fertility are the keys to this economic growth .Today soil degradation is almost universally recognized as a serious threat to the well being of human being and this is shown by the fact that most governments give active support to programs of soil conservation.

2.2. Problems of Land Degradation

Ethiopia is one of the sub Saharan African countries where soil degradation has reached a severe stage. Land degradation mainly due to soil erosion and nutrient depletion, has become the most important environmental problems in the country. Coupled with poverty, fast growing population, policy failures and social unrest, land degradation have posses a serious threat to national and household food security (Bekele, Siferaw and Holden, S.T. 1998).

A major survey undertaken around the early 1980s concluded that 50% of the highland region, roughly 270,000 Km2 had already lost its productive capacity (Hurni, 1988). Constable (1984) has indicated that in addition to soil degradation, which is extensive, current rates of soil erosion are very high and the estimates of soil loss from the highlands vary widely from less than a billion tons up to three billions tons per year. Moreover, Land Use and Regulatory Department of Ministry of Agriculture estimated the gross soil loss from the highlands at up to 1,900 million ton per year, of which, 80% (1520 million tons) is from croplands constituting only 22% of the highland areas. In general, the rate of soil loss in the country as a whole is estimated to be extremely high where its soil loss varies by type of land cover (Hurni, 1988). According to Hurni (1988), the rates of soil formation in Ethiopia vary between 2 and 22 tons/hectare/year, which are much lower than the rate of soil erosion. The average soil loss rate is six times greater than the rate of soil formation and it causes an annual reduction of 4 mm in soil depth (Tsigie, Z., 1995).

According to Ayalneh (2002), extensive land degradation in the highlands of Ethiopia is often a direct outcome of individuals' and governments' failure not fully recognize and integrate environmental values into the decision making process. The problem is only identified after the situation has already become serious, usually by the time, much of the topsoil has been lost, and the productivity of the land seriously impaired. Even then, plans are prepared with emphasis on physically keeping the soil in place, and with planners seldom giving attention to the problems of faulty land use and management, of which excessive run off and soil loss are only the symptoms. Often contact between planners and the stakeholders used to be minimal. Finally, framers are directly or indirectly persuaded, even some times forced to implement the plans. Such strategies have seriously undermined the incentives for land users to involve themselves in the implementation of plans and the conservation programs have generally been far from success.

According to Ayalneh (2002), often, resource users have been blamed for the failure of the plans without any attempt being made to analyze their circumstances. Nevertheless, it appears that various soil and water conservation strategies have been known and practiced in different places for hundreds of years. The reason that introduced soil and water conservation have been unsuccessful should be traced in terms of the faulty approaches they have adopted. Now a days, there is growing commences that soil conservation strategies need to be based on an approach that will ensure the participation of rural people in conservation because of the benefits that conservation brings.

3. METHODOLOGY

3.1. Description of the study site.

Gubalafto is one of the thirteen districts of North Wollo Zone and it is located in the South Western part of North Wollo Zone. The district shares its boundaries with Habru district to the East and South East, Kobo district to the north, Meket and Wadlla districts to the West and South-West. It's absolute location is marked as 11^0:36' – 11^0:59'N latitude and 39^0:12' – 39^0:49' E longitude (GWOANR, 2011).

The total geographical area of the district is about 1042 km^2 with 34% dega, 46% weyna dega, and 18% kola, which are divided into 53 rural kebeles and two urban kebele, Woldia is the capital city of Gubalafto district.

The mean annual rainfall and temperature for Gubalafto district is 1700 mm and $21^{\mathbf{0}}$ c respectively. Rainfall is bi-modal and the short rainy season starts in January and extends to May. The long rainy season starts in June and extends to September.

The total population of Gubalafto district was 255420 out of which 97.8 % live in rural areas. It has a young population of 49% economically active population 48 % and aged population of 3%. It is one of the densely populated areas of the region with 171 persons per sq. km. This created the problem of deforestation and intensive cultivation including sloppy lands that aggravated the problem of soil erosion.

Livestock play important role in the economy of smallholder farmers. The total number of animals in Woreda are, cattle = 91,764, sheep and goat = 195,168, equines = 24,400 and hen = 68,963. Animals are kept as a source of milk, meat, cash, and draught power. Cattle dung is also an important source of fuel. In the study area the livestock production is also an important sub sector undertaken in line with crop production.(GWOANR, 2011).

Gubalafto is one of the few Woredas in North Wollo Zone where there is relatively better remnant of forest. About 8.75% of the total area is under forest cover. This consists of both natural and man- made forest (GWOANR, 2011).

The most common tree species include Tikur inchet, Wanza and Zigba. These trees, which are remarkably useful for timber, are tall with thick trunks. Exotic trees in the district are found to manmade plantation. Most of them are eucalyptus. The major parts of forest products are used for fuel, while the demand for house construction and industrial purpose could be ranked as the second requirement (GWOANR, 2011).

According to (GWOANR 2011), Gubalafto district is dominated by clay, porous & well-drained soils - Nitosols. They are deep reddish brown to red in color, have generally good potential for agriculture, and are easily workable. Northern peripheries of Gubalafto district with a relatively plain topography posses soils classified as pellic vertisol, while the remaining part is assumed to have orthic acrisol.

3.2. Research design

The research sites, Gubalafto Woreda, and dega (Baba-seat Kebele) and woyna dega (Gashober kebele) within the Woreda were selected using purposive sampling method because soil degradation is a serious challenge of the area and needs immediate conservation measure to save the natural resources for future wellbeing of the citizens of the area. Based on the presence of soil and water conservation activity 2 kebeles (one from dega and one from weyandega rural kebeles in the district.) will be purposely select Reconnaissance survey will be conducted to delineate the study site on the base of watershed concept. The households will be stratified based on wealth and other factors (sex, age, education, marital and etc) and, then from each group sample will be drown using random sample method. The sample sizes will be 45% of farm households of the study site.

3.3. Sampling Techniques and Methods of Data Collection

The primary data for the study will be generating from the sample households using a structured questionnaire. The questionnaire will consist issues such as household characteristics, land holding and farm characteristics, availability of labour, farmers' awareness and perception about soil erosion problems, soil conservation technologies and farmers' attitude, tenure arrangement, institutional support and wealth status of sample households. The questionnaire is attached as annex.

Eight enumerators will be recruited and trained for two days on the method of data collections and related topics. A structured questionnaire will be developed and pretest before conducting the formal survey. Data will be collected at household and plot level. Enumerators will generate the data under the supervision of the researcher. In addition to this the collected data will verified by interviewing Government office experts', kebele leaders and administration bodies. Both relevant qualitative and quantitative data will be collect from secondary sources.

3.4. Methods of Data Analysis

It is difficult to generalize about the factors affecting use of soil and water conservation technologies in different parts of the world or even in different regions of a country because of differences in agro-ecological and socioeconomic settings under which farmers operate (Bekele, 2003).

Though the basic assumption that the utility maximizing objective of farmers is the same, the specific attributes influencing the utility of farmers and adoption decision are far from being uniform and use of soil and water conservation practices depends up on this differences in attributes, some of which are specific to a particular region, village, farm or plot. Farmers in Gubalafto district, like other Ethiopian farmers, usually cultivate or manage more than one plot located at different places, having different soil color and distance from home etc. As a result, farm households may have different soil and water conservation decision for different plots depending on specific circumstances of a plot and the importance of the plot to the households. Therefore the data will be analysis using Statistical Package for Social Science **(SPSS)** model.

4. WORK AND BUDGET PLAN

4.1. Principal research resources

4.1.1. Information resources

Primacy data like land use, land cover, physiographic, socio-economy, agronomic practices; will be collected. Secondary data on number of population, soil conservation practices, crop production, topography, geology, and hydrology shall be collected from agriculture office, district administration & etc.

4.1.1.2. Human resources

For the effective & timely accomplishment of the research there will be a paramount important to recruit enumerator and assign a supervisor.

4.1.1.3. Physical resources

Materials & equipment like GPS & GIS soft ware's, clinometers, topographic maps, measuring tape 30 m length; compass & ruler are needed for the collection of basic data and execution of the research.

4.2. Work plan

The research work is plan to undertake begging from July 2012 & expected to be finalized at the end of November 2012. The detail work plan is presented in the following table.

Table 1. Work plan

S/N	Major activities	July.	August	Sept	Octo.	Nov.
1	**Pre-field work**					
1.1	Literature review	x	x	x	x	x
1.2	Reconnaissance survey of the site	x				
1.3	Checklist & structured questionnaire preparation.	x				
1.4	Secondary data collection		x			
1.5	Animators training on data collection		x			
2	**Actual field work**					
2.1	Primary data collection by suing questionnaire & FGW			x		
2.2	Delineation of command areas and kebeles				x	
2.3	Selection of sample plots				x	
2.4	Data collection from sample plots				x	
3	**Data analysis and thesis write up**				**x**	
3.1	Data arrangement				x	
3.2	Data analysis and interpreting				x	
3.3	Thesis write up, draft and final submission of report.					x

4.3. Budget for Research Work

During the proposed research work, human resources of skilled & semi skilled persons are needed at different times, especially during data collection phase. Beside, some basic stationery materials are needed for entire paper works. The assumption here is to utilize the existing office computer, copiers, printers, printer toner & printing/photocopy paper. The total research budget is also indicated in the table below

Table 2: Research Budget

A. Tools and Material Cost

N/S	Item	Unit	Quantity	Unit cost	Total cost
1	Measuring tape 30m	pc	1	100	100
2	Measuring tape 5m	pc	1	8	8
3	Water level/builders level	Pc	1	100	100
4	Nylon rope	Mt	30	1	30
5	Topographic map	pc	30	30	150
Sub total					**388.00**

B. Stationery cost

S/N	Item	Unit	Quantity	Unit cost	Total cost
1	Printer toner cartridge	Pcs	1	1200	1200
2	Photocopy & printing paper	Ream	4	60	240
3	Pen (ball point)	Pcs	12	1.25	15
4	Pencil	Pcs	4	0.25	1
5	Note book –medium size	Pcs	6	15	90
6	Clipboard	Pcs	4	25	100
Sub total					**1646**

C. Personnel and per diem cost

S/N	Description	Unit	Quantity	Duration in days	Rate per-day	Total expense
1	Researcher	Person	1	60	70	4200
3	Animators	Person	8	20	50	8000
4	Data recorder	Person	1	150	10	1500
Sub total						**15100**

D. Total budget summary

S/N	Cost title	Total expense
1	Stationary	1646
2	Personnel and per diem	15100
3	Materials expenditure	388
Total		17134
Contingency (10%)		1713.4
Grand Total (ETB)		**18,847.4**

Annex 6: Survey questionnaire

Name of the enumerator ________________________ Date_______

The objective of these questionnaires is to collect information related to soil conservation

Practice in Gubalafto woreda. The study is conducted for academic purpose. Hence, we request Your honest and fair responses to fill up this questionnaire.

General information of the Respondents

Q1.1.. Respondents Name:____________________

Q1.2. . Sex of the Respondent: 1) Male 2) Female

Q1.3. Age of the Respondent:__________________year

Q1.4. What is the marital status of the head of this household?

Married

Single

Widowed

Divorced/ separated

Other

Don't know

Q1.5. Who is the head of this household:

Myself

Husband or Father

Wife or Mother

Another man

Another woman

Q1.5. Religion: 1) Orthodox 2) Muslim 3) Catholic 4) Protestant 5) Other, specify______

Q1.6. Kebele Name:________

Q1.7. Village Name: -----------------------

Q1.8. Social position in the Kebele 1) Member of Kebele council 2) Religious leaderr 3) Others, specify

Q1.9. What is the level of education of the male head of this household? 1) Can't read or write 2)Read & write only, (no formal education) 3) Grade 1-6 4) Grade 7-8 5) Grade 9-10 6) Grade 11-12 7) > Grade 12

Household Characteristics

Q2.1. How many males 18 years or older usually live in this household? Adult males: |___|___|

Q2.2. How many females 18 years or older usually live in this household? Adult Females: |___|___|

Q2.3. How many children age 5-17 years old usually live in this household? Children 5-17: |___|___|

Q2.4. How many children under 5 years old usually live in this household? Children < 5: |___|___|

Landholding by the Household

No	Q.3.1.Type of land use	Q3.2. Area (in hectare)
1	Cultivated land	
2	Fallow land	
3	Grazing land	
4	Home stead area	
5	Forest (bush)	
6	Other	
	Total land holding	

Description of farm plots Charcterstices

No	Description	Plot 1	Plot 2	Plot 3	Plot 4
Q4.1.	Area of the plot (ha)				
Q4.2.	Type of crops grown 1)Teff , 2) Wheat 3) Maize ,4) Sorghum 5) Others (Specfiy)				
Q4.3.	Distance from home (walking minutes) to farm plots (in meter)				
Q4.4.	Slope: 1) Flat (0-6%) 2) gentle slope (6-15%) 3) Steep slope &Mountainous (>15%)				
Q4.5	Plot fertility :1)high 2)medium 3)low				
Q4.6	Source of the plot 1) inherited 2) received from Kebele 3) rented in				
Q4.7	Color of the soil 1)red 2)black 3)brown				
Q4.8	Degree of erosion problem on the plot 1)high 2)medium 3)low				
Q4.9	Number of years since the plot is used				
Q4.10	Irrigated or not 1)Yes 2) No				
Q4.11	Presence of at least one type of improved conservation structures 1) Yes 2) No				
Q4.12	Improved soil and water conservation structures built in meter				
	Soil bund				
	Cut of drain				
	Fanyajuu				

No	Description	Plot 1	Plot 2	Plot 3	Plot 4
	Other, specify				
Q4.13	Estimated area covered with improved soil and water conservations structures (in meter)				
	Soil bund				
	Cut of drain				
	Fanyajuu				
	Other, specify				
Q4.14	Who constricted the structures? 1)Community participation 2) Family (hired)labor 3)Financial incentives by government 4)labor exchange				
Q4.15	Do improved soil and water conservation structure maintained or not 1) Yes 2) No				
Q4.16	Who did the maintenance work? 1)Community participation 2) Family /haired labor 3)labor exchange				
Q4.17	Statues(degree)of use of improved soil and water conservation structure (practices) 1) removed totally; 2) partially removed 3)not removed 4)modified				
Q4.18	Traditional soil and water conservation structure built (in meter)				
	Traditional stone bund				
	Traditional ditches				
	Trash line				

No	Description	Plot 1	Plot 2	Plot 3	Plot 4
	Cut of f-drain				
	Other, specify				
Q4.19	Estimated area covered with traditional soil and water conservation structures (in hectare)				
	Traditional stone bund				
	Traditional ditches				
	Trash lines				
	Cut off-drain				
	Others, specify				

Q4.20 Which type of the traditional soil and water conservation structure do you like more? ____

____

Q4.21. Why? ____

Q4.22. What are the advantage of traditional soil water conservation structures over improved ones?____

Labor Availability

Q5.1. Do you Have labor shortage for your farm activities? 1) Yes 2) No

Q5.2. If the answer to question 5.1 is yes, how do you solve labor shortage? 1) Hiring labor 2) by cooperating with other farmers (Debo/Jigie) 3) other, specify________________

Q5.3. If labor is hired, what type of labor do you hire?1) Causal 2) permanent 3) both

Q5.4. Can you easily get labor whenever you need? 1) Yes 2)No

Q5.5. which farm activities do your female family members participate?

Q5.6. which activities do children (<14) participate?

Q5.7. which family members participate in soil and water conservation works?

1) Men 2) women 3) Children 4) all of them participate

Q5.8. Do you or your family members work on off-farm activities? 1) Yes 2) No

Perceptions of soil erosion problems

Q6.1. Do you think that soil erosion is a problem for your farm plots? 1) Yes 2)No

Q6.2. How do you perceive the soil depth of your plot since you owned it?

Plot	Trend (fertility)
1	
2	
3	
4	

Code: 1) increased 2) decreased 3) no change 4) I don't know

Q6.3. How do you compare the problem of soil erosion in your farm plots after Conservation structures were built?

Plot number	Problem of soil erosion
1	
2	
3	
4	

Code;1) aggravated 2)reduced 3)no change 4)I don't know

Q6.4. Give rank to the following major causes of soil erosion in your area?

1) Deforestation _________________ 2) Over grazing_____________________
3) Over cultivation_______________ 4) Poor agriculture practices____________ 5) Cultivations of steep slopes ________ 6) Excess rainfall _______________ 7) poor government polices_______8) others (specify) _______________

Q6.5. What do you think is the consequence of soil erosion? 1) Land productivity (yield) decline 2) Change in type of crops growth 3) Reduces farm plot size 4) other (specify)

Soil and water conservation technologies and farmers' attitude

Q7.1. Do you know the existence of improved soil and water conservation structures? 1) Yes 2) No

Q7.2. if yes, which type do you know?

1) Stone bunds 2) soil bunds 3) cutoff drain 4) water way 5) Fanyajuu 6) others

Q7.3. What is your source of information?

1)Neighboring farmers 2) Extension agents(DAs) 3) NGOs 4)From field days and training 5)Other, specify

Q7.4. which of the following type of soil and water conservation measurement are efficient to reduce the problem of soil and water erosion?

1) Stone bund 2) soil bund 3) cut off drain 4) water way 5) Fanyajuu

Q7.5. which of the following types of soil and water conservation measurement are more effective on sustainability?

1) Stone bund 2) soil bund 3) cut off drain 4) water way 5) Fanyajuu

Q7.6. what was the reason for selecting of such type of structure?-------------------------------------
----

Q7.7. which of the following types of soil and water conservation structures are more productive?

1) Stone bund 2) soil bund 3) cut off drain 4) water way 5) Fanyajuu

Q7.8. what was the reason for selecting of such type of structure?-------------------------------------
----

Q7.9. Have you participated in community conservation activities this year?

Q7.10. Did you under take the maintenance work by your own? 1) Yes 2) No

Q7.11. If No, what was the reason for not doing?

1) I have shortage of labor 2) Lake of skill and knowledge

3) Conservation structure were built without my knowledge and willingness

4) I expect the land will be transferred to other farmers

5) There was no need for maintenance 6) other, specify

Q7.12.) Do you believe that investment in soil and water conservation practices is profitable in the long run

1) Yes 2) No

Q7.13.) If the farmer did not use any improved conservation structures in all his plot, why you didn't it?

1) No problem of soil erosion 2) Shortage of labor

3) Expecting that the structure will be done by financial incentives

4) I feel that the land belongs to the government and it is the duty of the government to maintain the land 5) It reduced farm land

6) Due to problem of rodent and other pests 7) I did not get extension service

8) Other, specify

Q7.14.) Which type of soil and water conservation structures are suitable to which type of land use or land type.

1. Soil bund to____________________________________

2. Cut off drain to_________________________________

3. Fanyajuu to_____________________________________

4. Others, specify to____________

Q7.15) what are the problem related to each soil and water conservation structures?

problem	Soil bund	Cut off drain	Water way	Fanyajuu
Source of rodent				
Reduce farm land				
Difficult to turn oxen				
Labor intensive				

Difficult to implement (technically)				

Code: 1) Yes 2) No

Tenure arrangement

Q8.1. For whom do you think that the land be long ?

1) To my own 2) to the government 3) other______________

Q8.2. Do you think you have the right to in her it the land to your children? 1) Yes 2) No

Q8.3. Do you expect that you will use the lade throughout your life time 1) Yes 2) No

Q8.4. Do you agree if the government allows the ferment to sell their land?

1) Agree 2) Disagree 3) Difficult to decide

Q8.5. Have you rented in land before? 1) Yes 2) No

Q8.6. If yes, who is responsible for keeping the rented land quality, 1) the owner 2) myself 3) both of us.

Institutional support

Q9.1. Do you get extension service? 1) Yes 2) No

Q9.2. if, yes who provides the extension service?

1) Development agents (DAs) 2) NGOs 3) Others, specify-____________

Q9.3. How often you have been visited by DAs last year?

1) Ones per month, 2) Twice per month, 3) three times per month 4) Other, specify

Q9.4. How often you have obtained extension advice on soil conservation practices

1)Ones per month 2) Twice per month 3) Three times per month 4) ones per three months 5) Twice per three month 6) Other, specify_______

Q9.5. Have you participated in training of soil conservation for the last five years ? 1) Yes 2)No

9.6) IF you for how many days?__________Days

Thank you very much for your cooperation.

Survey questionnaire for / kebele leaders, Kebele Development Agent, Woreda Experts and Woreda Administration/

Name of the Enumerator_______________________ Date of Interview: __________________

The objective of these questionnaires is to collect information related to soil and water conservation

Practice in Gubalafto Woreda. The study is conducted for academic purpose. Hence, we request your honest and fair responses to fill up this questionnaire.

General information of the Respondents

Q1.1.. Respondents Name:____

Q1.2. . Sex of the Respondent: 1) Male 2) Female

Q1.3. What is your duty and responsibility? ____
____

Landholding by the Household

Do you know the land holding of farmer in the Woreda /Kebele?

No	Q.2.1.Type of land use	Q2.2. Area (in hectare)
1	Cultivated land	
2	Fallow land	
3	Grazing land	
4	Home stead area	
5	Forest (bush)	
6	Other	
	Total land holding	

Information about soil and water conservation.

Q3.1.	Estimated area covered with improved soil and water conservations structures (in km)	
	Soil bund	
	Cut of drain	
	Fanyajuu	
	Other, specify	
Q3.2.	Who constricted the structures? 1)Community participation 2) Family (hired)labor 3)Financial incentives by government 4)labor exchange	
Q3.3.	Do improved soil and water conservation structure maintained or not 1) Yes 2) No	
Q3.4.	Who did the maintenance work? 1)Community participation 2) Family /haired labor 3)labor exchange	
Q3.5	Statues(degree)of use of improved soil and water conservation structure (practices) 1) removed totally; 2) partially removed 3)not removed 4)modified	
Q3.6.	Traditional soil and water conservation structure built (in meter)	
	Traditional stone bund	
	Traditional ditches	
	Trash line	
	Cut of f-drain	

	Other, specify	
Q3.7.	Estimated area covered with traditional soil and water conservation structures (in hectare)	
	Traditional stone bund	
	Traditional ditches	
	Trash lines	
	Cut off-drain	
	Others, specify	

Q4. Which type of the traditional soil and water conservation structure farmers like more? ____

____

Q5. Why? ____

Q6. What are the advantages of traditional soil water conservation structures over improved ones?____

Q7. Labor Availability

Q7.1. Which family members participate in soil and water conservation works?

1) Men 2) women 3) Children 4) all of them participate

Q8. Perceptions of soil erosion problems

Q8.1. Do you think that soil erosion is a problem for community? 1) Yes 2) No

Q8.2. How do you perceive the soil depth after physical structure was constructed?

1) Increased 2) decreased 3) no change 4) I don't know

Q8.3. How do you compare the problems of soil erosion after Conservation structures were built?

1) Aggravated 2) reduced 3) no change 4) I don't know

Q8.4. Give rank to the following major causes of soil erosion in your area?

1) Deforestation __________________ 2) Over grazing______________________
3) Over cultivation________________ 4) Poor agriculture practices____________ 5) Cultivations of steep slopes ________ 6) Excess rainfall _______________ 7) poor government polices_____________8) others (specify) _________

Q9.Soil and water conservation technologies and farmers' attitude

Q9.1. Do farmers know the existence of improved soil and water conservation structures? 1) Yes

2) No

Q9.2. if yes, which type?

1) Stone bunds 2) soil bunds 3) cutoff drain 4) water way 5) Fanyajuu 6) others

Q9.3. What is the source of information?

1)Neighboring farmers 2) Extension agents(DAs) 3) NGOs 4)From field days and training 5)Other, specify

Q9.4. which of the following type of soil and water conservation measurement are efficient to reduce the problem of soil and water erosion?

1) Stone bund 2) soil bund 3) cut off drain 4) water way 5) Fanyajuu

Q9.5. which of the following types of soil and water conservation measurement are more effective on sustainability?

1) Stone bund 2) soil bund 3) cut off drain 4) water way 5) Fanyajuu

Q9.6. what was the reason for selecting of such type of structure?-------------------------------------
----

Q9.7. which of the following types of soil and water conservation structures are more productive?

1) Stone bund 2) soil bund 3) cut off drain 4) water way 5) Fanyajuu

Q9.8. what was the reason for selecting of such type of structure?-------------------------------------
----

Q9.9. Did community is under take the maintenance work by their own? 1) Yes 2) No

Q9.10. If No, what was the reason for not doing?

1) I have shortage of labor 2) Lake of skill and knowledge

3) Conservation structure were built without my knowledge and willingness

4) I expect the land will be transferred to other farmers

5) There was no need for maintenance 6) other, specify

Q9.11.) Do you believe that investment in soil and water conservation practices is profitable in the long run?

1) Yes 2) No

Q9.12.) If the farmer did not use any improved conservation structures in his entire plot, why isn't?

1) No problem of soil erosion 2) Shortage of labor

3) Expecting that the structure will be done by financial incentives

4) I feel that the land belongs to the government and it is the duty of the government to maintain the land 5) It reduced farm land 6) Due to problem of rodent and other pests

7) I did not get extension service 8) Other, specify________________________________

Q9.13.) Which type of soil and water conservation structures are suitable to which type of land use or land type?

1. Soil bund to_____________________________________

2. Cut off drain to__________________________________

3. Fanyajuu to_____________________________________

4. Others, specify to____________________________________

Q9.14) what are the problem related to each soil and water conservation structures?

problem	Soil bund	Cut off drain	Water way	Fanyajuu
Source of rodent				
Reduce farm land				
Difficult to turn oxen				

Labor intensive				
Difficult to implement (technically)				

Code: 1) Yes 2) No

10. Institutional support

Q10.1. Do farmer get extension service? 1) Yes 2) No

Q10.2. if, yes who provides the extension service?

1) Development Agents (DAs) 2) NGOs 3) Others, specify-____________

Q10.3. How often farmer have been visited by DAs last year?

1) Ones per month, 2) Twice per month, 3) three times per month 4) Other, specify

Q10.4. How often farmers have obtained extension advice on soil and water conservation practices?

1)Ones per month 2) Twice per month 3) Three times per month 4) ones per three months 5) Twice per three month 6) Other, specify________

Q10.5. Do you think farmer get training of soil and water conservation for the last five years? 1) Yes 2) No

Q10.6. IF yes, for how many days?________Days

Thank you very much for your cooperation.-

BIOGRAPHY

The author was born in south west Arsi Administrative Zone, Arsi Negale Woreda in June 1968. He attended his elementary and junior secondary education at Arsi Negale elementary and junior secondary school and his secondary school education at Arsi Negale senior secondary school.

Then he joined Hawassa Collage of Agriculture in September 1985 and graduated with Diploma in Agricultural Engineering in July 1987 and then he also joined Wondo Genet College of Forestry in2002 and graduated with degree in forest management in July 2006.

Following his graduation, he served as experts, team leader and office head in different Woredas and Zonal level under the Amhara Region Agricultural office at North Wollo. In June 2007, he was employed by organization for rehabilitation and development in Amhara region (ORDA) as project coordinator in kobo Woreda. Currently he also worked in ORDA at Woldya Millennium Development Goal wash program in the position of Program Manager. He joined Indria Gandhi National Open University since 2010 to pursue his MA degree in Rural Development.