ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
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CHALLENGES OF SUSTAINABLE LAND MANAGEMENT IN HIGHLAND ETHIOPIA: THE CASE OF THE FOOTHILLS OF ENTOTO MOUNTAIN

HAILEMARIAM BIRKE

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BY: HAILEMARIAM BIRKE

ADVISOR: WORKNEH NEGATU (Ph.D)

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Challenges of Sustainable Land Management in Highland Ethiopia. The case of the Foothills of Entoto Mountain

By
Hailemariam Birke

DEVELOPMENT STUDIES

APPROVED BY THE BOARD OF EXAMINERS: SIGNATURE

Dr. Mulugeta Feseha _____
FACULTY CHAIRMAN

Dr. Workneh Negatu _____
ADVISOR

Dr. Belay Simane _____
INTERNAL EXAMINER

Declaration

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in any University and all the sources used for the thesis have been duly acknowledged.

Declared by:

Name: Hailemariam Birke

Signature: 

Date: 23/07/2009

This thesis has been submitted for examination with my approval as a University advisor.

Name: Workneh Negatu

Signature: 

Date: 24/07/2009

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Acronyms

AAU	Addis Ababa University
ADLI	Agricultural Development Led Industrialization
CSA	Central Statistical Authority
DA	Development Agent
DAP	Di-ammonium Phosphate
EHRS	Ethiopian Highland Reclamation Study
EPA	Environmental Protection Authority
FAO	Food and Agricultural Organization
FGD	Focus Group Discussion
GDP	Gross Domestic product
GIS	Geographic Information System
ha	Hectare
HH	Household Head
HoREC/N	Horn of Africa Regional Environmental Center and Network
ILRI	International Livestock Research Institute
K	Potassium
KII	Key Informant Interview
Km	Kilometer
M	Meters
m.a.s.l	Meter Above Sea Level
mm	Millimeters
MoARD	Ministry of Agriculture and Rural Development
N	Nitrogen
NGO	Non Governmental Organization
P	Phosphorus

PASDEP	Plan for Accelerated and Sustainable Development to End Poverty
PLUP	Participatory Land Use Planning
REST	Relief Society of Tigray
SCRP	Soil Conservation Research Project
SLM	Sustainable Land Management
SPSS	Statistical Package for Social Sciences
SWoARD	Sululta Woreda Agricultural and Rural Development Office
SWC	Soil and Water Conservation
SWEMP	Sululta Woreda Environmental Management Plan
t	Metric ton
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environmental Program
USD	United States of America Dollar

Glossary of Local Terms

Belg	Spring season
Debbo	Traditional labour sharing arrangement
Got	Sub division of kebele
Kebele	The lowest unit of administrative hierarchy in Ethiopian government
Meher	Summer season
Shimagille	Traditional conflict resolution mechanism
Woreda	District

Abstract

Land degradation in the form of soil erosion is the most constraining factor of agriculture in the foothills of Entoto Mountain. It is increasingly understood that sustainable land management (SLM) is required, not only to balance land for food and nature, but also to unlock paths to sustainable development. However, several challenges impede its successful promotion. Thus, identification of these challenges is of paramount importance. Therefore, this study was aimed to fill this gap by investigating challenges of SLM in terms of the perception of farmers on the problem and causes of soil erosion; constraints of the existing SLM practices; and bio-physical, socio-economic and institutional challenges of promoting successful SLM.

To achieve these objectives, personal interview of 108 households was conducted in the selected six peasants 'gots' at the foothills of Entoto Mountain using structured questions. Proportional simple random sampling technique was used to select the households. In addition, field observation, focus group discussion and key informant interview were conducted. Descriptive statistics were employed for data analysis inline with the objectives of the study.

The result discloses that farmers have good perception of the problem of soil erosion. But their perception on the extent/severity of soil erosion is limited to visual authentication such as gullies and gives more emphasis to long time than short term indicators. Farmers' perception of population growth as a cause of soil erosion is also hardly longed-for. As most farmers have a good perception of controlling soil erosion, they use contour plowing, traditional terraces, traditional waterways, traditional ditches, unplowed strips, traditional check dams, and plantations. Moreover, manure, composting and fertilization are used to augment production. However, the existing practices are not effectively applied to control soil erosion due to various constraints of the technologies such as land shortage, labor shortage, rodents, conflict, erosion risk, lack of knowledge, high opportunity cost, low durability, high cost, and materials.

Derived by bio-physical, socio-economic and institutional forces: heavy run-off, free and unregulated grazing, cereal mono-cropping, prevalence of production oriented land use changes, engagement in non-sustainable off-farm income diversification activities such as sale of stone, fuel wood and dung cake, tenure insecurity, strategic problems, low resource endowment, and low credit and extension services constrained the promotion of successful SLM by distressing the level of investment households commit to SLM practices.

The study suggests the following implications which help to meet the challenges of sustainable land management in the foothills of Entoto Mountain. Extensive farmers' education for better elucidation of land degradation processes and management; technical support to farmers towards integration, design and specifications of SLM practices; non-politically demarcated integrated watershed management; introduction of modern SLM practices which have ecological and economical effectiveness; literacy campaign and family planning; environmental friendly off-farm opportunities; environmentally friendly alternative sources of energy; long-term lease tenure; integrated credit and extension services; and policies and strategies that coordinate and make strong both rural and urban systems.

CHAPTER ONE

1. INTRODUCTION

1.1 General Background

The Federal Democratic Republic of Ethiopia is the third largest country in Africa and lies between latitudes of 3°N to 15°N and longitudes of 33°E to 48°E in eastern Africa and shares boundaries with Eritrea in the north and northeast, Djibouti in the northeast, Somalia in the east and southeast, Kenya in the south and southwest, Sudan in the west and northwest. The total area of the country is 1,130,000 km^2 with a total human population of 73,918,505. The country is divided into nine regions, one for each of its main ethnic groups (CSA, 2008).

The physical features of Ethiopia is endowed with a complex variety of agro-ecological conditions including large area of flat land and gently rolling hilly areas as well as steep and rugged hills and valleys. Altitude ranges from slightly below see level (118 meter) to highlands soaring to over 4,600 meters above sea level, and slopes can be as high as 60% in the highlands, making large areas prone to erosion. The complex topography and wide altitudinal range ensure a variety of temperature and rainfall conditions. For that reason, the climate of Ethiopia varies mainly according to elevation (Selamihun, 2004).

Settled agriculture in Ethiopia has a long history dating back to antiquity, and is the mainstay of Ethiopian economy. The Agriculture constitutes 50% of GDP, 85% of employment, and 90% of total foreign exchange earnings (MoARD, 2007). Small holder farmers with an average holding of less than one hectare account for over 90% of the agricultural area under crop production and 95% of the agricultural outputs (Mulugeta, 2004). The agricultural production system is mainly of rain fed, traditional and subsistent.

The over all planned economic development policy in Ethiopia is Agricultural Development Led Industrialization (ADLI). The goal of this strategy is to achieve rapid and sustainable economic growth by improving the productivity of the agricultural sector. In recent years, various official documents of the government such as PASDEP (Plan for

Accelerated and Sustainable Development to End Poverty) reiterate that agriculture is the driver of economic development and the key sector in reducing poverty and ensuring food security in the country. This strong reliance on agriculture as an economic driving force entails the need for managing the natural resources of agriculture in a sustainable manner. It is sustainable management of the agricultural resources base (e.g. land) that will enable the country to achieve the desired sustainable rural and overall economic development goals on the basis of its agricultural economy. Therefore, land is a crucial resource up on which the lives of all people depend to a great extent, directly or indirectly (Aklilu, 2006).

Land degradation has been the foremost global issue because of its adverse impacts on agronomic productivity, the environment, and its effect on food security and livelihood. In Ethiopia, land degradation, low and declining agricultural productivity, and poverty are severe and inter related problems that appear to feed each other. In the light of the increasing population (2.5 percent growth per annum) and the low levels of urbanization (only 16 percent of the population live in urban area), all projections indicates that land degradation in Ethiopia is bound to proceed at aggravated rates unless significant progress is made in conservation, rehabilitation and restoration (MoAD,2007)

The highland part of the country (which constitutes 44% of the total land mass) is characterized by a complex configuration of mountains and plateaus. It is estimated that 88 percent of the total population of the country, over 95% of its regularly cropped lands, around two-third of its livestock, and almost half of its land area and over 90% of the national economic activities are all stationed in these highlands. However, the land resource of the Ethiopian highlands is degraded by several natural, socio-economic and institutional factors (McCann, 1995).

Of the different forms of land degradation in the Ethiopian highlands, soil erosion by water is the most pressing. According to Hurni (1993) an average soil loss rate on arable land is 42t/ha/year, which by far exceeds 10 times the rate of soil formation. It is also

estimated that close to 1.9 billion top soils are washed away every year mainly in the highlands.

The Ethiopian Highland Reclamation Study (FAO, 1984) reported that agricultural cost of land degradation in the next 25 years is estimated to be 150,000 million birr (the exchange rate in 1984 was 2.7birr to 1 USD). The study further asserted that land degradation could destroy the farm lands of some 15 percent of the population or 10 million highlanders by the year 2010. If the present trend continuous, today's children could see over a third of highlands become incapable of sustaining cropping while the population triples with in their life time.

In order to curb and reverse the problem of land degradation, there have been large efforts made by donors and the Ethiopian government to promote soil conservation and environmental rehabilitation in the country. More of the recent soil conservation measures rely largely on food for work programs as an incentive and are oriented towards labor-intensive activities such as terracing, bund construction and tree planting. There appears to be a mounting consensus that the effects of many of past conservation programs were unsatisfactory, due to its top-down interventions, inadequate consideration of farmers' outlooks, the extensive and uniform application of similar sustainable land management practices disregarded local agro-ecological and socio-economic variations, limited options provided to farmers, low profitability of the options provided to farmers, high cost requirement of interventions, etc (Aklilu, 2006; Ababu,2004; Tesfaye (2003); and Woldeamlak, 2003).

1.2 Statement of the Problem

The foothills of mountains like Entoto Mountain have suffered from the problem of land degradation mainly in the form of soil erosion for many years. The causes of land degradation in the area are complex and diverse. Aligned with the natural, socio-economic and institutional factors, land degradation in Entoto and other similar mountain foothills is mainly a function of heavy reliance by the growing population on exploitative subsistent agriculture and rudimentary production methods. The farming system of the area is dominated by cereal crops, which provide little ground cover when the most erosive rainfalls. Farmers repeatedly work and pulverize the soil, making it more vulnerable to erosion. Poor land management, expansion of agriculture in to forested areas, livestock pressure, and use of dung and forest for fuel furthermore contributed to land degradation and its productivity.

The poverty derived rural- urban linkages based on resources such as labor, forest, dung, and stone contributed to the degradation of land in the area. The penalties of pressure created by Addis Ababa on land resources of the study area are far-off imagination. Often, as observed in many parts of Ethiopia, when forest resources are getting scarce, and when reforestation efforts are negligible with no alternative energy source, shortage of fuel wood has been supplemented by cattle dung. This leads to heavy mining of soil fertility and deterioration of soil physical properties. This again leads to poor infiltration capacity of the soil, a phenomenon that reduces recharging effect of the aquifers and enhance high run-off and soil erosion rates (Gete et al, 2006). Similarly, the rural-urban interaction based on construction stone resource detains the promotion of terrace applications and resulted in continued soil erosion. Furthermore, a high demand for human resource in Addis Ababa, and a high supply and low management of this resource in the study area resulted in lack of watchdog for rural land. This once more gives free will for the tremendous soil erosion problem in the study area.

The implications of land degradation in the study area are therefore exceedingly imperative since the livelihoods of the people of the area are knotted with land resources. Land degradation, just as limited access to land, trim down productivity and

thus make it difficult to produce enough to feed the people of the area. It may also intensify people's susceptibility to food shortage and become a threat to the mere survival of the people. Sustainable land management (SLM) is therefore strongly needed so as to enhance the ability of the land to restore its agricultural and ecological productivity (Aklilu, 2006 and Gete et al, 2006).

Sustainable land management (SLM) is therefore, has emerged as a new approach to soil and water conservation affair of Ethiopia in general and the study area in particular. This is not only because of the increasing population pressure on limited land resources, demanding for increased food production, but also by recognition of the fact that the degradation of land resources is accelerating rapidly in the country. The growing interest in the concept of sustainability was given added stimulus at the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in June 1992. Chapter 10 of Agenda 21 is concerned with the planning and management of land resources. For these reasons sustainable land management (SLM) is now receiving considerable attention from development experts, policy makers, researchers and educators (Mitiku, et al, 2006).

Sustainable land management (SLM) is decisive for the study area for minimizing land degradation, rehabilitating degraded lands and ensuring the optimal use of land resources for the benefit of present and future generations. However, as the Sululta Woreda Environmental Management Plan (SWEMP) indicates, the different attempts made in the study area to promote successful sustainable land management through different structural and biological practices hardly succeeded and the upshots of these efforts were far below expectation (SWoARD, 2007). Moreover, efforts to identify sustainable land management challenges to give remedial policy and strategic measures are very limited in the country in general and in the study area in particular. Owing to this, the tragedy nexus between land degradation and poverty become persistent in the area.

Even if no research reports were found with the same topic, the available related studies in Ethiopia were limited. These includes: Hurni (1993), Slomon (1994), Belay (1998), Fitsum et al (1999), Yohannes (1999), Michael (2002), Belay (2003), Gete (2003), Betru (2003), Tesfaye (2003), Woldeamlak (2003), Gete et al (2006), and Aklilu (2006). Added to this, given the diversity in the physical, socio-economic, and spatial variations, any effort to study sustainable land management challenges and providing implications for measures need to be site specific. This is because there are no universal formulae or solutions that can work across the globe. Rather, solutions should be problem detailed, locally specific and closely tied into socio -economic set up of the communities. Above all, an empirical literature on challenges of sustainable land management is not conducted for the study area so far.

Furthermore, considering the complex and interwoven problems of land degradation in general and soil erosion in particular, and the threat to the quality of human life, it is, therefore, evident that for the foothills of Entoto Mountain, characterized by subsistence agriculture, agricultural development with the promotion of successful sustainable land management cannot be an option, if not an indispensable element of all development efforts.

Therefore, this study is aimed to fill this gap by undertaking a locally specific an in-depth and action oriented research by investigating the perception of farmers on the problem and causes of soil erosion, assessing the existing land management practices and their constraints and identifying the bio-physical, socio-economic and institutional challenges and forwarding policy implications for successful sustainable land management (SLM).

1.3 Objectives of the Study

1.3.1 The General Objective

The overall objective of this research is to understand challenges of sustainable land management practice so as to capture alternative policy and strategy implications for promoting successful sustainable land management.

1.3.2 Specific objectives

The specific objectives of the study are setout to:

i. Investigate the perception of farmers on the problem and causes of soil erosion.
ii. Assess the existing land management practices and their constraints.
iii. Identify bio-physical, socio-economic, and institutional challenges to promote successful sustainable land management practice in the study area.

1.4 Research Questions

To attain the above objectives, the following questions are raised for thorough investigation.

i. How do farmers perceive soil erosion as a problem?
ii. What do farmers perceive as indicators of soil erosion?
iii. How do farmers perceive the severity of soil erosion problem on their farm land?
iv. What do farmers perceive as triggers of soil erosion process?
v. Which indigenous and modern SLM practices are available in the study area?
vi. What are the constraints of the existing SLM practices?
vii. What are the major bio-physical, socio-economic and institutional challenges of promoting successful sustainable land management practice in the study area?
viii. What policy and strategy implications can be drawn to promote successful sustainable land management?

1.5 Significance of the Study

The agricultural sector is given particular emphasis for the over all future transformation of the national economy. One of the factors for its success is the sustainable utilization of land resources. Thus, the current trend of land degradation in general and soil erosion in particular is a threat to the viability of the economy. The need for its reversal through SLM is extremely important. For that reason, studies pertaining to identifying the challenges of sustainable land management are crucial to give a wider relevance of enlightening some policy and strategic implications for local land users, local planners, administrators, and funding agencies in promoting successful sustainable land management. Therefore, this is the broad-spectrum substance of this study. This study also contribute to fill the gap in empirical and local-scale understanding of land degradation, management practices and challenges of promoting successful SLM. Moreover, the study will dish up a stepping stone for further researches of similar topics.

1.6 Scope and Limitation of the Study

The paper focuses on identifying the challenges of sustainable land management practice with prominence on the perception of farmers towards the problem of soil erosion and its causes, assessing the existing SLM practices and their underlying constraints, and bio-physical, socio-economic and institutional constraints of promoting successful SLM practice based on farmers view mainly, and adding up literature and experts view.

The term land is holistic and comprises of soil, water and vegetative resources, etc. But it is difficult to conduct research on each of these land resources with the allotted time. Therefore focusing on one which is the central of all and severely threatened is handy, that is soil. For that reason, this study primarily deals with the agricultural soil resource.

Land degradation can occur in various forms such as deforestation, soil fertility decline, soil erosion, etc. In this study land degradation in the form of soil erosion is well thought-out since it is the most pressing problem. In addition, soil erosion caused by other agents

except by water is not conducted in this study in view of the fact that run-off and run-on are the foremost burning problems.

The term sustainable land management practices is broad and includes many things. In this study it incorporates the existing soil and water conservation measures which are either indigenous or modern. The existing indigenous and modern soil fertility improving measures are also incorporated in the study as they play a role to control soil erosion by improving the physical and structural makeup of the soil.

From the view point of spatial extent, the study is limited to one of the Ethiopian highlands, the foothills of Entoto Mountain, due to finance and time constraints. Hence, inter-spatial variations were not taken care of in this study. The other limitation of the study is lack of experimental design due to time and financial constraints.

1.7 Organization of the Study

This thesis is organized in five chapters and related topics under each section. Chapter one deals with the introduction of study including background and justification, problem statement and objectives of the study. Chapter two present literature review focusing on both theoretical and empirical studies. Chapter three focus on the analytical framework and research methodology of the study. This chapter describes the analytical framework of the study, the study area and its selection for the study, methodologies persuade in identifying sample households, data collection, analysis and presentation. Chapter four presents results and discussion. Finally, chapter five presents conclusions and some recommendations.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 Definition and Concepts

Land: Land is a spatial unit where ownership, resource availability, boundary conditions and the policy and economic environments play an important role (Hurni, 2000). The United Nations Convention to Combat Desertification (UNCCD) defined land as the terrestrial bio-productive system that comprises soil, vegetation, other biota, and the ecological and hydrological processes that operate with in the system (Pagiola, 1999). In this paper the tern 'land' is used to mean agricultural crop land, that is soil.

Land Degradation: Land degradation is a broad, composite, and value-laden term that is complex to define and it has no single readily-identifiable feature, but instead describes how one or more of the land resources (soil, water, vegetation, rocks, air, climate, etc) has changed for the worst and loss in economic productivity (MoARD, 2007).

However, the lack of clarity on the definition of land degradation has created two schools of thought. One school of thought acknowledges the occurrence of land degradation as threatening the ecosystem and the future of people on planet earth. This group may be called the 'land degradation' school. This school follows the Malthusian thesis of population and environment which posits that high population growth is the determinant cause of land degradation due to its diverse needs. The second school of thought describes the ongoing process of natural resource development and utilization as a normal phase with in the dynamic process through which people adapt their environment without necessarily degrading it. This group can be called the 'Eco-dynamics' school, led by the Ester Boserup (Tesfaye, 2003).

Many studies have misconstrued soil degradation and soil erosion to be tantamount with land degradation (MoARD, 2007). Soil degradation is a narrower term and an ingredient

of land degradation for declining soil quality, encompassing the deterioration in physical, chemical and biological attributes of the soil. That is, it refers to a process that lowers the soil's actual and/or potential capability to produce goods and services. Six specific processes are recognized as the main contributors to soil degradation: soil erosion, wind erosion, water logging, excess salts, chemical degradation, biological degradation and physical degradation (MoARD, 2007). Soil erosion is therefore, a particular physical process that causes land and soil degradation, and refers to the wearing away of the land surface by water and/or wind as well as to the reduction in soil productivity due to physical loss of top soil, reduction in rooting depth, removal of plant nutrients, and loss of water (Richard and Birl, 2000).

Land degradation is a holistic term which consists of the degradation of soil, forest and water resources (Aklilu, 2006). Land degradation is therefore different from soil degradation in that the process affects multiple components of an ecosystem and usually discernable and must be addressed at multiple spatial scales. Consequently, this study focuses on land degradation problem in the form of soil erosion as it is the most pressing issue in the foothills of Entoto Mountain.

Sustainable: The word 'sustainable' in this paper is used to refer to the long lasting nature of the ways and means to realize successful sustainable land management practice.

Management: The term 'management' in this paper refers to an activity or practice on the ground, using appropriate technologies/practices in the agricultural land use systems (Hurni, 1997 and Wright, 1984).

Sustainable Land Management (SLM): SLM can be defined as the use of land resources such as soil, water, and plants for the production of goods to meet changing human needs while assuring the long-term productive potential of these resources, and the maintenance of their environmental functions (Herweg et al, 1998). Hurni (1997) also defined it as a system of technologies and /or planning that aims to integrate ecological with socio-economic and political principles in the management of land for agricultural

and other purposes to achieve intra-and intergenerational equity. Sustainable land management is therefore, the foundation of sustainable agriculture, and a strategic component of sustainable development and poverty reduction (Hurni and Meyer, 2002).

Moreover, the original concept of SLM was associated with technologies that contribute to sustainable agriculture (World Bank, 1997). Nevertheless, today the concept is associated with essential elements of the global life support system. That is, it does not only deal only with technologies but also with the three development elements: technology, policy and land use planning. It comprises biophysical, socioeconomic, and environmental concerns that must be viewed in an integrated manner. It combines technologies, polices and activities aimed at integrating socio-economic principles with environmental concerns so as to simultaneously satisfy the five pillars of sustainable land management, i.e., productivity, security, protection, viability, and acceptability (Mitku et al, 2006 and Dumanski, 1997).

Because each pillar of SLM is a bit complex, the following points are forwarded for clear understanding and further explanation (Dumanski and Pieri, 1997 and Mitiku et al, 2006).
Productivity: aimed to maintain or enhance production/services (eg. crop yield). Moreover, the return from SLM may extend beyond material yields from agricultural and non-agricultural uses to include benefits from protective and aesthetic aims of land use (Mitiku et al, 2006 and UNEP, 1992).
Security: aimed to reduce the level of production risk (eg. soil cover). Thus, management methods that promote balance between a land use and prevailing environmental conditions reduce the risks of production (Dumanski and Pieri, 1997).
Protection: aimed to protect natural resources and prevent their degradation (eg. soil quality). Consequently, the quantity and quality of soil resource have to be safeguarded, in equity for future generations (Herweg et al, 1998 and Raise etal, 1997).
Viability: aimed to verify the economical practicality of the contribution of the activity (eg. does the contribution of off-farm work to income sufficient to make its contribution continuous attractive?) Therefore, if the land uses being considered are locally not viable, the use will not survive (Dumanski and Smyth, 1993 and Mitiku et al, 2006).

Acceptability: aimed to bear out the social acceptability of a given land use practice (eg. land use changes and use of conservation practices). Land use practices can be expected to fail, in time, if their social impact is unacceptable (Dumanski and Smyth, 1993).

Sustainable Land Management Practices: Terms for land management practices are not consistently used and mean different things for different people and even to the same people at different times. In fact, no globally approved or endorsed system exists. Some given names refer to the appearances such as terraces, bunds, ditches. Some combine the appearance with the materials used such as stonewalls, earth bunds, grass strips, some add the slope or drainage e.g. graded ditches or infiltration ditches. Some refer to the land management such as enclosure, others to the way of construction, such as "Fanya juu" (an assimilated Swahili term describing the way soil is 'thrown upward' to build the bund) or to the function and impact e.g. cut-off drains, etc (Liniger et al, 2002).

Sustainable land management practices that have been used in this paper include both indigenous and modern along with combinations of the physical/structural and biological practices. The classification of SLM practices in to structural/physical and biological is subjective since they are not mutually exclusive, that is, they overlap and complement to each other. The best example is contour plowing, which is structural, agronomic and vegetative (Yohannes, 1999). Therefore, the classification has been used to smooth the progress of the discussion and analysis in an organized manner.

2.2 Empirical Literature

2.2.1 Land Degradation Problem in Ethiopian Highlands

Land degradation is one of the foremost threats to food security and natural resource conservation in Ethiopian highlands. Soil degradation as part of land degradation has long been an intimidation in the Ethiopian highlands. Because highlands endowed with favorable climatic conditions for settlement, the highlands have seen a bumpy increase in human activities. This has produced continuous and cumulative pressure whose damaging effect has already had a disastrous impact on the environment (Gete, 2000).

Soil erosion is the major cause of soil degradation in Ethiopian highlands. Soil degradation, caused mainly by soil erosion in much of the Ethiopian highlands has reached a stage where it is increasingly difficult to even maintain the present-day production of basic foods, a level that is already insufficient in some regions. According to EPA (1997), approximately 17 percent of the country's potential Gross Domestic Product (GDP) was lost because of physical and biological soil degradation. In this regard, soil degradation certainly contributes to a higher vulnerability of the highland people for food insecurity and poverty.

Recently, Sonneveld (2002) applied an approach that combines a soil and water erosion model with a spatial agricultural yield function under alternative scenarios of soil conservation, migration and technology changes to project the cost of land degradation under each alternative scenario. Under the scenario of no soil conservation, no change in technology and no migration, he estimated that agricultural production could be reduced due to land degradation by about 10 percent from 2000 until 2010 and this is substantially caused by soil erosion.

Measured soil loss, in the highlands of Gojjam for instance, was reported to be as high as 320 and 263 tone/hectare/year on bare and cultivated plots respectively. In the same area it is also reported that soil productivity is decreasing very fast (up to 5% per year), and the current erosion rate on cultivated lands exceeds the soil formation rate by a factor of 10 to 15 (Gete, 2003).

2.2.2 Causes of Land Degradation

Different authors pointed out that land is under enormous threat of degradation. The factors contributing to land degradation are varied, complex and inter-related. They can be human, physical, and socio-economic (Lakew, et al 2002). However, there is no consensus on some of the causes whether they are real causes or not. For example there is mixed result whether population pressure is a real cause or not. A study done in north Shoa by Million (1996) clearly depicts population pressure is a cause to land degradation and leading to a reduction in crop yield. Similarly study in the western Ethiopian highlands done by Gete (2003) shows population pressure as a root cause of land degradation.

On the contrary, some researchers argued population pressure does not always contribute to land degradation rather increases conservation activities. For example in Kenyan Machakos district population pressure is used as a means of conservation (Ataklti, 2003). A study done in Ethiopia by Fitsum et al (1999) also indicates population pressure used as an intensive labor for soil and water conservation in Tigray region. Despite the fact that the controversial arguments, different studies done at different times generalize population growth in the Sub-Saharan Africa including Ethiopia is a cause to land degradation (FAO, 2001 and Muchena et al, 1997).

A study done in the eastern highlands of Ethiopia by Wogayehu (2003) indicates deforestation, overgrazing, limited application of sustainable land management practices, and decline in the use of fallow are the proximate causes of land degradation. Similarly, a study in western Ethiopian highlands indicates weak economic development strategies, unstable institutional frameworks, and weak link between research and extension have been found as a root cause of land degradation (Gete, 2000).

Mismanagement of land resources such as non-adoption of sustainable land management practices, improper crop rotation, and use of marginal lands contribute to the prevalence of land degradation. In Africa the contribution of different management factors towards

land degradation is estimated to be 49%, 24%, 14%, 13% and 2% for over grazing, mismanaged agricultural activities, deforestation, over cultivation and industrial activities respectively (Vanlauwe et al., 2002 cited in Tilahun, 2003 and Sheng, 1989).

Natural factors also play their own role in triggering land degradation. The main triggering natural factors identified by Fitsum et al, (1999) are rainfall erosivity, determined by the energy, intensity and duration of rainfall; the erodibility of the soil, determined by soil type, texture, and organic matter content; the slop gradient and length, determined by topography; the type and density of vegetation cover; and the presence of vegetation cover.

2.2.3 Farmers' Perception about Soil Erosion

The reaction required for the implementation and formulation of proper land management policies and strategies can depend on the perception of land users or farmers. A study done on farmers' perception of land degradation problem and implementation of land management practices in Rwanda revealed that the majority of the farmers in the study area perceived the availability of land degradation problem and give due emphasis to manage their land (Nidaye and Sofranko 1994 cited in Kumela, 2007).

In Malawi an empirical study was done to assess farm level economics of soil conservation practices. The study understand that farmers perceive soil degradation problem and erosion rates in their farm land and showed them the ways of implementation of soil and water conservation technologies (Julius, 2009).

In Ethiopia a study was done by Aklilu (2006) to assess farmers' view of soil erosion problems and their conservation knowledge in Beressa watershed in the north central highlands of Ethiopia. The study revealed that 72% of the respondent farmers' perceive soil erosion problem in their farm land and express for the inevitability of land management practices. Another study done by Woldeamlak (2003) in Chemoga Watershed, north western highlands of Ethiopia also portrays the majority of farmers' perceived erosion as a problem and their confirmation of the increasing trend in the

severity of erosion and a decreasing trend in fertility of soils in their plots of land. A study done by Tesfaye (2003) in Wolayta also indicates most farmers perceive the presence of soil erosion in terms of the presence of rills and gullies.

2.2.4 Sustainable Land Management Practice in Ethiopian Highlands

Following the 1972/73 drought, the following three major conservation activities were undertaken by the previous government. Physical or structural conservations on farm lands including tied ridges, soil or stone bunds and various terraces; soil conservation on grazing lands including area closure and re-vegetation with shrubs; and soil conservation on hillsides, including terracing, and planting of multiple tree species, etc (Ababu, 2004).

The overall achievements of past soil and water conservation activities was construction of farm land terraces on about 998,000hectares of land, construction of hillside terraces on about 208,000 hectares of land, construction of check dams with a total length of 15,500km, forestations mainly on highly degraded areas has been undertaken on 296,000 hectare of land, and area closure to regenerate vegetation has been done on about 310,000 hectare of land (Ababu, 2004).

The current government also formulated and approved various policies, strategies and program measures that are important to support the struggle against land degradation and poverty. At federal level the environmental policy was approved in 1997 (EPA, 1997) in which regions can develop their own environmental policies specific to their own environment. Added to this a number of sector and cross sector specific policies have also been developed. These include disaster prevention and management, energy, population, and bio-diversity policies. Moreover, the government has also issued a Rural Development policy and strategy, and Sustainable Development Poverty Reduction Strategy Program, a food security strategy which has given due emphasis to Integrated Participatory Watershed Management as a major intervention for rehabilitation of degraded areas and improve the livelihood of the community through comprehensive and integrated natural resource development (MoARD, 2005). Inline with the aforementioned

policies and strategies a number of rehabilitation activities are also being undertaken in different parts of the country (ibid).

Several NGOs and bilateral organizations such as the GTZ also participated in sustainable land management activities by adopting their own system of intervention in collaboration with the government. For instance, the GTZ followed the Participatory Land Use Planning (PLUP) approach and brings significant rehabilitation outcomes in its areas of intervention such as in South Gondar (MoARD, 2005).

Different empirical studies have also revealed that there are different efforts of SLM undertaken by Ethiopian farmers at household and supra-household levels in different parts of the country. A study done in Amhara region by Birru (2003) indicates level bund is built more than 100 years ago in Ankober and Debresina in North Shoa, traditional ditches are common in the highlands of Gojjam, and contour plowing and crop rotation are practiced in many areas of the of the country. Similarly, a study done in chemoga watershed by Woldeamlak (2003) indicates farmers are using structural measures of fanya juu bunds, stone bunds, diversion ditches, and check dams to arrest the problem of soil erosion.

In Beressa watershed, north central highland of Ethiopia, farmers are using contour plowing, drainage ditches, stone terraces, waterways, trees, grass strips, and soil bunds to arrest the problem of soil erosion (Aklilu, 2006). In east Gojjam, traditional ditches, manure through animal parking (kraal), crop rotation, contour plowing, traditional vegetative fences, traditional waterways, traditional check dams, traditional stone terraces, unplowed grass strips, weed heaping, artificial waterways, modern cut-off drains, modern stone terraces, area closures, artificial fertilizer and compost are widely practiced (Michael, 2002 and Yilkal 2007).

In Tigray region, traditional terraces, grass strips, and hillside terracing are the commonly used practices by the farmers (Dagnew, 2007). In Konso, southern Ethiopia, stone terraces, tied ridges, trash lines, agro-forestry, intercropping, fallowing, manure, kraal

shifting, burning of debris, minimum tillage, and use of artificial fertilizer are applied by farmers to arrest the problem of soil erosion and maintain its fertility (Tesfaye, 2003).

2.2.5 The Challenges of Sustainable Land Management in Ethiopian Highlands

Despite the land management efforts done so far the degradation problem is not solved once and for all. Rather, it continues to be more threat in view of the fact that SLM promotion action is down curved. Policy constraints, technology constraints, land degradation awareness problem of the land users, socio-economic and biophysical constraints are among the foremost challenges of promoting SLM in the country. However, the empirical evidence on the impacts of these factors in affecting SLM promotion action has a mixed result. Constraints that affect one SLM practice may not affect another one. For example land tenure insecurity may significantly affect long-term durable soil conservation investments such as terracing and fallowing than near term investments such as fertilizer and manure. Similarly, households with better education are expected to have better awareness of new technologies and may be more likely to use new technologies. However, more educated households may be less prone to use labor-intensive SLM practices if they have higher labor opportunity cost as a result of better opportunities off the farm. At the same time access to urban market may facilitate use of agricultural inputs such as fertilizer. Nevertheless, it may adversely affect the use of manure and terracing because of dunk cake and stone selling, and labor competition in urban off-farm works (Mahmud and Pender, 2005).

Policy and Strategy related constraints: There are several possible reasons for the failure of past management interventions to meet users' expectation. The innovated management measures didn't consider local management practices, the interventions require high cost which can not be afforded by the local people, and the intervention didn't consider the local agro-ecological and socio-economic variations (Aklilu. 2006).

The challenges of land management practices in Ethiopia especially SWC programs are lack a holistic approach. These structures are also concentrated on farm lands and the degraded hillsides but are not properly taken care of. Sustainable land management

practices through biological measures such as organic matter management, maintenance of vegetative cover, improved follow practices and the livestock management practices are not well integrated. The rehabilitation of degraded hill sides, which had incredibly great success in terms of environmental rehabilitation and creation of assets, was over looked (Betru, 2003).

Gete et al (2006) based on their stakeholder assessment pointed out the promoting of SLM in Ethiopia is constrained by the overwhelming strategic problem of the extension system. Quick solutions rather than sustainability, quantity rather than quality, area coverage rather than impacts, and seemingly commanding control system rather than participation are identified as the most determining constraints.

Farmers' perception related constraints: the perception of farmers' about the problem of land degradation plays a vital role in promoting SLM. The empirical evidence on farmers' perception in promoting SLM is mixed. Some authors linked farmers' management initiation to the visible indicators of land degradation and perceptive severity of the problem (Aklilu, 2006; Tesfaye, 2003; Yilkal, 2007). On the other hand, the Ethiopian highland reclamation study pointed out that 98% of the interviewed peasants responded that land was being eroded, and 79% of them replied the rate of soil degradation was serious and accelerating, and they also reported as they are managing their land due to their awareness of the problem (FAO, 1984).

SLM practices/technologies related constraints: the successful promotion of SLM can be challenged due to technological related constraints. A study done in Gojjam by Michael (2002) reveals SLM practices are constrained by different factors for farmers' sustainable application. For example, manure require more labor force to transport, traditional ditches, traditional cutoff drains and traditional waterways aggravate soil erosion in areas where they are ill-designed. The same study also noticed the inflexibility, non-integrity, and specific functionality of SLM practices retarded the promotion of SLM in the area. Similarly, a study done in East Gojjam by Yilkal (2007) indicates high

dependence of technologies on land resources, sensitivity to environmental conditions, need of special training, and high financial requirement.

Bio-physical related constraints: of the different bio-physical constraints that affect the promotion of SLM are free grazing, the nature of topography, climate variability, and the associated run-off. A study done in Tigray by Dagnew (2007) reveals run-off and free grazing affected almost all stone terraces constructed by farmers on their farm land.

Population Pressure: even if finger counted studies have assessed the impact of population pressure on successful SLM, many empirical findings shows its negative impact. Using national level data Grepperud (1996) found both human and livestock pressure to be associated with land degradation and low promotion of SLM practices. Using community level data from Tigray and Amhara Pender et al (2001) found population pressure is associated with more decline in use of fallowing and manure.

Poverty: poverty is one of the deep-seated factors affecting the promotion of SLM, which most rural Ethiopians continue to face. Poverty derived pressure on natural resources brought resource degradation that leads to reduce household assets, which in turn affects degradation in Ethiopian highlands (Bekele and Stein, 1997). The poor is unable to apply SLM practices due to lack of the ability invest and lack of the access to innovations to improve productivity and cope up with calamities (Gete et al, 2006).

Land tenure insecurity: The impact of land tenure on the promotion of SLM has mixed analysis. Based on the national representative sample, Deininger, et al (2003) found that the impact of investment on land depends on the type of SLM practice. Investment in terraces was lower in woredas where who had experienced land redistribution priori while investment in planting trees was greater in woredas where there had been redistribution. The same study also depicts greater perception in future land redistribution is associated with less investment in both terracing and tree planting. In Amhara region, Benin and Pender (2001) found that fertilizer use is more common and crop yields higher though fallow less common in communities where redistribution had occurred. Tenure

insecurity may be present even in regions where there have not been land redistribution and affect the promotion of land degradation. Ayalew, et al (2005) cited in Mahmud and Pender (2005), using data from four villages in the southern region found that 36% of households expected a reduction in land size in the next five years (after the 1999 survey). The main source of insecurity was not future expectation of land redistribution rather expecting sharing of land among families (ibid).

Credit service: Agricultural credit program also play a great role in promoting SLM. Using data from a nationally representative household survey, Croppenstedt, et al (2003) found that greater access to credit in a village considerably increases households' possibility of using fertilizer. In Amhara region Pender, et al (2001) also found credit from Bureau of Agriculture (BoA) of Amhara region was negatively associated with use of fallow, manure and compost but positively associated with tree planting. The same study conducted in Tigray region shows credit from Relief Society of Tigray (REST) was linked to more use of compost, soil bunds, and tree planting and live fences. According to the study the variation in the application of SLM practices with credit sources is attributed to the technical assistance associated with the credit.

Extension service: The impact of agricultural extension also appears to be context-dependent. Using the national sample survey Deininger,et al (2003) found that access to woreda extension service was positively associated with farmers investments in planting trees and in building terraces. In Tigray Pender and Berhanu (2004) found statistically not significant impacts of contact with extension agents on farmers' land investments. But this study is conflicting with the above argument for that the national data reveals the statistical significant association between extension agents and SLM practices. Likewise a study made by Aklilu (2006) indicates farmers having extension contacts with extension agents tend to reduce investments in conservation. According to the study this is due to the more focus of the extension service on crop and livestock production than SWC.

Household endowment with human and physical capital: A household endowment with human capital plays a great role in promoting SLM. Available evidence shows a positive association between adult labor and stone terraces in Tigray (Berhanu and Swinton, 2003). However, the empirical evidence is mixed when family size is used as a measure of labor availability. Bekele and Stein (1998) found a negative link between family size and soil and water conservation in Andit Tid, North Shoa while Ayalew et al (2005) cited in Mahmud and Pender (2005) found no significant relationship between family size and long and medium term land management practices.

Available empirical evidence on the impact of farm size in promoting SLM practices is depend on the kind of technology being used. A positive relationship is found between farm size and investment in stone terraces in Tigray. On the other hand a negative association is found between fertilizer use and land size in Tigray (Fitsum, 2003)

Education also determines the promotion of SLM. According to available empirical evidences a positive association is observed between education level and fertilizer use (Berhanu and Swinton, 2003). Deininge, et al (2003) found a significant positive association between the maximum education of household members and investment in terraces and tree planting. On the contrary, Pender and Berhanu (2004) found a negative association between primary level of education and fertilizer use in Tigray.

Access to off-farm opportunities: the impact of off-farm opportunities on land management is theoretically ambiguous. Off-farm income may enable households to finance purchase of inputs or land investments, but such opportunities may undermine on-farm activities, especially labor intensive activities. In Tigray and Amhara, Pender et al (2001) found that increased use of fertilizer was less common in communities where off-farm income was an important, while investment in soil bund was greater in such communities. Similarly, the same authors found that households for whom off-farm is their primary income were more likely to invest in stone terraces in Tigray. On the other hand, a study made by Bekele and Stein (1998) shows a negative relationship between off-farm works and SWC technologies.

CHAPTER THREE

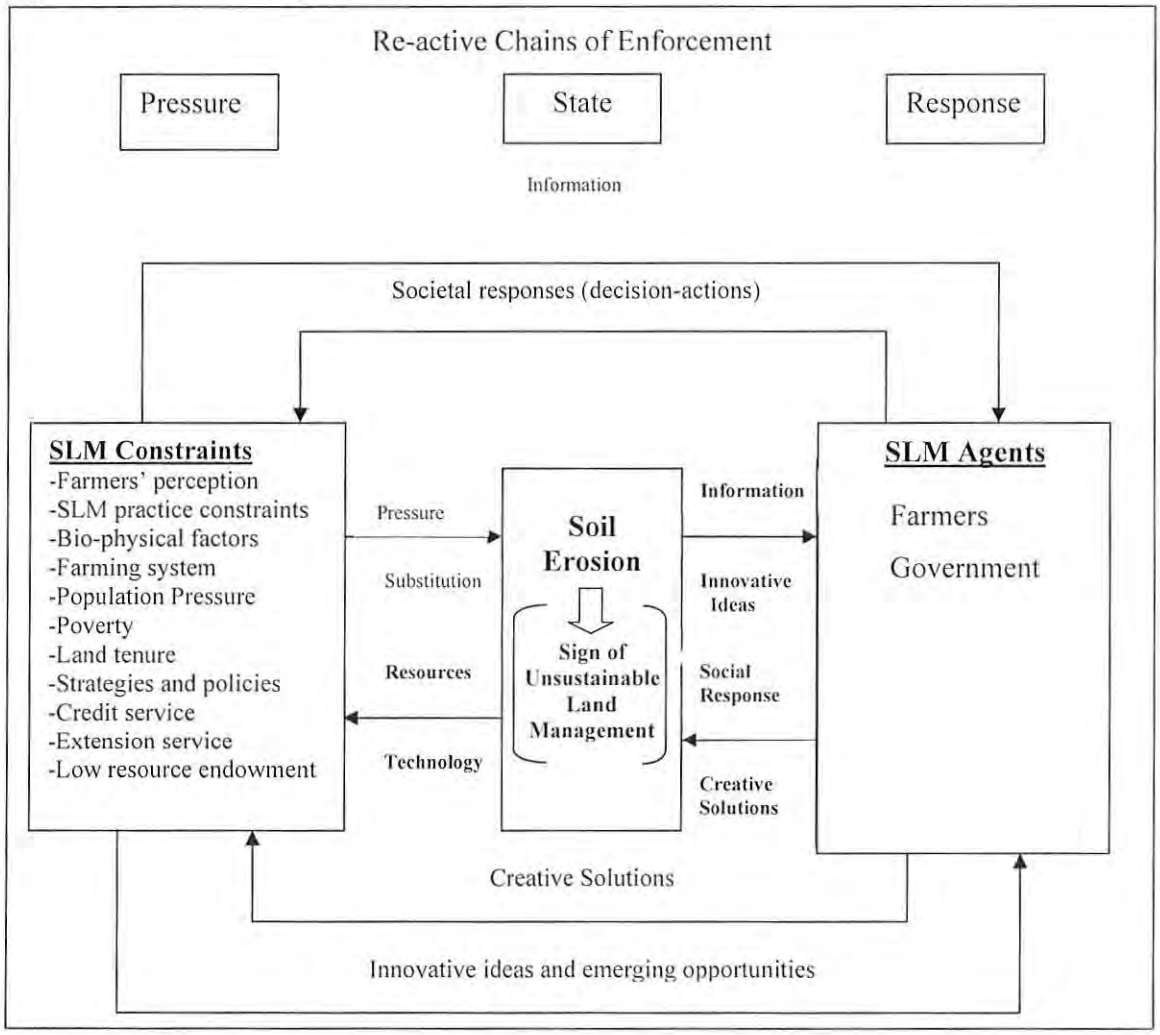
3. ANALYTICAL FRAMEWORK AND RESEARCH METHODOLOGY

3.1 Analytical Framework

Several studies indicate that the promotion of SLM is confronted with interrelated and networking sets of bio-physical, socio-economic, institutional and other farmers' outfitted settings. Different frameworks have been developed to study on SLM and with much emphasis on how best to integrate local community knowledge with external scientific knowledge. Nevertheless, deciding on a proper analytical framework accommodating all the dimensions of the objectives of the study is required to come up with realistic and applicable upshot.

The pressure state response framework (PSR) is a typical framework for this study, given that, it is a suitable illustration of the linkages among the pressures exerted on the land by human and natural activities (pressure box), changes in the quality of land (state box), and the response to these changes as society attempts to liberate the pressure or to manage land (response box). The interchanges among them form an incessant feedback mechanism that can be examined and used for the assessment of challenges in promoting SLM. The framework can thus be used to structure and classify information, and to assist in the identification of the challenges of promoting SLM in line with how farmers are managing their lands and the underlying promotion constraints. Figure 1 illustrates the conceptual analytical framework of the study.

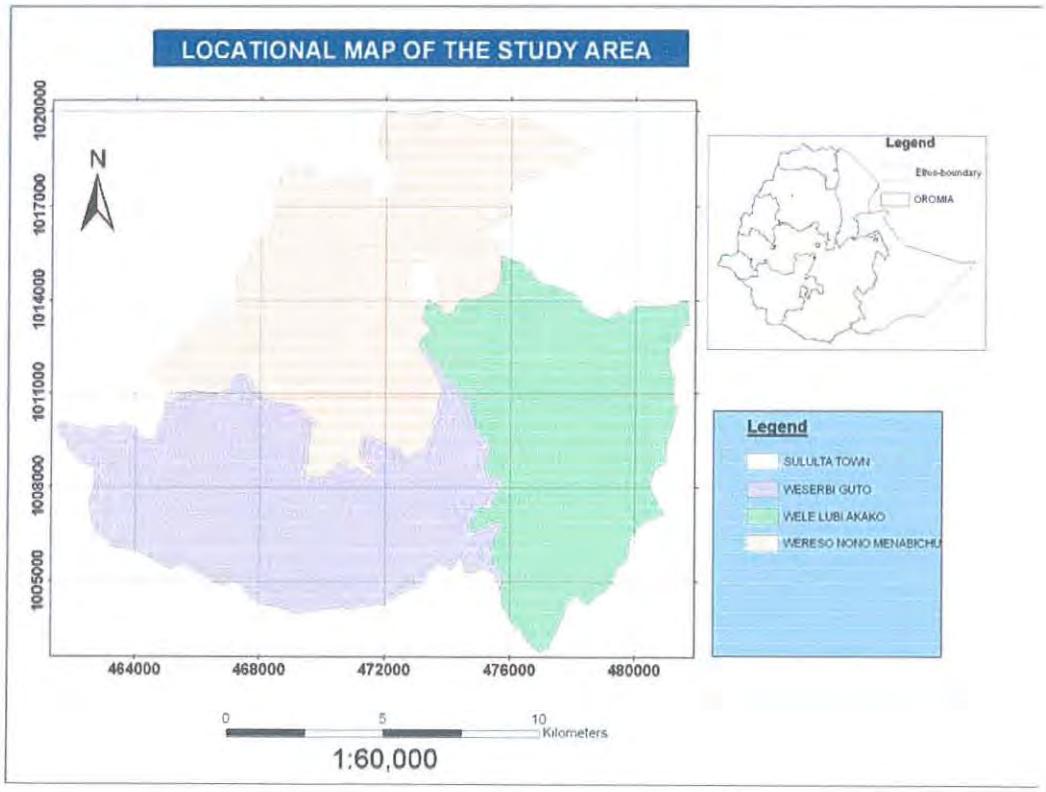
Figure1. Conceptual Analytical Framework



Source: Modified from Dumansiki and Pieri (1997) and Mitiku et al (2006)

3.2 The Study Area

Location: The foothill of Entoto Mountain is found in the Sululta woreda of North Shoa Zone, Oromya Regional State. On average it is found nearly 10.5 km away from Addis Ababa, the capital city. The astronomical location of the study area lies between latitudes of 9^0 04'N to 9^0 06'N and longitudes of 38^0 44'E to 38^0 49'E. Its vicinal location is just on the north western part of Entoto Mountain under the realm of the Blue Nile watershed. The study area includes three kebeles namely Woserbi Guto, Wolelube Akako and Woreso Nono Mennbicho. Within these three kebeles it consists of six 'gots' namely Akako, Shinkuro, Tikurie, Entoto, kaso and Nono. The location of the study area is depicted in map1.



Map1. Location Map of the Foothills of Entoto Mountain

Source: Own preparation using the 2007 CSA data.

Topography and Geology: The topographic feature of the study area is made up of rolling terrain (a rugged topography falling up and down) with an average elevations of

2800masl which ranges from 2500masl at Tikurie 'got' to 3100masl at Akako 'got' (SWoARD, 2007)

The foothills of Entoto Mountain has a similar geologic make up with that of the Entoto Mountain and consists of volcanic rocks like reddish rhyolite, trachytes, ignimbrites, tuffs, welded tuffs and black glassy obsidian. The common soil type in the study area includes luvisols, lepthosols, nitosols, vertisols, and cambisols (SWoARD, 2007).

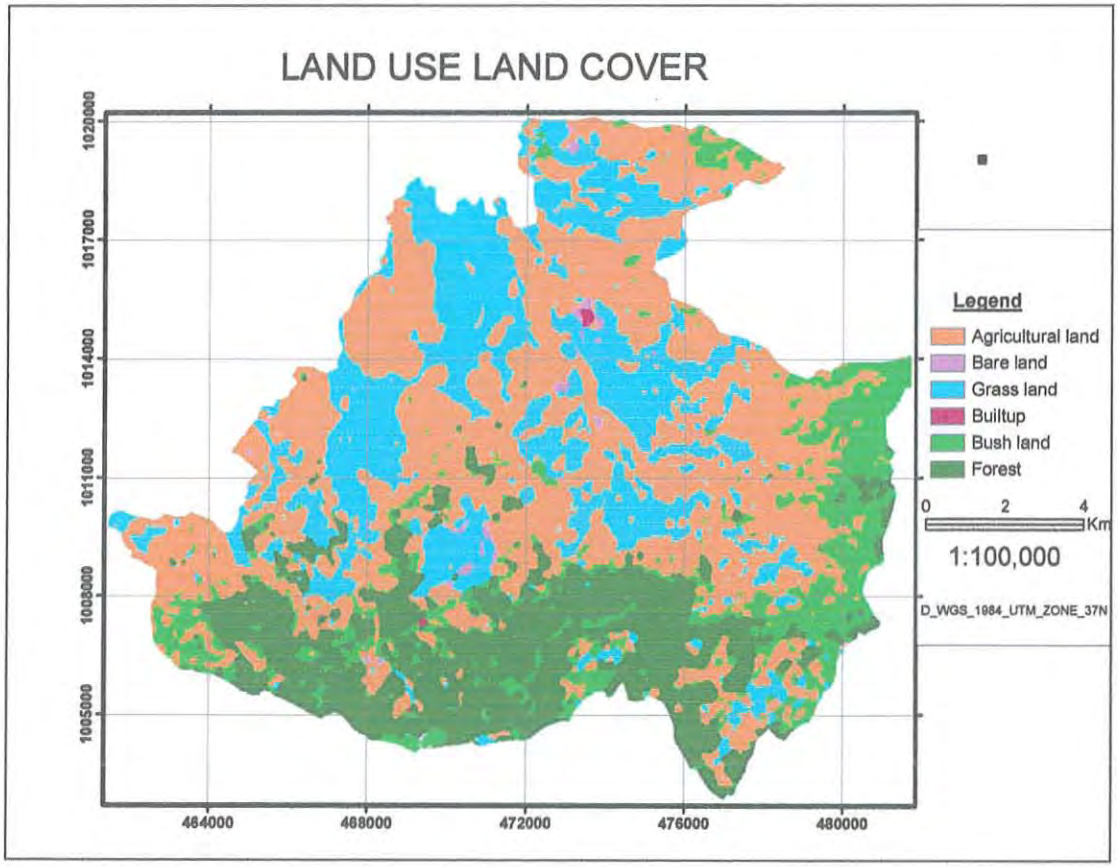
Climate: The study area has an average annual rainfall and temperature of 1400mm and 13^0C respectively. The precipitation together with altitude makes the area to be under Moist Dega agro-climatic zones. There are two rainy seasons per year, the small rains from March to May and big rains from July to September. The highest rain intensity occurs in July and August (SWoARD, 2007).

Agriculture: The farming system of the study area is crop-livestock production system. In the woreda communities produce about 18 varieties of crops. However, barley and wheat are the principal crops grown by farmers in the study area. The study area is conducive for livestock production in general and dairy in particular with a better access to road and proximity to big market centers. The study area has also large market potentials for livestock and livestock products. The livestock depends on grazing land, forest land and crop residue to survive except improved forage in rare cases. However, the socio-economic survey of the woreda shows the grazing land available is not enough for the existing livestock in the study area (SWoARD, 2007).

Forest Resources: Forest, being one of the profound natural resources of the study area has been devastated to the point of extinct both in size and variety. The forest area is composed of rare variety of tree species growing naturally and man made plantations. The available forest resource in the area is composed of Juniperous perocera (yehabesha tid), Hygenia abysinica (Koso), Acacia albida (girar), and homestead plantations of eucalyptus and cupressus lucitanica (Yefereng Tid) (SWoARD, 2007).

Land Use Type: the major land use types of the study area include agricultural land, forest land, bush land, grass land, settlement and bare land. Due to lack of available data on the size of the area the land use type covered it is not possible to append here. However, the researcher attached the land use land cover map of the study area prepared by GIS experts using satellite image of 30 m resolution so as to fill the gap (see Map2).

Map2. Land Use Land Cover Map of the Foothills of Entoto Mountain



Source: Experts preparation using the 2007 CSA data and Landsat ETM^{+} year 2001.

Population: The population of the study area is estimated to be 8789 of which 4361 are males and 4428 are females. The economically active (15-64) were 44% of the total population. Children below 15 years were 48%, while the elderly (65 years and above) were only 8% (SWoRD, 2007).

Sustainable Land Management: In order to reverse the problem of environment in general and land degradation in particular, different efforts were done at woreda level. At the woreda level both modern and traditional SLM practices such as agro-forestry, area closure, composing, cut-off drains, waterways, soil bunds, stone bunds, hillside terracing, and check dams are used on farm plots in order to arrest the problem of soil erosion. Moreover, different soil fertility maintenance practices such as compost, fertilizer, manure and crop rotation are used. In the study area the management of farm land is mainly using traditional SLM practices such as waterways, cut-off drains, terraces, manure, drainage ditches and grass strips. The common modern SLM practices used to manage farm land in the study area are compost and artificial fertilizer. The modern structural SLM practices used in the study area are minute and limited to communal lands. This includes cut-off drains, stone terraces, check dams, waterways, and some plantations (SWoARD, 2007).

3.3 Selection of the Study Area

This research is demand driven and taken care of by the Horn of Africa Regional Environmental Center and Network (HoREC/N). In line with this, the selection of the study area is based on the criteria that the area is prone to long-time land degradation as it is to be found in the highland zone. This includes the fact that land has become a scarce resource because of population pressure and cultivated land is of limited availability leading to degradation. The study area also represents a region where family farms are characterized by different type and level of agricultural intensification and unsustainable use of resources. Emphasis is also given to areas in which the study of identifying sustainable land management challenges is largely undone. The final criteria for selecting and defining the study area was the fact that natural, man-made and socio-economic gradients are manifested from top mountain to valley bottom and that, the transect across the area should reflect land of different levels of degradation and gaps in sustainable land management to address the diverse agro-ecological settings.

Based on the defined selection criteria, the study area is chosen in the foothills of Entoto Mountain of the Sululta Woreda in the North Shoa Administrative zone of Oromya

Regional State, 10.5 km away from North of Addis Ababa, the capital city of the country. The study area encompasses the *kebeles* of Woserbi Guto, Wolelube Akakao and Wereso Nono Menabicho embracing Akako, Shinkuro, Tikurie, Entoto, Kaso and Nono *gots*.

3.4 Nature of Data

This research employs qualitative and quantitative methods to investigate and display the multiple issues promised in the study in general and to achieve the stated objectives in particular. Such methodological plurality is said to allow explicability of research results. It help to identify and define appropriate activities, entry points, possible pathways and the necessary competence for action in a process that takes account of both the 'external' perspective, reflecting the views of researcher, and the 'internal' perspective, which reflects the local perceptions of nature and society.

The study is mainly of socio-economic in nature given that it enables to assess the social, economic, institutional and environmental aspects of the existing land management systems and trends. In addition it provides basis and lessons for alternative land resource management strategies. Data that have relevance for the study has been collected during the site visit. The data has been mainly focused on farmers view on the problem and causes of soil erosion, the existing sustainable land management practices and their underlying constraints, and bio-physical, socio-economic, and institutional constraints of promoting SLM practice. Moreover, literature and experts view were employed to substantiate the view of the farmers'.

3.5 Data Sources

The study is based on both secondary and primary data. Primary data is used for the overall research work while secondary is to triangulate the data. The primary data was obtained from transects and field observation, sampled peasant households, elderly farmers, chairman of the kebele, Development Agents (DAs) of the kebele, and Woreda natural resource management experts.

The secondary source of data was collected by reviewing, analyzing, and retrieving reports and records from different offices, published and unpublished documents,

electronic sources, and maps that are related to the study. The Federal Ministry of Agriculture and Rural Development, the Sululta Woreda Beureau of Agriculture and Rural Development, the kebele Administration office records, records of Development Agents, books, journals, electronic materials, etc. has been consulted so as to acquire information which are related to the study.

3.6 Method of Data Collection

As it has been depicted in many literatures, neither sample survey nor participatory methods provide a complete set of data for research and development work. Creative mix of the two methods, qualitative and quantitative methods, is required so as to consolidate the strengths, cross-check and triangulate any information which is central to the particular research question concerned. It also enables to collect information from and to disseminate research information (outputs) to the heterogeneous audiences (stakeholders) in different ways. This study used both qualitative and quantitative data from primary and secondary sources using different tools.

Household Survey: In order to acquire both quantitative and qualitative data at the household level, formal survey was taken using structured questionnaire on sampled farm households. Pilot survey was conducted before undertaking the formal survey for testing, and some revisions were made finally. Five enumerators were recruited based on their know-how of local language, educational background (Fourth-year BA and BSc students), and previous experience in similar works. In addition, enumerator training was held twice. The first training was done to make clear the overall procedure of the interview and the second one was to make clear the questions after each enumerator undertook pilot interview with some farmers.

The data collected from sampled peasant households includes basic household characteristics, type and amount of resources owned by farm families, farming systems and resource use, land size distribution, agricultural input use, vegetation and energy sources, on-farm and off-farm activities, farmers perception on soil erosion and their strategies against it, causes of soil erosion, indicators of soil erosion, long-term impacts of land degradation, land use changes, current sustainable land management practices and

their constraints, access to credit and extension services, and bio-physical, socio-economic, and institutional constraints of successful SLM promotion.

Focus Group Discussion (FGD): FGD was conducted with farmers who have similar socio-economic and cultural characteristics with the rest of the farmers. It includes purposively selected both male and female households. Accordingly, a total of 42 peasant households were organized into six equal groups, one group for each *got* by having seven peasant household members. The group discussion was carried out twice. The first one was before conducting the questionnaire based individual interview. It was mainly done to discuss some issues which require more clarification in preparing the survey in particular and to contextualize issues. The second one was the proper in depth discussion.

The data collected from focused group discussion includes awareness of the presence of soil erosion, common indicators of soil erosion, common forms of soil erosion, criteria for of severity of soil erosion, causes of soil erosion, practice of agriculture system, land use pattern, common types of existing SLM practices, common constraints of existing SLM practices and ongoing solutions, the problems of credit and extension services, the challenges of over all SLM promotion actions and undergoing way-outs.

Key Informant Interview: a total of 14 key informants were included in the interview. The key informants were three kebele chairmen, three DAs, six elderly farmers, and two woreda natural resource management experts.

The data obtained from elderly farmers and kebele chairmen include trends and causes of soil erosion, the sustainable land management trends, land use changes, local land use/management related conflict resolution mechanisms, practice of agriculture system, and concern about sustainable use of land resources.

The data collected from Development Agents and Woreda Natural Resource Management experts include their perception to the over all problem of land degradation in the study area, causes of land degradation, the management interventions done by the government

and the underlying constraints, bio-physical, institutional and socio-economic constraints of promoting successful SLM practices and the ongoing and proposed solutions.

Transects and Field Observation: field observation was important to know the area well and generate ideas helpful to prepare questions for survey, group discussion, and key informant interview. It helped to acquire information about the physical setting of the area, conditions of land degradation, status of present land management practices and the like. Checklists and participatory transect walks were used as means of observation. Transect walks with farmers, development agents, and kebele officials were conducted focusing mainly on the observation of land management practices in the area, eroded areas using visible indicators, the situation of land use systems, activities of individual farmers, deforested areas etc. The transect walk was also involved a sort of semi-structured interview of the participants. Digital camera was also used to collect the information.

3.7 Sampling Procedure

As it has been aforementioned, the foothills of the Entoto Mountain have never been studied so far. As such, it is very difficult, if not impossible, to define its exact geographical coverage and corresponding population for immediate consumption. However, before embarking upon data collection, the study area was defined at the very start and at the same time it should have to be in close proximity to Entoto Mountain, since it is a demand of the sponsoring agency, HoAREC/N. Then, kebeles in the study area were stratified in to *gots* from which representative sample was drawn. Thus, the sampling frame was the whole population in the selected *gots*. The selected sampling techniques ensured representativeness and help to assess the dynamics of social, economic and environmental interactions within the study area.

The three-stage sampling procedure was employed to draw sample household heads. In the first stage, out of 26 kebeles in the woreda all three kebeles which are in close proximity to Entoto Mountain namely Woserbi Guto, Wole Lube Akako and Woreso Nono Menabicho were selected purposively. At the second stage, from the selected three

kebeles, a total of six *gots* which have more proximity to Entoto Mountain namely Entoto, Akako, Shinkuro, Tikurie, Kaso and Nono were selected purposively. At the third stage, by considering time shortage, financial constraint and homogeneity of the population in terms of their socio-economic, demographic and bio-physical characteristics a total of 108 household heads who have their own land were selected proportionately from the list of household heads in the respective six *gots* using lottery method of simple random sampling technique. Finally, the analysis was done based on 108 sampled households as all of them are successfully interviewed (see table 1).

Table1. Total Number of Household Heads and Sample Size Determination

Woreda	Total Kebekes	No.of Sample kebeles	Name of sample Kebeles	No.of sample gots	Name of sample gots	Total Household heads in the Sample gots	Sampled households	Percent (%)
Sululta	26	3	Woserbi Guto WoleLube Akako Woreso Nono Menabicho	6	Akako	65	14	13
					Entoto	61	13	12
					Kaso	103	22	20.3
					Nono	84	18	16.7
					Shinkoro	94	20	18.5
					Tikurie	98	21	19.5
					Total	508	108	100.00

3.8 Data Analysis and Presentation

The data analysis was carried out during and after field investigation. The study was involving both qualitative and quantitative data analyses techniques. The quantitative data was analyzed using descriptive statistical techniques such as percentages, frequencies, and mean. The chi-square test was run to see if there is any systematic association between different nominal variables. In order to ease the computations of quantitative data, the SPSS program version 15.0 was used. The data analysis and results were organized in the form of tables and figures and interpreted using descriptive method. The qualitative data was analyzed through narrations, thematic expressions', descriptions and discussions. The analyzed data is presented in the form of text, narratives, maps and pictures.

CHAPTER FOUR

4. RESULTS AND DISCUSSION

4.1 Demographic and Socio-Economic Characteristics of Sample Households

4.1.1 Demographic Characteristics

I. Sex and Marital Status

The survey output disclosed that majority of the sampled households 80.6% was male headed while the remaining 19.4% was female headed households (Table2). Regarding marital status of the sampled households the majority, 88.9% was married and 11.1% was widowed. Almost all, 91.7% of the widowed sampled households were females. Since female participation in farming activities such as ploughing is limited by cultural taboos, the land of widowed female households was most of the time managed by their children, relatives, daily labourer, and share-cropper.

Table2. Sex and Marital Status of Sampled Household Heads

		Marital Status of the Household Head		
		Married	Widowed	Total
Sex the HHH	Male	86(78.7)	1(0.9)	87(80.6)
	Female	10(9.3)	11(10.2)	21(19.4)
Total		96(88.9)	12(11.1)	108(100)

Source: Own survey, 2009; The figures in brackets are percents.

II. Family Size and Age Structure

As shown in table3, the total family size in the study area ranges from 2 to 13 with an average of 7.27 people per household which is above the national average of 4.9 per household (CSA, 2001). The male members of the family ranges from 0 to 8 with an average of 3.52 while the female members from 1 to 9 with an average of 3.75 persons per household. The male-female ratio is 100 to 107, which is less than the national average 102 to 100 (CSA, 2008). The age of sampled household head ranges from 22 to 90 with an average age of 51.94 years, which is above the national average of 45 years (CSA, 2001). The age standard deviation is calculated as 14.77, which shows a significant age variation of the respondents as the age range is 68.

Table3. Age and Family Size Distribution of Respondents

	Minimum	Maximum	Range	Mean	Std. Deviation
Age of the Household Head	22	90	68	51.94	14.774
Total Number of Males	0	8	8	3.52	1.501
Total number of Females	1	9	8	3.75	1.703
Total Number of Family Size in the Household	2	13	11	7.27	2.486

Source: Own survey, 2009

III. Education, Religion and Ethnicity

Low level of education and high illiteracy rate is typical in Ethiopia. As shown in table4, majority (60.2%) of the sampled households is illiterate, 19.4% can read and write, 14. 8% have a first cycle primary level of education (grade 1 to 4) and 5.6% have a second cycle primary level of education (grade 5 to 8).

Table4. Education Level of Sampled Household Heads

Education level	Frequency (f)	Percent (%)
Illiterate	65	60.2
Read and Write	21	19.4
Primary first Cycle	16	14.8
Primary second Cycle	6	5.6
Total	108	100.0

Source: Own survey, 2009

The dominant ethnic groups of the study population are Oromos (95.4%) followed by only small number of Amharas (4.6%). Religion wise all households are Ethiopian Orthodox Christians.

4.1.2 Socio-Economic Characteristics

I. Labour Sharing Arrangement

Although farmers reported they are facing with land shortage, the available populous people is not sufficient to manage some decisive activities during peak periods. These include weeding, threshing, harvesting, ploughing and some times manure and composting. Of the total households, 88% reported that they faced problem of labour shortage in such critical works. In order to manage the labour problem farmers in the study area use the traditional labour sharing activity locally known as *debbo* and some

times hired labour. However, the sampled farmers reported they are facing different problems when they use *debbo* and hired labour. For the latter is due to economic problem since the payment is in cash while for the former is food preparation problem, low quality of work and a problem of timing. The low quality of work is associated with the low responsibility of farmers since they did not consider the task as their own. The timing problem is credited to two factors. First, farmers are not willing to join the task early in the morning as they did in their own farm. Second, the task is accomplished behind the schedule looking for *debbo*. This indicates the early *debbo* user will have more of tasks are accomplished. However, regarding *debbo* requirement for construction of terraces, respondents stand in front. This is because the labour sharing arrangement is meant often for sake of production than conservation/protection.

II. Off-farm Income Generation Activities

Involvement of farmers in off-farm works is common in the study area. As shown in Table5, farmers engaged in sale of dung cake, fuel wood and stones, and daily labour and petty trading activities. This however results in the low promotion of SLM in the study area (the detail analysis is presented in section 4.4.4).

Table5. Sampled Households Off-farm Income Generation Activities

	Sell of dung cake	Sell of fuel wood	Daily labour	Sell of stone	Petty trading
Yes	103(95.4)	94(87)	87(80.5)	24 (22.2)	22(20.4)
No	5(4.6)	14(13)	21(19.5)	84 (77.8)	86(79.6)
Total	108(100)	108(100)	108(100)	108(100)	108(100)

Source: own survey, 2009; The figures inside the brackets are percents

III. Sustainable Land Management Tools

In the study area there are different land management tools. This includes: iron plough, yoke, plough beam, spade, sickle, saw, axe, iron hoe, and sledgehammer. The minimum average tool holding size is zero (sledgehammer) while the maximum is 4.32 (sickle). The detail holding of SLM tools is summarized in table6.

Table6. Household Agricultural Tool Ownership

Type of Tool	Minimum	Maximum	Mean
Iron-plough	1	5	1.83
Yoke	1	8	1.74
Plough beam	1	10	2.42
Spade/shovel	1	3	1.28
Sickle	2	10	4.32
Saw	0	2	.94
Iron Hoe	1	4	2.21
Axe	1	4	2.70
Sledgehammer	0	2	.60

Source: Own survey, 2009

IV. Livestock Ownership

Livestock is an important component of the farming system in the study area. There are different kinds of livestock owned by the sampled households. Cattle, sheep, goats, horses, and poultry are the common domestic animals.

Livestock are used for drought, sale and food purpose. Oxen are the main sources of drought power. The distribution of oxen among the sampled households of the study area ranges from 1 to 4 oxen. The average possession of oxen per the sampled households is 2.5. This shows oxen were not a serious constraint on farming operation in the study area. The maximum average size of livestock was sheep 8.13 while the minimum was goat 0.23. The minimum, maximum and average holding of livestock is shown in table7.

Table7. Size of Livestock Holding by the Sampled Households

Livestock type	Minimum	Maximum	Mean
Oxen	1	4	2.52
Cows	1	9	3.45
Heifers	0	6	1.82
Young bulls	0	5	1.38
Calves	0	4	1.61
Sheep	0	25	8.13
Goats	0	4	.23
Donkeys	0	5	1.83
Horses	0	3	.62
Poultry	0	21	4.93

Source: Own survey, 2009

V. Land Holdings and Crop production

As in many parts of the country, agricultural land is becoming scarce in the study area. This is aggravated by population pressure thorough urban expansion, investment, and growth of rural household size. The shortage of farm land has resulted in land intensification and land use changes. In the study area, the size of individual holding at present varies from 0.5 to 2.25 hectare, with an average farm size of 1.01 hectare per household.

Crop production is the major farming activity of the people of the study area. The crop farming system in the area is dominated by cereal crops. As it is shown in table8, barley was the main crop followed by wheat as 95.4% and 88% of the respondents indicated respectively. Pulses such as beans and peas are grown around homestead with small amount. Only 20.4% of the sampled farmers reported as the growers of pulses. The growing of cereal crops has its own repercussion on SLM promotion (see section 4.4.2).

Table8. Types of Crops Grown by the Sampled Households

	Types of Crops		
	Barley	Wheat	Beans and peas
Yes	103(95.4)	95(88)	22(20.4)
No	5(4.6)	13(12)	86(79.6)
Total	108(100)	108(100)	108(100)

The figures in brackets are percents
Source: Own survey, 2009

VI. Energy Sources

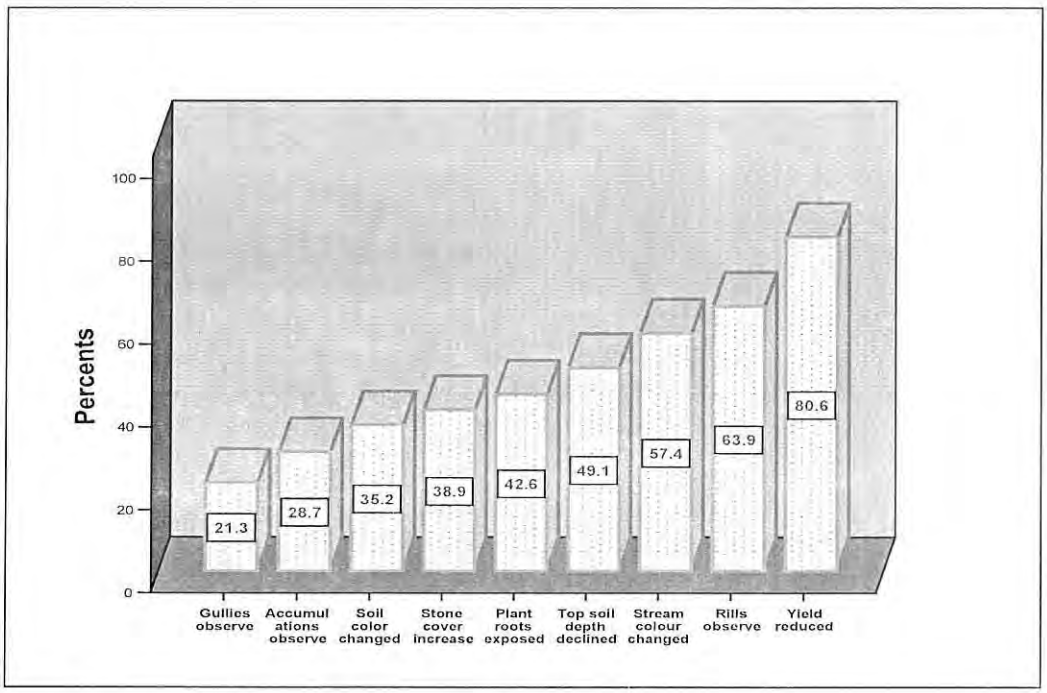
It is well known that the energy supply of most part of the country is mainly from traditional source such as dung, fuel wood, and crop residue. In the study area, the common energy sources are electricity, kerosene, fuel wood and dung-cake. Electricity is use for light purpose in all '*gots*' except in *Akako* and *Tikurie* where the service is not started. Benzene is used as light in *Akako* and *Tikurie gots* and other *gots* in case of electricity failure. Fuel wood and dung cake are the main energy sources for cooking purpose. Crop residue is not used as fuel source in the sampled households because it is used as livestock feed.

4.2 Farmers' Perception about the Problem of Soil Erosion

The knowledge of farmers about the problem of soil erosion is a critical determinant to implement SLM practices on their farmlands. Therefore, in order to formulate a successful policy and strategy to sustainable land management, investigating the perception of farmers to the problem of soil erosion in their farmland is the foremost step. This is also needed to empower farmers in all stages of sustainable land management plans and promotion activities from problem identification to openhanded solutions.

Farmers of the study area are well aware of the problem of soil erosion in their farmland. Almost all, 91.7% of the respondent farmers recognized soil erosion is a problem in their farm land. Farmers used different indicators to know whether soil erosion is a problem in their farm land or not. As it is depicted in figure3, farmers perceived the presence of soil erosion in terms of yield reduction, stream color change, appearance of rills, declining of topsoil depth, exposed plant roots, gully appearance, increase stone cover, soil color change, and presence of accumulations in foothills.

Figure2. Soil Erosion Indicators on Farmers' Farm Plots



Source: Own survey, 2009

Figure2 reveals soil erosion was perceived by the majority (80.6%) of the respondents as a problem reducing crop yield. This indicates that farmers in the study area perceive more long time indicators than current time indicators. In contrast, rills are the most perceived current-time indicator of soil erosion problem on farm plots.

As it is illustrated in table9, the statistical association between both age and educational level of the households with their perception of soil erosion problem is not statistically significant. This shows farmers' perception of soil erosion as a problem is not related by their education level or age. Education may not make difference between households in perceiving soil erosion as a problem since most of them are illiterate. At the same time even if the lowest age is 22, most 79.6% of households are under the age group of 45-90. Therefore, most of them are at the highest age group and understand the problem of soil erosion through experience. Similarly, young farmers can also understand the problem of soil erosion since they grown up through farming and are a bit literate.

Table9. Association between Education & Age with Farmers' Perception of Soil Erosion Problem

		Is soil erosion a problem on your farm land?					
		Yes	No	Total	$\chi 2$	p	r
Education	Illiterate	58(53.7)	7(6.5)	65(60.2)			
	Read and Write	20(18.5)	1(0.9)	21(19.4)			
	Primary 1^{first} Cycle	15(13.9)	1(0.9)	16(14.8)			
	Primary 2nd Cycle	6(5.6)	0(0)	6(5.6)			
Total		99(91.7)	9(8.3)	108(100.0)	1.4	.68NS	.30
Age group	22-44	22(20.4)	0(0)	22(20.4)			
	45-67	75(69.4)	9(8.3)	84(77.8)			
	68-90	2(1.9)	0(0)	2(1.9)			
Total		99(91.7)	9(8.3)	108(100)	2.8	.24NS	.16

NS: Not significant
Source: Own survey, 2009
The figures in brackets are percents

The presence of soil erosion in the area is also acknowledged by DAs and woreda experts using indicators of gullies, rills, appearances of exposed rocks, low infiltration capacity of soils, increased run-off, and exposed tree roots. Picture 1 and 2 illustrates appearances of out-cropped stones and gullies respectively as clearly seen during transect walks.

The picture on the right shows out-cropped stones due to soil erosion. The first picture was the farm land formerly. But due to difficulty to plow using iron hoe, now it is changed to bare land. The second picture shows stone-out cropping on the current farm fields.

Picture1. Out-cropped Stones Due to Soil Erosion
Photograph taken by the author, 2009

The picture on the right shows gully formed due to run-off just in the adjoining grazing, farm, and forest lands. This picture also show exposed plant roots.

Picture2. Observed Gully in the Study Area
Photograph taken by the author, 2009

An endeavor was also made to explore different forms of soil erosion in the study area. Sheet, rill and gully erosion forms are clearly notified by experts. Respondent farmers who have current soil erosion problem are also asked to indicate which forms of erosion are appearing in their farmland. Accordingly, 64.6%, 76.7%, and 21.3% of the respondent farmers' notified rill, sheet, and gully erosion forms are appearing in one or

more of their farm lands respectively (table10). This shows rills are the dominant and the most perceived erosion form in the study area. This observation agrees with a study of Tesfaye in Konso (2002).

Table10. Forms of Soil Erosion in the Study Area

	Erosion forms		
Alternatives	Sheet	Rill	Gully
Yes	64(64.6)	76(76.7)	21(21.3)
No	35(35.4)	23(23.3)	78(78.7)
	99(100.0)	99(100.0)	99(100.0)

The figures in brackets are percents
Source: Own Survey, 2009

An attempt was made to understand respondents' perception on the trend and extent of soil erosion in their farm land for the last 10 years. As it is indicated in Table11, 69.7%, 9.1%, and 21.2% of the respondent farmers replied increasing, decreasing, and no change respectively.

Table11. Trends of Soil Erosion on their Farm Plot

Erosion rate			
Increasing	Decreasing	No change	Total
69(69.7)	9(9.1)	21(21.2)	99(00.0)

The figures in brackets are percents
Source: Own survey, 2009

On the subject of the extent/severity of soil erosion problem, the majority of farmers rate it as moderate (60.6%). Farmers who said severe and low account about 18.2% and 21.2% of the sampled respondents respectively (Table 12).

Table12.Extent of Soil Erosion on Farm Plots

Extent of soil erosion			
Sever	Moderate	Low	Total
18(18.2)	60(60.6)	21(21.2)	99(100.0)

The figures in brackets are percents
Source: Own survey, 2009

A discussion with farmers revealed that they believe erosion to be severe when they observe gullies and moderate when they observe rills in their farm plots. This depicts although farmers were aware of erosion problems and its' rate, their understanding to the severity is limited to moderate to long time visual authentication. A study done by Aklilu (2006) in north central highland of Ethiopia also confirm this fact where 91% of the respondent farmers mentioned the prevalence of sheet and rill erosion on their farmland and majority of them (84%) rated the extent of the problem as moderate and/or minor. On the other hand, it was clear from field observation, transect walks, and interview with experts that both sheet and rill erosions caused considerable impact on farming activity of the farmers. Therefore, this depicts farmers' limited understanding of the severity of sheet and rill erosion is influencing their immediate investment decision on SLM practices adversely. This call up for more farmers' education for better elucidation of erosion process and impacts for an urgent decision for investing in SLM practices (Aklilu, 2006).

4.2.1 Perception of Farmers about the Causes of Soil Erosion

According to farmers' perceptions the most important factors which triggers soil erosion processes in the study area are erosive nature of rainfall (intensity and duration), the nature of topography, lack of vegetation cover, erodible nature of soil type, over cultivation, and over grazing (table13).

Table13. Farmers' Perception to the Causes of Soil Erosion Problem

Type of trigger	Agree	Disagree	Not clear	Total
Rain fall type	96(88.9)	8(7.4)	4(3.7)	108(100.0)
Topography	72(66.7)	22(20.3)	14(13)	108(100.0)
Deforestation	70(64.8)	19(17.6)	19(17.6)	108(100.0)
Soil type	29(26.9)	53(49.1)	26(24)	108(100.0)
Over cultivation	36(33.3)	42(39)	30(27.8)	108(100.0)
Over grazing	58(53.7)	21(19.4)	29(26.9)	108(100.0)
Population growth	40(37.1)	51(47.2)	17(15.7)	108(100.0)

The figures in brackets are percents
Source: Own survey, 2009

As illustrated in table13, most farmers (88.9%) notified intensity and duration of rainfall that falls during the rainy season (June, July and August) intensified the erosion process on their farm land. Farmers from Akako, Shinkuro and Tikunire also disclosed that soil erosion is common in their farm land even in spring (March, April, May) rainfall. Deforestation as a trigger of soil erosion is perceived by 64.8% of the sampled respondents. Most of them perceived that trees reduce the erosive force of heavy rainfall, but the infiltration capacity of roots is not well understood. The perception of farmers on deforestation as a trigger of soil erosion may imply their inclination to vegetative SLM practices on their farm land and discontinue cut and carry. But, farmers are not applying vegetative SLM practices due to various problems such as land shortage, and they continue cutting and carrying due to poverty.

The nature of topography is notified as a trigger of soil erosion by 66.7% of the respondents (table13). As the interview made with farmers to investigate the common slope type of their farm land, 49.1%, 36.1%, and 14.8% reported steep, moderate steep and gentle slope respectively. The perception of farmers on the nature of topography as a trigger of soil erosion may point out their desire to invest on structural and vegetative SLM practices on their farm land. But the reality is up sided down due to various constraints (it is discussed in detail in section 4.3.1, 4.3.2 and 4.4).

Moreover, evidence from field observation, interview with DAs and woreda experts depicts that the nature of topography of the study area can cause problem of soil erosion. It is accompanied with rugged terrains and steep slopes, which are convex in nature.

Erodible nature of the soil type as a trigger of soil erosion is perceived by minority (26.9%) of the sampled respondents (table13). However, interview with DAs and woreda experts clearly notified that the soil type of the area is easily erodible since the soil types in the study area are poor in humus content with poor physical structure and low infiltration capacity. This indicates there is gap in knowledge between experts and farmers in identifying the triggering nature of soil type and decision making to tackle the problem.

The most important factor behind the expansion of croplands to fragile sloppy forest areas and causing land degradation is population pressure (discussion with experts). However, the perception of farmers' on the causal role of population pressure is limited. As shown in table13, it was only minorities (37.1%) of the sampled respondents notified population growth escalate soil erosion processes in the study area. This is because majority of respondents consider their children as a sustainable labor force and property inheritors. This observation agrees with Tesfaye (2003) in Wolayta, and Senait (2004) in Ankober. Farmers in the focused group discussion also notified they are currently enjoying by the income they get from their children though off-farm works such as sell of fuel wood, dung cake and daily labor work.

Over cultivation is not perceived directly as a cause of soil erosion by farmers in the study area. It is perceived by only perceived by 33.3% of the respondents (table13). As discussants made clear, over cultivation is perceived by farmers as reducing soil fertility and productivity. This observation agrees with Tesfaye (2003) in Wolayta. This indicates farmers' perception may possibly affect their decision to invest on soil fertility maintenance SLM practices for the sake of erosion control unless and other wise they perceive that fertility declined.

Overgrazing as a trigger of soil erosion is perceived by majority (53.7%) of the respondents (table13). Farmers perceive the effects of over grazing from the point of view of erosion created by animal foot paths and removing grasses. This observation agrees with Tesfaye (2003) in Wolayta.

4.3 Sustainable Land Management in the Foothills of Entoto Mountain

According to the survey output all households believed soil erosion can be controlled. Farmers in all *gots* of the study area do something either at household or supra-household level in arresting the problem of soil erosion through their indigenous knowledge supplementing with the modern one to a lesser extent. The household level SLM practices include those measures that are practiced by a single household based on the management type requirement of the plot and specific opportunities of the household. The common SLM practices used at household level of the study farmers includes: traditional terraces, traditional drainage ditches, traditional diversion ditches, fallowing, manure, composting, fertilization, crop rotation, traditional waterways, unplowed strips, contour plowing and some plantations.

The supra-household level land management of the study area is conducted mostly at neighborhood level. The neighborhood level land management is conducted jointly by two or more land user households on adjacent farm plots based on the management type requirement of neighboring plots and the mutual understanding of the farmers. The neighborhood SLM practices include contour plowing, traditional waterways, unplowed strips and traditional cut-off drains.

4.3.1 Indigenous Sustainable Land Management Practices and their Constraints

I) Physical/Structural SLM practices

Physical SLM practices on crop lands are generally engineering works. They are mostly designed to reduce the effect of slope length and to intercept and slow-down run-off water so as to reduce soil erosion (Michael, 2002; Mitku et al, 2006; Yilikal, 2007). Table14 discloses the types of physical SLM practices used by sampled farmers in the 2007/2008 cropping year.

Table14. Types of Indigenous Physical SLM Practices Used by Farmers

	Types of physical SLM practices					
	Contour plowing	Drainage ditches	Diversion ditches	Waterways	Stone terracing	Check dams
Yes	108(100)	99(91.7)	90(83.3)	78(72.2)	52(48.1)	25(23.1)
No	0(0)	9(8.3)	18(16.7)	30(27.8)	56(51.9)	83(76.9)
Total	108(100)	108(100)	108(100)	108(100)	108(100)	108(100)

The figures in brackets are percents

Source: Own survey, 2009

i. Contour Plowing

Contour plowing is the all-embracing indigenous SLM practice in the study area as it has been used by 100% of the sampled respondents (table14). As discussant farmers revealed contour plowing is conducted for two main purposes. One is to reduce soil erosion and the other is to save oxen retirement from using up-down plowing. As it has been discussed with development agents of the study are and natural resource management experts of the woreda, the furrows that are formed along contours function to retain the rain water until it infiltrates in to the ground and hence moderate the eroding effects of surface run-off (Mitiku et al, 2006).

Conversely, this practice is not effective in area where the rains are intensive and the slopes are long and steep (Belay, 1998). At the same time, in addition to disintegrating the cohesive force of the soil, contour plowing also removes the vegetation cover and makes the land prone to erosion (discussion with DAs).

ii. Traditional Drainage Ditches/Furrow Ditches

Traditional drainage ditches are structures built with ox-plough, and are deeper than the normal furrow (Michael, 2002; Million, 2001; Yohannes and Herwog, 2000). As shown

in table14, almost all (91.7%) of the sampled households used traditional drainage ditches either to protect soil from erosion or to decrease water logging problems.

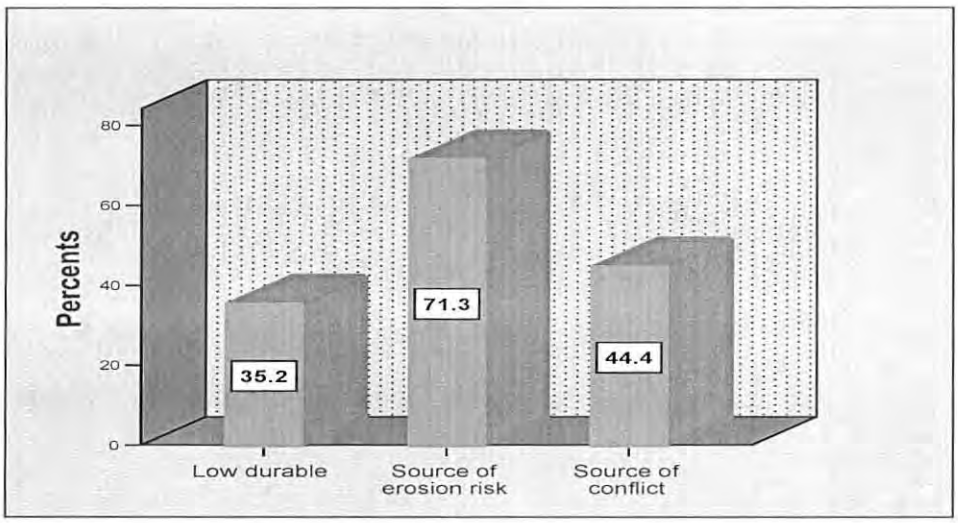
The use of traditional drainage ditches by the people of the study area is faced with various constraints. Ditches are filled with stones, silts, weed heaps, and broken by human foot during weeding and finally may grow to gullies. However, in order to minimize these constraints farmers used their labor to maintain ditches. Farmers' also mostly use children labor to clean stone filled ditches after ox-plow.

iii. **Traditional Diversion Ditches/Cut-off Drains**

Traditional diversion ditches are structures built with ox-plough assisted with hand dug iron-hoe and spade to remove soils and stone from the drains. As shown in table14, about 83.3% of the households use traditional diversion ditches to intercept surface run-off and convey it safely to an outlet in the 2007/08 cropping year. Farmers in the study area mostly practiced the diversion ditches to protect their cultivated land against run-off from slopes higher up and run-on from the farm plot itself.

The use of traditional diversion ditches in the study area is constrained by different factors. To construct diversion ditches a minimum of plowing, digging, and cleanout stones and soils is needed. Diversion ditches also need regular follow up even during in rainy times in case if they are conked out. As the respective 71.3%, 35.2%, and 44.4% of the respondents revealed erosion risk at its end point, low durability, and source of conflict between farmers due to its erosion effect are the most constraints in applying diversion ditches (figure3). As it is depicted in figure3, the most constraining factor in implementing diversion ditches is erosion risk which emanate from the practice itself. This is due to different reasons such as up and down construction of diversion ditches (discussion with DAs) and disagreement among farmers in using the practices to manage both run-off and run-on in a coordinated manner in their adjacent plots.

Figure3. Constraints of Diversion Ditch based on Respondents Farming Experience



Source: Own survey, 2009.

Farmers in the study area used different mechanisms to resolve the problem of conflict arrived due to diversion ditch construction. One way of solving the conflict is the use of *shimagle* (traditional conflict resolution mechanism) by using different alternatives. The first alternative is let the ditch pass only through the user plots. The second alternative is diverting ditches to other bare lands if possible. The third alternative is use ditches jointly. Regarding the problem of source of erosion risk at the outlet, farmers use a practice of widening the size of ditches at their outlet. But, it could aggravate erosion as shown in picture3. The low durability constraint is solved by using household labor by maintaining ditches now and again.

The picture on the right shows how soil erosion is facilitated due to up and down construction of traditional diversion ditch and the widening of its size at its end point.

Picture3. Erosion Risk of Widening Ditch at the End Point
Photograph taken by the author, 2009

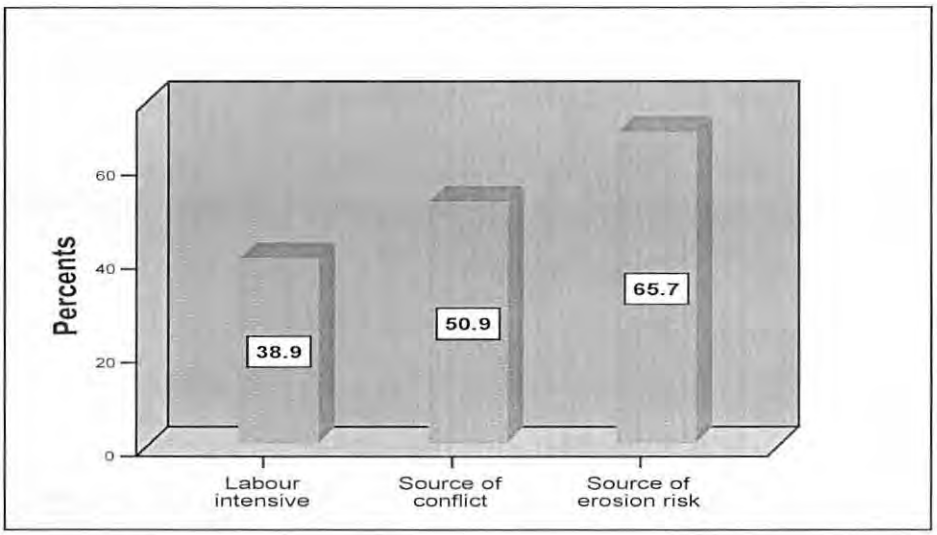
iv. Traditional Waterways

Waterways are similar to cut-off drains in controlling water coming from upslope. The difference between the two practices according to focus group discussion and DAs is traditional waterways are constructed either artificially or naturally and covers a wider area and they sometimes serve as a handset of drained out water through cut-off drains. According to the survey majority 72.2% (table15) of the sampled households used traditional waterway in the 2007/08 cropping year to manage run-off safely from hill slopes to valley bottom where it can join a stream/river.

Similar to traditional diversion ditches, the application of traditional waterways is constrained by different factors. Waterway construction requires the plowing and digging of uncultivated fields, bare lands, stony areas, etc. Therefore, it requires labor either at household level or neighborhood level. As shown in figure4, 38.9% of the sampled households reported the application of waterway is constrained by its labor requirement particularly in bare and uncultivable stony areas. The other constraint of waterway is its performing as source of erosion risk as 65.7% of respondents notified. This is due to the downward leaning of waterways at end points (discussion with DAs) and its breakage due to animal movement, high amount of rainfall and mismanagement. Waterways also become source of conflict among farmers as 50.9% of the respondents disclosed. This type of conflict mostly occurred between up and downstream land users during the construction of waterways. According to discussant farmers the question that results in conflict is raised mainly from the downstream users since they are the receiver of flood through waterways of upstream users from unknown direction. The other type of conflict is between the upstream-upstream and downstream-downstream users. This is mainly because of low integrated flood management between adjacent plots and low participation of some farmers in constructing the practice due to their engagement in other works such as daily labor. This indicates the intra and inter-stream coordination of run-off management in the study area is mismatched and stagnating the promotion of SLM. The efforts to solve the constraints and problems of waterway by the farmers are

similar to traditional diversion ditches except the use of neighborhood labor in waterways.

Figure4. Waterway Constraints Based on Respondents Farming Experience



Source: Own survey, 2009

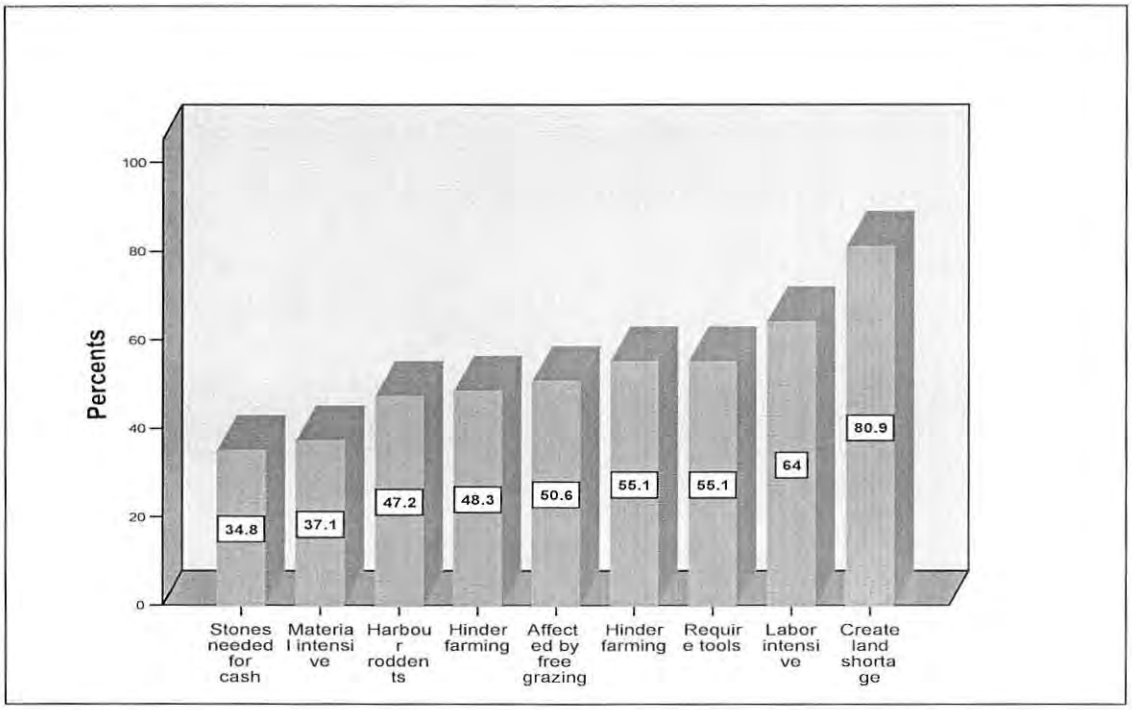
Figurw4 shows source of erosion risk, source of conflict and labor requirement are the significant constraints in using waterway in the study area in order of significance.

v. Traditional Stone Terraces

Traditional stone terraces are constructed across slopping land to reduce or stop the velocity of soil erosion. Terraces are constructed in areas where the construction material (stone) is available and sufficient human labor is at hand. The construction of terraces in the area is mainly on the upper boundary of a farm plot. Due to stone, labor, and land shortage, it is rarely constructed in the middle and lower part of a farm plot.

Even if stone terracing is not used in sustainable way, 48.1% of the total sample respondents practiced traditional stone terraces in one or more plots (table14). However, the application traditional stone terracing is determined by various constraints as shown in figure5.

Figure5. Traditional Stone Terrace Constraints Based on Households Farming Experience



Source: own survey 2009.

Figure5 depicts land shortage followed by labor intensiveness is the major constraint of stone terrace implementation as 80.9% and 64% of respondents respectively revealed. Space taking and hindering of farming practice is associated to the wide and long construction of stone terraces so as to resist the run-off coming from upslope. The strategies of tackling constraints in implementing terracing differ from problem to problem. For instance, to solve the land shortage problem farmers destroy terraces and to minimize its hindrance of farming activity farmers either minimize the height and width of the terrace or destroy it totally. In order to minimize the problem of rodents, farmers used *netela kab* (literally mini-terrace). Farmers borrow sledgehammer in order to minimize construction material shortage. With regard to solving the problem of stone shortage farmers did nothing except using waterways and ditches. Due to economic problem and high opportunity cost of stones farmers particularly in Nono and Kaso keep on selling.

Vi. Traditional Check Dams

Traditional check dams are constructed in areas where gullies are widely observed to rehabilitate gullies formed by potent run-off. Even if several gullies are observed in many fields of the study area, farmers are not in a position to construct check dams. It is minorities, 23.1% of the total respondents implemented check dams in the study area (table15). The low sustainable rate of practicing check dams in the study area is associated to different factors. Farmers in the focus group discussion associated the reason to the requirement of human labor to move and carry big stones and lack of construction tools like sledgehammer. However, DAs associate the problems to the low courage of farmers to construct check dams due to their engagement in off-farm works and the absence of community level SLM practices.

II. Biological Sustainable Land Management Practice

There are three basic principles through which biological SLM practices prevent soil erosion. The first principle is prevention of the direct impact of rain drops through the provision of adequate vegetation cover. The second principle is the prevention of concentration of surface flow of water in order to prevent the formation of heavy volume of water that cause run-off. To this effect, any vegetation (alive or dead) uniformly covering the ground, spreads out the surface flow thinly so that it doesn't concentrate in one spot to form bigger volume of water that eventually creates erosive rainfall. In addition physical barriers and organics increase the infiltration rate of water in the soil due to increasing the contact time of water to the soil and improving physical structure of the soil respectively. The third principle is increasing resistance of the soil from erosion. With the improvement of soil organic matter content, the percentage of water stable soil aggregates substantially increases, there by increasing its resistance to detachment by the direct impact of raindrops or run-off. When the soil is rich in organic matter content, its elasticity increases and it absorbs the kinetic energy of raindrops without being disintegrated into pieces (Betru, 2001). Table15 illustrates the common indigenous biological SLM practices used by farmers in the 2007/2008 cropping year.

Table15. Types of Indigenous Biological SLM Practices Used by Farmers

	Crop rotation	Manure	Unplowed strip	Fallowing	Plants
Yes	77(71.3)	92(85.2)	89(82.4)	17(15.7)	26(24.1)
No	31(28.7)	16(14.8)	19(17.6)	91(84.3)	82(75.9)
Total	108(100)	108(100)		108(100)	108(100)

Source: own survey, 2009 The figures inside the brackets are percents

i. Crop Rotation

It is a practice of growing different crops one after the other on the same plot of land season after season. It is a system by which nitrogen restoration is achieved by alternating different types of crops on the same cultivated plot. This practice is considered to be successful in maintaining the nitrogen status of the soil if leguminous plants are included in the rotation practice (Belay, 1998). This is because legumes fix atmospheric nitrogen and hence enrich soil fertility (Betru, 2001).

The common crops grown in the study area are barley and wheat except beans and peas in a few farms. Asked sampled respondents whether they practiced crop rotation or not 71.3% of the total respondents notified yes. According to the focus group discussion, the rotation cycle of crops in the study area is cereal-cereal (Barey-Wheat-Barley). As discussant farmers mentioned the main aim of crop rotation is to increase diversify production. This indicates farmers are well aware of the capability of rotating cops in increasing soil fertility. However, they are not in a position to recognize the role of crop rotation to reduce soil erosion rate.

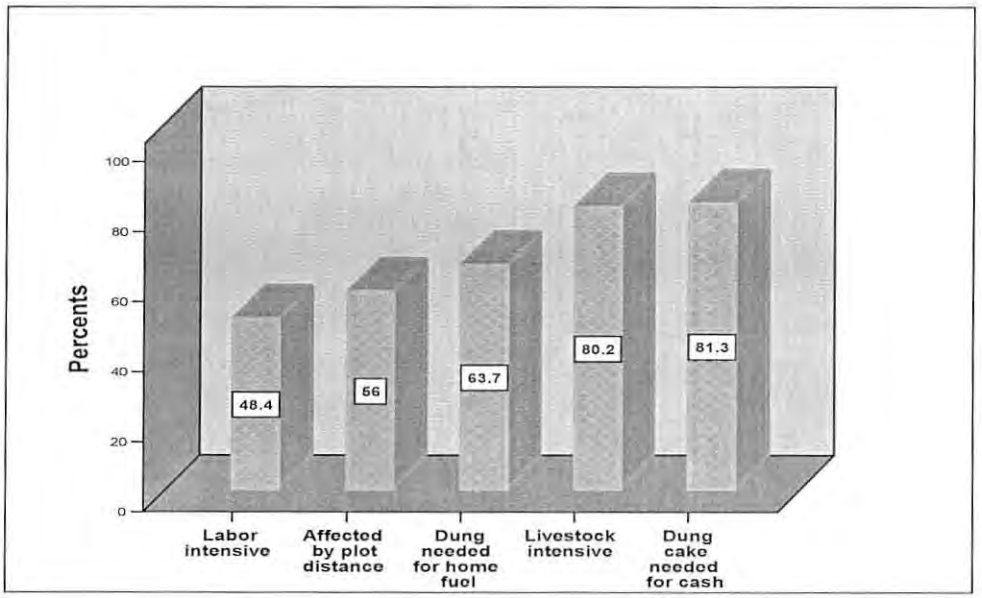
Farmers' choice of crops to grow in rotation and the type of crop grown in the area are constrained by a number of factors. The personal preference, suitability of the soil type used by farmers for preferred crops, rain fall pattern, and controlling pests/diseases

infestation are some of the constraints in practicing crop-rotation. Farmers prefer barley to control rust disease on wheat and prefer cereals to make *injera* (staple food) to pulses. This trend is also observed by other author (Belay, 1998) in the southern Wollo and Michael (2002) in north western highlands of Ethiopia. Barley is the most preferred crop using the above farmers' criteria including its ability to resist drought.

ii. **Manure**

Manure in the study area is mainly obtained from wastes of cattle, sheep, donkeys and horses. Even if the amount varies from households to household 85.2% of the sampled households use manure to improve the fertility status of their farm land (table15). Currently the use of manure to maintain soil fertility in the study area is constrained by a number of factors. As it is shown in figure6, the opportunity cost of manure for cash in the form of dung cake is the most constraining factor followed by the requirement larger size livestock for dung, household fuel use, distance of a plot and its labor intensiveness respectively. Farmers used nothing as a strategy to break the above constraints of using manure except few use *debbo* and donkeys to minimize the problem of labor.

Figure6. Manure Constraints Based on Respondents Farming Experience



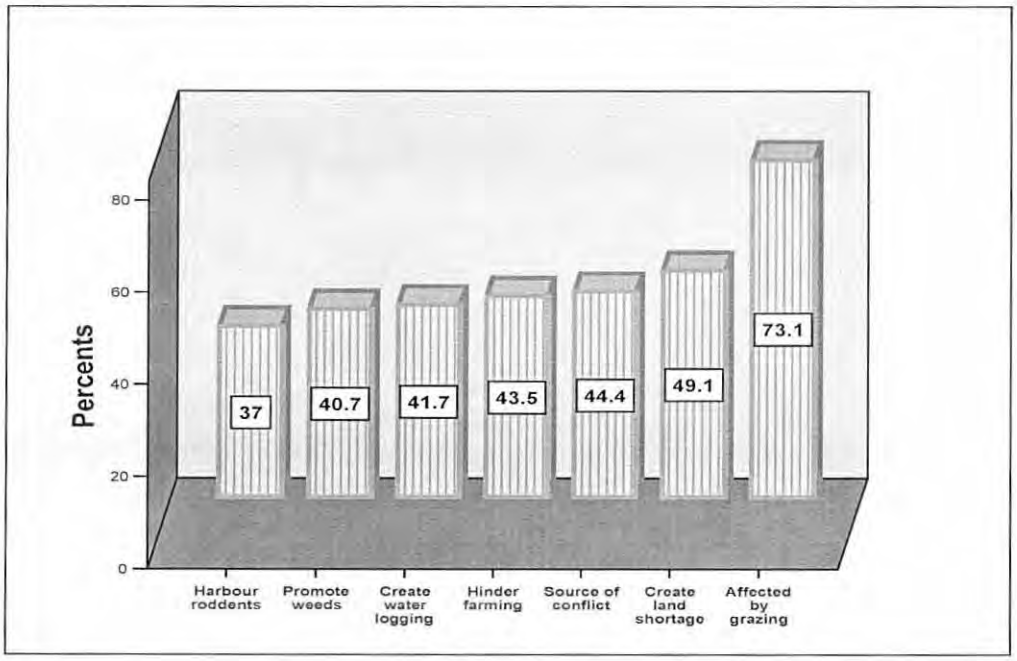
Source: own survey 2009.

iii Unplowed Grass Strip */Dinber*

It is the common SLM practice of retaining narrow piece of land along the contour during plowing period for several seasons. Naturally grasses grow on the piece of land and make it strong and durable. As shown in table15, majority (82.4%) of the sampled respondent farmers used grass strip in one or other plots for triple functions. Strip help farmers either to reduce surface run-off/run-on, as a boundary between different farm plots owned by different households or as a human pathway during land management activities such as weeding.

As shown in figure7, the use of unplowed stripe to arrest the problem of soil erosion is constrained by a number of factors such as free grazing, weed promotion, harboring of rodents, hinder farming practice, takes up space (farm land), become source of conflict, and create water logging. Free grazing is the most constraining factor in implementing unplowed strip followed by the creation of land shortage.

Figure7. Constraints of Unplowed Strip Based on Respondents' Farming Experience



Source: own survey, 2009

Farmers use some strategies to minimize for some of the constraints of using unplowed strip. Farmers minimize the width of strips to reduce its impact on farming problem, weed promotion and taking up space. But there are also farmers who destroy strips due to farm land shortage. The conflict arisen due to using unplowed strip is mostly during grazing of border strips and incision of water through strips. This is mostly solved by the *shimagle* and church leaders. Controlling free grazing is an unsolved constraint.

iv. Fallowing

Following is a practice of leaving the farm plots aside uncultivated for short (half a year to two years) to long periods (three to five years) to recuperate the fertility of the land (Tesfaye, 2003). In the study area a few number of farmers (15.7%) are practicing fallowing only for a year (Table14). This is because of the resulting land shortage due to rural population growth, urban and investment expansion in the area. There is nothing done to alleviate the problem of fallowing by the farmers except avoiding the practice.

V. Vegetative SLM Measures

As illustrated in table15, eucalyptus and *ameja (*hypericum revolutum) are the only plants found around in a few (24.1%) of respondents farm lands, while *tid* (cupressus lucitanica), *amfar* (budelegia polystachya), *endod* (phytolacca dodecandra), *imbway* (solanum campylacanthum) and *ameraro* (discopodium penninervium) are restricted to homesteads. However, as development agents and woreda natural resource management experts argued, eucalyptus is a production crop rather than a protection crop. Due to this reason they are not instigating farmers to grow this plant around farm lands. Rather, they tried to introduce other indigenous trees such as highland acacia in the area. But, due to farmers preference for the cash value of eucalyptus their effort was doomed to failure.

Conversely, farmers in the focus group discussion argued as they are getting benefits from eucalyptus such as fuel wood, cash income and shading of the soil from erosion. However, they raised a number of constraints for the sustainable application of

eucalyptus trees around their farmlands. The major one among them includes: land shortage, water shortage during dry seasons, free animal grazing damage seedlings, and water and nutrient computation with crops.

4.3.2. The Modern Sustainable Land Management Practices and their Constraints

According to the survey output, the modern SLM practices found in the farm lands of the respondents are only biological conservation measures while structural/ physical conservation measures are not well introduced in the study area. Table16 portrays the common modern SLM practices used by farmers in the 2007/2008 cropping year.

Table16. Types of Modern SLM Practices used by Farmers

		Types of SLM practices	
		Compost	Fertilizer
Yes	N (%)	58(53.7)	46(42.6)
No	N (%)	50(46.3)	62(57.4)
Total	N (%)	108(100)	108(100)

Source: own survey, 2009

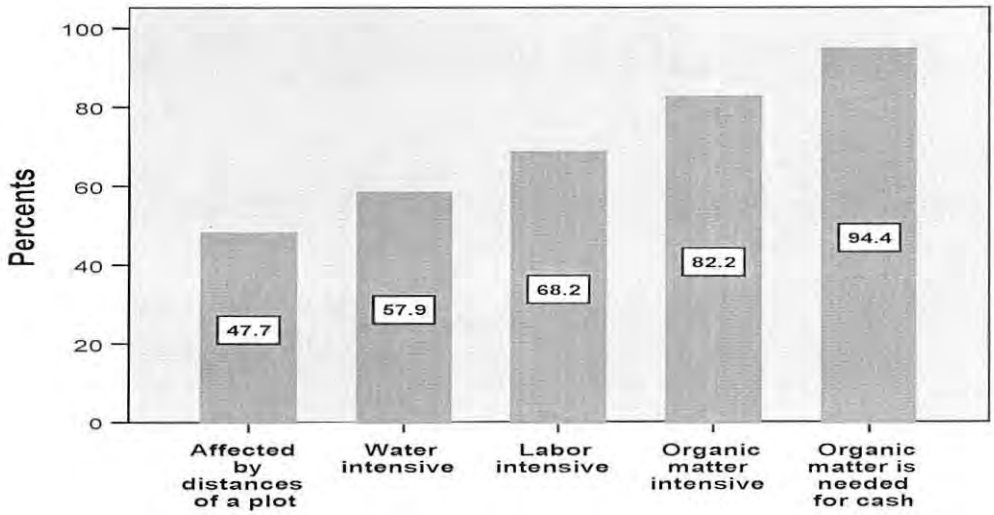
i. Compost

The preparation of compost engrosses the use of ash, leaves, grasses, cattle dung, and wastes from goats, donkey and horses etc. There are two types of compost preparation in the study area: the heap and pit methods. Heap method is composting with out digging a pit, but undertaken on an open space. A pit method requires digging three pits to turn and mix turn by turn the organic material. However, due to water shortage for preparation of compost, the pit method is extensively used since it retains moisture than the open one.

The household survey result reveals 53.7% of the sampled households used compost to increase the fertility status of their soil (table16). The preparation and use of compost in

the area is constrained by different factors. As indicated in figure8, opportunity cost of organic mater for cash, knowledge requirement, water shortage to prepare compost, labor requirement of compost preparation and application, and distance of a farm plot to apply are some of the constraints mentioned by farmers. Cash opportunity cost of organic matter is the most constraining factor for using compost followed by its intensive organic matter requirement.

Figure8. Compost Application Constraints in the Study Area



Source: own survey 2009

ii. Artificial Fertilizer

Farmers of the study are applying fertilizer on their cultivated plot of land to boost productivity. The commonly used fertilizer types in the study are DAP and Urea. The household survey data shows 42.6% of the sampled respondents use artificial fertilizer in their farm land during the 2007/08 cropping year (table16). The sustainable use of fertilizer in the study area is constrained particularly by sky rocketing price of fertilizer.

4.4. Bio-Physical, Socio-Economic, and Institutional Challenges of Promoting Successful Sustainable Land Management Practice

4.4.1 Physical Circumstances

The most important physical constraint that affects the promotion of SLM practices in the study area is heavy run-off due to topographic setting of the area. Discussant farmers made known that the impact of run-off is phenomenal in damaging traditional terraces; restrain the growth of grasses on unploughed strip due to frequent silt accumulations, and silt fill up of traditional waterways and diversion ditches (see picture4). This observation is in compliances with a study done by Dagnew (2007) in Tigraty region.

An attempt was made to see the statistical association between the heavy run-off and application of different SLM practices. As shown in table17, the association between heavy run-off and SLM practices such as stone terrace, unploughed strip, waterways, and planting trees is statistically significant. This indicates the use of the aforementioned SLM practices in the foothills is depending on the amount and strength of run-off coming from Entoto Mountain. Consequently, as the amount of heavy run-off increases the sustainable use of these SLM practices decreases and the vice versa given that they are affected by the strength and amount of run-off coming from Entoto Mountain. Therefore, this designates the absence of upstream run-off management and calls an immediate intervention for integrated watershed management in the area.

On the other hand the association between heavy run-off and check dam is statistically significant with positive relationship. This indicates the use of check dam is dependent on heavy run-off coming from upslope of Entoto Mountain. That is, as run-off increases the use of check dams also increases and vice versa. This may be associated to the construction of check dams to rehabilitate gullies formed by heavy run-off.

Conversely, the association between use of diversion ditches and heavy run-off is not statistically significant. This shows the impact of heavy run-off does not affect the use of diversion ditches. However, this does not mean run-off can not affect the practice.

Rather, either farmer maintain the affected ditch immediately after run-off since it does not require much labour as the others or it is always constructed after ploughing.

Table17. Statistical Association between Heavy Run-Off and SLM Practices

Heavy run-off affect SLM practices									
	Yes		No		Total		Pearson	P-	r
	N	%	N	%	N	%	$\chi 2$	Value	
Traditional terrace									
Yes	29	26.9%	23	21.3%	52	48.1%			
No	45	41.7%	11	10.2%	56	51.9%			
Total	74	68.5%	34	31.5%	108	100.0%	7.554	.006***	-.265
Unploughed strip									
Yes	39	36.1%	27	25.0%	66	61.1%			
No	35	32.4%	7	6.5%	42	38.9%			
Total	74	68.5%	34	31.5%	108	100.0%	6.993	.008***	-.254
Traditional check dam									
Yes	24	22.2%	1	.9%	25	23.1%			
No	50	46.3%	33	30.6%	83	76.9%			
Total	74	68.5%	34	31.5%	108	100.0%	11.389	.001***	.325
Waterways									
Yes	47	43.5%	31	28.7%	78	72.2%			
No	27	25.0%	3	2.8%	30	27.8%			
Total	74	68.5%	34	31.5%	108	100.0%	8.886	.003***	-.287
Diversion ditches									
Yes	61	56.5%	29	26.9%	90	83.3%			
No	13	12.0%	5	4.6%	18	16.7%			
Total	74	68.5%	34	31.5%	108	100.0%	.137	.711 NS	-.036
Trees									
Yes	12	11.1%	14	13.0%	26	24.1%			
No	62	57.4%	20	18.5%	82	75.9%			
Total	74	68.5%	34	31.5%	108	100.0%	7.940	.005***	-.271

*** Significant at 1%.

NS Not significant

Source: Own survey, 2009

Picture4. The Impact of Run-off from Upslope on SLM Practice of the Study Area

Picture taken by the author, 2009

However, the impact of run-off from Entoto Mountain on SLM practices is mixed from experts' perspective. Some development agents revealed there is no outlook to what extent farmers are facing the problem of run-off from up-slope areas of Entoto Mountain owing to its forest coverage. While other development agents and woreda natural resource management experts convinced by the problem and associate the problem to the influence of political boundary between Addis Ababa and Oromya region to undertake upstream successful SLM.

But, the field visit testifies soils inside the forest are even degraded due to lack of structural measures such as terracing. Added to this, leave alone the current mechanised deforestation of eucalyptus tree which makes the land bare (picture5), the female leaf and branch scramblers inside the forest also lend a hand to run-off affect negatively SLM practices. This is because the removal of leafs and branches reduce the infiltration capacity of the rainwater and the slow down of its kinetic energy on the ground. Sustainable land management (SLM) also should go beyond political boundary limits and should be managed in an integrated way.

The picture on the right shows how deforestation and logging is going on in the Oromya part of Entoto Mountain.

Picture5. Eucalyptus Deforestation in Oromya part of Entoto Moutain
Photograph taken by the author, 2009

4.4.2 Farming System

The study area is a mixed farming zone in which crop and livestock activities are interdependent and complementary to each other. The crop farming system in the area is dominated by cereal crops. However, cereals particularly barley need fine seedbed preparation and provide little ground cover during the most erosive storms and facilitates soil erosion (Belay, 2003 and Gete, 2003). This situation could also aggravate the low productivity of land as a factor for the reason that most (75%) of respondents revealed crop yield is decreasing for the last 10 years (table18). The main reasons for yield reduction notified by farmers include soil degradation, agricultural land reduction, and poor soil management practices.

Table18. Crop Productivity Trend for the Last 10 Years

	Number	Percent
Increasing	25	23.1
Decreasing	81	75.0
No change	2	1.9
Total	108	100.0

Source: Own survey, 2009

The dominant grazing system in the area is free and unregulated as 92.6% of the respondents notified. As shown in picture6, discussant farmers have revealed that the free and unregulated grazing of livestock inhibit the growth of unploughed strip, and damage trees during grazing; and damage traditional terraces, incise waterways and cut-off drains during animal walk.

Picture6. Free and Unregulated Grazing and its Impact

Photograph taken by the author, 2009

Picture6 clearly shows the impact of free grazing on the promotion of SLM practices and how animal movement facilitate soil erosion.

An endeavour was made to see the association between free and unregulated grazing system with use of unploughed strip. As shown in table19, the association between free and unregulated grazing and use of unploughed strip is statistically significant. This indicates the use of unploughed strip is dependent on the effect of free grazing. That is, as the more the grazing system is free and unregulated the low the use of unploughed strip. Therefore, this calls for integrated livestock management in the study area.

Table19. Association between Free/Unregulated Grazing and Unploughed Strip

		Free and unregulated grazing System					
		Yes	No	Total	Pearson $\chi 2$	P-value	r
Unplowed strip	Yes	43 (39.8)	23(21.3)	66(61.1)			
	No	35(32.4)	7(6.5)	42(38.9)			
	Total	78(72.2)	30(27.8)	108(100)	4.229	.040**	-.198

** Significant at 5%.

Figures in brackets are percents

Source: Own survey, 2009

4.4.3 Population Growth

Population growth in the study area increases the pressure on arable land. This give rise to land fragmentation, reduced fallow periods, over cultivation, plowing of fragile ecosystems, and land use change from its primary use. As shown in table 20, majority (68%.5) of the sampled respondents in the study area have reported they are destroying their SLM practices particularly traditional terraces and unploughed strips due to farm land shortage (see picture7). The survey reveals 87.6% of the sampled households have observed that their household size has been increasing for the last 10 years.

Table20. Reasons for Destroying SLM Practices

	For cash	Hider farming	Harbor rodents	Land shortage
Yes	27(25)	25(23.1)	17(15.7)	74(68.5)
No	81(75)	83(76.9)	91(84.3)	34(31.5)
Total	108(100)	108(100.0)	108(100)	108(100.0)

Source: Own survey, 2009 The number in brackets are percents

The survey output also discloses that it was only 15.7% of the sampled households practiced fallowing only for one year due to shortage of farm land as a result of population pressure (table15). An attempt was made to see the statistical association between use of fallowing and farm size. As it is depicted in table21, the association between farm size and use of fallowing is statistically significant with negative relationship. That is, farmers' use of fallowing is depends on their farm size, and as the size of the farm land increases the more they use fallowing and the vice versa.

Table21. Statistical Association between use of Fallowing and Farm Size

		Farm size category					
		0.0 - 1.01	>1.01	Total	Pearson $\chi 2$	P-value	r
Use of fallow	Yes	9 (8.3)	8(7.4)	17(15.7)			
	No	88(81.5)	3(2.8)	91(84.3)			
	Total	97(89.8)	11(10.2)	108(100)	29.8	.000***	-.527

*** Significant at 1%
The figures in brackets are percents
Source: Own survey, 2009

The picture on the right discloses the destroyed stone terraces due to land shortage as a result of increase in feeding mouths

Picture7. Destroyed Terraces for the Forthcoming Feeding Mouths
Photograph taken by the author, 2009

Most studies pointed out land use changes from its primary use are the principal signs of unsustainable land management (Solomon, 1994; Woldeamlak, 2003; and Aklilu, 2006). Based on FGD and interview with elders and kebele leaders the common earlier land use types in the study area were forestland, grazing land, cropland and rural settlements. Today land in the area is also used for investment and urban settlement. According to the survey output, 90.7% of the respondents notified their land use type is changed for the last 10 years either by themselves or government programs as shown in table22.

Table22. Land Use Changes in the Last 10 Years.

Land use changes	Yes	No	
Forest to crop	78(72.2)	30(27.8)	108(100)
Grazing to investment	66(61.1)	42(38.9)	108(100)
Crop to settlement	43(39.8)	65(60.2)	108(100)
Crop to investment	42(38.9)	66(61.9)	108(100)
Grazing to crop	41(38)	67(62)	108(100)
Forest to investment	34(31.5)	74(68.5)	108(100)
Forest to settlement	23(21.3)	85(78.7)	108(100)
Crop to grazing	23(21.3)	85(78.7)	108(100)
Crop to forest	20(18.5)	88(81.5)	108(100)
Total			370*(342.8)**

* Responses do not add 108 due to multiple responses; The figures in the brackets are percents
** Percentages do not add 100 because of repeated responses
Source: Own survey, 2009

According to table 22, most of respondents' notified forestland is changed to crop, investment and settlement. This change is attributed either to increase in rural and urban population or government land use and administration policy (Solomon, 1994; Aklilu, 2006). This also clearly portrays that the land use change is for production not for conservation. The change of forest to the other land use type implies the removal of land cover and is a sign of unsustainable land management since it facilitates both the erosivity of the eroding agents and the erodibility of the eroding subject (Morgan, 1995 cited in Wolde Amlak, 2003).

Picture8 on the right hand shows the change of forest land for investment and urban house construction. The first picture shows mechanized deforestation and second shows the ready made land for investment and house construction.

Picture8. Forest Land Change to Investment or Residence
Photograph taken by the author, 2009

Grazing and crop lands are changed to investment and urban settlement. This change is allied with increasing population growth in urban areas and government land use and administration polices. Beyond doubt, this change could negate SLM promotion because it distresses the investment capacity of farmers in SLM practices due to tenure insecurity.

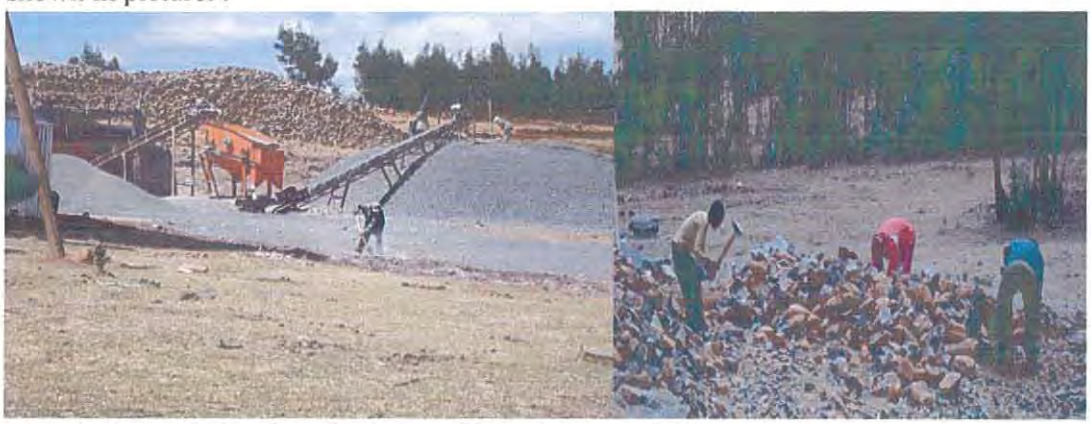
Grazing lands are also changed to croplands. This change is attributed to high rural population growth and the need to obtain additional farm lands (Solomon, 1994). In addition, it may be an opportunity to the low productivity of the farmlands due to their low fertility status. However, this may reduce the livestock population due to shortage of animal feed. Shortage of animal feed may result in grazing inside forest and reduction in livestock number. Grazing inside forest could result in deforestation while reduction in

livestock number could result in reduction in income, which leads to poverty, and reduction in manure use to maintain soil fertility.

The implication of crop land change in to grazing and forest land is the preference of farmers to participate in off-farm works such as selling dung-cake, fuel-wood and animals and their products (Aklilu, 2006 and interview with DAs). But this by itself, is a sign of low promotion of SLM practices in the study area, for the shifting is to overstocking and plantation of productive, not protective, eucalyptus trees (interview experts). Therefore, these changes are the positive causative constraints of SLM promotion in the study area.

4.4.4 Poverty

In the study area, poverty becomes an evident in constraining the promotion of SLM practices in a number of ways. Farmers in the study area are doing a number of unsustainable income diversification activities in order to escape from the immediate stick of poverty. The household survey output shows 80.5% (table5) of the households are employed as a daily labourer either in the city of Addis Ababa, some stone mining companies in the area or in other investment activities in the area. The employment of farmers in daily labour activities in the stone mining companies of the study area is shown in picture9.



Picture9. Households' Participation in Stone Mining Labour Activities
Photograph taken by the author, 2009

An attempt was made to see the impact of daily labour on the implementation of more labour and income requiring SLM practices. As shown in table23, the association

between household head employment in daily labour activities and application of terracing is statistically significant. That is, the application of terracing is influenced by the engagement of the household head in daily labour activities. Therefore, as the household head involves more in daily labour activities the less is the application of terracing and the vice versa. This shows to what extent daily labour is competing the labour force for terracing.

On the other hand, the association between engagement in daily labour and use of compost is not statistically significant. This indicates the application of compost is not as such affected by the engagement in daily labour activities. This may be attributed to the application of compost by other household members such as children since composting may not require more energy and engineering knowledge as that of terracing. Household heads also may apply compost after daily labour work since it may not require more energy as terracing and it is implemented around homesteads. Moreover, it may be done using *debbo* unlike terracing, which is not a labour-shared practice by the society. Similarly, engagement in daily labour has no a statistical significant association with the use of fertilizer. This depicts use of fertilizer is not affected by the income earned from daily labour work. That is the income earned from daily labour work is either used for household consumptions or fertilizer is obtained by other sources of income.

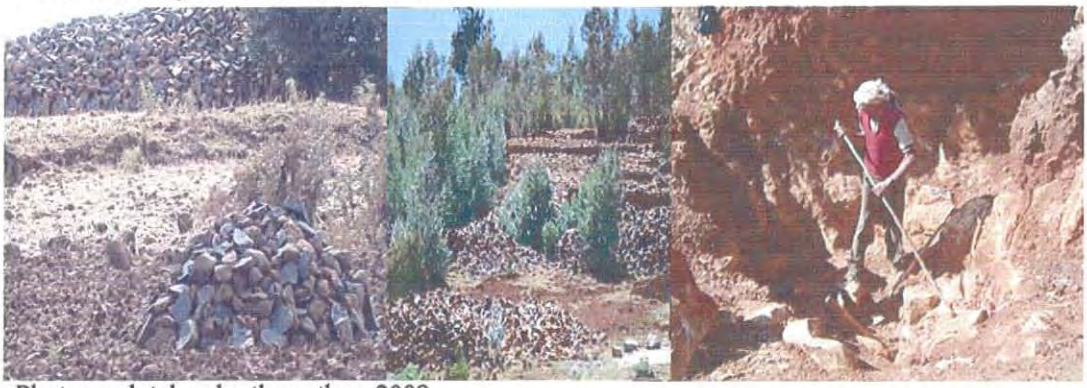
Table23. Association between Employment in Daily Labour and SLM Practices

		Yes	No	Total	$\chi 2$	P-value	r
Terraces	Yes	28(25.9)	24(22.2)	52(48.1)			
	No	46(42.6)	10(9.3)	56(51.9)			
	Total	74(68.5)	34(31.5)	108(100)	10.009	.002***	-.304
Compost	Yes	39(36.1)	14(13.0)	45(41.7)			
	No	35(32.4)	15(13.9)	50(46.3)			
	Total	74(68.5)	34(31.5)	108(100)	.095	.758 NS	-.030
Fertilizer	Yes	31(28.7)	14(13.0)	45(41.7)			
	No	43(39.8)	20(18.5)	63(58.3)			
	Total	74(68.5)	34(31.5)	108(100)	.005	.944 NS	.007

Note: *** Significant at 1%; NS: Not Significant
The figures in brackets are percents
Source: Own Survey, 2009

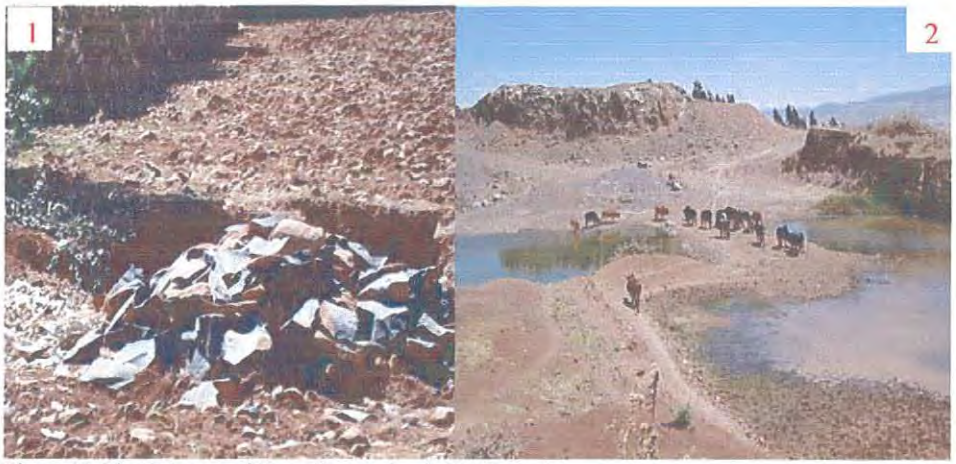
Farmers in the study area also tried to avert their economic problem through sell of dung cake, stone and fuel wood. According to the survey output, 22.2% of the sampled respondent households were engaged in selling of stones (table5). All farmers who sell stones are from the downstream of the study area such as in the villages of Nono and Kaso. They sell stones collecting from farmlands, destroying terraces, and searching from forests and bare lands as shown in picture10.

Picture10. Preparation of Stone for Sale



Photograph taken by the author, 2009

Picture shows stone preparation for sale from farmers' farm plot, forest areas and digging the underground stone when ever accessible so as to ward-off the problem of poverty. However, this type of solution not only affected the sustainable land management promotion through terrace construction but also the ecological and geological status of the land resource as shown in picture11.



Picture11. The Outcome of Stone Scavenging in the Study Area
Photograph taken by the author, 2009

The first picture of picture11 shows household stone scavenging just near to his home and indicates its potential to become gorge. The second picture shows the outcome of mechanized stone scavenging on the previous grazing land. As it is seen in the second picture the only positive response of such activity for farmers is the immediate cash benefit and the accumulation of water for livestock in dry seasons instead of growing grass for animals

As indicated in table24, the association between stone selling and use of terracing is statistically significant with a negative relationship. This indicates that the more farmers engage in stone selling activity, the less they apply stone terraces and vice versa. This is because stone is a limited resource with high opportunity cost in the area and needs careful management.

Table24. Association between Stone Selling and Application of Terracing

		Stone selling					
		Yes	No	Total	$\chi 2$	P-value	r
Terracing	Yes	3(2.8)	49(45.4)	52(48.1)			
	No	21(19.4)	35(32.4)	56(51.9)			
	Total	24(22.2)	84(77.8)	108(100)	15.71	.000***	-.381

*** Significant at 1%. The figures in brackets are percents

Source: own survey, 2009

Selling of dung-cake and fuel wood also become a habitual business in the study area due to the overwhelming poverty. According to the survey, 95.4% and 87% of the sampled households sell dung-cake and fuel-wood respectively to the city of Addis Ababa to attain their immediate cash demand (table5). However, the consequence of pressure created by urban centers on dung cake and fuel wood demand on the one hand and rural supply due to poverty on the other is far reaching, leading to unsustainable land management. The use of dung as fuel instead of soil nutrient leads to deterioration of soil physical properties which ultimately results in poor soil infiltration capacity and enhancement of run-off. A study done by Aklilu (2006) in North Shoa also indicates the nutrient loss due to dung cake burning estimated to be 21kg N, 4.5kg P, and 20.7kg K per hectare per year. This indicates farmers are loosing priceless long-term and beneficial

effects of using dung as manure. Deforestation of live trees for the sake of selling fuel wood also freeze the promotion of SLM, making the land open for erosive rainfall. Picture 12 illustrates the preparation of dung cake and charcoal for sale.

Picture 12 on the right hand shows prepared dung cake and charcoal making for sale. Farmers use their cattle dung to prepare dung cake and use the Entoto forest to make charcoal.

Picture12. Prepared Cattle Dung and Charcoal for Sale
Photograph taken by the author, 2009

Therefore, needed is providing environmentally friendly off-farm opportunities in urban areas, providing sustainable land management based alternative income generating activities in the study area such as beehive and forestation of indigenous trees in bare areas for timber export, efficient utilization of the population and health extension service, and undertaking of volunteer and environmentally friendly resettlement programmes.

4.4.5 Household Endowment with Human and Physical Capital

It is well known that education is the most important element in knowledge sharing and promoting new SLM practices. However, the situation in the study area is reversed. Development agents indicated that one of the results for low performance of farmer training centre in the study area is due to the illiteracy of farmers since the minimum requirement to train and graduate in farmer training centre is grade four. Development agents argued that farmers who fulfil the minimum educational level are also unable to read and write *Oromifa*, the local language, due to their Amharic educational background. The household surveys also pointed out that 79.6% of the sampled respondents have no at least primary level of education.

Discussion with development agents also showed the illiteracy of farmers restrain the promotion of new SLM practices. As it is shown in table25, the association between education level and use of compost is statistically significant. This indicates the application of compost is sensitive to the level of education. That is, as education level increases the more is the application of compost and the vice versa. On the other hand the application of terracing is not determined by the level of education as the two variables do not have statistically significant association. This may be ascribed to the adaptability of traditional terracing by the farmers through experience. Similarly, the application of fertilizer is not affected by level of education. This may be associated to either fertilizer is more affected by other factors such as income, it may not require more technical knowledge like compost or use of fertilizer is adapted through farmers exposure to activities that help to share knowledge such as *debbo* and farm level intervention of DAs.

Table25. Association between Education Level and use of SLM Practices

		Education level					
		No primary	Primary & above	Total	Pearson $\chi 2$	P-value	R
Terracing	Yes	39(36.1)	13(12.0)	52(48.1)			
	No	38(35.2)	18(16.7)	56(51.9)			
	Total	77(71.3)	31(28.7)	108(100)	.672	.412 NS	.079
Compost	Yes	61(56.5)	31(28.7)	92(85.2)			
	No	16(14.8)	0(0)	16(14.8)			
	Total	77(71.3)	31(28.7)	108(100)	7.56	.006***	.265
Fertilizer	Yes	30(27.8)	15(13.9)	45(41.7)			
	No	47(43.5)	16(14.8)	63(58.3)			
	Total	77(71.3)	31(28.7)	108(100)	.808	.369 NS	.086

*** Significant at 1%; NS: not significant
The figures inside the brackets are percents
Source: Own survey, 2009

The other manifestation of low household endowment is revealed through the inability of farmers to construct and repair SLM practices due lack of production tools such as sledgehammer. Farmers in the study area notified they were not using and repairing

terraces due to lack of sledgehammer to break big stones. Conversely, the field observation testifies that farmers in Nono and Kaso use this tool to break and sell the stone resource either to Addis Ababa or stone mining companies around the study area.

4.4.6 Tenure Security

Promoting measures that enhance land tenure security plays an incalculable role in promoting SLM practices. Land certification and participating farmers in agricultural annual plan could be usual measures to enhance land tenure security feeling (Kumela, 2007 and Ephrem, 2008). However, farmers in the area are neither certified nor participate in the woreda annual agricultural plan. Rather, farmers continued loosing their land due to urban or investment expansion.

As shown in table26, about 38% of the sampled households lost their land due to urban and investment expansion. Among households who lost their land, 28.7% lost their land due to investment expansion while the emaining 9.3% due to urban expansion. Sampled respondents were asked to indicate whether they loose their land in the future or not. Accordingly, majority (72.2%) of the sampled households replied as they feel they would lose their land in the future due to either urbanization or investment expansion. They also reported that their land management effort is banned by such state of affairs.

Table26. Households' Response on Loss of their Land for the Last 10 Years

	Yes	No	Total
Lost due to urban expansion	10(9.3)	98(90.7)	108(100)
Lost due to investment expansion	31(28.7)	77(71.3)	108(100)
Loose land in the future	78(72.2)	30(27.8)	108(100)

The figures inside the brackets are percents
Source: Own survey, 2009

An endeavour was made to see the statistical association between land tenure insecurity with different SLM practices, which require more labour, takes time to see their effect and takes up space as compared to the others. As it is clearly illustrated in table27, the association between tenure insecurity with use of terracing is statistically significant with negative relationship. This discloses that the application of terracing is depends on the tenure security of the household. That is, as the household is more secured in his/her

future land holding the more he/she is applying terracing and the reverse. This may be attributed to the labour, space and time requirement of terracing to be effective because farmers may not apply practices that need such requirements with out any outlook to whom their land would belongs in future. Similarly, the association between tenure insecurity and use of fallowing is statistically significant. This depicts the application of fallowing is adversely affected by tenure insecurity of the households. This may be because of the time and space requirement of fallowing to see its effect as that of terracing. This indicates that low land tenure security is constraining the promotion of SLM practices such as terracing and fallowing, calling for policy scrutiny.

On the other hand, the association between tenure insecurity with use of compost and trees is not statistically significant. This may be ascribed to different factors like use of compost and planting trees is limited around homesteads as farmers assumed their homestead land will belong to themselves. This assumption came from the experience farmers have, where homestead lands were retained during land redistribution times.

Table27. Association between Tenure Insecurity and Use of SLM practices

		Do you think you loose your land in the future?					
		Yes	No	Total	$\chi 2$	P-value	R
Terraces	Yes	31(28.7)	21(19.4)	52(48.1)			
	No	47(43.5)	9(8.3)	56(51.9)			
	Total	78(72.2)	30(27.8)	108(100)	7.945	.000***	-.271
Fallowing	Yes	6(5.6)	11(10.2)	17(15.7)			
	No	72(66.7)	19(17.6)	91(84.3)			
	Total	78(72.2)	30(27.8)	108(100)	13.71	.000***	-.356
Compost	Yes	42(38.9)	16(14.8)	58(53.7)			
	No	36(33.3)	14(13)	50(46.3)			
	Total	78(72.2)	30(27.8)	108(100)	.002	.962 NS	.005
Trees	Yes	18(16.7)	8(7.4)	26(24.1)			
	No	60(55.6)	22(20.4)	82(75.9)			
	Total	78(72.2)	30(27.8)	108(100)	.153	.696 NS	-.038

*** Significant at 1%: NS, Not Significant; The figures in brackets are percents
Source: Own Survey, 2009

4.4.7 Strategy Related Issues

One of the strategies that have been pessimistically heart-rending successful SLM in the study area is the categorization of the woreda under food self sufficient woredas and the related subjectivity in promoting SLM. The categorization is assumed to instigate from rain-fed based crop and livestock production perspective. This categorization has been instrumental in determining approaches towards land degradation problem and resulted in the non-intervention of SLM based income generating projects such as the safety net programme unlike the adjacent woreda kebeles (Gete et al, 2006). This constrained farmers' initiation for SLM and let farmers to continue in off-farm works with the outlay of the natural environment (discussion with woreda experts). Development agents also reported farmers are insisting to get hold of the chance to join in the safety net programme to implement SLM practices on their land.

Similarly, the annual plan for implementing SLM practices in the woreda in general and in the study area in particular is based on size of areas to be covered by the practice, amount of kilometres the practice will cover, and numbers of households use practices. The implementation report of SLM practices is also based on similar quantitative figures. This shows the approach of promoting SLM in the study area is quantitative biased and the qualitative, standard, integration and sustainability aspect is over and done. Thus, this could constrain the promotion of successful SLM at large (Gete, et al 2006).

The other important constraint of SLM promotion in the country was the strategy to collect land tax and fertilizer credits through the help of DAs. But according to a study done in Berressa watershed, north central highlands of Ethiopia, this creates an interaction gap between DAs and farmers since farmers consider DAs as tax collectors in non-productive times (DeWolf, 2004). What fascinated currently in the study area is DAs did not directly collect land tax and the previous fertilizer credits (currently cash system) rather tell them to pay for the kebele administrative finance officers. This once more creates an interaction gap between farmers and DAs since it has an analogous subtext with the above argument. Farmers themselves also noted that they prefer not to

communicate with DAs as they force them to pay land tax and fertilizer credit in non-productive times. So, change is needed not to assign DAs in such works in order to setup a horizontal relationship with farmers.

The current land management system in Ethiopia calls for huge investment in monetary and non monetary resources for better upshot (Belay, 2003; Gete et al, 2006 and Mare, 2008). In the study area, incentive and awarding model land management practitioner farmers does not exist. However, farmers in the FGD revealed they are seeking incentives particularly in monetary terms to implement SLM practices in sustainable way. This is because as discussants indicated, as a substitution for the income they would have gained through off-farm works. DAs in the study area also reported farmers are persuading them to allow them daily allowance to participate in farmers training leave alone in physical labour works. DAs observed that, due to the absence of incentive in the extension system, farmers preferred either engaged in daily labour, selling of fuel wood, dung and/or stones. These observations would lead one to think that absence of pro-incentive strategy constraining the promotion of successful SLM in the study area. Therefore, it needs a close attention to this issue by all stakeholders such as government, non-government, and the private group.

4.4.8 Credit Service

According to the survey output, all of the sampled respondents notified there is formal credit and saving institution in the woreda. Among these farmers, 20.4% took credit for the last 10 years mainly for fertilizer, petty trading and livestock fattening from the Oromya Credit and Saving Association. As indicated in table28, the remaining farmers who did not take credit pointed out several reasons for none partaking.

Table28. Farmers' Reason for not Take Credit

	Fear of risk	Lack of thrust on friends	Lack of experience of trade
Yes	43(39.8)	51(47.2)	17(15.7)
No	65(60.2)	57(52.8)	91(84.3)
Total	108(100)	108(100.0)	108(100)

The figures inside the brackets are percents
Source: Owen survey, 2009

Table28 shows 39.8% of the sampled households did not take credit due to fear of risk. This is happened because farmers assumed any failure to repay the loan result in harsh punishments such as overpay in cash, loss of livestock, loss of the land, and imprisonment. This finding was agreed with a study done in Tigray by Boetekees (2002). This depicts awareness creation is needed on taking and returning of credit service. Added to this, the accessibility of credit should not always be in cash but also be in kind to minimize the fear of risk. This is because there are farmers who took credit in cash and used not for the premeditated target (example drinking alcohol) and finally punished by selling their assets such as livestock (discussion with farmers).

The other point farmers raised for their low participation in credit services was lack of trust on friends. Credit in the study area is available for groups of ten farmers. The maximum amount for credit given for one group, which is a group of ten farmers, was thirty thousand birr (discussion with farmers). This indicates each one has a chance to get three thousand birr if they share equally. But, this type of credit delivering system generated a problem to farmers' in a number of ways. Every farmer is dissipating his time searching the will be trusted nine farmers. This is because they may disagree at the beginning of sharing the money or at the end of returning money due to repayment issue if they join randomly. This finally results in punishment of both groups (discussion with farmers). This indicates the credit delivery system in the area made farmers to do an assignment on finding the will be trusted farmers and hampered to get credit if they failed to do so. Therefore, it implies for credit supplier to revise the credit delivering system on household basis for the reason that farmers are demanding credit for their own objective without going in to hustle with a group.

According to respondents credit is also available for farmers who are interested to undertake petty trading and livestock fattening. But, due to their lack of experience in trading and fattening of livestock farmers were out of the system. This indicates the presence of weak linkage between the agricultural extension system and credit programme. Therefore, needed is strengthening the agricultural extension system to capable farmers use the credit programme.

As shown in table29 an effort was made to check the contribution of credit for the application different SLM practices. Accordingly, credit has not statistically significant association with the use of terracing and fallowing. This is because of the fact that the application of these practices is mainly constrained by other factors such as land shortage and tenure insecurity.

On the other hand, the use of trees, compost and fertilizer is determined by the credit service given that the association between credit service and those SLM practices is statistically significant. That is to mean the use of credit service can augment growing trees, preparing compost and apply fertilizer either directly or indirectly. For instance, credit service can directly affect farmers' use of fertilizer through buying it for market price. Likewise, credit service may indirectly augment farmers' use of compost and trees through involvement of farmers in other income diversification activities such as petty trading and livestock fattening rather than selling the raw materials of compost such as dung cake. However, it is not clear why credit service is not statistically significant with the use of manure as that of compost.

The association between credit service and use of unploughed strip is statistically significant with negative relationship. This indicates as the household involve more in credit service the use of unploughed strip can more adversely affected. This may make sound in different ways. First, credit in the area is delivered to farmers who are interested to fatten livestock. However, in the study area, livestock fattening at household level is conducted through open grazing. Thus, this may affect the growth of grasses over unploughed strips. Second, credit service may facilitate the low promotion of use of unploughed strip by equipping farmers with production tools for intensive cultivation of farm lands via destroying grass strips.

Table29. Association between Credit and Different SLM Practices

		Did you take credit for the last 10 years?					
		Yes	No	Total	χ2	P-value	R
Terracing	Yes	12(11.1)	40(37.0)	52(48.1)			
	No	10(9.3)	46(42.6)	56(51.9)			
	Total	22(20.4)	86(79.6)	108(100)	.453	.501 NS	.065
unplowed strip	Yes	7(6.5)	62(57.4)	69(63.9)			
	No	15(13.9)	24(22.2)	39(36.1)			
	Total	22(20.4)	86(79.6)	108(100)	12.31	.000***	-.338
Trees	Yes	11(10.20	15(13.9)	26(24.1)			
	No	11(10.2)	71(65.7)	82(75.9)			
	Total	22(20.4)	86(79.6)	108(100)	10.16	.001***	.307
Manure	Yes	21(19.4)	71(65.7)	92(85.2)			
	No	1(.9)	15(13.9)	16(14.8)			
	Total	22(20.4)	86(79.6)	108(100)	2.31	.129 NS	.146
Fallowing	Yes	4(3.7)	13(12.0)	17(15.7)			
	No	18(16.7)	73(67.6)	91(84.3)			
	Total	22(20.4)	86(79.6)	108(100)	.124	.725 NS	.034
Compost	Yes	16(14.8)	42(38.9)	58(53.7)			
	No	6(5.6)	44(40.7)	50(46.3)			
	Total	22(20.4)	86(79.6)	108(100)	4.021	.045**	.193
Fertilizer	Yes	14(13.0)	31(28.7)	45(41.7)			
	No	8(7.4)	55(50.9)	63(58.3)			
	Total	22(20.4)	86(79.6)	108(100)	5.486	.019**	.225

** Significant at 5%; *** Significant at 1%; NS: Not Significant
The figures inside the brackets are percents
Source: Own survey, 2009

4.4.9 Capacity of DAs to Promote Sustainable Land Management

DAs in the study area have limited capacity to promote SLM practices both in hardware and software. Practice embracing educational background plays a key role to work in the extension system (Gete et al, 2006). However, a discussion with DAs tells, all DAs in the study area were at diploma level of education, which was theory based. They do not get additional supportive training except a small general training (not educational background based) during the end of the budget plan. This is because, the woreda is categorized under food self-sufficient woredas and attention is given to the low food self sufficient woredas, where DAs get further trainings. Added to these, all of DAs reported that they have faced with the problem of extension materials such as raincoat, shoes, and lack of means of transportation such as mules, which DAs in the adjacent 'low food self sufficient' woredas

do have access. This implies the powerlessness of DAs to realize the embattled goal of promoting SLM.

It is also known that there are three DAs at *kebele* level with crop, animal science and natural resource management trainings. These set up an expectation of each of them were doing in their own field of study with in an integrated manner. However, the reality was DAs divided *gots* of the *Kebele* and do all the jobs in *gots*. This shows crop science graduate DA is doing all the tasks of animal and natural resource management activities for the *got* he is assigned. This could result in poor promotion and implementation of SLM activities particularly that required engineering knowledge (Gete et al, 2006).

Asked DAs why they were using this strategy they reported that they were advised by the *woreda* officials to do in such a way so as to minimize DA shortage and time wastage by moving here and there. Asked DAs about how they can manage to work out of their field of study, they reported they were doing things based on the common courses they had during college training and theoretical experience sharing with each other. This implies two-third of DAs activity in every *got* of the study area are worked outside own field of training. This may results in the low trust of DA profession by the farmers as DAs themselves indicated that farmers don not accept or accept with hesitation what ever they advised.

Investigation of new SLM practices, integration of SLM practices and selection of best SLM practices are elements of the applied agricultural extension systems. These are the crucial activities that should be done by experts together with the local farmers in order to manage the degraded land of the study area and scale up/out. However, all these were not done on a sampled household farm lands. Therefore, even if it is entrenched in socio-economic and institutional setbacks, this is a matter-of-fact for the low capacity of DAs to promote SLM practices in the study area. This once more enlightens building the capacity of DAs should be the foremost step of the agricultural extension system for effective promotion of successful SLM. Table30 illustrates the statistical association test between farmers' discussions with DAs and the application of different SLM practices.

Table30. Association between Discussions with DAs Use of SLM Practices

SLM application		Do you discuss with DAs about SLM?					
		Yes	No	Total	Pearson $\chi 2$	P-value	r
Terracing	Yes	46(42.6)	6(5.6)	52(48.1)			
	No	49(45.4)	7(6.5)	56(51.9)			
	Total	95(88.0)	13(12.0)	108(1000	.024	.878 NS	.015
Unplowed strip	Yes	60(55.6)	6(5.6)	66(61.1)			
	No	35(32.4)	7(6.5)	42(38.9)			
	Total	95(88.0)	13(12.0)	108(100)	1.391	.238 NS	.113
Trees	Yes	23(21.3)	3(2.8)	26(24.1)			
	No	72(66.7)	10(9.3)	82(75.9)			
	Total	95(88.0)	13(12.0)	108(1000	.008	.929 NS	.009
Manure	Yes	84(77.8)	8(7.4)	92(85.2)			
	No	11(10.2)	5(4.6)	16(14.8)			
	Total	95(88.0)	13(12.0)	108(100)	6.548	.010**	.246
Compost	Yes	55(50.9)	3(2.8)	58(53.7)			
	No	40(37.0)	10(9.3)	50(46.3)			
	Total	95(88.0)	13(12.0)	108(100)	5.576	.018**	.227
Fertilizer	Yes	43(39.8)	2(1.9)	45(41.7)			
	No	52(48.1)	11(10.2)	63(58.3)			
	Total	95(88.0)	13(12.1)	108(100)	4.200	.040**	.197
Check dams	Yes	23(21.3)	2(1.9)	25(23.1)			
	No	72(66.7)	11(10.2)	83(76.9)			
	Total	95(88.0)	13(12.0)	108(100)	.501	.479 NS	.152
Waterways	Yes	71(65.7)	7(6.5)	78(72.2)			
	No	24(22.2)	6(5.6)	30(27.8)			
	Total	95(88.0)	13(12.0)	108(100)	2.488	.115 NS	.152

** Significant at 5%; NS: Not significant; The figures inside the brackets are percents
Source: Own Survey, 2009

As per table30, the association between discussion with DAs and application of terraces, unploughed strip, trees, check dams, and waterways is not statistically significant. This indicates either the application of the aforementioned SLM practices is solely obtainable through local knowledge, or DAs intervention in the study area is not more on natural resource management aspect. This shows the participation of DAs to promote these SLM practices, which can reduce or halt soil erosion, is by far low. On the other hand, there is a positive statistically significant association between discussion with DAs and application of manure, compost and fertilizer. This is associated to different reasons. One is the intervention of DAs in the study area is mainly of on crop and animal science and the other is the technologies specially compost and fertilizer are modern and needs expert knowledge.

4.4.10 Awareness Creation Mechanisms to Promote Sustainable Land Management

Promoting SLM practices calls for proper mechanisms to meet the targeted goals. The availability of demonstration sites and farmers' training centres are the effective awareness creation mechanisms in addition to the house to house and meeting system techniques. In the study area the commonly used technique is the meeting system followed by the house to house technique (discussion with DAs). Even if most farmers did not know the availability of farmers training centre and demonstration sites, a discussion with DAs and some farmers revealed they were not effectively utilizing the resources for the needed objectives due to several reasons. They have no sufficient resources such as water, leave alone modern extension materials; training and demonstrations were formally allowed only to fourth grade and above farmers where most of them are illiterate; located faraway from farmers homestead; and some are currently out of the regional administration due to urban expansion (eg. the Nono FTC and Demonstration site). Added to these, most farmer training centres were used as a meeting hall for *kebele* administrative issues and lack of response to farmers request for daily allowance. Therefore, strengthening these resources for use is needed so as to promote SLM practices in sustainable way.

CHAPTER FIVE

5. CONCLUSIONS AND IMPLICATIONS

5.1 Conclusions

Mixed subsistent agriculture is the central economic base of the foothills of Entoto Mountain. Nonetheless, its performance is highly affected by land degradation largely in the form of soil erosion. The factors triggering soil erosion are varied, complex and interrelated. These can be either human or natural induced factors. Of the natural triggers of soil erosion erosive nature of rainfall (intensity and duration), steepness of the slope of the area, lack of vegetation cover, and erodible nature of soil type are identified. Population pressure, over cultivation, overgrazing, deforestation, misuse of land resources, mismanagement of land resource, and inefficient land resource-based agricultural system are identified as human induced triggers of soil erosion. Therefore, sustainable land management (SLM) in the foothills of Entoto Mountain is becoming a major issue of modern times because of the interplay among bio-physical, socio-economic and institutional factors, and its fragile ecosystem.

Farmers of the foothills of Entoto Mountain do have a good perception of the problem of soil erosion. However, the perception of farmers on the extent/severity of soil erosion is limited to moderate to long time visual authentication such as gullies since their perception is hardly longed-for for sheet and rill erosion forms. Farmers also give more emphasis to long time indicators of soil erosion such as yield reduction than short time indicators. Therefore, this has an effect on their urgent decisions to manage their land.

Farmers of the foothills of Entoto Mountain do have good perception of controlling soil erosion. Various kind of indigenous sustainable land management practices are used by farmers either at household or neighborhood level. However, except few biological SLM practices, the modern sustainable land management practices are not well introduced in the area. The commonly practiced indigenous SLM practices in the study area are both physical/structural and biological measures. The structural indigenous SLM practices include contour plowing, traditional drainage ditches, traditional diversion ditches,

traditional waterways, traditional stone terraces, and traditional check dams. The biological indigenous SLM practices include crop rotation, manure, unplowed grass strip, fallowing, and few plantations. The modern SLM practices practiced by farmers include compost and artificial fertilizers.

Despite the fact that farmers apply different indigenous and a few modern SLM practices, the problem of land degradation has not been arrested or minimized. Rather, it continued unabated. This is credited to different up-and-downs/challenges of sustainable land management in the study area. In addition to farmers' low awareness on the current time indicators and extent/severity of the problem of soil erosion, constraints of the existing SLM practices to arrest the problem of soil erosion, bio-physical, socio-economic and institutional constraints of promoting successful SLM practice are the foremost unsustainable land management dynamics.

Sustainable land management practices that are practiced by farmers of the study area are hampered by different constraints. Some measures generate land shortage, hinder farming practice, labor intensive, material intensive, create water logging, needs special construction tools, harbor rodents, promote weeds, and less durable. Others may be source of conflict, source of erosion risk, needed for other opportunities such as cash, compete for water and nutrient with crops, and take time to see their impact. In addition there are also practices affected by free grazing, personal preference, natural calamities, water shortage, land fragmentation, and cost of the practices.

A number of bio-physical, socio-economic, and institutional constraints of promoting successful SLM practice are identified. Run-off from upslope Entoto Mountain is found to be the most physical constraining factor for application of SLM practices. Either due to the natural setting of the topography of the area or escalated by human activity such as deforestation, run-off is barring the promotion of SLM either by destroying the practices totally or fill up with silt accumulations. In addition, the political boundary of the point

source of run-off and the forest coverage in the upslope is also dilemma in controlling run-off in the study area.

The area is becoming cereal mono-culture crop zone mainly because of farmers' preference of barley to make *injera* and to resist crop diseases. However, fine seedbed preparation and provide little ground cover during the most erosive rainfall could facilitate erosion. At the same time, fixing of atmospheric nitrogen and enriching soil fertility could be reduced at least if pulses are not grown. Free and uncontrolled grazing system is also found to restrain the promotion of SLM due to grazing and damaging of SLM practices.

The growth of population increases the pressure on land. This gave rise to inhibit the promotion of SLM through reduced fallow periods, destroying SLM practices, over cultivation, plowing of fragile ecosystems, and land use change from its primary use. Poverty is found to be one of the major constraining factors of promoting SLM by obliging farmers to engaged in unsustainable income diversification and environmentally unfriendly activities such as sale of stone, fuel wood and dung cake, and to be employed in daily labor activities during land management times. Moreover, poverty is curtailing the promotion of SLM through limiting education level and sustainable land management tools ownership of farmers.

Even if it depends on the kinds of practices, investment and urban expansion resulted in tenure insecurity of farmers in the study area. This may be due to the fact that the isolated urban and investment biased development strategies and policies undergoing in and around the study area. However, this is found to be constraining the promotion of SLM by degrading farmers' sense of ownership of their land in general and SLM practices in particular.

Different SLM strategic constraints are also found to be a challenge to promote SLM in the study area. The categorization of the area under food self efficient areas resulted in non-intervention of SLM based income generating projects. Moreover, the absence of incentives in any kind and model SLM practitioners awarding at *kebele* or *woreda* level has also resulted in low initiation of farmers in SLM activities. The planning, implementing and reporting of SLM practices is found to be done only in quantitative terms. The quality, standard, integrity and sustainability aspect of planning and implementing SLM practices is hardly longed-for and this has resulted in unsustainable land management upshots. Moreover, the practice of employing DAs in other fields of public services such to motivate farmers to pay credit and land tax created inconvenient interaction gap between farmers and DAs.

Extension and credit service can boost the promotion of SLM to arrest the problem of land degradation. However, extension and credit service is tied with different tribulations to promote SLM. Fear of risk, lack of trust on friends and lack of experience to trade or fatten livestock are the most important constraining dynamics for farmer participation in credit service.

Beyond doubt; introduction, investigation, integration and selection of best SLM practices are the priceless extension services which lend a hand to enhance SLM. However, it is over and done in the study area due to a range of reasons. The first reason is low practical education background of DAs accompanied by diverse socio-economic and institutional factors including lack of further training and extension materials. Secondly, low application of DAs recommendations by farmers because of lack of trust on DAs profession. This could be attributed to the low practical educational background of DAs and due to their job assignment in non-professional fields of extension services. Third, availability of dismal awareness creation mechanisms such as demonstration sites, farmer training centers, and the dichotomy of farmers in to educated and non-educated to participate in the ostensible extension trainings.

5.2. Implications

Based on the output of the study in general and the above conclusions in particular the following implications are drawn as a way forward for immediate action to control land degradation problem and promote sustainable land management (SLM) in the study area and other similar areas.

- ✓ Extensive farmers' education is called on for better elucidation of land degradation process, indicators, causes and impacts for an urgent farmers' perceptive decision in applying SLM practices to arrest the degradation problem.
- ✓ Farmers of the study area should have to learn about the watershed attributes of their area and build up their own indigenous SLM practices that are suitable to the biophysical settings and socioeconomic conditions of the study area.
- ✓ In addition to strengthening the existing ones, introduction of profitable modern SLM practices which are effective in both ecologically and economically is needed allowing for the existing bio-physical and socio-economic set up of the study area, and the full participation of farmers in all stages of technology generation and transfer.
- ✓ In order to arrest the current land degradation problem and reverse it, at least to the previous status, integrated watershed management is needed, and the concept of SLM should be beyond the scope of political boundary. Moreover, sustainable land management works should immediately implemented starting from the top of the terrain to its bottom.
- ✓ Farmers should be backed for the design, specification, integration, and monitoring and evaluation of SLM practices at field level so as to trim down the constraints and enhance the potentials.
- ✓ The concept of crop diversification should be incorporated in the minds of the farmers so as to expand production related activities on various crops, lessen risk and achieve successful sustainable land management as a whole.
- ✓ Livestock should be managed in an integrated way so as to reduce the impact of free and unregulated grazing on the promotion of SLM practices.
- ✓ The population pressure on the disturbed and fragile ecosystem of the study area should be controlled based on appropriate social and economic policies such as

literacy campaign and family planning in view of the fact that it is escalating the problem of land degradation and promotion of sustainable land management. Undertaking of volunteer and environmentally friendly resettlement programmes should be incorporated as a final policy option to reduce population pressure.

- ✓ In order to improve the problem of poverty in general and farmers participation in SLM regressing off-farm activities in particular, providing environmentally friendly off-farm opportunities and sustainable land management based income generating activities such as beekeeping, forestation of indigenous trees, livestock fattening, poultry, etc is needed.
- ✓ The full dependence of the local people on biomass fuel have to be reduced by providing environmentally friendly alternative sources of energy such as solar, wind, hydro electric power, etc.
- ✓ Farmers of the study area lack sense of ownership of their land and motivation to manage their land in sustainable way due to the influence of tenure insecurity as a result of investment and urban expansion. This needs proper land management on participatory basis with stable and appropriate long term lease tenure to enhance and integrate the mounting application of SLM practices for sustainable land use.
- ✓ Creating proper and strong rural-urban linkages, and formulating development strategies and policies that coordinate both rural and urban systems is needed.
- ✓ The hit and miss categorization of the study area under food self-sufficient areas leads in a deceptive conclusion for the promotion of successful SLM. Therefore, urgently redefined and appropriately recommended domain of sustainable land management area of intervention is required in the study area.
- ✓ The quantitative way of planning and implementing sustainable land management practices alone does not bring sustainability. Therefore, the qualitative, integrity and sustainability of SLM practices should also take in to account as far as successful SLM is concerned.
- ✓ The credit service should have to be integrated with agricultural extension system and delivered at household level through extensive education service.

- ✓ The capacity of DAs should be improved to promote SLM by providing further trainings and educations (for example up to BSc level), extension materials, and employing in specialized field of studies.
- ✓ Awareness creation mechanisms such as farmers training centers, demonstration sites, and farmer to farmer training systems should be on with out discriminating farmer participation on education, sex and age basis.
- ✓ Providing *kebele* level SLM promotion incentives and award for both farmers and extension workers is needed to furnish benefits and recognition of their work.
- ✓ The *woreda* agricultural annual plan should be developed with full participation of farmers or their *got* representatives in order to increase farmers' sense of ownership and accountability of SLM practices.

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APPENDICES

APPENDIX 1.

HOUSEHOLD SOCIO-ECONOMIC SURVEY QUESTIONS

PART I. GENERAL INFORMATION

Name of Interviewer _____ Date of interview _____ Code: ____

Name of the interviewed farmer _____

PA of the farmer _____Got of the farmer _____

PART II. HOUSEHOLD INFORMATION

1. Sex of the household head 1. Male 2. Female

2. Age of the household head _____

3. Marital status of the household head 1. Single 2. Married 3. Divorced 4. Widowed 5. Other, _

4. Religion of the household head 1.Orthodox 2. Protestant 3. Catholic 4. Muslim 5. Other,___

5. Ethnic group of the household head 1. Amhara 2. Tigray 3. Oromo 4. Guraghe 5. Other

6. Educational level of the household head 1. Illiterate 2. Read and Write 3. Primary first cycle 4. Primary second cycle 5. Secondary 6. Preparatory 7. Above preparatory

7. The total number of household members_____ Males_____ Females _____

8. For the last 10 years your household size has ___ 1. Increased 2. Decreased 3. The same

9. Do you think your household size is enough to manage your land? 1. Yes 2. No

10. If no for Q9, how do you manage your land mostly? 1. Hired labour 2. Debbo 3.Other_____

11. If you practiced debbo, have you faced with problem? 1. Yes 2. No

12. If yes for Q11, what types of problem you faced (multiple responses are possible)?

1. Low quality of work 2. Economic problem to prepare food

3. Problem in timing to work 4.Other, _____

PART III. OFF-FARM WORK AND ENERGY SOURCES

13. Are you involved in off-farm activities? 1. Yes 2. No

14. If yes for Q13, in which type of works (multiple responses are possible)?

1. Daily labourer 2. Petty trading 3. Sell of stones 4.Sell of Fuel wood

5. Sell of dung Cake 6. Other ___

15. If you sell stones, where is the source?

16. To whom do you sell stones?

17. If you sell fuel wood where is the source?

18. If you engaged in daily labour activities, where are you employed?

19. Which types of energy resources you use at home (multiple responses are possible)?

1. Fuel wood 2. Dung Cake 3. Crop residue 4. Electricity 5. Petroleum 6. Other, ___

PART IV. AGRICULTURE

SECTION 1. SUSTAINABLE LAND MANAGEMENT TOOLS HOLDING

20. Would you tell me the type and number of your SLM tools?

Type	Number	Type	Number
Iron plough(Maresha)		Saw (Megaz)	
Yoke (Kenber)		Iron hoe (Doma)	
Plough beam (Mofer)		Axe (Metrebia)	
Shovel/spade (Akafa)		Meraga	
Sickle (Machid)		Digino	

21. Do you think your tools enough to manage your land? 1. Yes 2. No

22. If no for Q17, how are you copping the problem (multiple responses are possible)?

1. Borrowing 2. Renting 3. Rent/share out the land 4. No copping mechanism 5.Other_____

SECTION 2. CROP PRODUCTION

23. Do you have your own farm land? 1. Yes 2. No

24. If yes for Q23, would you tell me your farm size? _____hectare

25. Do you think your farm size is enough to grow crops for your family? 1. Yes 2. No

26. Which crops you commonly grow? 1. Barley 2. Wheat 3. Bean and Peas 4. Other_____

27. How is your production/yield over the last 10 years?1. Increasing 2. Decreasing 3. No change

28. If decreasing for Q27, what do you think the reasons be (multiple responses are possible)?

1. Soil degradation 2. Low soil management effort 3. Shortage of agricultural land

4. Shortage of rain fall 5.other___

29. If decreasing for Q27, what mechanisms you are using to raise your production?

1. Increasing farm size 2. Use soil fertility maintenance practices

3. Use soil conservation activities 4. Other_____

30. How is the size of your farm land in the last 10 years? 1. Increasing 2. Decreasing 3. No change

31. If decreasing for Q30, why (multiple responses are possible)?

1. Expansion of rural settlement 2.Urban expansion 3.Investment 4.Land degradation 5. Other__

32. If decreasing for Q30, what are you doing to increase your farm size (multiple responses are possible)?

1. Expand through deforestation 2. Destroy SLM practices 3. Cultivate grazing lands 4.Other__

33. Was your land use type changed by yourself/ government for the last 10 years? 1. Yes 2. No

34. If yes for Q33, what are the changes (multiple responses are possible)?

1. Forest areas to crop land 2. Crop areas to investment 3. Forest areas to settlement

4. Crop areas to settlement 5. Forest areas to investment 6. Grazing areas to investment

7. Grazing areas to crop 8. Crop to grazing 9. Crop to forest 10. Others, _____

SECTION 3. LIVESTOCK PRODUCTION

35. Would you tell me the number and type of your livestock?

Animal type	Total Number	Animal Type	Total Number
Oxen		Goats	
Cow		Donkeys	
Heifer		Mules	
Young bulls		Horses	
Calves		Poultry	
Sheep		Others_____	

36. Where do you graze your livestock?

37. Would you tell me your dominant grazing system (multiple responses are possible)?

1. Free and unregulated 2. Regulated by number of animals grazed

3. Regulated by number of days grazed 4. Regulated by season 5. Other _____

38. Would you tell the size of your livestock number for the last 10 years?

1. Increasing 2. Decreasing 3. No change

39. If decreasing for Q38, what are the main reasons (multiple responses are possible)?

1. Shortage of feed 2.Shortage of water 3.Selling of livestock 4.Animal diseases 5. Other__

PART V. LAND DEGRADATION

SECTION1. PROBLEMS, CAUSES, AND EXTENT OF LAND DEGRADATION

40. What are the main environmental problems in your Kebele (multiple responses are possible)?
    1. Land degradation 3. Rainfall variability 4. Deforestation 5. Other__
41. Is soil erosion a problem on your farm land? 1. Yes 2.No
42. If yes for Q41, which indicators have you observed (multiple responses are possible)?
    1. Rills are observed 2. Gullies are observed 3. Increased stone cover 4. Yield reduction
    5. Exposed plant roots 6. Decline in depth of top soil 7. Stream colour changed
    8. Soil colour changed 9. Soil accumulations found in foot hills 10. Other_____
43. If yes for Q41, which erosion forms are appearing on your farm plots (multiple responses are possible)? 1. Sheet erosion 2. Rill erosion 3. Gully erosion 4. All are observed 5.Other, _____
44. If yes for Q41, would you tell me the trend of soil erosion on your farm plots for the last 10 years? 1.Increasing 2. Decreasing 3. No change
45. If increasing for Q44, how do you rate its extent?
    1. Very severe 2. Severe 3. Moderate 4. Low 5. Very low
46. Which natural factors you think triggers soil erosion (multiple responses are possible)?
    1. Type of rain fall 2. Erodible soil type 3. Type of Topography 4. Other___
47. If your answer is type of topography for Q46, what are the common slope types of your farm plot? 1. Steep slope 2. Moderately steep slope 3. Gentle slope 4. Other____
48. Which human factors you think aggravates soil erosion (multiple responses are possible)?
    1. Over grazing 2. Deforestation 3. Over cultivation 4. Population growth 5. Other, ___
49. What is your opinion on the final consequence of soil erosion (multiple responses are possible)? 1. Famine 2.Out-migration 3.Conflict over resources 4. Impoverishment 5.Other___

PART VI. SUSTAINABLE LAND MANAGEMENT PRACTICES AND CONSTRAINTS

SECTION 1. SLM PRACTICES AND THEIR CONSTRAINTS

50. Do you believe that soil degradation can be controlled? 1. Yes 2. No

51. If yes for Q50, do you use SLM practices? 1. Yes 2. No

52. If yes for Q50, which of the following SLM practices you used in the 2007/2008 FY?

SLM practices	Yes =1 No =2		Yes =1 No =2
Indigenous SLM practices		Modern SLM practices	
1.Traditional terrace (Kab)		14. Stone bund	
2. Unploughed strip (Dinber)		15. Soil bund	
3. Traditional Check dam		16. Compost making	
4. Traditional waterway		17. Fertilizer application	
5. Traditional drainage ditches		18. Rotational grazing	
6. Traditional diversion ditch/*Wagint/Trasboy*		19. Land use change	
7. Planting trees		20. Area closure	
8. Contour plowing		21. Grass strips	
9. Manure		22. Others, ___	
10.Fallowing			
11. Inter-cropping			
12. Crop-rotation			
13. Crop residue			

53. Are your SLM practices effectively control water erosion? 1. Yes 2. No

54. If no for Q53, what do you think the reason is (multiple answers are possible)?

1. Low level of integrating practices 2. Lack of knowledge on the technical requirements of practices 3. Low level of repairing of practices 4. Heavy run-off affects the practices

5. Impact of climatic variability 6. Free grazing affect practices 7. Other, ____

55. If you answer is run-off affects practices for Q54, where is its source?

56. If your answer is low level repairing practices for Q54, why?

57. Have you destroyed/avoided some of your SLM practices? 1. Yes 2. No

58. If yes for Q57, would you please tell me the reason (multiple responses are possible)?

1. Lack of clear standard/design__2. Lack of actual profitability__3. Shortage of farm land__

4. Harboring of rodents/birds__ 5. Hindering farming practice__6. For source of cash__7. other

59. Have you faced constraints in applying SLM practices on your farm land? 1. Yes 2. No

60. If yes for Q59, what constraints you faced during application of the following SLM practices based on your previous farming experience?

SLM practices	(Code A)	Constraints for applying SLM practices (Code A) Require more material eg. stone, dung/livestock=1 Create land shortage =2 Requires more labour =3 Hinder farming practice =4 Shortage of water =5 Harbours rodents =6 Harbour birds, insects and pests =7 Creates water logging =8 Favours growth of weeds =9 Long distance of plot location =10 High cost =11 Low durability =12 Affected by free grazing = 13 Opportunity cost; eg. Cash value =14 Source of erosion risk =15 Shortage SLM tools eg. *meraja* & *dijino*=16 Timing (season) of implementation =17 Source of conflict with neighbours =18 Shading effect =19 Compete crops for water and nutrients =20 Poorly integrated with other practices =21 Takes time to see its effect = 22 Needed for household use; eg. fuel= 23 Other =24
1.Traditional terrace (Kab)		
2. Unploughed strip (Dinber)		
3. Traditional Check dam		
4. Traditional waterway		
5. Traditional drainage ditches		
6. Traditional diversion ditch*/Wagint/Trsboy*		
7. Planting trees		
8. Contour plaughing		
9. Manure		
10.Fallowing		
11. Inter-cropping		
12. Crop-rotation		
13. Use of crop residue		
14. Stone bund		
15. Soil bund		
16. Compost making		
17. Fertilizer application		
18. Rotational grazing		
19. Land use change		
20. Area closure		
21. Grass strips		

SECTION 2. EXTENSION SERVICCE

61. Are there DAs in your Kebele? 1. Yes 2 No 3. I do not know

62. If yes for Q61, do you meet DAs? 1. Yes 2. No

63. If yes for Q62, how often do you meet them? 1. Once in a month 2. Once in three months 3. Once in six months 4. Once in a year 5. Every time 6.Other, ____

64. If yes for Q62, did you discuss with DAs? 1. Yes 2. No

65. If yes for Q64, on which issues you discussed with DAs?

66. Are DAs investigating new SLM practices in your area? 1. Yes 2. No 3. I do not know

67. Do you think integrating SLM practices bring SLM? 1.Yes 2. No 3. I don't know

68. Are DAs assist you to integrate SLM practices? 1. Yes 2.No

69. Are you selecting best SLM practices with DAs assistance? 1Yes 2.No

70. Are you monitor and evaluate SLM practices together with DAs? 1. Yes 2. No

71. Is there farmers' demonstration site in your locality? 1.Yes 2. No 3. I don't know

72. If yes for Q71, have you participated in the demonstration site? 1. Yes 2. No

73. If no for Q71, why not?

74. Is there farmer training centre in your area? 1. Yes 2. No 3. I don't know

75. If yes for Q74, have you get any training on SLM practices? 1. Yes 2. No

76. If no for Q74, why not?

77. If yes for Q75, do you think you acquired adequate knowledge to continue on implementing SLM practices on your farm plot? 1. Yes 2. No

78. If no for Q77, why?

79. Have you get any project incentive to conduct SLM practices? 1. Yes 2. No

80. If yes for Q79, what type of incentive (multiple responses are possible)?
1. Money 2. Food item 3. Equipment 4. Other, _____

81. Is there any effort to award model SLM practitioners in your area? 1. Yes 2.No 3. I don't know

SECTION 3. CREDIT AND SAVING SERVICES

82. Is there any formal credit and saving service in your area? 1. Yes 2. No 3. I don't know

83. If yes for Q82, did you obtain credit from formal institutions for the last 10 years?1.Yes 2. No

84. If yes for Q83, for what purpose you use it (multiple responses are possible)?

1. Trading 2. Buying livestock 3. For SLM 4. House construction 4. Buying assets 5. Other,_

85. If your answer is for SLM for Q84, for which practices you took (multiple responses are possible)?

1. Tree planting 2. Soil bunds 3. Stone terraces 4. Fertilizer 5. Others, __

86. If no for Q83, why you did not take credit (multiple responses are possible)?

1. Lack of experience of trade 2. Fear of risk 3. Lack of thrust on friends

4. It is not allowed for me 5.Other, _____

87. If your answer is not allowed for me for Q86, what are the reasons (multiple responses are possible)? 1. I am considered as rich 2. I have no experience of trade

3. Lack of resource allowance 4. Other,_____

88. What is your opinion on not returning credit on time (multiple responses are possible)?

89. Is there an effort made by the government for the compatibility of SLM practices with income generating activities? 1. Yes 2. No 3. I don't know

SECTION 4. LAND TENURE ISSUES

90. Is there any urbanization program in your locality? 1. Yes 2. No 3. I don't know

91. If yes for Q90, have you lost your land due to urban expansion? 1. Yes 2. No

92. Is there any investment program in your locality? 1. Yes 2. No 3. I don't know

93. If yes for Q92, have you lost your land due to investment? 1. Yes 2. No

94. If yes for Q93, by which investment?

95. Do you think you loose your land in the future? 1. Yes 2. No 3. I don't know

96. If yes for Q95, how (multiple response is possible)?

1. Land redistribution 2.Urban expansion 3.Investment 4.Other_____

97. What recommendations you would like to suggest in meeting the challenges of SLM your kebele?

98. Do you have any thing to say?

THANK YOU!!

APPENDIX 2.

Interview Guideline for Woreda Agriculture and Rural Development Officers

1. Name _____
2. Educational status _____
3. Position in the organization _____
4. How long have you worked at this post?
5. Discuss how farming system is going on around Entoto Mountain?
6. Do you think soil erosion is a problem around Entoto Mountain?
7. What indicators of soil erosion you observed around Entoto Mountain?
9. Which forms of water erosion are common in the area? How is its impact?
10. What is the extent of soil erosion around Entoto Mountain?
11. Discuss the major natural and human triggers of soil erosion problem in the area?
12. Discuss the common SLM practices implemented around Entoto Mountain? Which of them are implemented by your office?
13. Discuss constraints in using these SLM practices? How did you overcome the constraints?
14. Discuss the main physical, socio-economic, and institutional challenges to promote SLM in the area? How did you tried to overcome the challenges?
15. Does your office participate farmers in its annual agriculture plan? If no, why?
16. How is your plan to implement SLM practices? Quantity, Quality, or Sustainability?
17. Does your office gives incentives/subsides for SLM practitioner farmers in the woreda? If no why?
18. Does your office award model SLM practitioner farmers in the woreda? If no, why?
19. What are the over all challenges your office faced to promote SLM in the woreda?
20. What recommendations you would like to suggest in meeting the challenges of SLM in the woreda?
21. Do you have any comment?

Thank You!!!

APPENDIX 3.

Interview Guideline for Development Agents (DAs)

1. Name _____
2. Sex _____
3. Field of Study _____
4. When did you graduate_____
5. Your responsibility in the kebele? _____
6. How did you employed in this *got*? _____
7. How long have you worked at this post? ____
8. Are you working in your field of study? If no, how do you manage other fields?
9. How is farming system going on in the kebele?
10. Do you think there is soil erosion problem in the kebele?
11. Which indicators of soil erosions you observed?
12. Which forms of erosion are common in the area? How is its impact on agriculture?
13. What is the extent of land degradation in the kebele?
14. Discuss the major natural and human triggers of soil erosion problem?
15. What do you think about the perception level of farmers towards soil erosion?
16. Which SLM practices implemented in the kebele to arrest soil erosion so far? Which are due to your assistance?
17. Discuss the constraints in using these SLM practices? What did you do to overcome the constraints?
18. What do you think about the perception level of farmers to use modern SLM practices?
19. Discuss the main physical, socio-economic, and institutional constraints to promote SLM in the area? What did you tried to overcome the constraints?
20. Do you investigate and select best SLM practices in the kebele and plan to scale up?
21. Do you integrate SLM practices together with farmers to arrest soil erosion?
22. Do you get field training to promote successful SLM in the kebele? If no, why?
23. Which communication media do you use to disseminate information about SLM?
24. Is there SLM demonstration site in the kebele?
25. Which farmers are allowed to demonstrate? Why?

26. Is there SLM Farmer Training Centre in the kebele? Is it working at this time?
27. Which farmers are allowed to get training? Why?
28. What is your opinion on credit and incentive in promoting SLM?
29. Do you have another task in the kebele other than your primary post? If yes, in which task you engaged?
30. Discuss the major factors which determine your promotion of SLM in the kebele?
31. What do you think the over all problems to promote SLM in the kebele?
32. What do you suggest to meet the challenges of promoting SLM in the Kebele?
33. Do you have any comment?

Thank You!!!

APPENDIX 4.

Interview Guideline for Elders and Kebele Chairmen

1. How is the farming practice going on in your kebele? How is the productivity of crop and livestock for the last 10 years?
2. Which crops can grow in your kebele? Which crops are preferred by the farmers these days? Why?
3. What is the land use type of the kebele looks like for the last 10 years?
4. How the forest coverage of Entoto Mountain is looks like for the last 10 years?
5. How is the availability of stone in the kebele for the last 10 years?
6. Is there a problem of soil erosion in your kebele? How do you understand it? How is its rate for the last 10 years? How is its extent of rate for the last 10 years?
7. Discuss the major causes of soil erosion in your area?
8. Which kinds of traditional SLM practices the farmers are using to arrest the problem of soil erosion? What are the constraints of the practices? What farmers tried to overcome the constraints?
9. Which kinds of modern SLM practices are introduced by the government and used by farmers to arrest the problem of soil erosion? What are the constraints of the practices? What farmers get assistance from the government to overcome the constraints?
10. Discuss the major physical, socio-economic and institutional constraints to promote SLM in your kebeke?
11. How do you overcome land use/management conflicts in your kebele?
12. What is your opinion on the sustainable use of land resources?
13. Do you have any comment?

Thank You!!!

APPENDIX 5.

General Guideline for Focus Group Discussions (FGD)

1. How is the farming practice going on in your kebele?
2. Which crops can grow in your kebele? Which crops are preferred by the farmers these days? Why?
3. What are the common off-farm opportunities for farmer in your kebele along with farming?
4. What is the land use type of the kebele looks like from time to time?
5. How the forest coverage of Entoto Mountain is looks like from time to time?
6. Is there a problem of soil erosion in your kebele?
    - What are your indicators?
    - How is its rate?
    - How is the extent of its rate?
    - What are your indicators to know the extent to become very-sever, sever, moderate, low and minor?
7. Discuss the natural and human factors which trigger soil erosion.
8. D you think soil erosion can be controlled?
9. Which traditional SLM practices you used to control soil erosion?
    - Which of them you use at household level?
    - Which of them you use at supra-household level?
    - Discuss the constraints you faced in applying the practices.
    - Discuss the mechanisms you used to overcome the constraints.
10. Which modern SLM practices introduced by the government to control soil erosion? What problems you faced with these practices?
11. Discuss your support from government to promote SLM in terms of:
    - The over all role of DAs
    - Demonstrations
    - Farmer trainings
    - Credit services
    - Incentives
    - Land tenure security, etc.
14. Discuss the overall challenges of promoting SLM in your kebele?
15. Discuss the over all solutions to meet the challenges of SLM in your kebele?

Thank You!!!