FARMERS' PERCEPTION ON THE PROBLEM OF SOIL EROSION AND CONSERVATION KNOWLEDGE: A CASE STUDY OF RURAL KEBELES IN DESSIE TOWN

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This is to certify that the thesis presented by Ismael Yismaw, entities Farmers perception on the problem of soil erosion and conservation knowledge :A case study of rural Kebeles in Dessie town and submitted in partial fulfillment of the requirement for the degree of Master of Arts complies with the regulations of the university and Meets the accepted standards with respect to originality and quality.

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List of Acronyms

M.a.s.l. Mater above Sea Level

AEZ Agro-ecological Zone

BoA Bureau of Agriculture

CSA Central Statistics Authority

DA Development Agent

EHRS Ethiopian Highland Reclamation Study

EPA Environmental Protection Authority

FAO Food and Agricultural Organization

GDP Gross Domestic Product

IFAD International Fund for Agricultural Development.

NGO Non-Governmental Organization

SNNPR Southern Nation, Nationalities and Peoples Region

SSA Sub-Saharan Africa

SWC Soil and Water Conservation

USA United States of America

WFP World Food Program

Abstract

The study examines farmers' perception towards the problems of soil erosion and their conservation knowledge in Dessie town rural kebeles. With the use of structured questionnaire and interview, a total of 83 farmers were surveyed for the study. For many farmers, gully development and stoniness of soil were main indicators to soil erosion on their land. Others recognize by observing soil color. They also perceived well the causes of soil erosion in their lands as slope steepness of cultivation fields, ceaseless cultivation and absence of fallowing with many time preparations of soil for cropping; still other causes have great roles. Severity of soil erosion in the study area explained as severe, moderate, minor soil erosion and a few cultivation fields had no erosion risk. They also perceived well the causes of soil erosion in their lands as slope steepness of cultivation fields, ceaseless cultivation and absence of fallowing with many time preparations of soil for cropping; still other causes have great roles. Severity of soil erosion in the study area explained as severe, moderate, minor soil erosion and a few cultivation fields had no erosion risk. Consequently, farmers well understood the results of severe soil erosion on their farms and recognized as loss of topsoil, reduction of yield over time, loss of vegetation cover and grasses, change in soil color, requiring high input and management, formation of uncross-able gullies, lack of farm land and grazing field, and out migration. Farmers use a range of methods for soil erosion control. From the finding of this study, multidimensional factors of demographic and socio-economic characteristics were responsible for farmers' differential perception to the problem of soil erosion. In order to effectively plan for soil conservation measures application and introduce new techniques there is a need of involve local farmers and modifying educational/training programs which were provided for farmers by considering the existing knowledge and practices.

CHAPTER ONE

1. INTRODUCTION

1.1 Back ground of study

Soil erosion is one of the major factors of soil degradation in Ethiopia (Hurni, 1986). The most common form of erosion is the loss of topsoil under the action of water or wind. In Ethiopia, soil erosion by water constitutes the most widespread and damaging process of soil degradation (Woldeamlak, 2003). It has caused several negative impacts on land (Abiy k, 2007).

The Ethiopian highlands occupy 44% of the total area of the country, 95% of the land under crops and 90 % of the total population and75% of livestock (Amede et al., 2003). According to the Ethiopian Highland Reclamation Study (EHRS), out of presently utilized 13.5 m ha land nearly 50 percent (6.7 m ha) of the soils have been significantly eroded and 25 percent (3.4 m ha) seriously eroded. It is estimated that over 1900 million tons of soil are lost from high lands of Ethiopia annually (EHRS, 1986). These losses of productive topsoil are irreversible for it takes many years to generate a ton of topsoil. The Ethiopian highlands, which are the center of major agricultural and economic activities, have been the victim of soil erosion for many years. This study stated that about half of the highland‘s land area (about 27 Million hectares) is significantly eroded and over one-fourth (14 Million hectares) are seriously eroded. Moreover, 2 Million ha of land is permanently degraded that the land is no longer able to support cultivation (EHRS, 1986).

There are many causes for soil erosion in Ethiopia. These causes include deforestation, overgrazing, and cultivation of slopes not suited to agriculture together with the farming practice that do not include conservation measures. Population pressure and soil erosion in the areas are important causes for declining of arable lands in this area. The productivity of arable lands in the highlands is decreasing due to the washing away of the fertile top soil by water erosion. The increasing population and pressure of over cultivation and over grazing accelerated soil erosion also factors that mentioned as causes for soil erosion in Ethiopia highland.

In the Amhara region, the soil loss due to water erosion is estimated to be 58% of the total soil loss in the country (Dejene, A., 1990). This has already resulted in a reduction in agricultural productivity of 2 to 3% per year, taking a considerable area of arable land out of production. The situation is becoming catastrophic because increasingly marginal lands are being cultivated, even on very steep slopes.

The degree of the problem, however, increased due to an increase in deforestation, overgrazing, over cultivation, inappropriate farming practices, and increasing human population. Removing vegetative cover on steep slopes (slopes ranging between 15 and 50 percent) for several reason such as agricultural expansion, firewood and other wood requirements as well as for grazing space has paved the way to massive soil erosion(Belay,1992).

1.2 Statement of the Problem

Soil erosion is a major problem in Ethiopia agriculture. Tones of soil are lost from fields every year. According to USAID, (2000) the average annual rate of soil loss in Ethiopia is estimated to be 12 tons per hectare per year with losses as high as 300 tons per hectare per year.

In the Ethiopian high lands soil erosion is a major problem with an estimated loss of 16-50 tons/hectare/year (Berry, 2003). Worst affected are the Ethiopian highlands (>1500m a.s.l.), which normally account for more than 90 per cent of the agricultural activity and production systems in the country. The soil depth of more than 34 per cent of the land area is already less than 35 cm (Belay, 1992).

Human-related activities such as deforestation, overgrazing, intensive cultivation, soil mismanagement, cultivation of steep slopes, and urbanization with land use and management, topography, climate and social, economic and political conditions influence and accelerate the soil erosion hazard (Lal, 2008).

Decision on the use and types of SWC measures are not made by farmer concerned and there is little and rare attempt to made to include farmer experiences and knowledge (Wood, 1990). Many conservation practices in Ethiopia was carried out in the form of food for work without provide any opportunity for discussion and local participation in conservation planning (Wood, 1990). This program was not successful to achieve its objective. After phase-out of this

programs same farmers become unwilling to participate and maintain those already established project even they remove the structure from the field (Yeraswork, 1995).

The assumption that farmers have a negative perception of erosion problems and limited conservation knowledge has contributed to the external development of conservation technologies. Nonetheless, little confirmation exists in the literature that farmers' decisions are any more or less rational than recommendations based on professional advice (sonneveld, 2006). Thus, erosion and conservation cannot be understood without studying how people use the land and the reasoning that guides their decisions about land use.

Since the farmers have a great role in environmental protection, it is fundamental to know firstly farmers perceptions, and conservation knowledge they possess regarding the problem of soil erosion. The researcher believe that from the action and care of soil protection and management ,farmers perception on this problem is critical point to any further corrective measure to adapt and implement its effectively in the study area and as well as to others remaining regions of the country. Thus, this study will focus on the farmer's perception on the problem of soil erosion and their conservation knowledge at, Dessie rural kebeles South Wello.

1.3 Objective of the Study

1.3.1General objective

The main objective of this study is to assess farmers' perception on the problem of soil erosion and conservation knowledge in the rural kebeles of Dessie town.

1.3.2Specific objectives

The specific objectives are:

i. To assess farmers' perception on the causes, extent and consequences of soil erosion.
ii. Identify some of the factors that determine farmers' Perception on Soil erosion.
iii. To assess level of farmer's conservation knowledge on the problem of soil erosion.
iv. Identify the farmer's source of information with respect to land management practices.

1.4 Research Questions

Based on the specific objectives indicated above the following questions were posed as a basis for this research.

i. How farmers perceive the causes, extent and consequences of soil erosion**;**
ii. Is there any significant association between farmers of different background with their perception on the problem of soil erosion?
iii. What is the extent and level of farmer's conservation knowledge on soil erosion?
iv. What are the sources of information for the farmers with respect to conservation?

1.5 Significance of the study

Ethiopia is one of the countries of Sub-Saharan Africa, which is affect by serious environmental degradation specially soil erosion. In Ethiopia, however, farmer perceptions of erosion problems and farmer conservation practices have received little analysis or use in conservation planning. Therefore, this study is believed to contribute to in the following way:

- Awareness on the level of farmers' knowledge, perception and practices about soil erosion and can thus be use to take remedial actions based on the findings.
- It generates useful information for environmental protection organizations working to combat soil erosion and related environmental problems.
- It will also be used as a baseline for those researchers who want to conduct further research on the problem.
- Provides the basis for planning and soil conservation practices in the district and serves the officials and concerned body as a supplement to their knowledge.

1.6 Limitation of the study

In the course of this study the most challenging and facing problems are:

1. A very few respondents were not willing to give reliable information especially land and other related background variables questions partially.
2. Absence of very few sample household head at the time of interviews
3. Shortage of time and finance

4. Varying in quantitative some of information gap between concerned governmental administration

1.7 Scope of the Study

The scope of this study is to investigate the level of farmers' perception on the problem of soil erosion and there conservation knowledge at local level i.e. rural kebeles. And to assess some of the factors that determine farmers' perception on soil erosion problem. There are a number of factors that affects farmers' perception on the problem of soil erosion and there conservation knowledge. It constitutes the demographic, socio-economic, political, cultural and psychological factors. Even though, those factors are many in number they are interrelated and multiple.

The following list of determining factors such as demographic, socio-economic and access to information are taken into account to the sake of these studies. This is due to the time and budget constraints for further study of the rest of the factors.

In addition, the study is confined to small geographical area, i.e. six rural kebeles within which only three (3) rural kebeles will surveyed in Dessie rural kebeles south wello.

1.8 Organization of the Study

This thesis is organized in five chapters. Chapter one presents back ground, statement of the problem, objectives of the study, research questions, significances of the study and scope the study. Chapter two provide conceptual frame work and review of related literature. While chapter three deals with back ground to the study area and methods. Chapter four presents result and discussion. Finally chapter five presents summary, conclusion and recommendations.

CHAPTER TWO

2. Conceptual Framework and Review of Related Literature

2.1 Conceptual Frame Work

The farmer's perception of soil erosion and their conservation knowledge are being influenced by their current status of demographic and socio-economic characteristics. The conceptual framework of the factors, which consist of two key concepts of variables, is shown in figure 1.The dependent elements that include the framework for this study are farmer perception on soil erosion and there conservation knowledge. The demographic characteristics include household head, age, sex, household size, literacy and marital status. Literacy status of the household head, farm size, and assesses to information of farmers is important socio-economic factors included in this model. Demographic and socio- economic factors are the independent variables, which are expected to have farmers' perception and there conservation knowledge to soil erosion

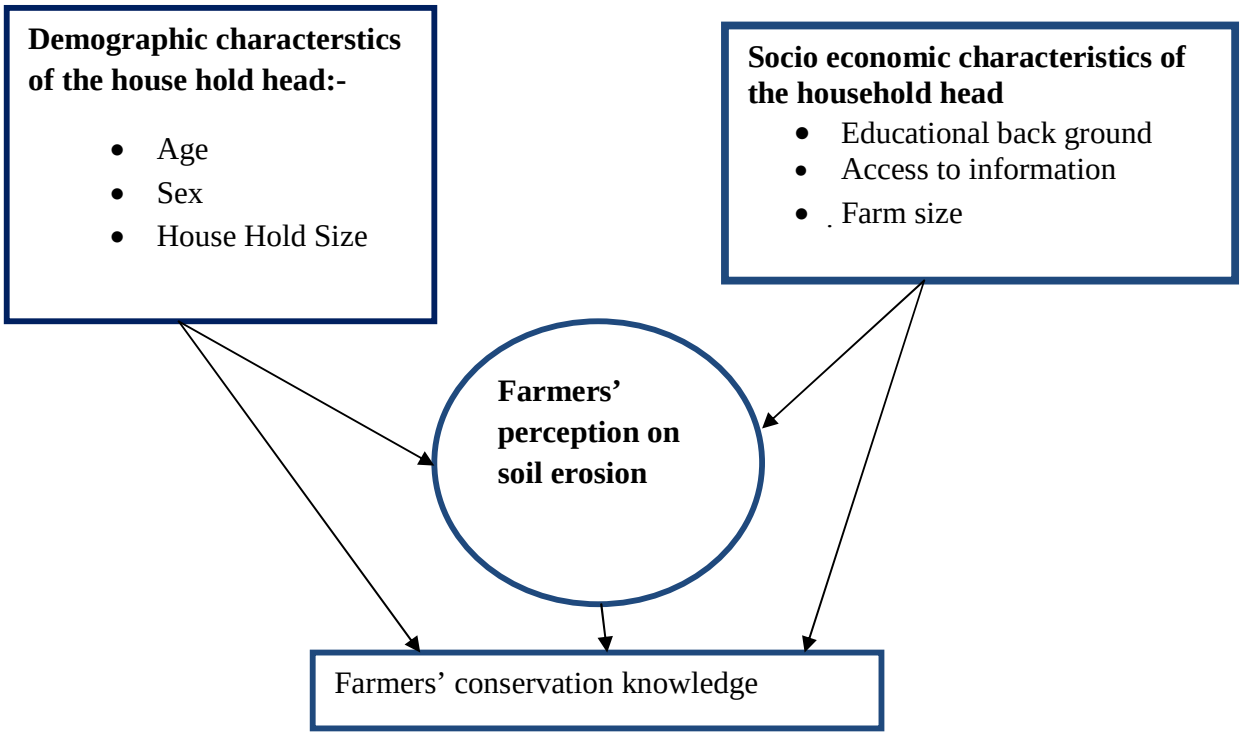


Figure 1: The conceptual framework for the study area.

2.2 Review of Related Literature

2.2.1 Soil Erosion and Its Extent

Definition of the term soil erosion is very diverse in the literature. The word erosion is derived from the Latin word erodere, meaning to gnaw away. In some studies the term erosion is used for the disruption of the soil mantle the pedosphere (Greek pedon - soil), or the underlying rock base - the lithosphere (Greek lithos - stone, sphaira - ball) by the action of matter of exogenous origin, i.e. by external geomorphic factors. In the broadest sense of the word these factors include water, snow, ice, air (wind), weathered debris, organisms (plants and animals), and man. These factors may be classified as biotic (Greek bios - life), i.e. relating to life, and biotic (Humberto, 2008).

Soil erosion refers to detachment and transport of soil and soil material by water, wind, ice or gravity-water. Soil erosion is a three-phase process consisting of the detachment of individual soil particles from the soil mass and then transport by erosive agents such as running water or wind. When sufficient energy is no longer available to transport the particles, a third phase, deposition, occurs (Morgan, 2005citted in Ayele 2006).As mentioned by Lala (2008) Soil erosion is a physical process of soil degradation and the most widespread form of land degradation as quoted by (Kassu kebede 2011). Lala also mentioned soil erosion as process which involves the detachment and transportation of soil particles from one place to another with a degree ranging from splash erosion to the alarming stage of gully formation. Tripathi also mentioned that soil erosion is a process which consists of detachment of soil particles from the surface; their transportation, which requires a source to carry the detached particles away (Tripathi et al., 1998).

Erosion can be either geological (natural erosion – steady and slow process of nature which is non-destructive); or it can be human induced that is caused by disturbance of nature's balance by human activities like large scale cutting of forests, leveling and cultivation, etc. A one inch soil of the surface which took a thousand years can be lost in just one year (Tripathi et al., 1998) and this kind of erosion which is a result of human interference, is known as accelerated erosion. In agriculture, soil erosion refers to the wearing a way of a field's topsoil by the

natural physical forces of water and wind or through forces associated with farming activities such as tillage (Ritter, 2012).

Soil erosion is a complex physical and chemical process that involves soil properties, ground slope, vegetation rainfall and intensity (Montgomery, 2007). Soil erosion occurs when soil is exposed to water or wind energy. When Rain drops hit exposed soil with great energy and it picked soil particles along with the water in to the air. This is starting of soil erosion and resulting sheet erosion remove the thin film of soil from the land surface (Pimentel & Kounang, 1998). Soil erosion therefore impacts agricultural production negatively by depleting nutrients needed for plant growth and reduce the depth of top soil that is vital to plant growth. Hartemink (2006) reports that, loss of top soil by soil erosion results in a serious reduction in soil chemical fertility in tropical regions**.** Mitchell (1980) also defined soil erosion and soil loss in the following way: "Soil erosion is the gross amount of soil moved by drop detachment or runoff and Soil loss is the soil moved off a particular slope or field".

Soil erosion can be a slow process that continues relatively unnoticed or can occur at an alarming rate, causing serious loss of topsoil. Soil compaction, low organic matter, loss of soil structure, poor internal drainage, salinisation and soil acidity problems are other serious soil degradation conditions that can accelerate the soil erosion process .Soil erosion is a three-phase process consisting of the detachment of individual soil particles from the soil mass and then transport by erosive agents such as running water or wind. When sufficient energy is no longer available to transport the particles, a third phases, deposition, occurs (Morgan, 2005). However, the acceleration of this process through anthropogenic perturbations and poor land use can have severe impacts on soil and environmental quality. Poor land use practices include deforestation, overgrazing, unmanaged construction activity and road or trail building. Yet, improved land use practices can limit erosion, using techniques like terrace building and tree planting etc.

Soil erosion is one form of soil degradation along with soil compaction, low organic matter, and loss of soil structure, poor internal drainage, salinization, and soil acidity problems. These other forms of soil degradation, serious in themselves, usually contribute to accelerated soil erosion (Montgomery, 2007). The loss of soil through land degradation processes particularly by erosion is one of the most serious environmental problems. Pimentel (2006) has argued that

the reduction in water availability due to land degradation and soil erosion is a major global threat to food security and the environment.

Worldwide, soil erosion rates are highest in agro ecosystems located in Asia, Africa, and South America, averaging 30–40 t/ha/yr. In developing countries, soil erosion is particularly severe on small farms because they often occupy marginal lands where the soil quality is poor and the topography steep and hilly (Southgate and Whitaker 1992).

More than 80% of land degradation is due to soil erosion out of which 56% is due to the water induced soil erosion (Oldeman, 1992). During the last few decades, nearly one-third of the world's arable land has been lost by erosion and continues to be lost at a rate of more than 10 million hectares per year (Pimentel et al, 1995). As to this study, with the addition of a quarter of a million people each day, the world population's food demand is increasing at a time when per capita food productivity is decline.

Each year, about 75 billion tons of soil is eroded from the world’s terrestrial ecosystems. Most agricultural land in the world is losing soil at rates ranging from13 tons/ha/year to 40 tons/ha/year. Because soil is formed very slowly, this means that soil is being lost 13–40 times faster than the rate of renewal and sustainability. For that reason, soil erosion ranks as one of the most serious environmental problems in the world. Its effects are pervasive, and its damages are long lasting (Pimentel et al, 1995).

Soil erosion is one of the most serious environmental problems in the world today, as it threatens agricultural and natural environment (Vrieling, 2006). As sources cited by study on global soil loss has indicated that soil loss rate in the United States is 16 t/ha/yr; in Europe it ranges between 10 – 20 t/ha/yr, while in Asia, Africa and South America between 20 and 40 tons/ha/yr Deore (2005).Erosion by water is a primary agent of soil degradation at the global scale, affecting 1094 million hectares, or roughly 56% of the land experiencing human induced degradation (Oldeman, 1992). Likely, soil from the world's croplands is being swept and washed away 10 - 40 times faster than it is being replenished).

Although soil erosion has been taking place slowly in natural ecosystems throughout geologic time, its cumulative impact over billions of years is significant.

Worldwide, erosion rates range from a low of 0.001–2 tons/hectare/year (t/ha/yr) on relatively flat land with grass and/or forest cover to rates ranging from 1 to 5 t/ha/yr on mountainous regions with normal vegetative cover. Even low rates of erosion sustained over billions of years result in the displacement of soil (Pimentel, 1998).

According to Brawn 1993, approximately 75 billion tons of fertile soil is lost annually from the world's agricultural systems, whereas other investigators have estimated that only 24 billion tons of soil is lost each year (wolf, 1997). Lal(1990) report that 6.6 billion tons of soil per year is lost in India and 5.5 billion tons are lost annually in China. Based on the fact that these two countries occupy about 13% of the world's total land area, the estimated 75 billion tons of soil lost per year worldwide is entirely logical.

Since 1945 moderate, severe, extreme soil degradation has affected 1.2 billion hectares of agricultural land globally, an area size of China and India combined. Some 80 percent of this degradation has taken place in developing countries (Pimentel, 1998) and most countries lack sufficient resources to repair degraded land.

2.2.2 Soil Erosion in Ethiopia

Soil erosion is not a new phenomenon in Ethiopia; it is a process as old as the history of agriculture in the country (Hurni, 1988, 1989). This process has been accelerated by population growth and more deforestation. Soil Erosion is one of the most important environmental problems among various forms of land degradation that poses serious challenge to the food security of the population and future development prospects of the country (Wagayehu and Lars, 2003).

Soil erosion is one of the major factors of soil degradation in Ethiopia (Hurni, 1986). Due to the dissected terrain with nearly 70% of the highlands having slope above 30% and the high intensity of the rainfall the highlands receive contributed to accelerated erosion. Crop production system widely practiced in the highlands of the country which require fine tilled seed bed and single cropping of fields encouraged soil loss via erosion (Belay, 2000; Kassaye, 2004). This is exacerbated by the ever increasing population.

Soil erosion is a phenomenon, which occurs mainly in the highlands of Ethiopia. Here the surface is rugged, steep and deeply dissected, and slopes exceeding 15% are commonplace. In addition the rainfall is often torrential in many parts thus exacerbating erosion. More than 5000 years of cultivation has taken its toll on the resources of Ethiopia. It is a direct accumulation result effect of the past and the present agricultural practices in the highlands (Kassaye, 2004) .The most common form of erosion is the loss of topsoil under the action of water or wind. Soil erosion on the highlands is aggravated by the continuing extensive deforestation through clearing and by fire (Kassaye, 2004).

As mentioned by FAO (1995), the recorded annual soil erosion in Ethiopia ranges from 16-300 tons/ha/yr depending mainly on the slope, land cover, and rainfall intensities. According to the Ethiopian highland reclamation study (FAO, 1984), in mid 1980's 27 million ha or almost 50% of the highland area was significantly eroded, 14 million ha seriously eroded and over 2 million ha beyond reclamation.

Studies show that large proportion (almost half of soil losses) occurs from the cultivated fields that cover only 13% of the country and on average 42 tones of soil is being washed out from a hectare of cultivated fields (Hurni, 1990).The same study also indicated that the highest average soil loss occurs on currently unproductive land with less vegetation cover that was once under cultivation. It was estimated that every year Ethiopian highlands lose about 1.9 to 3.5 billion tones of topsoil (EPA, 1993). This large amount of soil loss made the country to be described as one of the most serious erosion areas in Africa and in the world (Hurni, 1996). Excessive soil loss with other factors led to reduced average crop yield per unit area.

According to FAO, (1986) cited in Girum (2007), annual soil loss in Ethiopia is estimated at 1.5 and 3 billion tons. Of this, 50 % occur in croplands where soil loss may be as high as 296 tons/ha/year on steep slopes. However different land use types have different soil loss rate table1 Hurni, (1993) cited in Girum, (2007).

In general, Soil erosion is one of the major factors causing severe land degradation problem in Ethiopia, which in turn is threatening the agricultural productivity and the very survival of the overwhelming majority of the rural population. The rate of soil loss, depletion of soil organic matter and nutrients as a result is so high and much faster than they can be replaced. The

Ethiopian Highland Reclamation Study (FAO, 1986) estimated that water erosion moves nearly 1.9 billion tons of fertile soil from highlands annually.

Table 1: Soil loss rate estimates made for different land cover/ land use in Ethiopia

Land cover/ land use area	Percentage	Soil loss (t/ha/yr)
Crop land (annuals)	13.10	42
Perennial crops	1.70	8
Currently uncultivated land	18.70	5
Totally degraded landscape	3.80	70
Grazing/browsing land	51.00	5
Wood and bush land	8.10	5
Forests	3.60	1
Average	100.00	12

Source: Hurni (1993)

2.2.3 Causes of Soil Erosion

Erosion occurs when soil is exposed to water or wind energy. These process influenced by the decisive factors which include the climate, the relief, the nature of the surface, and the activity of organism, especially the activity of man which has been responsible in recent years for an increasing specific influence on erosion system(Mohammed, 2011).

According to Lal, (2007)cited in Humberto, (2008) anthropogenic activities involving deforestation, overgrazing, intensive cultivation, soil mismanagement, cultivation of steep slopes, and urbanization accelerate the soil erosion hazard. Land use and management, topography, climate, and social, economic, and political conditions influence soil erosion. In developing countries, soil erosion is directly linked to poverty level. Resource-poor farmers lack means to establish conservation practices. Subsistence agriculture forces farmers to use extractive practices on small size farm (0.5–2 ha) year after year for food production, delaying or completely excluding the adoption of conservation practices that reduce soil erosion risks (Lal, 2007).

Raindrops hit exposed soil with great energy and launch soil particles along with the water into the air. Raindrop splash and resulting sheet erosion remove a thin film of soil from the land surface. Sheet erosion is the dominant form of erosion (Allison 1973; Foster and others 1985). The impacts of both are intensified on sloping land, where more than half of the soil contained in the splashes is carried downhill to valleys and waterways (Pimentel 1995). Wind energy dislodges soil particles and carries them off the land. Airborne soil particles are often transported thousands of miles (Pimentel, 1995).

In Ethiopia the severity of soil erosion can be attributed to intense rainfall and rugged and dissected nature of the topography with nearly 70 percent of highlands having slopes exceeding 30 percent. Rapid population growth, cultivation on steep slopes, clearing of vegetation, and overgrazing are the main factors that are accelerating soil erosion in Ethiopia (Wood, 1990). The annual rate of soil loss in the country is higher than the annual rate of soil formation. Hence, the underlying cause for the excessive rate of soil loss is the unsustainable exploitation of the land resource which is manifested by extensive de-vegetation for fuel wood and other uses and expansion of cultivation and grazing into steep land areas (Kibrom and Lars, 2000; Woldeamlak, 2003; Aklilu, 2006).

2.2.4 Consequences of Soil Erosion

Throughout Ethiopia, the landscape is subject to water erosion under the action of rainfall. The slope, nature of soil, vegetation and human activity also influence the decisive soil erosion process (Jurg, 1988). The consequences of soil erosion and sediment deposition occur both on- and off-site. Onsite effects are particularly important on agricultural land where the redistribution of soil within a field, the loss of soil from a field, the breakdown of soil structure and the decline in organic matter and nutrients result in a reduction of cultivable soil depth and a decline in soil fertility .The net effect is a loss of productivity, which at first, restricts. What can be grown and results in increased expenditure on fertilizers but later might lead to land abandonment (Pimentel et al., 1995, cited in FAO, 2000). Off-site problems result from sedimentation downstream, which reduces the capacity of rivers and retention ponds, enhances the risk of flooding and muddy flood shortens the design life of reservoirs. Sediment is also a pollutant in its own right and, through the agro-chemicals adsorbed to it, can increase the levels of nitrogen and phosphorus in water bodies and result in eutrophication (Humberto, 2008).

Erosion reduces the overall productivity of ecosystems in several ways. First, in order of importance, erosion increases water runoff, thereby decreasing water infiltration and the water-storage capacity of the soil (Pimentel, 1995). Also, organic matter and essential plant nutrients are lost in the erosion process and soil depth is reduced. These changes reduce biodiversity in the soil (Pimentel, 1995). Because these factors interact with one another, it is almost impossible to separate the specific impacts of one factor from another.

Several studies have demonstrated that the soil removed by either wind or water erosion is 1.3–5.0 times richer in organic matter than the soil left behind (Barrow, 1991). Eroded soil typically contains about three times more nutrients than the soil left behind on the eroded land (Lal 1980; Young 1989). Both wind and water erosion selectively remove the fine organic particles in the soil, leaving behind large particles and stones .Because most of the organic matter is close to the soil surface in the form of decaying leaves and stems, erosion of the topsoil significantly decreases soil organic matter.

Generally the effect of soil erosion by water extends beyond the removal of valuable topsoil. Crop emergence, growth and yield are directly affected by the loss of natural nutrients and applied fertilizers. Seeds and plants can be disturbed or completely removed by the erosion (Lal, 2001).Soil quality, structure, stability and texture can be affected by the loss of soil. The breakdown of aggregates and the removal of smaller particles or entire layers of soil or organic matter can weaken the structure and even change the texture. Textural changes can in turn affect the water-holding capacity of the soil, making it more susceptible to extreme conditions such as drought (Lal 1990).same studies show that soil erosion by water also has off site impact(Barrow CJ. 1991). Due to eroded soil, deposited down slope, inhibit or delay the emergence of seeds, bury small seedlings and necessitates replanting in the affected areas.

On site and off site effect off soil erosion in developing country like Ethiopia is high. As stated by Hurni (1993) soil erosion by water constitutes a severe threat to the national economy of Ethiopia. Moreover, FAO (1986) estimated soil erosion to cost Ethiopia on average 2.2 percent of land productivity annually from that of the 1985 productivity level. In addition, Sutcliffe (1993) also estimated that erosion costs Ethiopia 2 percent of its GDP between 1985 and 1990. Besides to these, Sutcliffe (2002) discussed that the cost of erosion in Ethiopia is very high and

it accounts more than anticipation per year. This shows that the trend of the impact of erosion is increasing from time to time rapidly in the country.

2.2.5 Factors affecting soil erosion by water

Soil erosion is a complex process that involves soil properties, ground slope, vegetation rainfall and intensity (Montgomery as quoted by kassa, 2011). These factors are not totally independent, as geology affects topography, which can influence climate and the like. Human disturbances, such as tillage and construction, and natural disturbances, such as severe weather or fire, dramatically increase erosion (Israel, 2011).

2.2.5.1Climatic factors

Climatic attributes affecting erosion are precipitation, temperature, wind, humidity, and solar radiation (Israel, 2011).Both rainfall and runoff factors must be considered in assessing water erosion problems. The loss of soil is closely related to the impact of raindrops on the soil surface to separate down soil aggregates and disperse them. The energy of the raindrops influences the kind of soils that are detached. This applies particularly to erosion by overland flow and rills, for which intensity is generally considered to be the most important rainfall characteristic (Humberto, 2008). It appears that erosion is related to two types of rain event, the short-lived intense storm where the infiltration capacity of the soil is exceeded, and the prolonged storm of low intensity that saturates the soil (Humberto, 2008). Runoff depends on rainfall intensity and infiltration capacity of soil. It can occur when rainfall intensity exceeds the rate of infiltration; as a result, the excess water cannot be absorbed into the soil so it forms surface runoff. The amount of runoff can increase if infiltration is reduced due to soil compaction, saturation, crusting or freezing, (Girum, 2007). Lighter soil materials can be easily removed by raindrop splash and runoff, but larger and denser materials require raindrops with higher energy. Soil movement is usually high and easily noticeable during short-duration and high-intensity thunderstorms. Less intense, long lasting rainfall should not be misinterpreted as being not capable of moving significant amount of soil when compounded over time.

The rainfall in Ethiopia ranges from under 100 mm per year to close to 2200 mm per year (Hawando. 2000). The rainfall is high in the highlands areas. On the other hand, lowland areas that are 110 m below sea level receive little rainfall. The annual temperature varies from 0°C in

the Mountain Ras Dejen to over 40°C in Danakil Depression (110 m below sea level) (Blaich, 2005). Climate diversity creates challenges to control factors that affect soil erosion. Hawando (2000) reports that mean rainfall are 900 mm per year. Most of the rain is received in three to four months during the summer months (Dubale, 2001). According to United Nations cited in Hawando (2002), Vertisols in the Highlands region occurs in areas that receive between 642 to 1117 mm of rain per year. Water infiltration on vertisols is limited once the soil is wet. This condition exacerbates soil erosion.

2.2.5.2 Soil Factors

Physical properties of soil affect the infiltration capacity and the extent to which particles can be detached and transported. The physical factors which affect erodibility of soil are aggregate stability, particle size distribution, base minerals, organic carbon content, clay mineralogy, infiltration capacity, pore size, pore stability, moisture holding capacity of soil, topographic features and management of the land (Hudson, 1996 and (Shestha, 2002)

Although a soil's resistance to erosion depends in part on topographic position, slope steepness and the amount of disturbance, such as during tillage, the properties of the soil are the most important determinants(Humberto,2008).Erodibility varies with soil texture, aggregate stability, shear strength, infiltration capacity and organic and chemical content(Shestha, 2002). Generally, soils with faster infiltration rates, higher levels of organic matter and improved soil structure have greater resistance to erosion. Sand, sandy loam and loam-textured soils tend to be less erodible than silt, very fine sand, and certain clay textured soils. Tillage and cropping practices that lower soil organic matter levels, cause poor soil structure, and result an increases in soil erodibility (Shestha, 2002).

2.2.5.3 Topographic Factors

Erosion would normally be expected to increase with increase in slope steepness and slope length as a result of respective increases in velocity and volume of surface runoff (Doere,as quoted by Israel 2011) Further, while on a flat surface raindrops splash soil particles randomly in all directions, on sloping ground more soil is splashed down slope than upslope(Shestha, 2002). Generally, soil erosion by water increases as the slope and the length of a field increases

due to the greater accumulation of runoff. Consolidation of small fields into larger ones often results in longer slope lengths with high erosion potential, due to increase in the velocity of water, which permits a greater degree of carrying capacity for sediment (Hawando, 2002).Consolidation of small fields into larger ones often results in longer slope lengths with high erosion potential, due to increase in the velocity of water, which permits a greater degree of carrying capacity for sediment (Shestha, 2002)

2.2.5.4 Vegetation Cover Factor

Vegetation acts as a protective layer or buffer between the atmosphere and the soil. The aboveground components, such as leaves and stems, absorb some of the energy of falling raindrops, running water and wind, so that less is directed at the soil, while the below-ground components, comprising the root system, contribute to the mechanical strength of the soil (Hudson, 1996).

Soil erosion potential increases if the soil has no or very little vegetative cover of plants and/or crop residues. Plant and residue cover protects the soil from raindrop impact and splash. Plant and residue cover tends to slow down the movement of surface runoff and allows excess surface water to infiltrate. The erosion-reducing effectiveness of plant and/or residue covers depends on the type, extent, and quantity of cover (Gronvall, 1995). The effectiveness of any protective cover also depends on how much protection is available at various periods during the year, relative to the amount of erosive rainfall that falls during these periods. Generally, the less the disturbance of vegetation or residue cover at or near the surface the more effective the tillage practice in reducing erosion (Hudson, 1996).

2.2.5.5 Conservation Measures

Certain conservation measures can reduce soil erosion especially in agricultural areas. Tillage and cropping practices, land management practices, directly affect the overall soil erosion problem and solutions on a farm (Girum, 2007). When crop rotations or changing tillage practices are not enough to control erosion on a field, a combination of approaches or more extreme measures like contour plowing, strip cropping, or terracing might be necessary(Israel, 2011). The aim of soil conservation as mentioned by Alemayhu (1996) is to reduce erosion to a level at which the maximum sustainable level of agricultural production, grazing or

recreational activity can be obtained from an area of land without unacceptable environmental damage.

2.2.6 Soil Erosion Types

According to Israel (2011), soil erosion by water occurs in various forms (e.g., splash, sheet, rill, and gullies) depending on the stage of progress in the erosion cycle and the position in the landscape. Some of the types of erosion are discussed below:

2.2.6.1 Rain Splash Erosion

Rain splash Erosion is the result of water falling directly on to the ground during rainstorms or when it is intercepted by the canopy and finds its way through the ground (Morgan, 1995).it is the most important detaching agent. As a result of raindrops striking a bare soil surface, soil particles may be thrown through the air over distances of several centimeters (Alemayhu, 1996). According to Miller et al., 1997 cited in (Girum, 2007) raindrops fall with an approximate speed of 914 cm/s. When raindrops strike bare soil, they beat it into flowing mud, which splashes as far as 61 cm high and 152 cm away.

2.2.6.2 Sheet Erosion

Sheet erosion occurs as a shallow 'sheet' of water flowing over the ground surface, resulting in breakdown of soil surface structure and surface runoff; it occurs rather uniformly over the slope and may go unnoticed until most of the productive topsoil has been lost. Although often difficult to recognize, sheet erosion is responsible for extensive soil loss in both cultivated and non-cultivated environments (Hawando, 2000).

2.2.6.3 Rill erosion

Rill erosion results when surface runoff concentrates forming small yet well-defined channels. Rills are eroded channels that are small enough to be removed by normal tillage operations. Rill initiated at a critical distance down slope where surface runoff concentrates and becomes channeled .The water in a rill has sufficient depth for turbulence to develop in it and therefore entrain large particles (Morgan, 1995).

2.2.6.4 Gully Erosion

Gully erosion produces channels larger than rills. Surface water runoff, causing gully formation or the enlarging of existing gullies, is usually the result of improper outlet design for local surface and subsurface drainage systems (Morgan, 1995). Gully erosion results in significant amounts of land being taken out of production and creates hazardous conditions for the operators of farm machinery.

According to Hurni (1985), erosion seriously reduces the productivity of the land and unfavorably affects the environment. Its results can be visualized by large gullies, or less obvious but more seriously by sheet erosion.

2.2.7 Conservation Efforts

There was not government policy on soil conservation or natural recourses management in Ethiopia until the 1970s, after which national efforts for soil conservation expanded rapidly (Hurni, 1986; Wogayehu and Lars, 2003). The famines of 1973 and 1985 provided a base for conservation work compensation for labor, especially in the form of food-for-work (FFW), and in some cases cash-for-work (CFW), has been the main direct economic incentives used for soil conservation in Ethiopia(Campbell, 1991). Apparently, the 1974 drought provided the initial motivation for the mobilization of rural labour force for conservation in the country using FFW programmes (Hoben, 1996).In addition to FFW and CFW programs, tree seedlings distribution at minimal prices for private use, and free of charge for use in community lands, has been another direct economic incentive used for soil conservation in the country. According to Campbell cited in Tadel(2007)up to 1986, food aid used for payment of conservation and related works as food-for-work payment accounted for approximately 29% of total food aid (71% of the food aid was distributed as emergency food). With this, Ethiopia became the largest food–for-work program beneficiary in Africa and the second largest country in the world following India (Campbell, 1991). A total of 50 million workdays were devoted to the conservation work between 1982 and 1985 through food-for-work.

Aside from the introduced soil and water conservation measures, reports indicate that peasants have been aware of problems related to soil erosion and developed indigenous soil and water

conservation practices that sustained agriculture for centuries. These include different conservation practices in the Northern Highlands. Well developed terracing systems of Konso in southern Ethiopia (FAO, 1990); ditches in Northern Shewa in the Central Highlands (Alemayhu, 1996); and different techniques in the Eastern Highlands .It appears that these traditional practices were not given due consideration in the massive soil conservation and a forestation campaign under the FFW schemes.

According to Gebremedh factors that inhibiting farmer investment in soil and sustainable use of soil conservation practices in the land includes tenure insecurity, the low profitability of conservation practices and the absence of adequate short-term benefits from soil conservation. In order to encourage soil conservation at the farm level, several factors that either raise the discount rate of farmers, or reduce the profitability of conservation practices need to be considered in designing incentives.

2.2.8 Farmers' Perception on Soil Erosion

Ethiopian farmers' perception and response to soil erosion problems are linked with various hidden or unseen socio-economic, cultural and demographic factors as well as its wide geographical area and large population. The study conducted in Awassa District by Awdenegest and Holden (2006) clearly shows that 92 percent of farmers in the catchments were aware of the problem of soil erosion and believed the severity of the problem had increased in recent years and 94 percent of the farmers in the catchment were aware of the problem of soil fertility decline. The most important reasons suggested for soil erosion were: deforestation (66%), no terracing (47%), runoff (42%), no or scarcity of grazing land (17%), high rainfall rates (14%) and steep slopes (13%). From these, one can easily understand that the reason for soil erosion can vary in space (landscape) and time. Morgan, (1995) described that high rainfall in steeply sloped areas with poor vegetation cover and an absence of protective measures will result in high rates of soil erosion. In these area, farmers suggested indirect reasons that aggravate the problem, such as gullies and rills, high population, labor shortage and lack of soil conservation practices (e.g. terracing, cut-off drains) (Awdenegest and Holden, 2006).

According to Dejene, (1996), Gedion, (2003), Sisay,(1998)cited in Tadel, (2008) that demographic and social-economic back ground of the farmers have a significant effect on perception on degree of soil erosion and their response to varies conservation strategies. Similarly, studies showed that, farmers with higher educational levels are expected to be better in perception and response to soil erosion problems (Challachew, 2004). According to Baharu (1993) cited in Abiy, (2002) showed that farmers with small land holding are more likely to apply conservation measures and make an effort to utilize their limited resources more efficiently and adopt new technologies at faster rate than those farmers who have large farm land holdings. The size of the house hold has a determinant role in perception. According to Abiy (2002) the size of house hold has a positive correlation with farmer's perception of soil erosion problems. According Endrias et al (2005) cited in Tadele,(2008)that household with large family size is expected to adopt wide range of conservation techniques compared to house hold with small family size. According to Mulugeta (1992) farmers who had contact with DAs had a significant association with their response to soil erosion problems and higher the frequency of extension contact the more likely a farmer will receive valuable information about the adoption of new techniques for environment management.

CHAPTER THREE

3. Back Ground to the Study Area and Methods

3.1 Back Ground to the Study Area

3.1 .1 Location

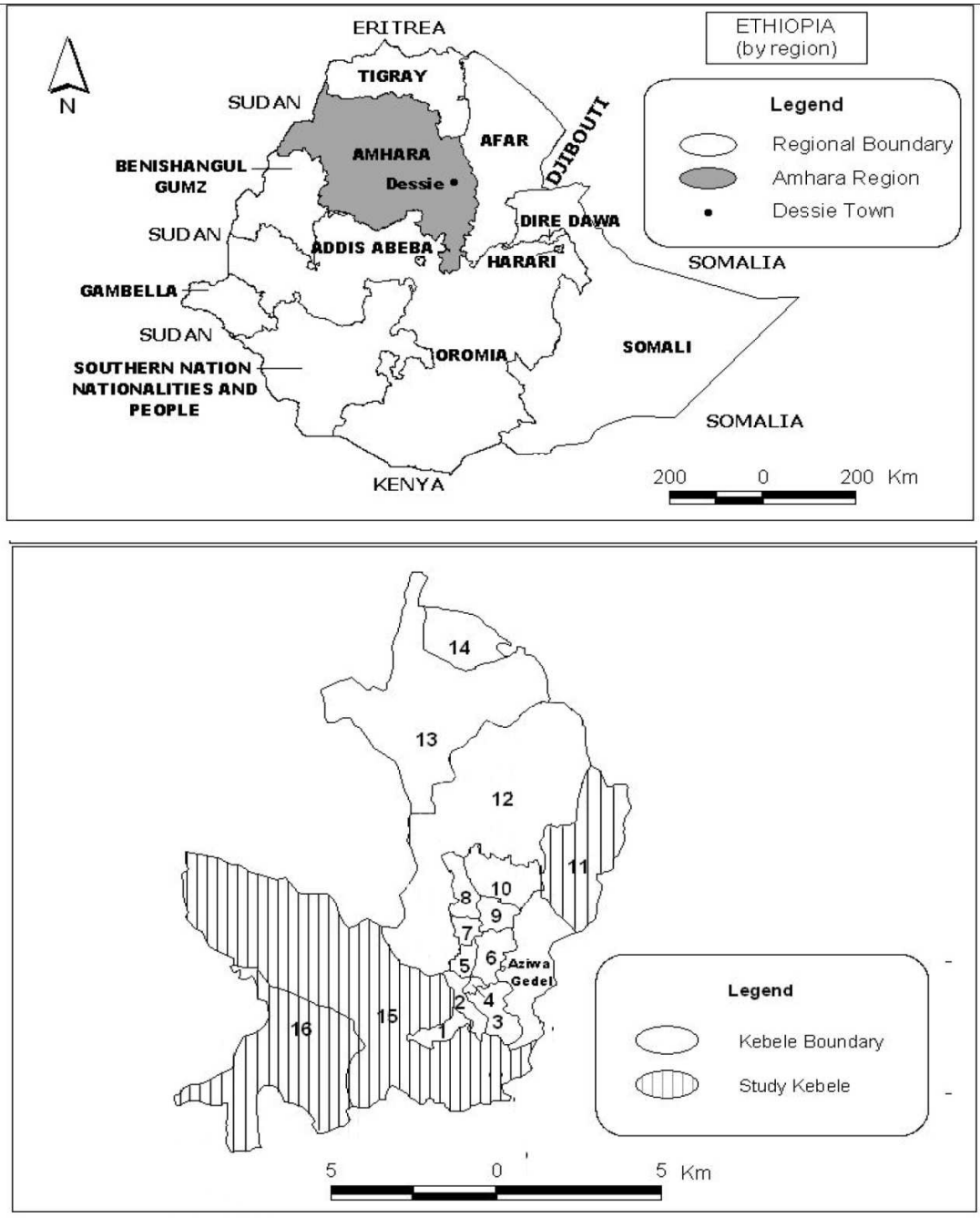
Dessie town is found in South Wello zone, eastern margin of Amhara region and in north central part of Ethiopia at a road distance of 401km from Addis Ababa. Astronomically, the town lies on the intersection of 11°8′N 39°38′E.Administratively, the town is subdivided in to 16 kebelles. From this 10 are urban kebelles while the remaining 6 are rural kebeles of the town, (Dessie town administration office magazine, 2009 cited in Solomon Cheru, 2011).

This study focus on only the three of the rural kebeles of the town namely 015(Gerado Bilen), 016(yito Medhanialem) and 011 (Tita). Gerado Bilen is a rural kebele is found in the western part of Dessie town at a road distance of 5k.m from Dessie town. Similarly the second sample kebele is Yitomedalem rural kebele is also found in the south western parts of Dessie town. The last sample kebele was Tita rural kebele, it found around in the north eastern part of Dessie town at a road distance of 8 km from Dessie town

3.1.2 Climate

Dessie falls within “dega” agro climatic zone with an average monthly minimum and maximum temperature of 12.37°and 26.27°c respectively. As a result, it has cooler temperature and high precipitation. According to the metrological data record at kombolcha station (which is 10km air distance from Dessie) there are two rainy seasons: spring (march-may) and summer (July-September), of which summer season has the highest rainfall. The average annual rainfall for the period between 1994 and2001were calculated to be 1070mm (Sileshi, citied in Solomon Cheru, 2011).Gerado Bilen (015 rural kebeles) rural kebeles is found on the average elevation range of 2200-2800meter above sea level and it falls within “Dega“ 5% and 95% within “wienadega” climatic zone.It has an average monthly minimum and maximum temperature of 12°c and 15°c respectively. In this rural kebeles there are two rainy seasons. Spring and summer of which summer season has the highest rain fall. Average annual rain fall is

900mm.Yito- Medanialem kebele is found on average elevation 2400meter above sea level and has two rain season with the average annual rainfall 900mm.It has an average monthly minimum and maximum temperature of 12°c and 16°c respectively. Tita rural kebeles also has the average elevation range from 2380-2680meter above sea level and it falls within “dega“ 35% and 65% within “wienadega” climatic zone .it has an average monthly minimum and maximum temperature of 11°c and 14°c respectively. In this rural kebele there are two rainy seasons. Spring and summer of which summer season has the highest rain fall. Average annual rain fall ranges 900 - 1200mm.



Map 3.1: Location of Dessie town in Amhara National Regional State of Ethiopia

3.1.3 Topography and soils

The average elevation of the Dessie town ranges from 2400 to 2800 meter above sea level. The town is bounded and squeezed by a series of ranges and escarpments with rugged surfaces between the cliffs of Tossa and Azuwa, and Borkena River divides this basin in to two parts. According to the town administration Dessie town rural kebeles has an estimated area of 12994.28ha with the population size of 36839 of whom 19776(53.7%) were males and 17063(46.3%) were females. Out of the total area of the town rural kebeles land with the slope of up to 10 %, covers 55.3 percent , land with the slope 11 %up to 15 %covers 8.5percent and the lands with the slope of more than 30% covers 36.2 percent.

Table 3.1: Dessie town rural kebeles steepness of Land in percentage

Slope steepness in percent	**Total Coverage in percent**	**Cumulative percentage**
0-5	39	39
6-10	16.3	55.3
11-15	8.5	63.8
16 and above	36.2	100

Sources: Dessie town office of agriculture 2011.

According to the kebele administration of Gerado Liben, the kebele has a population of 11845 and size of 3240ha of land. According to the town agriculture office out of the total area of the kebeles, flat plain covers 53% of the area the average elevation this rural kebeles range from 2200-2800meter above sea level. Similarly, according to the town agriculture office, Yito – Medenialem kebele hasa total area of 1804.26.out of the total area of this kebele flat plain land covers 65%with the average elevation 2400meter above sea level. According to the kebele administration of Tita, the kebeles has a population of 5430 and size of 1340 ha of land. Out of the total area of the kebeles, the land with the slope of more than15% covers 58.1% of land. The average elevation this rural kebeles range from 2380-2680meter above sea level.

There is no detailed soil surveys have been carried out in the study area especially in the three sample kebeles and also true to others district. According to the data from Dessie town rural kebels agricultural and rural development office, the dominant soil type of the study area is black soils(Verti soils).Based on farmers' classification, the dominant soil types are listed below.

Table 3.2 Major soil types of Dessie town rural kebeles

Soil types	**Coverage in hectare**	**Coverage in Percent**	**Cumulative percent**
Black clay soil	8580.7	58	58
Grayish soil	1494.2	10.1	68.1
Red clay soil	177.5	1.2	69.3
Brownish soil	3698.6	25	94.3
Others	843.3	5.7	100
total	14794.28	100	

Sources: Dessie town office of agriculture, 2011.

3.1.4. Landholding Size of Respondents

The landholding of farmers in the study area is very small, as in most of the highlands of the country. Landholding among households varies significantly and minimum and maximum sizes of land holding were 0.12 ha and 4.5ha farm land. 73.5 percent of sample households have less than 1 hectare of land. More over the land is fragmented (broken up) in to a number of small separate plots, often located at distance from each other.

3.1.5. Crop Production and Economy

The farmers in the study area cultivate a variety of cereals, pulses and root crops. These cultivated food crops in the study area include wheat (*Triticum sp.*), *teff* (*Eragrostis sp.*), sorghum (*Sorghum bicolor*), bean and peas (*Vicia fabia* and *Pisum sativa*), linseed (Linum usitattissimum)maize (*Zea mays*), barley (*Hordeum sp.*) and fenugreek(Trigonella foenum-grecum).finger millat(Eleusine coracana),vetch (Vicia sativa), soya bean (Glycine max)and emmer wheat (Avena sativia).Major crops such as teff, wheat and maize are cultivated during the long rainy season and supplementary irrigation in spring especially in Gerado-

Liben and Yito-Medanialem sample kebeles. The farmers also cultivated a variety of vegetables and root crops include head cabbage (Brassica oleracea capitata), beetroot (Beta vulgaris rubra), carrot (Daucus carota sativa), onion (Allium cepa) and potato (Solanum tuberosum) in homestead gardens or where irrigation exist especially Gerado-Liben and Yito-Medanialem sample kebeles.

Economically, agriculture serves as the main economic foot and means of livelihood to the majority of the people and characterized by traditional mixed farming as it includes both crop and livestock production. More of it is rain-fed and supplementary traditional irrigation especially in Gerado-Bilen and Yito Medanialem sample kebeles.

3.1.6 The Land Use of Dessie Town Rural Kebeles

The cultivated land and forest land which occupied the largest part (more than 65%) of the total area of the rural kebeles of Dessie town. The shrub land was mainly located on the steeper slopes of the mountain unsuitable for crop cultivation and formed the third largest spatial extent.

Table4.3 The land use of Dessie town rural kebeles

Land use	**Total area (ha)**	**Percentage**
Cultivated land	7924	53.6
Grazing land	1366	9.2
Forest land	2178	14.7
Construction land	1116	7.5
Unproductive land	10	0.09
Bush/shrub land	1714	11.6
Covered with water	2	0.01
Others	485	3.3
	14795	100

Sources: Dessie town office of agriculture, 2011.

3.2 Research Methods

3.2.1 Type and Source of Data

Data for this study came from two sources: primary and secondary sources .Data were obtained from a survey undertaken in the three rural kebeles of desse town (Tita, Gerado kelina and yito Mednialem). In this research, farmers were the major sources of primary data. Hence, field observation, focus group discussion, interviews with selected farmers and other key informants were primary data sources. As part of the primary data, information was also collected from Zonal and district agricultural experts, Kebele administrators, soil and water conservation supervisors and DAs. In addition, secondary sources of information used for this study. These include published materials such as reports, plans, official records, census records, project reports, research papers and data files from internet/ web pages.

3.2.2 Sampling Procedures

Dessie town rural kebeles were selected as a study areas where to conduct this research. Within Dessie town there are six rural kebels. Two stage sampling technique was employed to select sample farmers. In the first stage three (3) town-rural kebeles was selected as study samples ,namely Grado-Bilen ,Yitomidenialem and Tita rural kebeles with the total population 11845,4106 and 5430 respectively(Dessie town administration office magazine, 2009). The selection was made through the use of topography/slope and population size as criteria. Tita kebeles was selected due to its slope ranging from moderately steeping to steep slope (slope estimated to 16-30% and above). It accounts 58.1% of the total land of the kebele .The second sample kebele Grado-Bilen was selected based on its population size. Due to this in this rural kebeles the pressure on natural resource especially on land is significantly higher than the remaining kebeles. The third sample is Yito-Medanialem kebele that was selected again based on slope from gentle/flat area. From the total area of the kebeles 65% of land has the slope estimated 0-5%.Because the researcher assumed that the perception on soil erosion might differ by slope categories and as well the severity of soil erosion problems.

In the second stage a systematic random sample of 83 farm households was selected from the three rural kebeles for personal interviews. The sampling was done using a list obtained from

the respective rural kebeles administrations and DAs and there were about 3232 household heads residing in the three rural kebeles. Out of 3232 household heads, 933 residing in Tita, 1450 in Gerado-Bilen and 849 in Yito-Medanialem rural kebeles. Proportional to the size of the representative sampling household heads each kebeles study sample were selected from the list of households. Accordingly, from Tita 24 house hold heads, from Gerado-Bilen 37house household heads and from Yito-Medanialem 22 house hold heads were selected using systematic random sampling technique.

The head of the household was considered to be the unit of analysis because s/he was the ultimate decision-maker with respect to farming activities. When the head of a selected sample household was unavailable (after repeated visits), interviewers went to the next household on the list. It is known that sample size depends on variability of a population to be sampled and taking time, cost and accessibility. Given the relative homogeneity of the subsistence farmers in the study kebeles in terms of physical environmental factors and resource endowments, this number was considered maximum which could be handled effectively with in the research time and budget.

3.3 Methods of Data Collection

Combination of the following data collection tools were employed to gather relevant information.

3.3.1. Field Observation and Informal Interviews

Field observation was conducted throughout the whole process of the research in order to ensure the validity of information obtained. It was aimed of understanding the local condition of the community in terms of their culture, farm practices and traditional way of resources utilization and application of conservation measures, etc. It was also done with the purpose of getting guidance for development of the formal question and to get additional information in related to soil erosion severity, existing soil conservation measures, yield conditions, soil color, topography and land use and land cover. In this regard, the three sampled rural kebeles were observed purposefully.

On the other hand informal interviews were carried out with farmers was aimed to obtaining information for developing to produce structured questionnaires which is the core instrument for collected information and were conducted in an informal and easy manner.

3.3.2 Structured Interviews

This was the most important and largely used instrument for data collection tool in this research. Based on information acquired from informal discussion with farmers and field observation, and from literatures reading; structured questionnaire (Appendix 1) was developed and employed on 83 farm house holds randomly selected.

The survey was conducted using a structured survey questionnaire to obtain farmers 'perception to words the problems of soil erosion and their conservation knowledge. The enumerators were selected (one was high school teacher and the other was high school graduate) for structured interviews. Prior to implementing the survey, the questionnaire was used to train enumerators and tested for their clarity.

The questionnaire was comprised of both open-ended questions and questions with codified answers, and was administered after pre-testing. The questions pertained to of four main topics: (1) respondents household characteristics, (2) land and landholding characteristics of respondent, (3) cause and effect of erosion, and (4) conservation knowledge and practices.

During the field survey, especially on the third main topics of the questioner (cause and effect of erosion) the respondents were asked ranking and yes or no item questions regarding their perception to soil erosion. The first questions were about the causes and consequences of soil erosion. These questions involved 8 possible ranking choices and the respondents were asked to rank from the highest to the lowest level based on their perception towards each. These ranking questioners were used to analyze causes, extent and consequences of erosion in the study area. The second question on the cause and consequences of soil erosion were involved 8 possible item of yes or no question and the respondents were asked to answer the question based on their perception towards each question. The yes or No questioners item were used to identify some of the factors that determined farmers' perception on the cause and consequences soil erosion.

3.3.3. Focus Group Discussions (FGD)

Additional information was obtained through community group discussions. Focus group discussion was conducted in all three kebeles with 24 selected farmers. In each sample kebeles, discussion groups were comprised of eight people, both males and females of differing ages.

Figure 2 show partial members of focus group discussion at Yito Medaniealem.

3.3.4. Methods of Data Analysis and Presentation

The survey generated both qualitative and quantitative data, the first task was therefore to summaries, categories and code all qualitative responses into numeric values and then enter them in SPSS statistical program. The findings of the study were presented in tables, figures and charts. Some structured household survey data were analyzed using percentages, multiple response (frequency and cross tabulation), and descriptive statistics (frequency and cross tabulation) using the Statistical Package for Social Sciences (SPSS) for Windows 20.

Information obtained from focus group discussion and informal interviews with different elderly people in the kebeles and extension officer were mostly in form of verbal/narrative information. This information is more qualitative in nature and will be used to support the coded qualitative and quantitative data analysis.

CHAPTER FOUR

4. Results and Discussions

4.1 Household Characteristics of the Respondents

From the total 83 respondents 63.9% (53) and 36.1% (30) were male and female respectively. According to the field survey the age-sex composition of the sample population is presented in table (4.1). Accordingly, respondent bellow age 41 constituted 61.5% of the total and above 40 the remaining 37.5%.

Table 4.1 age-sex composition of sample households.

Age group	**Sex of respondents**					
	Male		**Female**		**Total**	
	frequency	**Percent**	**frequency**	**percent**	**frequency**	**Percent**
20-30	-	-	6	7.2	6	7.2
31-40	34	41	11	13.3	45	54.3
41-50	13	15.7	9	10.8	22	26.5
>50	6	7.2	4	4.8	10	12
total	53	63.9	30	36.1	83	100

Source: field survey, 2014.

According to the field survey the distribution of the household by number of person is mainly dominated by household with 4-6 members. The household head with less than or equal to 3 members make up 8.4%. Household with 3-6 members constituted 74.7% and household with 7 and above constituted the remaining 16.9%.

Changes in the distribution of marital status have an important impact on the size and structure of families household. According to the field survey, 92.8% of the respondents were married, 2.8% were widowed and the reaming 2.4% were single.

The level of literacy in the study area was low. Among the literacy category about 22% of the respondents were literate, 78.3 of the respondents could read and write. Only 49.6% of the total had any formal education, either at elementary or/and secondary level. In the study area literacy rate is better compared to the rest of rural area of the country. These differences may be due to

the study kebeles found proximity to Dessie town, urban center where they may be more positive towards and exposure to formal education.

Table: 4.2 Educational levels of sample household head.

Educational level	**Frequency**	**percent**
Illiterate	18	21.7
Adult literacy	21	28.9
Attended elementary education	31	37.3
Attended secondary education	9	10.8
Attended above grade ten	1	1.2
Total	83	100

Source: field survey January, (2014).

4.2 Farmers' Perception on Erosion Problems

4.2.1 Land size, soil futility and land productivity

Land availability often influences farming practice and affects the soil erosion process. In the study area most of the agriculture land has been sub divided to the smallest land holding that area insufficient for small holder subsistence .Farmers' response also revealed the existing land shortage. Out of 83 interviewed farmers, 85.5 percent of the household reported that the land they cultivate is insufficient to support their house hold and they are not imposition to inherit land from their parents when they get married the household land holding have decrease.73.5 percent of sample households have less than 1 hectare of land. More over the land is fragmented (broken up) in to a number of small separate plots, often located at distance from each other.

Farmers recommended the positive solution for this cultivable land scarcity to be involving in non-farm activities such as daily laborers (49.4%) ,increasing the existing land productive by using modern technologies includes improved seed (28.9%), migration to other area (urban area) (14.5%) and going to resettlement (7.2%). None of the farmers suggested expanding cultivable land by cleaning forest and common land. This is agreeing with the finding of KIbemo, (2011).

Farmers posses a detailed knowledge of soil fertility they are cultivating. Farmers in the study area often perceive soil fertility associated with crop yield. About 88 percent of the farmer related yield to the position of slope suitable for cultivation, 49.4 percent of the farmers preferred gentle undulating slope for high yield and 38.6 percent of the respondent farmer chooses moderately stepping slope for high yield, while a few farmer 9 percent and 1 percent of the total respondent, preferred flat and steep slope for high yield respectively. This is due to fear of water logging in flat slope and erosion problem in steep slope land.

According to the field survey 62.7% of the farmers reported decline of the productivity of their land. 25.3% and 12% of the respondent perceived they productivity of their land is improving and constant respectively. They also reported that 49.4% of the respondent farmers perceived that fertility of their land declined and 32.5%mentioned as improving the fertility of their land.

As the farmers indicated the main factors attributed for the decline of the productivity of their land were over cultivation 50.75%, remove of soil by erosion38.5% ,obscene of following 28% and 8.75% high coast of fertilizer mentioned as the causes for decline of their land productivity. Out of 57 cases (26 respondents say no decline in their land productivity). This observation agrees with the findings Aklilu et al., (2004) at Beressa watershed, central highlands of Ethiopia.

Table: 4.3 farmers' perception on causes for land productivity decline.

Causes for productivity decline	**Responses**		
	frequency	**percent**	**Percent of cause**
Absence of fallowing	16	22.2	28
High coast of chemical fertilizer	5	6.9	8.75
Removal of soil by erosion	22	30.6	38.5
Over cultivation	29	40.3	52.75
Total	72	100	126

Source: Field survey, (2014).

4.2.2 Indicator, Causes, Extent and Consequences of Erosion

During the field survey, the respondents were asked two ranking questions regarding to their perception to soil erosion. The first questions were about the cause of soil erosion and the second one was about consequence of soil erosion. Both questions were involved 8 possible ranking choices and the respondents were asked to rank from the highest to the lowest level based on their perception towards each.

Soil erosion was perceived by the farmers in the study area as a problem of farming. Farmers described existence of soil erosion on their land as severe, moderate, minor, and no erosion risk (Table 4.4).The survey showed that 94% of the respondent farmers reported erosion problem on their farm land. The farmers rated the degree of soil erosion problem as sevier 16.9%, moderate 47% and minor 30.1%.While 6% of the respondent reported no erosion problem. This is more than or comparable to the findings of other studies made in different part of the country. For instance, the study made in Gununo Area in the SNNPR Belay, (1992) cited in Habtamu(2006) at the beginning of1990s indicated that about 74% of farmers interviewed perceived soil erosion problem on their cultivation field (Belay, 1992).Recent study in Beressa watershed indicated that among the interviewed farmers reported that erosion problems on their farmland 72% in Debele, 76% in Wushawushign , and 67% in Faji (Aklilu et. la,2004).

Table: 4.4 Farmers' Expression of Soil Erosion by Degree of Severity

Soil Erosion Severity Level	**Frequency**	**percent**	**Cumulative percent**
Severe	14	16.9	16.9
Moderate	39	47	63.9
Minor	25	30.1	94
No erosion risk	5	6	100
Total	83	100	

Source: Field survey, (2014).

As mentioned by the majority of the farmer (Table4.5) the dominant form of erosion in the study area was sheet and rill types .From the farmers who reported erosion problem, 43.6% mentioned the prevalence of sheet erosion, 46.1% mentioned the prevalence of rill erosion .The

two forms of soil erosion together accounted for 89.7% of the total reported prevalence of erosion forms .while gully form of erosion is mentioned by 10.3% ofthe respondent farmers.

However, the majority of the farmers (77.1%) reported that the extent of erosion problem as moderate and minor. From the field observation in Gerado- Bilen and YIto-Medanialem kebeles sheet and rill forms of erosion caused considerable damage to the farmland. Especially in Gerado-Billen kebele due to its slope that is plain land form farmers may have limited understanding of the severity of sheet erosion and this could influences their perception on sheet erosion negatively.

Table 4.5 Dominant forms of erosion in the study area.

forms of erosion	**Frequency**	**Percent**
Sheet	34	43.6
Rill	35	46.1
Gully	8	10.3
Total	83	100

Source: Field survey, (2014).

Figer 3 Root exposure in the study area.

Figer4: Development of rill erosion in the farm land of study area.

Figer 5 shows the development of gully in the study area.

Among interviewed farmers, 53% and 19.3% farmers mentioned the causes for soil erosion as intensity of rain fall and slope steepness of cultivated land respectively (Table 4.6). This is clearly in agreement with the finding of Shibru (2010) on farmer of Limu wereda of Hadiy zone who stated that the main causes for soil erosion are intensity of the rain fall and slope steepness of the cultivated land. In addition Kibemo (2011) study on farmer perception on soil erosion in Sora district slope steepness mention as the main cause for soil erosion. Moreover, deforestation and soil erodibilty mentioned as causes of soil erosion by 10.9% and 8.4% of the respondent farmers respectively. Most farmers did not associate terms of land preparation for cropping as causes for soil erosion in their farm land.

Out of the total possible causes of soil erosion farmers in the study area mentioned intensity of rain fall (53%), slope steepness (19.3%) and deforestation (10.9%) indicated one up to three as the causes of soil erosion in higher percentage than the rest possible causes. In terms of sample kebeles, farmers of Gerado-Bilen reported 26.5%, 7.3%and 6% that intensity of rainfall, deforestation and slope steepness of the cultivation land respectively as the causes of soil erosion in higher percentage. Even if this kebeles is more a flat plain land, absences of forests are plying a major rule in erosion process. Out of the total area this kebeles (3240ha) only 0.92 %(30ha) of land covered by forest. Having large population size (almost mare than 11,000) also exert pressure on the reaming forest resource and aggravate the erosion process significantly. In the reaming two sample kebeles of the study area intensity of rainfall (8.4%),

deforestation (3.6%) and slope steepness of the cultivation land (8.4%) indicated by farmers of Yito-Medanialem, and by farmers of Tita Intensity of rainfall (18.1%), types of soil and erodiblity(7.2) and slope steepness (4.8%) were mentioned as the causes of soil erosion one up to three.

Table (4.7) indicates that the number and percentage distribution of respondent who perceived the main indicators of soil erosion on their land. About 26.5 percent, 27.7 percent, 12 percent of the respondents were mentioned accumulation of dump near to valleys, rill and gully formation, and stoniness of soil and slope steepness as indicator of soil erosion on their farm land. About 7.2 percent of the respondents were mentioned poor crop and grass grow as indicator of soil erosion. Absence of fertilizer and root exposure mentioned as indicators of soil erosion by 4.8% and 3.8 % respondents of the farmers respectively. While the reaming percent that is 6% of the respondent mentioned change of the color of the soil as indicators of soil erosion.

Table: 4.6 Percentage Distribution of Respondent by Their Perception for the Causes of Soil Erosion.

Respondents' perception to the Causes of soil erosion	**Frequency**	**percent**	**Cumulative percent**
Slope steepness of the cultivated land	16	19.3	19.3
Ceaseless cultivation and absence of fallowing	2	2.4	21.7
Types of soil and erodibility	7	8.4	30.1
Intensity of rainfall	44	53	83.1
Absence and delay of soil conservation measures	2	2.4	85.5
Deforestation	9	10.9	96.4
Overgrazing	2	2.4	98.8
Terms of land preparation for cropping	1	1.2	100
Total	83	100	

.Source: field survey, (2014).

Table 4.7 Percentage Distribution of Respondent by Their Perception for the indicators of Soil Erosion.

Erosion indicators	**frequency**	**percent**
Rills and Gully development	22	26.5
Observing the color of soil	5	6
Accumulation of sediments near to valleys	23	27.7
Stoniness of soil	10	12
Slope Steepness	10	12
Absence of fertile topsoil	4	4.8
Root exposure	3	3.8
Poor crop and grass growth	6	7.2
Total	83	100

Source: field survey, (2014).

Generally out of the total respondent more than 50% reported that the main indicators of soil erosion were accumulation of sediments near to valley and rill and gully formation. In the flat/plain slop area of the study kebele farmers were perceived accumulation of dump (soil) near to valley as the main indicate of soil erosion on their land.

According to the field survey almost more than 50% of the farmer in Gerado-Bilen kebele reported that the main indicator of soil erosion were accumulation of dump near to the valley (plain slope) .where as the farmers in the steeply slope study area particularly Tita kebele nearly 50% of the interviewed farmer mention rill and gully formation as the major indicator of soil erosion in their farm land.

Almost 51.8% of interviewed farmers mentioned the effect of soil erosion on their farm land is loss of top soil, about 14.5% and 13.3% of interviewed farmer mentioned the effects of soil erosion is formation of gullies and yield reduction over time respectively. In addition farmers reported that loss of vegetation cover and grass 8.4%, require high input and management (3.6%), Change in soil color (3.6%) , out migration (3.6) and lack of farm land and grazing field (1.6%) as the effects of soil erosion by interviewed farmers in the study area, (see table

4.8).out of the first three reported effects of soil erosion loss of top soil were indicated by almost farmers of Tita (25.3%), Gerado-Bilen(19.3%) and Yito-Medianialem (7.2%) from the total 51.8%.

Table: 4.8 Percentage Distribution of Respondent by Their Perception for the Consequence of Soil Erosion.

Consequences	**Frequency**	**percent**	**Cumulative percent**
Loss of topsoil	43	51.8	51.8
Reduction in yield over time	11	13.3	65.1
Development of gullies	12	14.5	79.6
Loss of vegetation cover and grasses	7	8.4	88
Change in soil color	3	3.6	91.6
Require high input and management	3	3.6	94
Lack of farm land and grazing field	1	1.2	96.4
Desertification, and out migration.	3	3.6	100
Total	83	100	

Source: Field survey, (2014).

4.3 Factors That Influence Farmers' Perception towards the Problem of Soil Erosion

This sections has examined farmers perception to the impact of back ground characteristics such as demographic and socio economic on soil erosion. These characteristics include in this study were the respondents sex, age, household size, educational (literacy) level and farm size of the house hold.

The chi-square of independent was made to know whether or not there was a significance association between the independent variables (perception to the cause and consequence of soil erosion) and a set of explanatory variables with a significant level (P- Value). When P- value is

< 0.05 at, there is a significant association between each of independent variable with dependant variable.

4.3.1 Analysis of data on farmer's perception to the causes and consequences of soil erosion

During the field survey, the yes or no questioners item were used to identify some of the factors that determine farmers' perception on the cause and consequence soil erosion.

The first questions were about the cause of soil erosion and the second one was about consequence of soil erosion. Both questions are involved 8 possible item of yes or no question and the respondents were asked to answer the question based on their perception towards each question.

4.3.1.1 Relationship between Respondents Age and perception about the causes and consequence of soil erosion.

Table (4.9) show that among young farmers 84.3%72.5%, ,51%,39.2% and 41.2% were reported that they are perceived soil erosion caused by deforestation, intensity of rain fall, slope steepness of the cultivation land, overgrazing and terms of land preparation for cropping, respectively . On the other hand old age group (> 40) farmers who accounted for 62.5% (absences and delay of soil conservation measure),53.1 %(ceaseless cultivation and absences of fallowing) and 40.6% (types of soil and erodibility) mentioned as the causes of soil erosion in higher percentage than the young age farmers. Generally, Chi square test indicate that a significant association was found between age of the respondents and perception in related to the causes of soil erosion in only two causes of soil erosion (Over grazing and deforestation and desertification) (X^2 = 9.548 at $p<0.05$ and X^2 = 6.828 at $p<0.05$).

Table: (4.9) chi-square distribution of respondents age and perception towards the causes of soil erosion (at one degree of freedom).

Causes of soil erosion	**Age categories**								**X^2**	**p-value**
	20-40				**>40**					
	Yes		**No**		**Yes**		**No**			
	Freq.	**Perce.**	**Freq.**	**Perce.**	**Freq.**	**Perce.**	**Freq.**	**Perce.**		
Slope steepness of the cultivation land	26	51	25	49	15	46.9	17	53.1	0.113	0.176
Ceaseless cultivation and absences of fallowing.	23	45.1	28	54.9	17	53.1	15	46.9	0.507	0.476
Types of soil and erodibilty.	16	31.4	35	68.6	13	40.6	19	59.4	0.740	0.390
Intensity of rainfall.	37	72.5	14	27.5	18	56.2	14	43.8	2.337	0.126
Absence and delay of soil and water conservation measure	37	44.6	14	27.5	20	62.5	12	37.5	0.923	0.337
Deforestation And desertification	43	84.3	8	15.7	17	53.1	15	46.9	9.548	0.002**
Overgrazing.	20	39.2	31	60.8	4	9.3	28	87.5	6.828	0.009**
Terms of land preparation for cropping	21	41.2	30	58.8	13	40.6	19	59.4	0.002	0.960

Sources: Field survey, (2014). ** Statistically significant.

According to the field survey young age group (20-40) farmers seems better in their understanding than old age (> 40) farmers in 5 possible consequence of soil erosion.

Table (4.10) show that among young farmers which accounted 47.1%of them repeated that (loss of top oil), 52.9% (reduction of yield over time), 60.8 %(formation of gullies), 33.3 %(change in soil color) and 45.1 %(desertification and out migration) perceived that as consequence of soil erosion in better percentage than their counter parts.

Table: (4.10) chi-square distribution of respondents in their age and perception towards the consequence of soil erosion (at one degree of freedom).

Effects of soil erosion	**Age categories**								**X^2**	**p-value**
	20-40				**>40**					
	Yes		**No**		**Yes**		**No**			
	Freq.	**Perce.**	**Freq.**	**Perce.**	**Freq.**	**Perce.**	**Freq.**	**Perce.**		
Loss of top soil.	24	47.1	27	52.9	8	25	24	75	4.039	0.044**
Reduction in Yield over time.	27	52.9	24	75	24	47.1	8	25	4.039	0.044**
Reproduction gullies.	31	60.8	20	39.2	10	31.2	22	68.2	6.681	0.009**
Loss of Vegetation cover and grasses	25	49	26	51	23	71.9	9	28.1	4.212	0.040**
Change in soil Color.	17	33.3	34	66.7	4	12.5	28	87.5	4.515	0.034**
Require high input and management.	19	37.3	32	62.7	17	53.1	15	46.9	2.016	0.156
Lack of farm land and grazing	28	54.9	23	45.1	21	65.6	11	34.4	0.935	0.334
Desertification and out migration.	23	45.1	28	54.9	14	43.8	18	56.2	0.014	0.904

Sources: Field survey, (2014). ** Statistically significant.

On other hand old age group (>40) farmers are better in perceiving loss of vegetation and grass, require high input and managements and lack of farm and grazing land. A significant association was found between age and their perception in related to the 8 possible consequences of soil erosion on five possible consequences of soil erosion. (X^2 =4.039 at $p<0.05$, X^2 = 4.039 at $p<0.05$, X^2 = 6.681 at $p<0.05$, X^2 = 4.212 at $p<0.05$ and X^2 = 4.515 at $p<0.05$) (See table 4.10).

4.3.1.2 Relationship between respondents' sex and perception about the causes and consequence of soil erosion.

Table (4.11) shows that Among male farmers 71.7%(intensity of rainfall), 71.7%(deforestation and desertification) ,52.8%(terms of land preparation)were found better in percentage perceived as a causes of soil erosion than a female farmers. The female farmers were better perceiving the causes of soil erosion in higher percentage in slope steepness of the cultivated land (53.3%), Ceaseless cultivation and absences of fallowing (60%), types of soil and erodibilty (40%), deforestation and desertification (73.3%) and Overgrazing (30%) than their counter parts.

Generally, Chi square test indicate that a significant association was found between sex of the respondents and perception in related to the causes of soil erosion in only in the terms of land preparation for cropping (X^2 = 8.538 at $p<0.05$). (See table 4.11).

Table: (4.11) chi-square distribution of respondents in their sex and perception towards the causes of soil erosion (at one degree of freedom).

Causes of soil erosion	**sex categories**								X^2	**p-value**
	Male				**Female**					
	Yes		**No**		**Yes**		**No**			
	Freq.	**Perce.**	**Freq.**	**Perce.**	**Freq.**	**Perce.**	**Freq.**	**Perce.**		
Slope steepness of the cultivation land	25	47.2	28	52.8	16	53.3	14	46.7	0.291	0.589
Ceaseless cultivation absences of fallowing.	22	41.5	31	58.5	18	60	12	40	2.623	0.105
Types of soil and erodibilty.	17	32.1	36	67.9	12	40	18	60	0.529	0.467
Intensity of rainfall.	38	71.7	15	28.3	17	56.7	13	43.3	1.936	0.164
Absence and delay of soil and water conservation measure	38	71.7	15	28.3	19	22.9	11	36.7	0.623	0.430
Deforestation desertification	38	71.7	15	28.3	22	73.3	8	26.7	0.026	0.873
Overgrazing.	15	28.3	38	71.7	9	30	21	70	0.027	0.870
Terms of land preparation for cropping	28	52.8	25	30.1	6	20	24	28.9	8.538	0.03**

Sources: Field observation, (2014). ** Statistically significant

Table: (4.12) chi-square distribution of respondents in their sex and perception towards the consequence of soil erosion. (at one degree of freedom).

Effects of soil erosion	Sex								X^2	p-value
	Male				Female					
	Yes		No		Yes		No			
	Freq.	Perce.	Freq.	Perce.	Freq.	Perce.	Freq.	Perce.		
Loss of top soil.	23	43.4	30	56.6	9	30	21	70	1.451	0.228
Reduction in yield over time.	29	54.7	24	45.3	22	73.3	8	26.7	2.802	0.094
Reproduction of gullies.	31	58.5	22	41.5	10	33.3	20	66.7	4.850	0.028**
Loss of Vegetation Cover and grasses.	31	58.5	22	41.5	17	56.7	13	43.3	0.026	0.872
Change in soil color.	15	28.3	38	71.7	6	20	24	80	0.699	0.403
Require high input and management	24	45.3	29	54.7	12	40	18	60	0.218	0.641
Lack of farm land and grazing	25	47.2	28	52.8	24	80	6	20	8.538	0.003**
Desertification and out Migration.	24	45.3	29	54.7	13	43.3	17	56.7	0.029	0.864

Sources: Field observation, (2014). ** Statistically significant.

Table 4.12 indicated that male farmers were found better in perception in five possible consequence of soil erosion than their counter parts. Generally, Chi square test indicate that a

significant association was found between sex of the respondents and perception in related to the effects of soil erosion in only in two possible effects of soil erosion (X^2 = 4.850 at P<0.05 andX^2 =8.538 at p<0.05 reproduction of gully and lack of farm land and grazing land)

4.3.1.3 Relationship between respondents' Literacy status /Education level and perception about the causes and consequence of soil erosion.

The literacy status of farmers is useful to know their perception about the current soil erosion problem. The data presented in Table ,(4.13) indicated that literate farmers were found better in perception in four possible causes of soil erosion than in their counter parts ceaseless cultivation and absence of fallowing(39.8%), absence and delay of soil conservation measure(69.2%), 80 %(deforestation and desertification), 47.7 %(terms of land preparation).

Generally, Chi square test indicate that a significant association was found between literacy states of the respondents and perception in related to the causes of soil erosion in only in three possible causes of soil erosion (X^2 = 6.209 at P<0.05,X^2 =8.896 at p<0.05and X^2 = 5.611 at P<0.05 ceaseless cultivation and absence of fallowing, deforestation and desertification and terms of land preparation respectively).

This clearly provides support for the findings of Shibru (2010) who stated that education is one factor which appears to have an influence on local people's perception towards the causes of soil erosion. He found that the educated rather than the uneducated perceived deforestation as causes of soil erosion in his study area. In addition (Barrow 1995, Abiy 2002, Shibru 2002 and Challachew 2004) cited in Tadele(2008) showed that, farmers with higher educational levels are expected to be better in perception and response to soil erosion and deforestation problems.

Table (4.13) Chi-square distribution of respondents in their literacy status and perception towards the causes of soil erosion (at one degree of freedom).

Causes of soil erosion	**Education levels of the house hold head**								X^2	**p-value**
	illiterate				**literate**					
	Yes		**No**		**Yes**		**No**			
	Freq.	**Perce.**	**Freq.**	**Perce.**	**Freq.**	**Perce.**	**Freq.**	**Perce.**		
Slope steepness of the cultivation land	10	55.6	8	44.4	31	47.7	34	52.3	0.349	0.555
Continuous cultiv and absences of fallowing.	4	22.2	14	32.6	36	55.4	29	67.4	6.209	0.013**
Types of soil and erodibilty.	8	44.4	10	55.6	21	32.3	14	67.7	0.913	0.339
Intensity of rainfall.	14	77.8	4	22.2	41	63.1	24	36.9	1.363	0.243
Absence and delay of soil and conservation measure	12	66.7	6	33.3	45	69.2	20	30.8	0.043	0.836
Deforestation and desertification	8	44.4	10	55.6	52	80	13	20	8.896	0.003**
Overgrazing.	7	38.9	11	61.1	17	26.2	48	73.8	1.112	0.292
Terms of land preparation for cropping	3	16.7	15	83.3	31	47.7	34	52.3	5.611	0.018**

Source: field survey, (2014 ** statistically significant.

The literacy status of farmers also influences their perception about the consequence of soil erosion. The literate farmers were found better in perceiving five possible consequences of soil

erosion in higher percentage than their counter parts. These includes loss of top soil, reproduction of gullies, loss of vegetation cover and grasses, change in soil color and desertification and out migration (See Table 4.14).

Table: (4.14) chi-square distribution of respondents in their literacy status and perception towards the consequence of soil erosion (at one degree of freedom).

Effects of erosion	**Education levels of the house hold head.**								**X^2**	**p-value**
	illiterate				**literate**					
	Yes		**No**		**Yes**		**No**			
	Freq.	**Perce.**	**Freq.**	**Perce.**	**Freq.**	**Perce.**	**Freq.**	**Perce.**		
Loss of top soil.	1	5.6	17	94.4	31	47.7	34	52.3	10.565	0.001**
Redaction in yield over time.	12	66.7	6	33.3	39	60	26	40	0.264	0.607
Reproduction gullies.	6	33.3	12	66.7	35	53.8	30	46.2	2.373	0.123
Loss of vegetation cover and grasses.	8	44.4	10	55.6	40	61.5	25	38.5	1.689	0.194
Change in soil color.	2	11.1	16	88.9	19	29.2	46	70.8	2.449	0.118
Require high input and management.	12	66.7	6	33.3	24	36.9	41	63.1	5.078	0.024**
Lack of farm land and grazing land	12	66.7	6	33.3	37	56.9	28	43.1	0.553	0.457
Desertification out migration	2	11.1	16	88.9	35	53.8	30	46.2	10.42	0.001**

Sources: Field observation, (2014 ** statistically significant.

Generally, Chi square test indicate that a significant association was found between literacy status of the respondents and perception in related to the effects of soil erosion in only in three possible effects of soil erosion (X^2 = 10.565at P<0.05,X^2 =5.078at p<0.05and X^2 =10.420 at P<0.05 loss of top soil, require high input and management and desertification and out migration respectively).

4.3.1.4 Relationship between respondents' house hold size and perception about the causes of soil erosion.

According to the field survey the distribution of the house hold by number of person is mainly dominated by house hold with up to seven members' .The data presented in table (4.18) show that nearly 83.1% of the respondent had at least six house hold members. The remaining respondent had more than six members. Among the respondent of household with size up to six members had better perception in higher percentage than their counter parts in five possible causes of soil erosion.

Generally, Chi square test indicate that a significant association was found between house hold size of the respondents and perception in related to the causes of soil erosion in only in one possible causes of soil erosion (X^2 = 8.505 P<0.05 absences and delay of soil conservation and measure).see table 4.15

Table: 4.15 chi-square distribution of respondents in their size of household and perception towards the causes of soil erosion. (at one degree of freedom)

Causes of soil erosion	**Size of house hold**								**X^2**	**p-value**
	Up to 6 members				**More than 6 members**					
	Yes		**No**		**Yes**		**No**			
	Freq.	**Perce.**	**Freq.**	**Perce.**	**Freq.**	**Perce.**	**Freq.**	**Perce.**		
Slope steepness of the cultivation land	34	49.3	35	50.7	7	50	7	50	0.002	0.961
Continuous cultivation and Absences of fallowing.	32	46.4	37	53.6	8	51.1	6	42.9	0.540	0.462
Types of soil and erodibilty.	26	37.7	43	62.3	3	21.4	11	78.6	1.352	0.245
Intensity of rainfall.	47	68.1	22	31.9	8	57.1	6	42.9	0.627	0.428
Absence and delay of soil and water conservation measure	52	75.4	17	24.6	5	35.7	9	64.3	8.505	0.004**
Deforestation and desertification	51	73.9	18	26.1	9	64.3	5	35.7	0.539	0.463
Overgrazing.	21	30.4	48	69.6	3	21.4	11	78.6	0.459	0.498
Terms of land preparation for cropping	28	40.6	41	59.4	6	42.9	8	57.1	0.025	0.874

Sources: Field survey, (2014). ** Statistically significant.

Table 4.16 showed that among the respondent households with the size of greater than six members were found better in perceiving on five the total possible consequences of soil erosion in higher percentage than their counter parts. They reported that reduction in yield over time (92.9%), formation of gullies (57.1%), loss of vegetation cover and grass (64.3%), change in soil color (85.7%) and lack of farm and Grazing land (85.7%) as the effects of soil erosion.

Table: (4.16) chi square distribution of the respondents in their house hold size and perception towards the consequence of soil erosion.

Effects of soil erosion	**Size of house hold.**								X^2	**p-value**
	Up to six members				**More than six members.**					
	Yes		**No**		**Yes**		**No**			
	Freq.	**Perce.**	**Freq.**	**Perce.**	**Freq.**	**Perce.**	**Freq.**	**Perce.**		
Loss of top soil.	28	40.6	41	59.4	4	28.6	10	71.4	0.708	0.400
Redaction in Yield over time.	38	55.1	31	44.9	13	92.9	1	7.1	7.014	0.008**
Reproduction of gullies.	33	47.8	36	52.2	8	57.1	6	42.9	0.404	0.252
Loss of Vegetation Cover and grasses.	39	56.5	30	43.5	9	64.3	5	35.7	0.288	0.592
Change in soil color.	18	26.1	51	73.9	3	21.4	11	78.6	0.134	0.715
Require high input and management	24	34.8	45	65.2	12	85.7	2	14.3	12.292	0.000**
Lack of farm land and grazing land	37	53.6	32	46.4	12	85.7	2	14.3	4.956	0.26
Desertification and out migration	32	46.4	37	53.6	5	35.7	9	64.3	0.536	0.464

Sources: Field survey, (2014). ** Statistically significant.

4.3.1.5 Relationship between respondents' farm size and their perception about the causes of soil erosion.

According to the field survey, about 73.5% of the respondent has less than or equal to one hectare of land and only 26.5% had more than 1 hectare of land. The data presented in table 4.18 showed that among the farmers who have less than 1 hectare of land found better in perceiving in four possible causes of soil erosion and reported that 55.7% (ceaseless cultivation absence of fallowing), 41%(types of soil erodibility), 75.4 %(intensity of rain fall) and 41%(terms of land preparation for cropping) as the causes of soil erosion in higher percentage than the farmers who has more than one hectors of land.

Generally, Chi square test indicate that a significant association was found between farm land size of the respondents and their perception in related to the effects of soil erosion in only in three possible causes of soil erosion (X^2 =6.518 at P<0.5 X^2 = 5.247at P<0.5 X^2 = 8.609 at P<0.5 slope steepness of the cultivated land, ceaseless cultivation absence of fallowing and intensity of rain fall respectively). (See table 4.17).

Table: 4.17 Chi sequence distribution of the respondents in their farm size and perception towards the causes of soil erosion.

Causes of soil erosion	**Size of farm land**								**X^2**	**p-value**
	Up to one hectare				**More than one hectare.**					
	Yes		**No**		**Yes**		**No**			
	Freq.	**Perce.**	**Freq.**	**Perce.**	**Freq.**	**Perce.**	**Freq.**	**Perce.**		
Slope steepness Of the cultivation land	25	41	36	59	16	72.7	6	27.3	6.518	0.011**
Continuous cultivation and absences of fallowing.	34	55.7	27	44.3	6	27.3	16	72.7	5.247	0.022**
Types of Soil and erodibilty.	25	41	36	59	4	18.2	18	81.8	3.698	0.054

Intensity of rainfall.	46	75.4	15	24.6	9	40.9	13	59.1	8.609	0.003**
Absence and delay of soil and water conserv measure	41	67.2	20	32.8	16	72.7	6	27.3	0.229	0.633
Deforestation and desertification	44	72.1	17	27.9	16	72.7	6	27.3	0.003	0.957
Overgrazing.	15	24.6	46	75.4	9	40.9	13	59.1	2.095	0.148
Terms of land preparation for cropping	25	41	36	59	9	40.9	13	59.1	0.000	0.995

Sources: Field survey February, (2014). ** Statistically significant.

Table 4.18 indicated that among the farmers who have less than or equal to 1 hectare of land perceived the consequence of soil erosion as loss top soil (49.2%), reduction yield over time (70.5%) loss of vegetation cover and grass (65.6%), change in soil color (26.2%), desertification and out migration (47.5%) and lack of farmland and grazing land (60.7%) in higher percentage than farmers who had more than 1 hectare of land. They also found better in perception in six of possible effects of soil erosion in higher percentage than their counter parts. Generally, Chi square test indicate that a significant association was found between farm land size of the respondents and perception in related to the effects of soil erosion in only in five possible effects of soil erosion (X^2 =10.969 at P<0.05 X^2 = 7.949 at P<0.05 X^2 = 12.587 at P<0.05X^2 = 5.657 at P<0.05 X^2 = 7.501 at P<0.05 loss top soil, reduction yield over time ,formation of gullies , loss of vegetation cover and grass and require high input and managements respectively.(see table 4.18)

Table: 4.18 chi-square distribution of respondents in their farm land size and perception towards the consequence of soil erosion

Effects of soil erosion	**Size of farm lands.**								X^2	**p-value**
	Up to one hectare				**More than one hectare**					
	Yes		**No**		**Yes**		**No**			
	Freq.	**Perce.**	**Freq.**	**Perce.**	**Freq.**	**Perce.**	**Freq.**	**Perce.**		
Loss of top soil	30	49.2	31	50.8	2	9.1	20	90.9	10.969	0.001**
Redaction in yield over time.	43	70.5	18	29.5	8	36.4	14	63.6	7.949	0.005**
Reproduction of gullies.	23	37.7	38	62.3	18	81.8	4	18.2	12.587	0.000**
Loss of vegetation cover and grasses.	40	65.6	21	34.4	8	36.4	14	63.6	5.657	0.017**
Change in soil color.	16	26.2	45	73.8	5	22.7	17	77.3	0.105	0.746
Require high input and management	21	34.4	40	65.6	15	68.2	7	31.8	7.501	0.006**
Lack of farm land and grazing land	37	60.7	24	39.3	12	54.5	10	45.5	0.250	0.617
Desertification And out migration	29	47.5	32	52.5	8	36.4	14	63.6	0.818	0.366

Sources: Field survey, (2014). ** Statistically significant.

4.4 Training on soil erosion and conservation practices

According to the field survey and discussion with farmers, they have knowledge on causes, extents and consequences of soil erosion on their living with different level. Farmers who had no access to training gained experience from their neighbors and traditionally from their elders. Farmers adjacent to each other can acquire experience in either strength or weakness of specific soil conservation measures from nearby farmers and neighboring kebeles. About 81% of the surveyed farmers got training on soil conservation applications and from these 65 .1% have got only a limited training and only 15.7 % have received adequate training (Table 4.19). About 19.2% of the surveyed farmers did not get training.

Farmers require training on soil and water conservation, crop production and yield maximization, yield storage system, enhancing soil fertility and land tenure and land use. The construction soil conservation structure requires relatively frequent training and support. In the study area there were construction of structural soil conservation particularly bunding (soil and stone) in steep slope area, stone terrace and cheeks dam along in gullies developed area with the participation farmers and DAs.

Table: 4.19 Percentage distributions of respondents in their getting training on soil and water conservation practices.

Training on soil and water conservation	**Frequency**	**Percent**	**cumulative frequency**
Always	13	15.7	15.7
Sometimes	54	65.1	80.8
Never	16	19.2	100
Total	83	100.0	

Sources: Field survey, (2014).

Table 4.20 indicated that with the application of conservation measure and its changes observe in the study area about 51.8% of the respondents mentioned that they could prevent soil erosion after they apply conservation measures on their farm lands .Hence due to application of water

and soil conservation measures land cover condition in the study area were improved. Among the total respondents 26.4% reported such changes. Many farmers mentioned referred the changes observed in their farm lands after soil water and conservation measure was taken. These includes 20.9 %(Increase soil fertility) and 20.9 %(Increase in land productivity) are the changes they observe as the result of conservation measure.

Table: 4.20 percentage distribution of changes because of conservation practices.

Changes	**Frequency**	**Responses**	
		percent	**Percent of Case**
Increased soil fertility	23	17.4	27.7
Increased in land cover	29	22	34.9
Increased in land productivity	23	17.4	27.7
Prevented soil erosion	57	43.2	68.7
Total	132	100	159

Sources: Field survey, (2014).

Farmers' willingness to use soil and water conservation (SWC) practices is largely determined by their knowledge of the problem of soil erosion. The results of field survey showed that about 94 % of the farmers recognized soil erosion problems, and were of the opinion that conservation was necessary. Out of the total respondent 96.4% believe that erosion can be controlled if necessary conservation measures are applied. In addition 98.8%of the respondents reported that with the application of conservation measures crop yield can be increased.

The measures mentioned include stone terraces, drainage ditches, bunding, contour plowing, Vegetative and crop cover, strip-cropping and tree planting (Table 4.21). Check dams, terracing / bunding and tree planting constituted the most important local conservation measures.

Table: 4.21percentage distribution of types of practiced conservation methods.

Conservation Methods	Responses		
	frequency	**percent**	**Percent of case**
Cultivation along the contour	23	10.6	27.7
Terracing	49	22.5	59
Strip-cropping along the contour	10	4.5	12.2
Bunding	35	15.9	42.2
Vegetative and crop cover	19	8.5	22.9
Drainage ditches	20	9.1	24.1
Tree planting	25	11.4	30
Check dams	39	17.7	46.9
Total	220	100	265

Sources: Field survey, (2014).

Soil (stone) bund is an embankment or ridge built across a slope along the contour. Soil bunds are made of soil or mud. On moderately sloping areas the farmers construct the soil bunds for erosion control. In the study area 42.2% of the respondents have constructed soil and stone bunds (Table 4.21), in the common eroded lands especially in hilly areas, farmers constructed bunds because of the cash they would earn from a safety net program. Check dams for the gully control in the study areas made of stones, soils or brush-woods. Figure 7 showed that checks dams constructed by the farmers of Tital kebele. This type of gully control measure was practiced by 46.9% by the respondents in the study area and about 0.75km in the study area. Figure 8 also showed that the constructed check dams that used to control soil erosion slope area of Tita kebele.

On steep eroded bare lands stone terraces are most used structures in study area (59%). According to the Dessie town office of agriculture Gerado-Bilen,Yito-Medanialem and Tita sample kebeles ,15k.m,10 km and 64 km stone terraces were constructed respectively. As it is stated by key informants during focus group discussion the stone terraces are considered effective in erosion control in slope areas, although it is labor-intensive, hosts rodents, and returns investment only gradually.

Trees are planted along the contour sometimes together with other conservation practices. This type of conservation method is applied by 30% of the respondents in order to reduce runoff and conserve the soil and water round the root of the plants. Trees help to preserve fertility of the soil through the return of organic matter and the fixation of nitrogen. They improve soil's structure and help to maintain high infiltration rates and greater water holding capacity. As a result less runoff is generated and erosion is better controlled (akililu, 2004). In certain study areas, lands are closed off to livestock to protect it from grazing and planted with trees for regeneration.

Drainage ditches are one of the widely used soil and water conservation practices in the study area and also known as traditional ditches. Locally farmers in the study area, call the drainage ditches "boye". These are micro channels constructed on cultivated farms to drain off excess water and control soil erosion. Out of total respondents, 24.1% applied indigenous drainage ditches. These are low cost measures in which construction is part of the normal ploughing activity.

Leaving crop residues on the field after harvest is another traditional practice used by the farmers in the area. The survey results showed that only 22.9% of the farmers implemented this type of measure to improve the fertility of soil and there by protect soil from erosion.

Strip cropping refers to the practice of growing crops in alternate strips of row crops or forage/grass. This cropping system is an effective practice to reducing soil erosion because it breaks sloping landscapes in wide segments with diverse vegetative cover which intercepts runoff and promotes water infiltration, thereby reducing runoff and soil erosion. In the study area from the sample farmers 12.2 % applied this method**.**

Contour ploughing is a practice of tilling the land along the contours of the slope in order to reduce the runoff on a steep sloping land. Cultivation along the contour is the practice of tilling, planting, and performing all agricultural operations following the contour lines of the field slope. In the study area of all the sample hose holds 27.7 % applied this structure and carried out using the ox-drawn plough. Hence, it is part of the normal farming activity; it needs no extra labor and time for construction.

Figure 6: that the construction of stone terraces

Figure 7: show that construction check dam by farmers.

Figure 8 check dam made by stone and soil.

4.5 Respondents' Information Sources on soil and water conservation practices.

Table 4.22 shows the information sources of the respondents on soil and water conservation practices. The result shows that DAs and extension agents were indicated by the respondents' as a most significant source of information. About 71.1% of the respondents used DAs and extension agents as a source. While 20% of the respondents indicated they are traditionall sources and 8.4% neighbors use as sources of information on soil and water conservation practice.

Table 4.22: Percentage Distribution of Respondents in their Information sources about soil and water conservation practices.

Sources of information	Frequency	Percent	Cumulative percent
Traditionally	17	20.5	20.5
From neighbors	7	8.4	28.9
From DAs and experts	59	71.1	100
Total	83	100.0	

Sources: Field survey, (2014).

4.6 Farmers' Contact with Development Agents (DAs)

Access for information and contact with DA has a role on the practice of soil conservation measures and to adopt new technology. Having good relation with DA helps farmers in reducing hazard associated with soil erosion and conservation strategy by providing information. Among respondent farmers, 95.2% have contact with development agents. Of these farmers, 16.9%, 47% and 31.3% had contact with DAs limited, good and very good respectively table. However, 4.8% of farmers have no contact with development agents and other soil conservation experts.

Table: 4.23 percentage distribution of respondents in their degree of contacts with DAs.

Degree of contact with DAs	Frequency	Percent	Cumulative Percent
very good	26	31.3	31.3
Good	39	47	78.3
Limited	14	16.9	95.2
None	4	4.8	100
total	83	100.0	

Sources: Field survey, (2014)

CHAPTER FIVE

5. Summary Conclusions and Recommendations

5.1 Summary

Soil erosion is one of the major agricultural problems in the highlands of Ethiopia. The Ethiopian highlands, which are the center of major agricultural and economic activities, have been the victim of soil erosion for many years. The result of the present study show that over 90%of the farmers in the study area recognized soil erosion problems and have no problem of perceiving the existence of soil erosion by water. Sheet and rill erosion were the dominants forms of erosion reported by 89.1% of the respondents farmers.

Farmers' posse detailed knowledge of soil fertility they cultivate. They perceive soil fertility associated in with crop yield and related yield with to the position of slope suitable for cultivation. They preferred gentle and undulating slope and moderately steeping slope for high yield. They also indentify arrange of factors attribute for the decline of their land productivity includes over cultivation, removal of soil by erosion, absences of fallowing and high coasts of fertilizer.

Farmers recognized a various forms of erosion indicators existing over the land scope and adversely affect their soil. These indicators include accumulation of sediments, rill and gully formation, root exposure, poor cropland grass growth, slope steepness, stones of soil and color change. As a farmer noted accumulation of sediments is a vital indicator of soil erosion and followed by rill and gully development.

Factors like intensity of rain fall, slope steepness of the cultivation land ,ceaseless cultivation and absence of fallowing, types of soil and erodibility , absence and delay of soil conservation measure, deforestation and desertification ,overgrazing and terms of land preparation for cropping were recognized by farmers as the causes of soil erosion. As farmers note, intensity of rain fall, slope steepness, and deforestation and desertification have been mentioned by more than 80 percent of farmers as vital causes of soil erosion. However, other causes such as Ceaseless cultivation and absence of fallowing, over grazing, absence and delay of soil conservation measure and terms land preparation for cropping are appeared have been highly

undermine. A type of soil and erodibilty as causes of soil erosion has been mentioned by 8.4 percent of the respondents.

The extent and consequences of soil erosion have been explained comparatively and they mentioned the effects of soil erosion in both on and off site effects of soil erosion. These include loss of top soil, reduction in yield over time, formation of gullies and rills, loss of vegetation cover and grasses, change in soil color, require high input and management, lack of farm land and grazing field and desertification and out migration. Among the consequence of soil erosion as noted by farmers, losses of top soil have been mentioned by half of the respondents as the major effects of soil erosion. Formation of gullies and reduction in yield over time occupies the second and third position mentioned as effects by 14.5% and 13.3% of the respondents respectively. However loss of vegetation cover and grass as the effects of the soil erosion have been reported by 8.4% of the respondents and occupies the fourth positioned. Effects of soil erosion like change in soil color require high input and management and migration and out migration have been reported in equal amount of percentage (3.6%).lack of farm land and grazing field as effects of soil erosion has been mentioned by 1.2%of the respondents and occupies the last position.

In the study area farmers use a range of methods for soil erosion control. Among them, Terracing, check dams, and bunding (soil and stone) constitute the most widely used techniques and mentioned by 59%, 46.9% and 42.2% the respondents' farmer. Others conservation measures practices in the study area includes tree planting 30%, contour plowing 27.7%, drainage ditches24.1%, vegetative and crop cover 22.9% stripe cultivation12% mentioned by the respondents farmers.

DAs have been mentioned by all of the respondents as source of information in soil and water conservation practices. About 71.1% of the respondents used DAs and extension agents as a source of information for soil and water conservation practices. From traditionally and neighbors as sources were mentioned by only 20% and 8.4% of the respondents, respectively. Majority of farmers in the study area have contacts with DAs and have good interaction with DAs.

5.2 Conclusion

Farmers 'perception towards the problem of soil erosion have been influenced by different factors. The most important and considered factors in this study include age ,sex, literacy status, house hold size and land size of the respondents. The major finding of this study with respect to perception of farmers on the problems soil erosion includes the following.

- Young age farmers have been found better perceiving in higher percentage than the old age farmers in 5 possible causes of soil erosion and Chi square test indicate that a significant association was found between age of the respondents and perception in related to the causes of soil erosion in only two causes of soil erosion (Over grazing and deforestation and desertification (X^2 = 9.548 at $p<0.05$ and X^2 = 6.828 at $p<0.05$.) According to the filed survey young age group (20-40) farmers seems better in their perception than old age (> 40) farmers in 5 possible consequence of soil erosion .A significant association was found between age and their perception in related to the 8 possible consequences of soil erosion on five possible consequences of soil erosion. (X^2 =4.039 at $p<0.05$, X^2 = 4.039 at $p<0.05$, X^2 = 6.681 at $p<0.05$, X^2 = 4.212 at $p<0.05$ and X^2 = 4.515 at $p<0.05$) loss of top soil ,reduction in yield over time, reproduction of gullies, loss of vegetation cover and grasses and change in soil color respectively.
- The female farmers were better perceiving the causes of soil erosion in higher percentage in slope steepness of the cultivated land (53.3%), Ceaseless cultivation and absences of fallowing (60%), types of soil and erodibilty (40%), deforestation and desertification (73.3%) and overgrazing (30%) than their counter parts. However , Chi square test indicate that a significant association was found between sex of the respondents and perception in related to the causes of soil erosion in only in the terms of land preparation for cropping (X^2 = 8.538 at $p<0.05$).Male farmers were found better in perception in five possible consequence of soil erosion than their counter parts. Generally, Chi square test indicate that a significant association was found between sex of the respondents and perception in related to the effects of soil erosion in only in two possible effects of soil erosion (X^2 = 4.850 at $P<0.05$ andX^2 =8.538 at $p<0.05$ reproduction of gully and lack of farm land grazing land)

- The result of the study indicated that literate farmers were found better in perception in four possible causes of soil erosion in higher percentage than in their counter parts. These include continuous cultivation and absence of fallowing (39.8%), absence and delay of soil conservation measure (69.2%), 80 %(deforestation and desertification), 47.7 %(terms of land preparation). However, Chi square test indicate that a significant association was found between literacy states of the respondents and perception in related to the causes of soil erosion in only in three possible causes of soil erosion (X^2 = 6.209 at P<0.05,X^2 =8.896 at p<0.05and X^2 = 5.611 at P<0.05 ceaseless cultivation and absence of fallowing, deforestation and desertification and terms of land preparation respectively). The literate farmers were found better in perceiving five possible consequences of soil erosion in higher percentage than the counter parts .These include(47.7%) loss of top soil, (53.8)reproduction of gullies,(61.5%) loss of vegetation cover and grasses,(29.2%)change in soil color and (53.8%)desertification and out migration. However, Chi square test indicate that a significant association was found between literacy states of the respondents and perception in related to the effects of soil erosion in only in three possible effects of soil erosion (X^2 = 10.565at P<0.05,X^2 =5.078at p<0.05and X^2 =10.420 at P<0.05 loss of top soil, require high input and management and desertification and out migration respectively).
- Nearly 83.1 percent of the respondents' farmers had at least 6 houses hold members and had better perception in higher percentage than their counter parts in five possible causes of soil erosion. Generally, Chi square test indicate that a significant association was found between house hold size of the respondents and perception in related to the causes of soil erosion in only in one possible causes of soil erosion (X^2 = 8.505 P<0.05 absences and delay of soil conservation and measure) . The results of this study show that among the respondents house hold with the size of greater than six members were found better in perceiving on five of the total possible consequences of soil erosion in higher percentage than their counter parts. They reported reduction in yield over time (92.9%), formation of gullies (57.1%), loss of vegetation cover and grass (64.3%), change in soil color (85.7%) and lack of farm and grazing land (85.7%). However , Chi square test indicate that a significant association was found between house hold size of the respondents and perception in related to the effects of soil erosion in only in two

possible effects of soil erosion (X^2 = 7.014 P<0.05 X^2 =12.292 P<0.05 reduction yield over time and change in soil color.

- Farmers who have less than or equal to 1 hectare of land have been perceived the consequence of soil erosion as loss top soil (49.2%), reduction yield over time (70.5%) loss of vegetation cover and grass (65.6%), change in soil color (26.2%), desertification and out migration (47.5%) and lock of farmland and grazing land (60.7%) in higher percentage than farmers who had more than 1 hectare of land. They also found better in perception in six of possible effects of soil erosion in higher percentage than their counter parts. Generally, Chi square test indicate that a significant association was found between farm land size of the respondents and perception in related to the effects of soil erosion in only in five possible effects of soil erosion (X^2 =10.969 at P<0.05 X^2 = 7.949 at P<0.05 X^2 = 12.587 at P<0.05X^2 = 5.657 at P<0.05 X^2 = 7.501 at P<0.05 loss top soil, reduction yield over time, formation of gullies, loss of vegetation cover and grass and require high input and managements respectively.

5.3 Recommendations

On the bases of the results from this study, the following recommendations have to be taken in to consideration.

1. It is essential to involve local farmers and utilize their forwarded about the soil resources and the soil erosion in order to effectively plan for soil conservation measures application and introducing new techniques.
2. Local administrative leaders and farmers should design laws that govern them to protect soil erosion and deforestation and to use and maintain the constructed conservation structure.
3. Creating of an alternative energy and income source and employment opportunities to farmers may partly reduce farmers' complete dependants of resources of soil and forest.
4. The training programs which were provided for farmers should be modified by considering the existing knowledge and practices in a particular area and DAs must create harmony and cooperative working environment with farmers.

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Appendix 1

ADDIS ABABA UNIVERSITY COLLEGE OF SOCIAL SCIENCES DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES

A Questionnaire to be completed by Farmers of Dessie rural kebeles

Dear Farmers,

This questionnaire is meant to gather information for a study on farmers' Perception on the problem of soil erosion and their conservation knowledge. I hope that the research out comes contribute to the improvement of training programmers' in land management practices.You are kindly requested to give answers freely and openly. Any information you give is to be kept confidential. Thus, your cooperation is very necessary to achieve the desired goal of the study.

N.B.1.The response you give will not have any negative impact on you.

2. No need of writing your name on the questionnaire.
3. Please respond for in feeling free warty on think is correct.

Thank you for your cooperation In advance

Yours faithfully Ismael Yismaw

Part-I: Respondents Household Characteristics

Part one – Background information of the respondents

Please give the required information by choosing the number.

1.1 Names of rural kebeles_____

1.2 Age of household head: 1.20-30 3. 41-50
2. 31-40 4. > 50

1.3 Sex of household head: 1. Male 2. Female

1.4 Size of household: 1. <3 2. 4-6 3. >6

1.5 Marital status of household head: 1 Single 2. Married
3.widowed

1.6 What is educational level of household head?

1. Can't read and write (illiterate)
2. Can read and write (Adult literacy)
3. Attended elementary level.
4. Attended secondary level
5. Attended above grade 10

1.7 How do you make your living (your income)?

1. Farming alone
2. Farming and livestock raring
3. Trading
4. All

Part- II: Land and Landholding Characteristics of Respondent

2. Land size and landholding

2.1 Do you own land? 1. Yes 2. No

2.2 If yes, how many hectares do you own?

1. <0.5 ha3.
2. 0.5 ha-1.0 ha
3. 1.0 ha-1.5 ha
4. 1.5-2.0
5. >2.0 ha

2.3 How did you get the land you have currently? (More than one choice is possible)

1. Through renting
2. Through share cropping
3. Inherited from parents
4. Allocated by Kebele

2.4 How do you perceive the fertility of your land?

1. Improving
2. Constant
3. Declining
4. Do not know

2.5If the fertility of your land is declining what is the indicator?

_____

_____

2.6 If the fertility of your land is declining, what could be the cause?

_____

_____

2.7 How do you perceive the productivity of your land?

1. Increasing
2. Decreasing
3. Constant
4. Do not know

2.8If the yield from your land is decreasing, what could be the reason behind? (More than one answer is allowed)

1. Absence of fallowing
2. High coast of chemical fertilizer.
3. Removal of soil by erosion
4. Rainfall fluctuation
5. over cultivation
6. Other reason_____.

2.9 How do you describe the slope of your land?

1. Flat
2. Gently undulating
3. Moderately steeping
4. Steeply slopin

2.10 Do you perceive that the slope has impact on productivity of your land?

1. Certainly
2. Never
3. Uncertain

2.11 Which land do you perceive more productive?

1. Flat
2. Gently undulating
3. Moderately steeping
4. Steeply sloping

2.12 How do you think that current landholding to support the household?

1. Insufficient
2. Sufficient
3. Excess

2.13 What do you do if the land scarcity is a problem?

1. Going to resettlement area
2. Migration to other areas (urban area)
3. Involving in non-farm activities
4. Increasing the productivity of land using modern technologies
5. Increasing farm land through clearing forest and common land
6. Other option specify_____

Part-III: Soil Erosion

3. Questionnaires on Indicators, causes, severity and consequences of soil erosion

3. 1 Do you know what soil erosion is? 1. Yes 2. No

3.2 If you yes what are the indicators of soil erosion in your land?

No	Indicators	Orders/ranks
1	Rills and Gully development	
2	Observing the color of soil	
3	Accumulation of dump near to valleys	
4	Stoniness of soil	
5	Slope Steepness	
6	Absence of fertile topsoil	
7	Root exposure	
8	Poor crop and grass growth	

3.3 What condition brings soil erosion in your land? (Put in order from most to least important)

No	Causes of Soil Erosion	Rank (1, 2…)
1	Slope steepness of the cultivation land	
2	Ceaseless cultivation and absence of fallowing	
3	Types of soil and erodibility	
4	Intensity of rainfall	
5	Absence and delay of SCM	
6	Deforestation and desertification	
7	Overgrazing	
8	Terms of land preparation for cropping	

3.4 What is the effect of soil erosion on your land?

No	Effects of Soil Erosion	Rank (1, 2…)
1	Loss of topsoil	
2	Reduction in yield over time	
3	Reproduction of gullies	
4	Loss of vegetation cover and grasses	
5	Change in soil color	
6	Require high input and management	
7	Lack of farm land and grazing field	
8	Desertification, and out migration.	

3.5 What condition brings soil erosion in your land?

No	Perception on the Causes of Soil Erosion	Responses	
		Yes	No
1	Slope steepness of the cultivation land		
2	Ceaseless cultivation and absence of fallowing		
3	Types of soil and erodibility		
4	Intensity of rainfall		
5	Absence and delay of SCM		
6	Deforestation and desertification		
7	Overgrazing		
8	Terms of land preparation for cropping		

3.6 What is the effect of soil erosion on your land?

No	Farmers' perception on Effects of Soil Erosion	Responses	
		yes	No
1	Loss of topsoil		
2	Reduction in yield over time		
3	Reproduction of gullies		
4	Loss of vegetation cover and grasses		
5	Change in soil color		
6	Require high input and management		
7	Lack of farm land and grazing field		
8	Desertification, and out migration.		

3.7 How do you describe the degree of soil erosion in your farmland?

1. Severe
2. Moderate
3. Minor
4. No erosion risk

3.8 Which type of erosion is severe in your land? (More than one is allowed)

1. Sheet erosion
2. Rill erosion
3. Gully erosion

3.9 Have you taken any of the following measures because of erosion?

1. Abandoned your cultivated land?
2. Expanded to marginal land?
3. Have taken off-farm employment?
4. Other (specify) ----------

4.10 Do you believe that erosion can be controlled?

1. Yes 2. No

Part-IV: Soil Conservation

4. Soil conservation knowledge and practices

4.1. Do you perceive that the yield be increasing with soil conservation practices?

1. Yes
2. Never
3. Do not know

4.2. If your answer for question '4.1' is 'Yes', have you been practicing soil conservation?

1. Yes
2. No
3. Do not know

4.3 If your answer for question '4.2' is 'No', what is the reason behind?

_____

_____

4.4. If your answer for question ‘4.2’ is ‘Yes’, what kinds of soil conservation methods do you apply? (More than one answer is allowed)

1. Cultivation along the contour
2. Terracing
3. Strip-cropping along the contour
4. Bunding
5. Vegetative and crop cover
6. Grassed waterways
7. Tree planting
8. Check dams
9. Other (specify)

4.5 Have you observed changes as a result of the practiced activities?

1. Yes 2. No

4.6 If yes, what are the changes (mark all that apply)

1. Increase in soil fertility
2. Increase in land cover
3. Increase in land productivity
4. Prevent soil erosion
5. Others (specify) _____

4. 7 Do you get training on soil and water conservation technologies?

1. Always
2. Sometimes
3. Never
4. Do not know

4. 8 where did you get information on soil and water conservation practices?

1. Traditionally
2. From neighbors
3. From DAs and experts
4. From other non-governmental organizations
5. Other sources specify_____.

4. 9 Do you have contact with DAs?

1. Yes
2. No
3. Do not know

4.10 How do you describe the contact you have with soil and water conservation experts?

1. None 2. Limited 3. Good 4. Very goo

QUESTIONNAIRE TWO

A QUESTIONNAIRE ON THE FOCUS GROUPS

To be replied by focus group discussants

This discussion will handled by the researcher

1. Do you think that the rural communities do perceive the existence of problems of soil erosion in your area?
2. If yes how do you know their perception?
3. What is the level of rural community perception of soil erosion problem and their conservation knowelege?
   - Is there gender variations?
   - Is there work status variations?
   - Is there age Variations?
   - Is there house hold size Variations?
   - Is there educational variations?
   - Is there farm size variations?
4. What do you think are the possible causes of soil erosion in your area?
5. What do you think are the major consequence of soil erosion in your area?
6. Do you think that the individual or the communities are actively responding to these environmental problems?
7. Are there any governmental or nongovernmental organizations which are working on environmental issues? If yes, what are their contributions to the rural community?
8. In your opinion, what are the major constraints to implement conservation activities in your area?