ADDIS ABABA UNIVERSITY SCHOOL OF GRADUATE STUDIES ENVIRONMENTAL SCIENCE PROGRAM

LAND DEGRADATION AND FARMERS' PERCEPTION: THE CASE OF LIMO WOREDA, HADYA ZONE OF SNNPR, ETHIOPIA

Thesis Submitted to School of Graduate Studies, Addis Ababa University, in Partial Fulfillment of the Requirements for the Attainment of the Degree of Masters of Science in Environmental Science

By Shibru Tefera Blata

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List of Acronyms

M.a.s.l. Mater above Sea Level
AEZ Agro-ecological Zone

BoA Bureau of Agriculture

BOPED Bureau of Planning and Economic Development

CSA Central Statistics Authority

DA Development Agent

EHRS Ethiopian Highland Reclamation Study

EPA Environmental Protection Authority

FAO Food and Agricultural Organization

FYM Farm Yard Manure

GDP Gross Domestic Product

GLASOD Global Assessment of Soil Degradation

IFAD International Fund for Agricultural Development.

IK Indigenous Knowledge

NGO Non-Governmental Organization

NP Nitrogen and Phosphorous

PRA Participatory Rural Appraisal

PSNP Productive Safety Net Program

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

Lack of appreciating farmers' knowledge and their perceptions of soil degradation and soil conservation measures was the reason for low adoption of recommended technologies. This research was carried out to evaluate farmers' perceptions of soil degradation and their knowledge of the existing soil and water conservation measures in Limo woreda of the Southern Ethiopian Highlands. Field observations, focus group discussion and semi-structured household surveys were carried out in two selected kebeles, with 112 households. The results indicate that farmers were aware of the on-going soil degradation and of several erosion control measure and land husbandry practices. They perceive soil degradation mainly by reduced yields, soil changing in appearance and becoming stony or coarse. The most frequently mentioned soil erosion indicators were rill and gully formation followed by exposed underground rocks, soil becoming coarse and stony, and topsoil removal. The most important perceived indicator of soil fertility loss was reduced crop yield, followed by poor crop performance and yellowing of the crop. Majority of farmers preferred water diversion ditch, ridges and counter ploughing for soil and water conservation and chemical fertilizer, crop rotation and mixed cropping for soil fertility amendment while they did not recognise agroforestry and farm yard manure as a conservation and fertility amendment measure. Farmers faced several constraints in adopting SWC measures: decrease in farm size, its inconvenience during for free movement of oxen plough, and multiplication of rats in the stone bunds. Any programme designed to address soil degradation should consider those farmers criteria for adoption.

Key words: Soil degradation, Erosion, fertility, Farmer perception

1. Introduction

1.1 Background and Justification

More than 80% of the human population and 75% of the livestock population are concentrated in and about 90% of the country's total agricultural produce is generated from the highlands of Ethiopia but the highlands of Ethiopia cover nearly 45 percent of the country. The Ethiopian Highlands are the centre of the economic activity of the country.

The Ethiopian highlands also provide basic ecosystem services that are of regional and global environmental significance. These highlands account for more than half of the total area of the highlands of Africa and play a significant role in the regional climate. More importantly, from these highlands originate international rivers watering the arid and semi-arid lowlands and the neighbouring countries. In terms of genetic resources, the Ethiopian highlands are known to be one of the twelve Vavilov centres of the world (Tewolde, 1990).

The region, however, has been experiencing severe land degradation problems that are emanating from the demands of the growing human and livestock populations. This environmental situation not only undermines the agricultural production capacity but also threatens the ecological sustainability of the region. Decline in agricultural productivity in the highlands has largely been associated with high population density, deforestation and intensive cultivation of steep slopes without effective conservation measures.

Realizing the national and global importance, governmental and non-governmental institutions have made various attempts to avert the trend of degradation. But despite the heavy capital and human resources investment, results remain disappointing (Hudson, 1991). Some experts think that farmers are ignorant of the seriousness of the on-going land degradation and are reluctant to changes (Hudson, 1991). Awareness, perceptions and attitudes towards the problem of resources degradation is one of the many socio-economic, cultural and psychological factors which are known to influence acceptance and adoption of conservation measures by farmers elsewhere (Baum and Wolff, 1993). The recognition of the problem as such is the first step towards taking curative as well as preventive measures. Generally, it is rather common that public awareness and perception concerning the need for SWC is low (Osgood, 1992). Two reasons can be mentioned for this. First, land degradation as a process is gradual and long-term. Its effect on crop yield is often felt or recognized after decades following the initiation of the degradation process. Second, the process is in its nature abstruse, and hence, incomprehensible for one without the requisite skills.

However, previous approaches made no positive changes with respect to the rate of land degradation, primarily because they hardly considered farmers' knowledge and their perceptions of the land degradation and SWC measures. Thus, experts need to seek existing knowledge, perception and opinions of farmers before enforcing new recommendations (Hudson, 1991; Shaxson, 1988). There is also need to evaluate farmers on the performance of the existing conservation measures and their expectations and experiences. Such knowledge could probably improve fieldworkers' approach when working with farmers. Therefore this paper intends to provide insight on farmers' assessment of ongoing soil degradation.

1.2 Objectives

This paper intends to evaluate farmers' knowledge and their perceptions of soil degradation processes and the existing conservation measures through the following objectives:

i. Describe the existing community baseline condition, with a focus on socio-economic factors that have led to the decline in soil fertility

ii. Assess farmers' knowledge of soil degradation and perceived impact on land productivity

iii. Identify the traditional knowledge, techniques and practices used by households to control soil erosion, enhance soil fertility, and increase crop and livestock productivity among smallholders and

iv. Assess farmers' knowledge of the existing SWC measures and identify constraints to their adoption

1.3 Research Questions

Both primary and secondary data which were collected during fieldwork aimed in the study area at answering the following research questions:

i. What are the socio-economic characteristics of small-scale farmers in the study area?

ii. How do local people perceive and interpret factors and indicators of soil erosion and fertility decline in Lemo Woreda?

iii. What are the traditional knowledge, techniques and practices used by farming households to control soil erosion, enhance soil fertility, and increase crop and livestock productivity in the Woreda?

iv. What are the constraints to adopt the existing SWC measures, if any?

1.4 Significance of the Study

The study findings will therefore help the woreda agricultural officials, experts and development agents to design strategies, investment programs and projects that could bring positive synergies to restore soil productivity, enhance food security, and avert the vicious cycle of poverty and natural resource degradation. Furthermore, the analysis contributes to the general literature on land and soil degradation. This is essential to long-term progress because of the scarcity of primary data at the farm and household level to address land degradation.

1.5 Organization of the Study

The rest of the report is organized as follows. The next chapter reviews the literature and presents the conceptual and empirical frameworks and hypotheses that guided this study. Chapter 3 discusses the ecological and socio-economic characteristics of the study area. Chapter 4 discusses the research methodology, including data collection and analytical methods. Chapter five includes results and discussion from the field survey are presented in relation to research objectives and questions stated in chapter one. For the sake of convenience and clarity the chapter is divided in to three main sections. The first section presents a description of the socio economic characteristics of the sample farmers in the study area. The second section involves discussions on farmers' Perceptions of and attitudes towards land degradation. Traditional knowledge, practices and techniques used by households to control erosion, maintain and improve soil fertility, and increase crop and livestock productivity are also discussed in this section.

2. Literature Review

Socio-economic and political factors have forced many regions in Ethiopia to bring new land under cultivation and to reduce fallow periods to meet the food and income needs of the rapidly increasing population. This extensive approach is reflected in poor yields per hectare (ha) in Ethiopia. The average yield of cereals is, about 1.2 tons per ha in Ethiopia while it is 2.3 tons per ha for developing countries (World Bank and FAO, 1995). Much of the unutilized land in many parts of the country is of marginal quality in fragile ecosystems, and extensification of agriculture compounded with lack of conservation measures often results in depletion of soil fertility and in land degradation.

In the densely populated highlands areas of Ethiopia, intensification of agriculture is reducing fallow periods and increasing the farming intensity on crop land. On the other hand, limited access to knowledge of viable soil management options, lack of capacity to invest in soils especially in fertilizers, and having less ability to bear risk and wait for future payoffs from investment constrained farmers attempt to improve soils. As a result, a major part of agricultural land in Ethiopia suffers from intensive cultivation, steep slopes, poor water control and land management, soil erosion and loss of soil nutrients, and is unlikely to support the growing population (FAO, 2003).

Soil degradation is widespread in Ethiopia. The degradation and loss of soil resulting from soil erosion all over the country was estimated to be about 2 billion tones per year(EHRS, 1986), of which around forty-five percent occurs on crop farmlands and 21 percent occurs on overgrazed rangelands (EPA, 1986). This has resulted in loss of top soils and land degradation with a third of the soils having less than 5 cm depth (FAO, 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. The annual net nutrient depletion is estimated to exceed 30 kg nitrogen, 20 kg potassium and equivalent amount of phosphorus from arable lands of Ethiopia, Kenya, Rwanda and Zimbabwe (Smaling, 1993).

The land degradation process is not well understood, and most studies have centered on the physical aspects of this process. The most significant study on extent and nature of land degradation was that of the Global Assessment of Soil Degradation (GLASOD) study by Oldeman, Hakkeling, and Sombroek. GLASOD defines land degradation as a process that lowers the present or future capacity of the soil to produce goods and services. There are multiple factors that cause land degradation at short and long terms in the country. The major environmental factor that causes significant soil and nutrient loss in a short period of time is water erosion followed by wind erosion. In Sub Saharan Africa, the major agents of land degradation are water erosion, wind erosion, chemical degradation and others that affected soil loss by 47, 36, 12 and 3.5 %, respectively (Amede, 2003). Given the mountainous and commonly slopy landscape of most of cultivated area, water erosion is expected to be the major environmental agent affecting land degradation in Ethiopia. Degradation occurs over time, and could have either a negative or a positive impact on land productivity. Certain types of soil degradation, such as geological erosion, are part of the natural process. This study focuses on degradation caused by human activities, and, which, therefore, can be prevented.

The contribution of different management factors towards land degradation in Africa is estimated to be 49%, 24%, 14%, 13% and 2% for overgrazing, agricultural activities, deforestation, overexploitation and industrial activities (Vanlauwe et al., 2002). Although the degree of soil erosion is highly related to the interaction of Wischmeier factors, the type of land use and management may have played an important role in Ethiopia. The contribution of different management factors towards land degradation in Africa is estimated to be 49%, 24%, 14%, 13% and 2% for overgrazing, agricultural activities, deforestation, overexploitation and industrial activities (Vanlauwe et al., 2002). The livestock sector is a very important component of the system both as an economic buffer in times of crop failure and economic crisis and as a supportive enterprise for crop production. There is a considerable concern, however, that the number of animals per household is much higher than the carrying capacity of land resources. Overgrazing due to very high livestock population density in the country is expected to contribute most to land degradation.

Another very important factor that aggravated land degradation in Ethiopia is deforestation. The forest cover went down from 40% at the beginning of this century to less than 3% at present. Deforestation accelerated land degradation in many ways. Firstly deforested land is easily susceptible to erosion; both wind and water, and hence cause a considerable nutrient movement. Secondly the amount of litter that could have contributed for maintaining the soil organic matter is considerably reduced. Thirdly deforestation in the highlands caused lack of fuel wood, and hence farmers use manure and crop residue as cooking fuel, which otherwise could have been used for soil fertility replenishment.

Overexploitation of land resources with out returning the basic nutrients to the soil is also an important factor that contributed most for soil fertility decline in Ethiopia. The main cause of nutrient outflow in Stoorvogel's and Smaling's estimates is soil erosion (about 60 kg/ha), followed by removal of harvested products and crop residues; while inflows from manure and chemical fertiliser are very low (averaging less than 10 kg/ha). A major cause of the high removal of nutrients in crop residues and low addition of manure is burning of dung and crop residues to satisfy household energy needs. In sum, the major land degradation problems in Ethiopia are overgrazing, deforestation and overexploitation. In sum, the major causes of land degradation in Ethiopia are overgrazing, inadequate farming practices, and deforestation.

Densely populated highland areas, which cover nearly 45 percent of the total land area and support over 85 percent of the population in Ethiopia, are highly susceptible to erosion and other forms of land degradation. Socioeconomic and institutional factors influence land degradation through their impacts on farmers' decisions regarding land use and land management practices, including plowing, fallow, use of manure and other sources of organic matter, fertiliser use, and adoption of soil and water conservation measures. A non-exhaustive list of such factors influencing these decisions includes population pressure, poverty, land tenure relationships, the nature of local markets, local institutions and organisations, and farmers' perceptions and attitudes.

The Ethiopian highlands have become a relatively densely populated region and the population density per unit of arable land is much higher (138 persons per square km). As a result, farm sizes are very small and the use of fallow is rapidly disappearing, causing problems of declining soil fertility and erosion. Population growth increases the demand for land and contributes to farming on steep and fragile soils, also leading to erosion problems. It increases demand for biomass as a source of fuel, leading to deforestation and increased burning of dung and crop residues, thus increasing the problems of erosion and nutrient depletion. Population growth increases demand for livestock products and therefore leads to increased livestock numbers, causing overgrazing and consumption of crop residues by animals.

The extreme poverty existing in Ethiopia likely contributes to land degradation for many reasons. Population pressure on the land is worsened because people lack access to alternative sources of livelihood. Deforestation and burning of dung and crop residues are increased by people's inability to afford or lack of access to alternative fuel sources. Poverty similarly limits farmers' ability to purchase feed or livestock products, contributing to overgrazing, and their ability to purchase chemical fertiliser, contributing to soil nutrient depletion. Poor farmers may lack access to draft animals, implements, or other capital items needed to make major investments in land improvements. Poverty tends to increase farmers' short-term perspective, limiting their interest in investing in soil and water conservation measures that yield benefits only in the longer term (Holden et al., 1998)

Although the degree of soil erosion is highly related to the interaction of land use or cover, soil type, slope, slope length, rainfall amount and intensity, the type of land use and management may have played an important role in Ethiopia. These causal factors, driven by socio-economic and political forces manifest themselves in market, policy and institutional failures, inadequate technologies and practices, population pressure, poverty, cultural values, and individual behavior (Sharma et al., 1995).

The natural resources base (land, water and forest) is fundamental to the survival and livelihood of the majority of people in rural ETHIOPIA. These resources are under intense pressure from population growth and inappropriate farming and management practices. Small-scale farmers, who depend on these resources, face severe constraints related to intensive cultivation, overgrazing and deforestation, soil erosion and soil fertility decline, water scarcity, livestock feed, and fuelwood crisis. These factors often interact with one another and bring a downward spiral of declining crop and livestock productivity, food insecurity, high population growth rate and environmental degradation, (referred to as the nexus problem, Cleaver and Schriber, 1994). The net result is that a re-enforcing cycle is set trapping more and more of the rural population in poverty, food insecurity and in the degradation of natural resources.

Nutrient loss on arable land is significant in areas strongly affected by the nexus dynamic. Estimates show a net loss of 700 kg of nitrogen (N), 100 kg of phosphorus (P), and 450 kg of potassium (K)per ha in 100 million ha of cultivated lands over the past 30 years (Sanchez et al., 1995). Crop residue and manure, which were once a major source of enriching soil fertility, are being used as fodder and fuelwood. This considerable nutrient loss is reflected in the widening gap between the actual and potential yield for all the major food crops in SSA. For example, average farm yield for maize, sorghum, and wheat is 1.6 mt/ha (metric tons per hectare), 0.5 mt/ha, and 1.5 mt/ha, while the potential yield is 5mt/ha, 2.5 mt/ha and 3.5 mt/ha respectively (Sharma et al., 1995). The relative impact is probably greater in Ethiopia, where soil nutrient depletion is more severe than the other SSA countries.

Loss of soil productivity leads to reduced farm income and food insecurity, particularly among the rural poor and thus continuing or worsening poverty. Land degradation can contribute directly to poverty, separately from its impact on agricultural productivity, by reducing the availability of other valuable goods and services important to poor households (for example, fuelwood, construction materials, wild foods, and medicinal plants) and by increasing the demands on labor needed to forage for such goods. Poverty in turn is hypothesized to contribute to land degradation as a result of poor households' presumed short-term perspective and inability to invest in natural resource conservation and improvement (Reardon and Vosti, 1995). The poor also face financial and socio-economic constraints. These factors seriously impede improved land management practices and innovations, which lowers the productivity and income of the poor and reinforce the "vicious cycle". Hence, narrowing this productivity gap between actual and potential yield is essential to avoid the poverty and natural resource degradation trap.

2.1 Perceptions of Natural Resource Degradation

Methods and Theories in Understanding land degradation Problems

The diagnoses of and the solutions to the land degradation problem vary greatly across disciplines and among stakeholders. Whilst it is well understood that there are differences between "insiders" (local people) and "outsiders" in the way in which each perceive land degradation, this difference can be partially attributed to methods and theories used in studying land degradation problems.

If soil and water conservation issues are juxtaposed alongside development paradigms that have dominated development discussion, three dimensions emerge: The classic approach, the neo-liberal approach (much favoured by the World Bank in the 1990s) and thirdly, the neo-populist approach (Blaikie, 1996).

The classic approach to soil and water conservation and to environmental management in general is top-down; state instigated and influenced by state or internationally sponsored scientific institutions.

The classic approach assumes that technical solutions to land degradation are available and that the problem is implementation related. The emphasis of this approach has been on technical fixes and expert opinions, and little merit has been attached to local land users' practices and participation (Clay and Schaffer, 1984). This approach sees local resource users' knowledge in a dismissive and adversarial manner (Blaikie, 1996). Such analysts tend to assume that "local knowledge is part of the problem, leading to backward production techniques and environmental degradation" (Blaikie, 1996:10). Since local knowledge is seen as defective, irrational or traditional, the solution lies in the adoption of expert-led knowledge and innovations. Many soil conservation and land reclamation projects have been influenced by the classic approach, which has often resulted in conflict between technology and local farming and socioeconomic conditions.

In addressing SWC problems, the classic approach sought answers from outside the affected communities. Where externally driven solutions failed, as it was the case with most SWC programmes, excuses were sought not in the solutions themselves, but elsewhere. Hudson, who did a review of 35 SWC projects undertaken by FAO, made this conclusion in explaining their failure:

"Design errors were mainly the result of incorrect assumption made at the design stage overestimating the effect of new practices…the rate of adoption of new practices…the ability of host country to provide back-up facilities…the time required to mobilise staff and materials for the project… estimate of the economic benefits… capacity to provide counterpart staff and…the recurrent costs…strength of national research base and its ability to contribute to the project…underestimate the problem of coordination among different ministries or departments" (Hudson, 1991:vii–viii).

Apparently, diagnosing the causes of the failure in this way actually led to further top-down expert technological drives, and less participation of the resource users. This approach has been criticised and led to a "paradigm shift" to what is referred to as neo-populist stance which calls for bottom-up approaches (Chambers, 1983, 1993; Pimbert and Pretty, 1994). This approach links poverty and environmental degradation. It emphasizes the participation of local people by using their knowledge and practices as a guide for policy and action (Chambers, 1983; Blaikie and Brookfield, 1987; Mascarenhas et al., 1991; Richards, 1985; Hudson, 1991).

The neo-populist school recognises that protection of soil resources has been part and parcel of local people's production systems and understanding of the use of different qualities of natural resources (Blaikie, 1996). Thus neo-populist scholars have established that in the area of SWC there are close to one hundred practices, most of which are short-term water conservation rather than ways of keeping soil in place (IFAD, 1992). Some projects are now emulating good examples from traditional experiences and promote their wide use –e.g. in Burkina Faso (Dialla, 1994). Also credible evidence is abundant in East Africa that there are indigenous technologies that can maintain production whilst saving soil and water efficiently. Evidence that farmers in East Africa had developed and adopted techniques that effectively conserved soil and water over long periods in the face of increasing population is also available (Tiffen et al.., 1994).

The neo-populist school advocates a process of learning from the farmers and using the so-called bottom-up approaches and techniques. Most of these techniques fall within the broader context of participatory approaches (Chambers, 1983, 1993; Scoones and Thompson, 1994). Dealing with a related issue, Oudwater and Martin (undated) have combined systematic and participatory approaches to study indigenous knowledge on soil and soil and water management. Their conclusion is that farmers' knowledge is site-specific and relative rather than absolute and universal. In general they conclude that farmers tend to compare soil types in terms of colour (darker/lighter) or fertility (less/more) when describing a particular soil. Increasing SWC problems, and the spread and adoption of participatory approaches in these studies have stimulated studies on indigenous knowledge (IK) in SWC matters. Without romanticising IK, it is crucial to note that it does not always provide the answers to all SWC problems, neither is it adequate on its own. Nevertheless, for researchers to be effective, they should not ignore IK and focus on endogenous knowledge alone. Also, for local people to participate in externally motivated developments, local knowledge must be understood so that issues that affect the people are adequately understood and addressed.

This suggests that local resource users know very well what they are doing and why they are doing those things. To them, SWC is an integral part of sustainable livelihood system (Blaikie, 1996). If this is true then on what technical, social and methodological grounds do outside institutions intervene in SWC problems? Indeed even some of the neo-populist approaches still address matters up side down, by paying too much attention to developmentalists, rather than to the needs of the local people.

However, some of the neo-populist scholars are now including issues of land tenure, property regimes, local institutions, gender and equity in the discussions of SWC issues. Nevertheless, external agenda of soil conservation are still prevalent in the donor driven development programmes of sub-Saharan Africa. It is therefore clear that proper methodologies, which genuinely serve local resource users, are yet to be developed and used.

The third approach, often called neo-liberal, draws from both the classic and populist approaches. From the classic approach, it takes the idea that technology to control land degradation exists, and from the populist approach, it borrows the notion of empowerment of the people. It then argues that the major degradative causes are institutional failures, and the lack of adequate incentives for the adoption of appropriate conservation technologies among land resource users (Binswanger, 1989; Repetto and Gillis, 1988; World Bank, 1992).

Understanding the Problem and Its Essence

There are many approaches of looking at soil and water conservation problems, this section looks at two common approaches. The first approach is to look at SWC problems through the "eyes" of the scientists. This is called the "etic" approach (Kaplan and Manners, 1972 in Kikula, 1997). Scientists determine what the problem is and suggest solutions. In this approach, it may be assumed that local people are not aware of the problem, hence they may require some form of awareness rising, by the scientists. The second approach is called “emic” or the local indigenous view of environmental problems (Kikula, 1997). This view assumes that local people are aware of the problems and are taking some measures to address the problems.

These approaches express different perceptions of SWC issues. It is important to understand these differences in order to find out how gaps between scientists and local resource users or amongst either of these groups, can be bridged to bring about sustainable use of natural resources. Perceptions may mean many things to different people, but in this section perception as defined by Kikula (1997) means awareness, concern and attitude of scientists or local people on SWC problems.

Studies on perceptions of environmental matters have become important as they shed more insights into areas of conflict between scientists and local communities, and how these differences in perception help or hinder efforts in environmental management. Differences in perception can also occur among people living in the same location, sharing the same resources. It is equally important to understand the basis for these differences and how they influence the use of natural resources.

Soil fertility, soil erosion and water management problems are closely associated with what is often called land degradation. Land degradation can mean many things to different actors. In grappling with this issue, Kikula (1997) highlights some contrasting perceptions. For example, a rangeland manager would consider land degradation to include tree and shrub loss. According to Kikula, the loss of productivity and vigour, loss in cover, shift in botanical composition, are but some of the indicators of land degradation along a continuum of change. Furthermore, soil degradation is defined as a process, which reduces the capacity of land to produce crops (Kikula, 1997). The fall in soil fertility could be one of the observable features of soil degradation. How these problems are understood is important because they shape and influence decisions about the measures to be taken.

Official and local land users often have different perceptions about the land degradation problem. This continues to be a serious impediment to successful land degradation control projects (Blaikie and Brookfield, 1987; Fortman, 1989; Biot et al., 1991). A great deal of literature supports the idea that indigenous knowledge and practice are often well-informed and should be seriously considered in the development of technologies and intervention measures to address land degradation (Chambers, Spacey, and Thrupp, 1989; Fujisaka, 1989; Toulmin, 1991; Huijsman and Savenije, 1991; Critchely, Reij, and Willcocks, 1994; Sconnes, 1993; Kruger et al., 1995). While the official view is drawn from references to the little data available (often derived from science), farmers' views are based upon their observations, values, and experiences. These factors help them to interpret changes on indicators of soil and land degradation and to make decisions about specific actions.

The interpretation of change in some indicators, and the assessment of its impact on land resources, adds to the perception gap. For example, there is a common assumption among officials that land degradation is widespread. This perception is not shared by local land users. Local technical knowledge is based on experience and tradition, and has low risks and external inputs. It is accumulated slowly and cannot keep pace with changes that impact the farming system (Ravnborg, 1992). Thus, enhancing farmers' ability to interpret changes according to the new circumstance, and improving local knowledge and integrating it with scientific knowledge, is a significant challenge.

2.2 Farmers' Perception and Attitude on Land Degradation

Soil fertility, soil erosion and water management problems are closely associated with what is often called land degradation. Land degradation can mean many things to different actors. In grappling with issue, Kikula (1997) highlights some contrasting perceptions. For example, a rangeland manager would consider land degradation to include tree and shrub loss. According to Kikula, the loss of productivity and vigour, loss in cover, shift in botanical composition, are but some of the indicators of land degradation along a continuum of change. Furthermore, soil degradation is defined as a process, which reduces the capacity of land to produce crops (Kikula, 1997). The fall in soil fertility could be one of the observable features of soil degradation. How these problems are understood is important because they shape and influence decisions about the measures to be taken. Studies on perceptions of environmental matters have become important as they shed more insights into areas of conflict between scientists and local communities, and how these differences in perception help or hinder efforts in environmental management. Differences in perception can also occur among people living in the same location, sharing the same resources. It is equally important to understand the basis for these differences and how they influence the use of natural resources.

Although an understanding of the physical erosion phenomena is important for the formulation of erosion control strategies, it is also vital to understand social relations influencing management choices. Traditional land resource utilization in many areas has followed an exploitative sequence consisting of clearing, cultivation, erosion, finally abandonment (Kuru, 1986). This unsustainable farming practice is linked to a lack of choice due to poverty rather than linked to neglect. Interviews with farmers in Tigray verify that they are, in fact, concerned about the degradation of their land (Hunting, 1976). However, there is apparently a widespread apathy due to the fact that they are living barely on a subsistence level. They do not have the economic or labour capacity to implement necessary conservation measures. In some cases farmers are aware that some of their actions are actually damaging the land, but the immediate benefits of these actions seem more important than long-term degradation. However, there are a few studies on farmers' awareness and perception of land degradation hazards in Ethiopia. The results are mixed. According to Hurni (1985b), "low perception of local peasants" about the problem of land degradation is a problem that needs to be circumvented for SWC efforts in the country. On the other hand, in his study in southern Ethiopia, Belay (1992) concluded that farmers have a good perception of the problem of soil erosion, but a "wrong perception of topsoil depth" (farmers thought that it was deeper than it actually was). Berhe and Chadhokar (1993) also believed that there has been some level of awareness of the problem of land degradation throughout the country and, so, a range of traditional conservation measures were in place. In the eyes of others, however, those measures have been "defective" (Azene, 1997, 11). More recently, a study by Omiti et al. (1999) showed that farmers are well aware of the problem of land degradation, stating that 85% of the households covered in their survey (n = 892) indicated erosion as "an important economic problem".

A study of Ethiopian farmers' attitudes to land degradation and conservation by Admassie and Gebre (1985) indicated that farmers were aware of the problems of land degradation. Erosion was identified as the main cause for land degradation, followed by drought, deforestation, rainfall, and improper farming practices. According to the farmers, the effects of land degradation were famine, drought, reduced yield, and poverty. Soil and water conservation activities undertaken by farmers prior to the food-for-work projects were mainly construction of drainage canals and ditches as well as soil and stone bunds. Farmers also practised fallowing, mulching and crop rotation. Among the food-for-work activities, soil bunds, hillside terraces, reforestation, and stone bunds were considered by farmers to be the most effective for soil and water conservation. In the Gunono area of Wolaita, 80 % of the farmers were of the opinion that soil bunds increase yields, 7 % responded that there is no change, 6 % did not know, and 7 % did not construct bunds or terraces at all (Gebre Egziabher, 1988).

Even so, traditional as well as modern soil conservation measures have been carried out in different parts of the country, to combat soil erosion and soil nutrient depletion. For centuries communities in Ethiopia have been carrying out traditional soil conservation measures. Soil conservation measures that have been used to date include the construction of terraces, soil bunds, micro-basins, the protection of regenerating natural vegetation, and tree planting. Despite the efforts that have been made to conserve as well as restore soil fertility of arable lands, soil degradation is proceeding so fast nowadays that it can constraint the hope of achieving sustainable agriculture in the foreseeable future. The livelihoods of millions are being put at risk as a result of lower agricultural yields, water shortages and a shortage of natural resources such as fuelwood and fodder.

Droughts combine with falling productivity to threaten food shortages and famines over wide areas.

Past top-down technology transfer approaches to address the problem were mostly based on physical measures, such as creating mechanical barriers to soil movement. They were expensive and provided few benefits to the land users themselves. They attacked the symptoms of the problem, not for the causes. Furthermore, before project implementation farmers are rarely consulted, a priori, about their specific circumstances, priority problems, and their preference for type of intervention. As a result, most were poorly maintained, and fell into disrepair. This leads to consideration of a broader set of possible solutions than simply conservation programmes, though these have to be also considered. To provide alternative solution, analysis of factors which affect farmers' decision on land use and management practices including plowing, fallow, use of manure and other sources of organic matter, fertilizer use, and adoption of soil and water conservation measure at grass root level must be assumed. Land degradation is the direct result of incorrect land use and poor land management. It follows that an analysis of the reasons why land is incorrectly used or managed is needed if lasting solutions are to be found. Failure to do so will result in the development of programmes which deal with the symptoms of the problem rather than the causes.

Although farmers are often more acutely aware of the condition of their land than is sometimes assumed by experts, they may not be fully aware of land degradation, its causes, or consequences (Ervin and Ervin, 1982). As a result they are reluctant for adoption of soil conservation technologies. Farmers' perceptions and attitudes can have a major relevance to land management and land use. Researchers argue that local people's perception of environment, their interests and priorities constrain their action to prevent land degradation (Chimbidzani, 2006). By its nature soil degradation is often a very slow and long term process and may be almost invisible. Farmers thus may not observe ongoing erosion or nutrient depletion problems, or perceive them as immediate problems. While they do observe low or declining yields, farmers often attribute deterioration of crop yields to declining rains. But soil degradation may also have affected the water holding capacity and thereby reduced the soil's ability to overcome situations of water stress, thus contributing to the decline of yields. The very thin layer of topsoil and low organic matter content of the soil a result of erosion and limited recycling of organic matter limit the moisture holding capacity of the soil. Low soil moisture in turn reduces the ability of plants to utilise the nutrients that are available, leading to increased nutrient losses through leaching and volatilisation. It also reduces the return and increases the risk of applying fertiliser, thus reducing inflows of nutrients as well.

Lack of early awareness about soil erosion and soil fertility decline by farmers is thus, one of the major important socio-economic factors that used to affect land management. A study in Chemoga watershed by Woldeamlak (2000) reported that when farmers were asked to describe their indicators of soil erosion, they stated gully/rill formation, exposed underground rocks, land slides, wash away of crops, shallowing of soils and siltation of the soil. These are soil traits that appear in a much later stage of soil degradation, after the soil organic matter and nutrients of the soil are removed. Similarly farmers' indicators of soil fertility decline include stunted crops, yellowing of crops, weed infestation, and change of soil color to red or Grey, traits that appear at the later phase of soil fertility decline. This suggests the process is in its nature obscure, and hence, incomprehensible for one without the basic skills, it is recognized only after reaching some threshold levels, a point where it is usually difficult for the subsistence farmers to arrest it with their meager resources and technical capabilities. If farmers respond to soil erosion at this stage, the probability of reversing the fertility status to its earlier value would be difficult. Therefore, the recognition of the problem as early as possible by the recourse user or managers is very essential for taking effective remedial as well as preventive measures. Unless the land managers perceive soil degradation as a major determinant of decreasing crop yields the trend will certainly not be reversed by only external body efforts.

In some cases farmers do accurately perceive land degradation as a problem, but they may not be induced to act to reverse it. They may attribute the problem to natural or divine causes beyond their control. They may understand that the problem is affected by their own actions, although the alternatives that they are aware of to address the problem may be too costly relative to the perceived near term benefits. The benefits of larger-term practices like terracing may not be recognized with in short time and in some cases, conservation measures reduce farmers' yields in the near term by reducing cropped area or harboring pests (Herweg, 1993). These problems are compounded if farmers discount the future heavily as a result of poverty and/or credit constraints (Holden et al., 1998; Pender, 1996).

There are many, usually confounding, reasons why land users permit their land to degrade. Many of the reasons are related to societal perceptions of land and the values they place on land. Degradation is also a slow imperceptible process and so many people are not aware that their land is degrading. Creating awareness and building up a sense of stewardship are important steps in the challenge of reducing degradation. Appropriate technology is only a partial answer. The main solution lies in the behaviour of the farmer who is subject to economic and social pressures of the community/country in which he/she lives. Food security, environmental balance, and land degradation are strongly inter-linked and each must be addressed in the context of the other to have measurable impact.

2. 3 Traditional Knowledge and Practices

The structure of development has transformed moving drastically towards grassroots focused paradigms. In the past, the focus was on modernism; with the classic transfer-of technology model and top-down approaches. With a more grass-roots approach being implemented in the past decade, indigenous knowledge is often incorporated into agricultural systems and participatory development when non-governmental organizations (NGOs) and outside agencies are implementing development projects.

Indigenous knowledge is a profound, detailed and shared beliefs and rules with regards to the physical resource, social norms, health, ecosystem, culture and livelihood of the people who interact with environment both in rural and urban settings. It has been the basis for local level decision making in agriculture, health care, food preparation, education, natural resource management, and a host of other activities. Indigenous knowledge is characteristically holistic, integrative, and situated within broader cultural traditions (Ellen et al., 2000). Indigenous knowledge is dynamic; at least it must be dynamic. It evolved from years of experience and trial-and-error problem solving by groups of people working in their environments drawing upon resources they have at hand.

Studies indicate that for the successful rehabilitation of degraded lands in developing countries local concerns about immediate tangible benefits must be integrated into global concerns about the environment. This can be accomplished by building on indigenous knowledge and traditions (saxena et al., 2001) and by involving the whole village community in decision making or representing them through traditional organization. Local management by those who are familiar with the ecosystem and have a personal interest in the well being of the natural resources appears to be the most effective procedure for conservation and sustainable development in developing countries (saxena, et al., 2001).

Often times when government involvement or stakeholders in natural resources management are involved, indigenous knowledge is often overlooked and ignored. Many development and conservation related projects have failed due the lack of involvement and knowledge of local people and the ecosystems. In the past, top-down approaches were initiated by outside agencies attempting to develop natural resource management or extraction techniques which were also unsuccessful due to local ecosystem constraints (Gegeo, 1998) and lack of interest in local perspectives or involvement. The influx of indigenous knowledge approaches has led to a locally informed perspective into development. The most relevant approach to working with indigenous groups is the neopopulist, as it advocates participation and empowerment. The neopopulist focus is to contribute long-term positive change, promoting culturally appropriate and environmentally sustainable adaptations as increasing resources are commercially exploited (Sillitoe, 1998: 224). The acknowledgments, by that local people have their own effective science and resource use practices are now recognized more than ever before (Sillitoe, 1998: 223). Indigenous groups are quite capable and have developed their own methods of conservation and sustainable management practices (Colfer, 1997; Gegeo, 1998).

Likewise indigenous/traditional soil fertility management and SWC technologies are evolved by farmers over the course of time to suit certain environmental conditions. According to Shetto (2000) these technologies are technologies evolved as a result of a gradual learning process and emerge from a knowledge base accumulated by rural people by observation, experimentation and a process of handing down across generations peoples' experiences and wisdom. Apparently the technology is dynamic and not static in nature, frozen in time or stuck in history.

Most local soil and water conservation practices are location specific and accordingly vary in purpose. They may conserve soil in situ such as stone and earth bunds; conserve soil while simultaneously improving soil fertility such as mixed cropping, crop rotation, strip cropping, mulching, or ridging; harvest water such as tied ridges; and dispose off excess water from crop lands such as traditional ditches or cut off drains. Thus indigenous soil conservation systems may be agronomic, vegetative or physical in nature. Quite frequently, a combination of these practices exists. The traditional practices are efficient in controlling soil loss in some cases, but should be modified and developed further. However, the potential of these indigenous soil and water conservation practices have very often been ignored or underestimated by researchers, soil conservationists and government staff (IFAD, 1992).

2.3.1 Physical Conservation Practices

Bench terraces are widely applied in the tropics in indigenous conservation systems. Terracing may have developed in western Asia and then spread southwards to Africa, westward to the Americas, and eastward to Southeast Asia, largely by known sea routes (Hallsworth, 1987). More likely, it may have evolved independently in several areas as farmers were forced to cultivate steep lands for several reasons, e.g., to escape hostile tribes on the plains, to avoid malaria at lower and warmer altitudes, and due to increasing population density (Hudson, 1992). It appears that indigenous conservation knowledge has accumulated particularly in areas where the natural resource base is under severe pressure from local communities, the ecosystems are fragile and there is a long history of adaptation to adverse conditions. The construction of terraces is not new to Ethiopia (Hurni, 1984b). The Konsos of southern Ethiopia are well known for their traditional soil and water conservation practices. Konso land is poor quality and the country is cut up by deep eroded gullies and canyons. Rain is unreliable, increasingly so in recent years. These harsh conditions have bred what some call ‘the toughest farmers in Africa’. Their farming is based on an elaborate system of terraces, a variety of other soil and water management practices and the integration of livestock and forestry with the rest of their agriculture (FAO, 1990).

Stone bunds are generally quite common in the dry zones of the tropics, since they are relatively easy to construct during the dry season. They are barriers of stones placed at regular intervals along the contour. They have been used for generations in Ethiopia where they are locally known as "dhagga" and in some parts of South Africa. The size of the stone bunds varies between 0.5-2m and may be 5 to 10m apart, depending on the availability of stones and the topography. Stone bunds retain or slow down run off and hence control erosion. They also allow the accumulation of soil, which may be redistributed after the bunds are dismantled. Earth bunds are also other physical conservation structure built by farmer and it is essentially a soil and water harvesting technique. Earth bunds are used mainly for water harvesting in rice production in the drier parts of Africa. Earth bunds about 0.5m high are constructed around rice fields in order to collect runoff water from the higher slopes. In some other parts like Ethiopia, earth bunds are used for slowing down runoff in maize and sorghum fields where they are usually constructed along the contour after planting the crop. The bunds are constructed by digging a trench about 25cm deep with the scooped soil forming embankments or ridges.

Traditional ditches may be made to allow excess water to infiltrate easily and drain out of cultivated land, to the side of an artificial or natural waterway. A ditch may sometimes be dug on the upper side of the cultivated land to act as a cut off drain to protect the field from the runoff coming from the higher land. Thus traditional ditches drain excess water from the field, protect the soil from being washed away by runoff and reduce surface runoff generated within the cultivated land. They are commonly made throughout the eastern Africa and in Ethiopia. They are constructed using a 'maresha' arid plough pulled by oxen. Ridges have traditionally been associated with the growing of specific crops such as beans, groundnuts, sweet potatoes and cassava. Ordinary ridges are 20-50 cm high and are usually spaced between 60-80cm. When they are laid across the slope they control the soil erosion. Ridges also improve the soil fertility through in situ composting of vegetation that is buried under during ridge formation. In some areas, broad-based ridges have evolved, furthering more the concept of soil fertility restoration with the incorporation of more grass, and trash. Other physical conservation structures traditionally built by farmers include check dams, and mulching.

2.3.2 Agronomic and Vegetative Techniques

Agronomic techniques may be biological or cultural. They include such practices as crop rotations, mixed cropping and trash lines. Crop rotations and mixed cropping are traditional systems that are widely practiced in eastern Africa. Good crop rotations such as maize followed by legumes facilitate the conservation and addition of humus, restoration of soil structure and fertility and reduction of pests and diseases.

In mixed cropping, two or more crops are grown in the same field in the same season. In most cases grains and leguminous crops are mixed. The fast growing legumes provide soil cover early in season, shielding the impact of raindrops. They fix nitrogen too, and thus help to maintain soil fertility.

In slopping hillsides, maize Stover is sometimes used to make trash lines, which help in slowing down the flow of runoff, and traps eroded soils. The technique is used both for erosion control and fertility improvement. Other traditional soil conservation practices are contour ploughing, grass strips and tree planting. The traditional way of ploughing graded contours is used by nearly all farmers. Due to the population increase, traditional fallow periods have become very short and rare, if existent at all. Manure is used by some farmers, but due to the shortage of fuel wood, it is most commonly dried and used for cooking and heating purposes.

The objectives of traditional practices give us an understanding of farmers' way of thinking (Hudson, 1992). The aim of farmers does not necessarily correspond with the aim of the scientist. Some practices are simply good farming practices that happen to reduce soil erosion. At other times, conservation practices are applied where there is no recognition of erosion as a reducer of yields, but they are used for other purposes (Hallsworth, 1987).

Land degradation symptoms must be seen within the political, institutional and socioeconomic forces under which local land users operate. The "short-time horizon" of the poor is often due to policy and institutional failures such as absence of clearly defined property rights, limited access to markets and credit, and lack of safety nets. For example, the drought and environmental crisis in SSA in the 1980s is partly attributed to high military spending, government-dominated marketing and distribution systems that squeezed the surplus from peasants, and inappropriate land and forest management policies which stifled incentives for production and protection of the environment (Timberlake, 1986). Such broader analysis offers deeper insights into the land degradation problem, suggesting appropriate policy measures that should be applied before the process becomes irreversible. The cost of rehabilitating already degraded land is prohibitively expensive -- about ten to fifty times higher than that of preventive measures taken at an earlier stage (World Bank, 1992).

3. Materials and Methods

3.1.1 Location

The households interviewed for this study are located in Lemo woreda of HADYA zone, Southern Nation, Nationalities and People Region (within 7°14'N to 7°45'N and 37°05'E to 37°52'E). Limo is bordered on the south and southeast by the Kembata Alaba and Tembaro Zone, on the southwest by Soro, the west by Konteb, and on the north by the Gurage Zone; most of its eastern boundary is defined by the course of the Bilate River.The woreda constitutes 35 kebeles (the lowest administrative unit) of which 33 rural and 2 rural town kebeles. Limo has 67 kilometers of all-weather roads and 56 kilometers of dry-weather roads, for an average road density of 123 kilometers per 1000 square kilometers (SNNPR Bureau of Finance and Economic Development, 2009).

Population

Based on figures published by the Central Statistical Agency in 2007, this woreda has an estimated total population of 118,578 of whom 58,663 were males and 59,915 were females and 3% of its population are urban dwellers, which is less than the Region and Zone average of 10.28% and 8.1% respectively. With an estimated area of 1,002.03 square kilometers, Limo has an estimated population density of 437.1 people per square kilometer, which is greater than the Zone average of 378.7 and the Region average of 133.9 people per square kilometer. The Woreda has an estimated population density of 440.5 persons per km^2 of arable land and the average arable land holding is 0.98 hectares per household, varying from 0.25 ha to 2.0 hectares. More than 85% of households own less than one hectare of farmland (Limo Woreda office of agriculture, 2001).

The five largest ethnic groups reported in Limo were the Hadiya (62.13%), the Silte (30.3%), the Amhara (3.05%), the Kambaata (2.67%), and the Sebat Bet Gurage (0.45%); all other ethnic groups made up 3.4% of the population. Hadiya is spoken as a first language by 57.81%, 31.35% Silte, 6.63% spoke Amharic and 3.36% spoke Kambaata; the remaining 0.85% spoke all other primary languages reported. 58.52% of the population said they were Muslim, 22.09% embraced Protestants, 18.36% were Ethiopian Orthodox Christianity, and 0.45% Catholic. Concerning education, 30.97% of the population were considered literate, which is less than the Zone average of 33.01%. Concerning sanitary conditions, 68.48% of the urban houses and 21.33% of all houses had access to safe drinking water at the time of the census; 48.52% of the urban and 5.71% of all houses had toilet facilities.

3.1.2 Agro-ecology

The woreda is commonly divided into two major and fairly homogeneous agroecological zones. The moist mid-altitude (Amharic: Weinadega) comprises 91% of the woreda (2100-2300 m.a.s.l, 1200-1600 mm average annual rainfall, 15.0°C -19.9°C average annual temperature range). The cool moist highland (Amharic: dega) comprises 9% of the woreda (2300-2400 m.a.s.l, 1600-2000 mm average annual rainfall, 15.0°C -19.5°C average annual temperature range). The study sites are located in the Weinadega and dega areas of Limo Woreda, approximately 25KM south of the capital city of the Hadya zone, Hosanna.

3.1.3 Climate

Rainfall tends to be bimodal with rainfall becoming more continuous as elevation increases. Most of the rainfall falls during the "Meher" season from June to September (it is most intense during July and August). There is short rainy season called "Belg" which falls during the months of mid February-March. However, the short rains are highly variable and since they often fail, farmers claim they are relying on them for grain production less and less.

3.1.4 Agriculture

Agriculture in the area is characterized by small-scale subsistence mixed farming-system, with livestock production as an integral part. Crop production is mainly rain-feed. Almost all of the cropland (Table 1) is planted to annual food crops, including cereals (maize, sorghum, barley, wheat, teff), pulses (beans, soybeans), and root crop (potatoes). A very small fraction of farmers produce vegetables or fruits. These crops are grown mainly in homestead gardens or where irrigation exists. Perennial crops such as enset, stimulants (coffee, chat), timber (eucalyptus), are also grown in considerable amounts. Livestock are also very important to agriculture in the woreda. The woreda has an estimated population of 126,786 cattle, 27,488 sheep, 24,395 goats, 7839 horses, 15934 donkeys, 5820 mules and 78563 chickens. Out of the total 26,811 farm households found in the woreda around five percent have no ox. The remains own at least one ox. Donkeys are the most common pack animal. The availability of feed and water are serious constraints to livestock production in the woreda. Communal grazing areas, private pastures and crop residues are the principal sources of feed.

3.1.5 Land use

Table 1 the land uses of Lemo Woreda

Land use	Total area (ha)	Percentage
Annual crop land	23697	67.76
Perennial crop land	3744	10.70
Grazing land	1078	3.08
Natural forest	519	1.48
Cooperative and private forest	1040	2.98
Cultivable land	349	1.00
Unproductive land	859	2.46
Construction	3686	10.54
Total	34972	100

Source: - Lemo Woreda office of agriculture (2001E.C.)

3.1.6 Land Degradation

Land and soil degradation, reoccurring drought, small farm plots, high population density and input shortage including draught animal and improved seed are the major agricultural problems of the woreda. These agricultural production problems are enhanced with poor delivery of research technology and extension support. Cash income for household financial requirements is mainly generated from sale of livestock and crop products. Households facing seasonal food shortage receive cash or food transfer, either 'for work' (through a public work program to employ beneficiaries in SWC works, building roads and other infrastructures) or 'for free', from productive safety net program (PSNP). A total of 10745 families have got support from food security program.

3.2. Methods

3.2.1 Household Survey

Primary data were obtained through structured and semi-structured questionnaires administered to various respondents. A structured survey questionnaire was used to gather primary household data at the village level. Primary data was also generated by interviewing local extension agents. In addition, direct field observations and a number of informal discussions with village elders, farmers groups, and extension workers were conducted to cross-check and verify additional some information of interest to this study.

The woreda has two different types of agro-ecologies (Table 2), which were used as units for sampling. Two representative sample Kebeles (one from each agro-ecology) were selected with the help of woreda agricultural officers that have extensive experience and knowledge of the area. The questionnaire was prepared, tested, and amended to fulfill the objectives of the present study.

In the villages, up-to-date farmers list which obtained from the respective kebeles office was used as a sample frame. With the lists, systematic random sampling procedure was used to select a total of 112 sample households which were later interviewed using a structured questionnaire (Appendices). 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 villages (kebeles) in terms of physical environmental factors and resource endowments, this number was considered maximum which could be handled effectively within the research time and budget. Table 2 shows some details about the study villages (kebeles).

Table 2 the study villages in the woreda

Study village	Average elevation (m)	Climatic zone	Total no. of households	Sample size
Ana belesa	2500-3000	Dega	563	55
Lisana kusa	1500-2500	Weinadega	641	57

Interviews at the household level were conducted by going to each interviewee's homestead by the researcher. In cases where the selected interviewee's may not be interviewed due to various reasons, a randomly selected sample substitute was included. The purpose of this interview was to obtain basic household data. Informal discussions with village elders and farmers groups were conducted using a check list of topics to guide the sessions (Appendices). This interview was conducted to cross-check household data and to obtain aggregated data for the entire study.

3.2.2 Key Informants Interview

The last level of the informal interview was conducted with village extension workers. The interviews were intended to gather information about the type of soil conservation and fertility practice, farming practices, extent of using market inputs such as fertilizers, improved seeds, and the type of extension services rendered and also to establish if there is a gap in communication between farmers and extension workers.

3.2.3 Data Analysis

The survey generated both qualitative and quantitative data, the first task was therefore to summarise, categorise and code all qualitative responses into numeric values and then enter them in SPSS statistical program, so was the quantitative data for analysis of various parameters.

Information obtained from unstructured interviews and informal interviews with different elderly people in the village and extension officer were mostly in form of verbal/narrative information. These were written down during the survey and summarized. This information is more qualitative in nature and will be used to support the coded qualitative and quantitative data analysis. Descriptive statistics; sum, mean, and percentages are presented in tables to enable easy interpretation and quick visual comparisons of variables within the study area.

4. Results and Discussion

4.1. Socio-Economic Characteristics of Sample Farm Households

The total population of the 112 households is 884, of which 416 are males and 468 are females (Table 3). The female population exceeds in numbers than that of the male population giving a sex ratio of 112.5%. The mean household size is 7.89 persons, which is greater than the region average of 4.9. The mean household size of village Ana belesa and Lisana kusa is 7.4 and 8.3 respectively. By the average household size, it is meant to refer to the number of individuals currently living under one roof, thus excluding children of some households who may have established their own households.

Table 3 Demographic composition of the sample households, number of individuals by age and sex

	Ana belesa			Lisana kusa		
Sex	Age			Age		
	0-14	15-64	≥65	0-14	15-64	≥65
Male	97	91	6	115	103	4
Female	112	95	8	135	115	3
Total	209	186	14	250	218	7

Source: this study

The study revealed that children constitute 52% of the total populations. The large number of children, as compared to adults, indicates that there will be growing demand for land, and that in the future, the pressure on land resources may become much more severe given the limited arable land and shortage of employment opportunity in other sectors. The number of individuals whose age is 65 and above was twenty one. The working age population, following the conventional categorization, is 404. The age-dependency ratio is therefore 118.8%, which is composed of 113.6% young-age dependency and 5.2% old-age ratio. Such high age-dependency ratio places a considerable burden on producers.

Landholding

Land availability often influences farming practice, and affects the land degradation process. Most of the agricultural land in the study area has so far been subdivided to the smallest land holdings that are no longer economically viable for smallholders' subsistence. Farmers in the study area cannot expand land holdings because the frontier is limited and the availability of arable land has shrunk dramatically from 0.42 to 0.23 ha per capita over the past 30 years (CSA, 2005). Farmers' responses also revealed the existing land shortage. Out of 112 total interviewed farmers, 84.6 percent of households reported that their present landholdings are too small compared to the land needs of the household and they are not in a position to inherit land to their children. Young male farmers used to inherit land from their parents when they get married. However, multi-generational households, with married children living with parents until their death, have become more common as household land holdings have decreased. Over 90% of sampled households have less than 1.0 hectare of land; the mean landholding is 0.79 ha and the mean house hold size is 7.90 (Table 4).

Table 4 Socio-economic characteristics of sample farm households

Characteristic	Percent of total	Mean	Standard Deviation
Family size	-	7.89	2.41
Male household members	-	3.71	1.68
Female household members	-	4.18	1.44
EA household members	-	3.61	1.49
ED household Members	-	4.29	1.83
Land holding (hectares)	-	0.79	0.34
Oxen (heads)	-	1.60	1.31
Other cattle (heads)	-	4.73	1.54
Goats & sheep (heads)	-	2.38	3.29
Chicken (heads)		1.94	0.5
Donkey, mule & horse (heads)		0.95	1.01
Formal Education	-	-	
None	44	-	
1 – 3 years	26	-	
4 – 6 years	17	-	
> 6 years	13	-	

Source: This study

EA = Economically Active = Family member ≥ 15 and < 65 years old.

ED = Economically Dependent = Family member < 15 and ≥ 65 years old.

Livestock

Most householders have some livestock (Table 4). Livestock is an integral part of the farming system. In both villages, cattle are as much important. Oxen provide the draught power needed for the farming. Sheep, goats and poultry are very important sources of cash and food. The few donkeys, mules and horses available give the service of locomotives to transport goods and peoples. Livestock ownership is also used as a measure of wealth status of households, hence the social stigma attached to the number of livestock owned regardless of economic value and the feed shortage. There is a serious shortage of animal feed. Out of interviewed farmers 74.9% reported that feed shortage is currently the biggest obstacle to keeping livestock. In the *kiremt* season, the livestock are dependent on heavily degraded (overgrazed) communal lands and on some crop residues collected in bega season.   In the bega season, crop residues are the main feed. There is also a serious shortage of on farm grazing land. For example, seventy-two percent of sampled households reported that grazing areas on their farm was decreasing. 52.8% of the respondents reported that the grazing land was needed for increased crop production, 16.3% reported a combination of expanding crop production and tree planting, and 2.9% needed more land for their house. It appears that many households are increasing the proportion of cultivated land planted with food crops at the expense of on-farm grazing land to address the food insufficiency due to increasing family size that many households are currently facing. The increase in stocking rates over time has very detrimental effects on grazing lands and crop lands, given that of the decrease in the size of communal grazing areas and on-farm grazing land, and lack of intensive methods of feed production.

Despite the chronic feed shortages and grazing land scarcity, few farmers reported adoption of more intensive methods of fodder production. This indicates the need for an effective extension service along this direction to improve the current livestock management system.

Cash income for household financial requirements is mainly generated from sale of livestock and crop products. A limited number of households generate off-farm income. For instance, only 17 percent of all households surveyed were engaged in off-farm activities. Hence, in spite of the fact that agricultural land is under intense pressure, lack of alternatives which helps to absorb the excess manpower and reduce the burden on the land would likely aggravated the problems of land degradation and nutrient loss on arable land could be more significant. Lack of non farm activities can also affect land management by the inability to finance purchase of inputs and investments.

It is apparent from the foregoing observation that there is intense pressure on the villages' land due to increasing family size, limited arable and grazing land, and lack of off-farm employment. Limited arable land and rapid population growth have increased pressure on the forest and grazing land resources besides aggravating soil degradation via extended farming into steep and marginal areas, shortened fallow system, tilling more frequently and unchecked depletion of the inherent soil nutrients. As a result of such land clearing activities, which usually involve deforestation and burning of vegetative covers from steep lands, more and more land and some times even a whole catchment is exposed to excessive erosion and land degradation. Such chain reactions of soil degradation leads to complete dry out of springs, desertification, etc., which finally make the environment of an area uninhabitable ending up in famine and population migration unless accompanied by integrated soil fertility management and diversified livelihood systems which reduce the pressure on land.

4.2 Farmers' Perception toward Soil Degradation

4.2.1 Awareness of Soil Erosion and its Effects

This research revealed that 71% of farmers experienced soil erosion on their fields in spite of the existing SWC structures on most of their farms. Farmers were aware of soil erosion processes, which they defined as "carrying away of soil or removal of top-soil by water or loss of soil triggered by human activities". Farmers' perceived reasons for continued soil erosion processes were listed and scored (Fig. 1).

Table 5: Farmers' awareness of the existence of soil erosion on their land

Village	Yes (%)	No (%)
Ana belesa	67.3	10.9
Lisana kusa	75.4	7.0

The highest number of farmers reporting an awareness of soil erosion on their fields was in Lisana kusa (75.4%), followed by Ana belesa (67.3%). This is in line with what can be observed in the field. The linear erosion features such as rills and gullies are denser in Lisana than Ana belesa. Most of the natural drainage ways are actively eroding in Lisana kusa. Though the topography of these two villages is broadly similar, there is most probably a difference in the intensity of the rainfall occurring and soil type. Ana belesa being at a higher elevation than Lisana Kusa, the rainfall energy must be significantly lower, thus causing a lesser damage. Another plausible explanation for the observed soil erosion in Lisana could probably be due to soil properties. The sandy soil which prevails over the village is more prone to erosion than the red soil of village-Ana belesa. As a result Lisana was more affected by soil erosion.

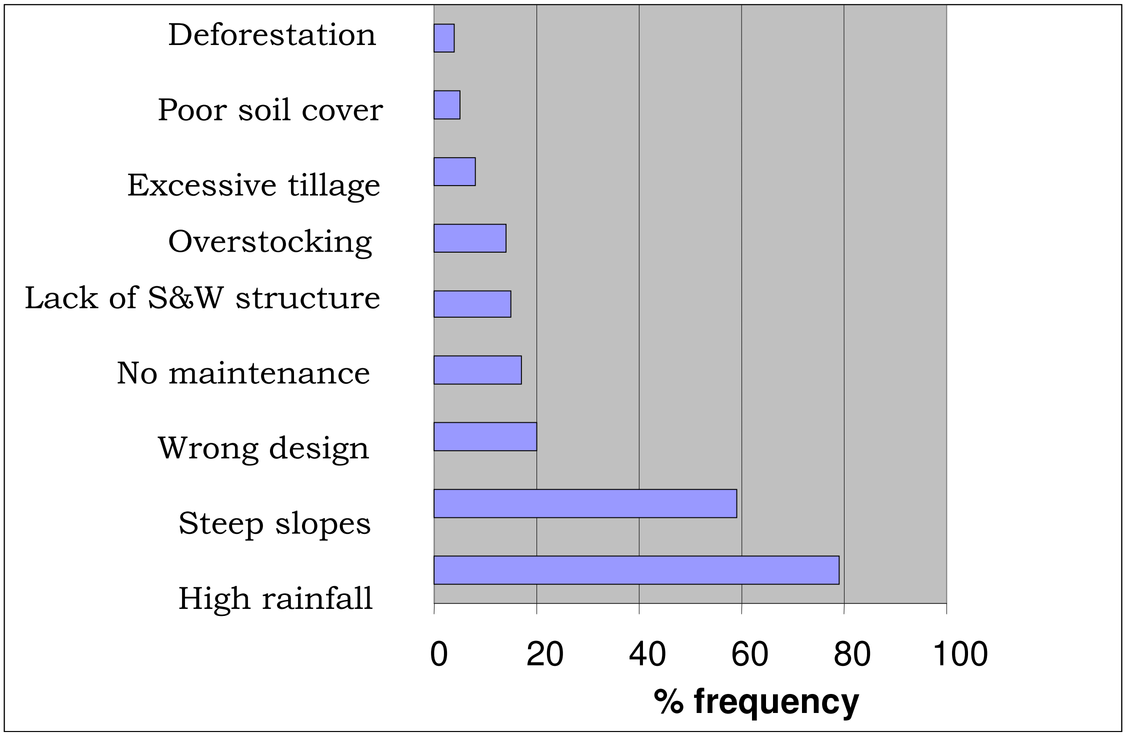


Figure 1 Perceived reasons for continued soil erosion

Most farmers mentioned high rainfall and steep slopes as the major causes to soil erosion (Figure 1). Other causes of erosion were lack of maintenance and wrongly designed SWC structures. Most farmers did not associate overstocking, excessive tillage practices (given the steep slopes), deforestation and poor soil cover with the on-going soil erosion. The evidence of the on-going soil erosion was demonstrated with identification of several on-site erosion indicators (Table 6, left hand side). The most often observed indicators were rills, sheet wash and gullies. Relatively few farmers observed root exposure and exposed underground rocks, and appearance of gravels in large proportion on crop lands was only acknowledged as indicators in Lisana kusa. Despite the variation in observing erosion indicators, most farmers associated their development with high rainfall, runoff and steep slopes (Table 6, right hand side). These findings do confirm that farmers are aware that erosion is damaging their fields by factors they cannot control effectively. The farmers' perceptions are in some way in agreement with Sierra Leone farmers who associated the erosion problem on their land with high rainfall, steep slopes and lack of vegetation (Millington, 1987 cited in Morgan, 1996).

Table 6 Percentage distribution of the observed erosion indicators and their perceived causes, based on 112 respondents

Erosion indicators	No. of observed indicators	Perceived causes (%)			
		Rainfall	Runoff	Steep slopes	Others
Rills	106	60	18	15	7
Sheet wash	100	56	22	14	8
Gullies	54	52	33	7	8
Root exposure	21	26	56	14	4
Exposed underground rocks	18	42	34	6	18
appearance of gravel/stoniness	8	23	58	17	2

It was learned during informal discussions, splash erosion is abstract process to the majority of the respondents. The farmers were also interviewed about whether livestock contribute to land degradation. The proportion of farmers firmly responding `no' was in the majority. In fact, they believed that livestock contributed to improvement of land fertility. Out of the total of 112 farmers interviewed, more than 72 % thought that livestock do not contribute to land degradation. The remaining 14% believed that livestock contributed to soil erosion. This implies that destocking will be a difficult strategy to embark on for land management purposes. Deforestation as cause of erosion was mentioned by only 4% of respondents. The farmers' perception is not in agreement with scientific knowledge that acknowledges livestock with above carrying capacity of grazing areas and deforestation as major causes of soil erosion.

It is also important to discuss various factors causing difference in perception about causes of soil erosion among local people as this will most likely lead to solving or arresting problems considered not critical with the majority of the rural community. Education is one factor which appears to have an influence on local people's perception towards the causes of soil erosion. For example the educated rather than the uneducated perceived deforestation and overstocking as causes of soil erosion in the area. It can be assumed that they regarded deforestation, overstocking and soil erosion as a problem. This implies that awareness of the causes of land degradation issues is acquired in school education. Further more the study made a casual observation that there is a high association between perception of land degradation and the position in the village administration, for instance all village officials in the study villages had a strong concern and awareness for some of the socio-economic and environmental consequences of deforestation, like accelerated soil erosion and climatic changes. Thus the proposition of officials perceiving land degradation as a problem is greater than that of non-officials.

4.2.2 Effect of Erosion on Productivity

To gain further insight in farmers' knowledge of land productivity and how it was affected by erosion, farmers were interrogated on what criteria they used to determine good soils. Discussion with key informants proved that farmers in the study area divided their land into several plots for various purposes. Farmers identify/classify fields based on certain critical criteria. In this study only three land suitability criteria were considered i.e. soil erosion status, level of soil fertility and crop yield production potential. In the study area most field holdings tended to stretch from the very steep hill slope to Gentle slop segments. Therefore farmers were in a position to express their perceptions for each slope position.

Results indicated that farmers knew that the rate of soil loss and level of soil fertility were related, which consequently determined the crop yield potential on any landscape positions (Table 7). The majority of farmers perceived that steep and very steep slopes were landscape segments with high risk of soil erosion and low levels of soil fertility resulting in low crop yields. Gentle slopes clearly ranked fairly showing moderate yield potential. The farmers' description is in agreement with scientific knowledge that acknowledges effects of slope steepness on land productivity (Lal, 1994; Morgan, 1996; Rockström *et al*., 1999). Other scientific experiments agree with farmers' observation (Daniels *et al*., 1985; Stones *et al*., 1985; Rockstöm *et al*., 1999). The farmers' knowledge is also in agreement with findings by Steiner (1998) on farmers in Rwanda who associated soil suitability with slope position. Steeper slopes generally had shallower soils whereas on plateau and foot slopes fine textured soils dominated, implying soils of high fertility.

Table 7 Perceived scores on different land suitability criteria by slope position (N=112)

Slope position	Land suitability criteria								
	Soil loss rate			Soil fertility			Potential crop yield		
	high %	mod %	low %	high %	mod %	low %	high %	mod %	low %
Very steep	90	2	3	0	4	80	1	4	92
Steep	81	10	3	1	9	86	2	16	82
Gentle	4	78	16	10	83	4	14	85	2

4.2.3. Soil Conservation Measures

The overwhelming majority of farmers in the study area reported practicing some type of soil conservation measures (Table 8).

Table-8 Types of soil erosion control measures being practiced

Types of measures	Lisana kusa (%)	Ana belesa (%)
Water diversion ditch	100	100
Ridges	100	100
Contour ploughing	87.7	72.7
Check dams	38.7	47.3
Terracing	18	12
Bunding	13.6	8
Tree planting	11.1	16

The results indicate that water diversion ditch, ridges and contour ploughing were the most widely used traditional soil and water conservation measures. A significant proportion of farmers constructed check dams to refill and prevent further development of rills and gullies near their farm boundaries. Despite their wide fame, terracing and soil bunds were only adopted by a small percentage of the interviewed farmers. Least recognised as a SWC measure was the woodlot practices.

Water diversion ditch, ridges and contour ploughing are relatively less labour intensive short-term SWC practices. This could explain the high adoption rate. Studies from elsewhere have shown that these measures are short-term water management practices to improve crop productivity rather than ways of keeping soil in place (IFAD, 1992). Interestingly, despite the observed trees planted in the farm boundaries of most farms in the research area, the results of this study do indicate that the contribution of trees to SWC was not recognised by farmers. Tree planting has always been promoted foremost as a source of construction timber and fuel-wood but not for soil erosion control, given that their dominant niches are on farm boundaries.

4.3. Soil Fertility

A decline in soil fertility was a common problem in both case study villages (Table 9). This finding is similar to woldeamlak (2003) study which showed that farmers in all the major farming systems experienced a decline in soil fertility. The proportion of sample farm households that perceived the problem of soil fertility decline was larger in Lisana (96.3%) than Ana belesa (76%). It is consistent with the severe and wide spread soil erosion in the village.

Table -9 Farmers' perceptions of soil fertility decline

Villages	Yes (%)	No (%)
Ana belesa	69.1	21.8
Lisana kusa	87.7	3.7

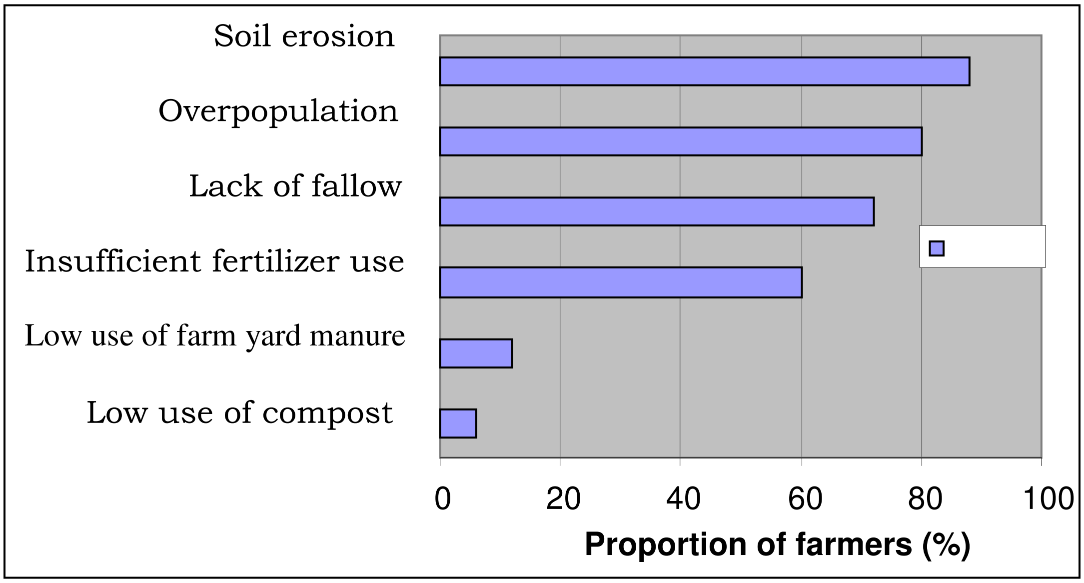
An important finding of the study is that the practice of fallowing is virtually absent in both villages. In both villages, this further reflects pressure from the growing population forces farmers to discontinue fallow. The traditional field operations in the study area that could be characterized by multiple-tillage, cereal-dominated cropping and very few perennial tree components in the system were very erosive for soils and nutrients. Thus, continual farming, without considering conservation measures and using adequate external inputs to compensate for the loss, is expected to result in severe soil fertility decline. A study conducted in at the Gununo site, Bolosso Sore district (Areka) Wollaita Zone near to the study area, has shown that most plots that are cultivated every year without fallow, are subject to a significant loss in soil fertility (Eyasu 1998; Amede et al 2001).

The most frequently cited indicator of soil fertility decline is a decrease in crop yields. The majority of farmers in Lisana kusa (87.7%) followed by Ana belesa (78.2%) pointed out that a decrease in crop yield is a significant indicator of soil fertility decline. Crop yield is often used as a proxy measure for land degradation among officials and experts. Other indicators mentioned by farmers include, change in crop color or crop leaves, stunted growth, crops unable to cope with weed dominance, high amount of straw yield compared to crop yield and disappearance of grass.

Farmers are also aware of the existence of plant species which signify soil fertility decline level. The following plant species are identified by their vernacular names: Gendelac, weowa, kurinichet, shebula and enikiridad. The plant species indicators are, however, site-specific, and their importance as signs may be applicable only within a specific locality. For example, in Ana belesa, 27.3 percent of the farmers cited shebula as an indicator, while this species was not reported in Lisana kusa. Gendelac, weowa and kurinichet are only cited as plant species indicators in Lisana kusa. An effort should be made to tap into indigenous knowledge regarding indicator plant species and by working with key informants. During discussion with key informants, they pointed out that, if shebula and enikiridad appear in large amount over wheat cultivated land, this indicates the land is particularly exhausted to produce wheat for the next production year as a result wheat must be replaced by other crops. Similarly, whenever kurinichet starts to emerge in cultivated field, the land is reached to a stage that it is unable to produce any kind of crops. This was confirmed through discussions with local extension agents. The extension agent informed that kurinichet is truly an indicator of soil fertility decline. Whenever it colonizes, a severe loss of soil nutrients follows.

Regarding the causes of soil fertility decline, most farmers mentioned soil erosion as a major cause of soil fertility decline. It also indicates that there is recognition of erosion as a reducer of yields. The next important causes were overpopulation/high population density, lack of fallowing and low use of chemical fertilizer. The gradual declining of crop yields and the resulting income reduction, and the progressive price increment of fertiliser due to elimination of the subsidy could explain the low application rates of purchased input. It is critical that other low-cost input sources that can address soil fertility problems should be identified, given that the higher price of chemical fertilizer and farmers inability to afford it. But, the use of such organic practices as manuring, composting, mulching, and leguminous crops for biological nitrogen fixation is relatively limited (Figer.2).

The results of this study do indicate that majority of farmers did not consider farmyard manure (FYM) and compost as the sources of improving soil fertility of croplands. With low use of farmyard manure and compost over the crop fields (Table 10), very few farmers considered them as causes of soil fertility decline.



Figer.2 Major causes of soil fertility decline according to farmers

4.3.1. Soil Fertility Amendment Methods

Most farmers are taking various measures to improve soil fertility in the study villages. This could explain the perception that the effect of soil fertility loss is a decrease in crop yields. It also demonstrated the great concern to achieve better yields.

Table 10: Soil fertility measures being practiced

Practices	Ana belesa (%)	Lisana kusa (%)
Use of farm yard manure	100	100
Use of inorganic fertilizer	100	100
Crop rotation	92	92.6
Inter cropping	40	25.9
Agroforestry	20	15.7
Use of compost and mulch	12	0

Hundred percent of the interviewed farmers used farm yard manure but only to maintain soil fertility of homestead gardens in both study villages (Table 10). The major land use systems in the community include homestead farms, where the most important crops such as enset, some coffee, chat and vegetables are grown. Enset (Ensete ventricosum), is a long-lived, banana-like perennial plant used for food, feed and fiber throughout the Southern Highlands of Ethiopia. The traditional enset system of the highland regions of Southern Ethiopia is an indigenous, famine-avoiding agricultural system unique to Ethiopia. The primary strategic importance of enset in food security is that enset helps prevent famine by surviving during droughts when other food crops fail. This makes enset an important food security crop, however, enset-based livelihood systems do face some fundamental structural weaknesses particularly the need for manure to maintain vigorous growth. Since enset is considered as security crop, and both coffee and chat are important cash crops, totally farmers use animal manure for enset, chat and coffee fields every year.

Inorganic Fertilizer

All of the interviewed farmers used chemical fertilizer as the sole source of improving soil fertility of outer fields where cereal and pulse crops are grown (Table 10). Relatively very few farmers tended to use a combination of organic e.g. FYM and inorganic fertilisers instead of purely relying on inorganic fertilizers, as was more common with the majority of farmers.

Discussions with local extension agents and farmers proved that the progressive increment of fertilizer cost after subsidies were being phased out was a major bottleneck to use equal amount of fertilizer what farmers had used before. However, in small scale farming systems like of the study area, where inorganic fertilisers are too expensive and unaffordable, combined application of organic fertilizers with small amount of mineral fertilizers was found to be promising route to improve the efficiency of mineral fertilizers and to achieve higher yields in small holder farms. Long term trials conducted in Kenya on organic and mineral fertiliser interaction also showed that maize grain yield was consistently higher for 20 years in plots fertilised with mineral NP combined with farmyard manure than plots with sole mineral NP or farmyard manure (S.M Nandwa, 1997).

One potential source of organic fertilizer is farmyard manure. Fortunately in both villages, the availability of cow dung is much better because of the reason that fuel wood is not a problem in the study area. However, as indicated above farmers were not using manure for soil fertility replenishment of crop fields. This could be partly due to the lack of relevant knowledge about the combination of judicious use of mineral fertilizers and improved organic residue management through composting and application of farmyard manure.

Improving the organic matter content of crop fields is very crucial to arrest the present trend of land degradation and the accompanied low/reduced productivity. Farmyard manure has a long residual effect and does not have to be applied every year. Farmyard manure could help to trap the chemical fertilizer and make it more effective. Hence, increasing the supply of farmyard manure is a viable option in the restoration of soil fertility and enhancing soil organic matter among smallholders in the study area. Increased organic matter content will increase efficiency of inorganic fertilisers through increased water availability, reduced nutrient loss from leaching and denitrification and increased microbial activity.

Cropping System

A common feature of the cropping systems in the study area is the widespread practice of crop rotation. Traditionally, the major cereals are grown in rotation with sorghum or maize. More than 92% of the respondents reported that they practiced crop rotation. But, a relatively high proportion of farmers reported that they grown sorghum or maize in rotation with teff, wheat or barley. Asked why they preferred this sequence of crop rotation, they perceived that soil fertility was improved when cereals were grown in rotation with sorghum or maize. Contrary to the farmers' preferred crop rotation practices, studies from elsewhere have shown that sorghum has a negative effect on the proceeding crop via exhaustion of nutrient and water reserve of the land (Tilahun et al., 2001).

Intercropping is another type of cropping system in the study area but not widely practiced. Out of interviewed farmers 32.7% of the respondents practiced intercropping. Intercropping, particularly that which utilizes legumes is a deliberate measure to maintain soil fertility. For example, in both villages, intercropping is so intercropping always involves incorporating a legume, such as beans or faba bean, with other crops. The emphasis on legumes is to enhance soil fertility, since inorganic fertilizer use has fallen drastically because of the high prices.

Under this system different crops are intercropped which include maize + faba bean, maize + potato, maize + cabbage and faba bean + potato. There are essentially two practical advantages of the intercropping system for example mixing legumes with a grain crop especially maize. Firstly, legumes are nitrogen fixing plants, therefore, by intercropping the two, farmers don't even have to apply fertilizer or reduce the amount since most of them cannot even afford to buy fertilizer. Lastly, legumes are a cover crop so they suppress the growth of weeds and minimize the difficult task of weeding.

Agroforestry

The findings of this study also suggest that agroforestry is rarely used as a means of maintaining soil fertility (Table 10). In the study villages, scattered trees on crop land are also found, but the trees are widely spaced and probably have little effect in maintaining soil fertility. Agroforestry could play a potentially valuable role in enhancing soil organic matter and improving land productivity (Sanchez, 1995; Cooper et al., 1996; Nair, 1992; Kidd and Pimentel, 1992; and Cook and Grut, 1989). Soil organic matter helps retain essential nutrients, improves infiltration and water-holding capacity, and reduces erosion (Wommer and Swift, 1994). Even when inorganic fertilizer is available, a minimum amount of organic matter is required for its efficient use (Budelman and Zander, 1990). Given that external inputs may continue to be unaffordable agroforestry could be useful in maintaining soil fertility. But further investigation is merited to establish agroforestry as a profitable investment and the best alternative for the sustainable increase of land productivity.

Major Uses of Crop Residue

The results indicated that use of crop residues for livestock feeding were common practices in the study villages. Discussion with farmers and extension agents revealed that crop residue from small cereals (wheat, barley and teff) and legumes (beans and faba bean) are transported from the crop field to the home compound and stored for animal feed due to chronic feed shortage. In addition to that maize and sorghum stalk are used mainly for fuel wood and fencing respectively while the leaf and leaf sheath were grazed by animals right in the field. It implies that soil fertility is declining most rapidly in the main fields, as crop residues from these areas are used for livestock feed while animal manure is used only to maintain soil fertility of homestead gardens where enset, coffee and chat crops are grown as discussed above. Field observation showed that the homestead soils are dark brown to black in colour mainly due to high organic matter content. Soils of the neighbouring field except the homestead are red in colour. Even the homestead soils changed their colour due to organic matter application. Red soils are less fertile (Amede et al., 2001). A study conducted in neighbouring district showed that the main field is the most depleted and there is a clear nutrient gradient from the homestead to the main fields (Eyasu, 1998). This implies that soil fertility decreases with distance from the homestead, which is attributed mainly to crop residue and farmyard manure management.

Mulching, covering soil surface with crop residues, is another potential measure to reduce soil/nutrient loss. Through mulching, the hydraulic force of the raindrop on the soil particle will be reduced, thereby soil detachment is minimized. However, mulch is not applicable in the study villages farming systems because of unavailability of crop residue.

In the subsistence farming systems of study area, where inorganic fertilisers are unaffordable, crop residues play a major role in soil fertility restoration. However, poor management and unwise use of crop residues may have reduced the quality and availability of residues to be used for soil fertility restoration. One constraint typical of the study villages is that farmers are exporting crop residue from the outfield where crops grown to the Enset field of the home garden every year. The nutrient export from the crops field to the Enset field is practised mainly because Enset is considered as a security crop for the household. Earlier investigations in neighbouring district showed that the Enset field is the most fertile corner of the farm, especially in terms of organic matter and nitrogen (Elias, 1998), and hence there may not be a need to further mining of the outfield. Therefore, there is urgent need to stop further removal of crop residues from the out field by working with farmers.

Fuel Wood

Out of total interviewed farmers, none was responding ‘yes’ for question about shortage of fuel wood. Ninety percent of the respondents reported that firewood is the single most frequently used source of household energy and the remaining 10% use dung and crop residues in addition to firewood. Thus, farmers in both villages don’t face firewood shortage and it is not a problem in the study area. Ninety two percent of the respondents grow eucalyptus on their farm boarder area and extremely degraded lands for firewood and building materials. It indicates that there is no competition for animal dung between soil fertility improvement and fuel wood. However, planting of eucalyptus particularly on farm border caused high moisture stress and further aggravate soil degradation problem. The rest eight percent collect firewood from remnants forest. These farmers explain that the time and distance travel show progressive increment. To small-scale farmers deforestation is measured by the distance of the forest from the village now compared to before. The reconnaissance survey and the household questionnaire revealed that small-scale farmers’ perceived deforestation mainly through an increasing scarcity of tangible forest products such as fuel-wood and building poles.

4.4. Perceived Effects of SWC Measures and Constraints of Adoption

1) Effects of SWC measures on productivity parameters

Given that the importance of SWC measures in controlling soil erosion was not a new concept to the farmers in the research area, we wished to evaluate the effect of SWC measures on soil productivity and the expectations farmers had on installed SWC measures: terraces and soil bunds. The majority of farmers perceived that SWC measures increased crop yield, prevent soil erosion and improved soil-water retention capacity of the soils (Table 11). But very few farmers believed that SWC measures could indeed assure long-term productivity of the land. This implies that farmers were likely to invest in simple and cheap short-term benefit measures rather than to go for the recommended mechanical structures such as bench terraces and soil bunds. Because of the top-down enforcement to adopt mechanical SWC measures that were not properly implemented, farmers had formed an opinion that conservation measures were less successful in soil erosion control. As such, 93 percent of farmers perceived that conservation measures were incapable of preventing (or stopping) soil erosion phenomenon, based on the performance of the SWC on their fields, despite the positive perceptions they had for the SWC measures. This finding is similar with the study by (Woldeamlak, 2003) which showed that the major cause of disinterest shown by most of the farmers towards the SWC activities is their perceived ineffectiveness of these technologies.

Table 11 Farmers' perceived impact of SWC measures

What SWC can influence	Yes (%)	No (%)
Improved soil-water retention	87	13
Increased crop yield	68	32
Improved soil fertility	64	36
Prevent soil erosion	7	93
Assured long-term productivity	4	96

2) Constraints to adoption of SWC measures

Farmers listed several constraints encountered when adopting SWC measures. Generally, the main constraints were technology attributes and small farm size. In the study area, the SWC technologies under implementation were physical structures: soil bunds, stone bunds, diversion ditches and check dams. Of these, farmers were more willing to participate in construction of diversion ditches and check dams than that of stone bunds and soil bunds. The average landholding in the study area is very small as a result of population pressure and thus soil conservation technologies, which take some land out of production, like construction of soil conservation structures, have little acceptance by farmers in the study area. The next important constraint was property rights. In the study area, cropped areas remain 'private' only as long as the crop is on the farm. After harvesting, the areas revert to open access or common property that can be used as communal grazing land. This makes it difficult to maintain conservation measures, particularly physical and vegetative ones. Land tenure, construction know-how and women-headed households were least recognised constraints to the adoption of SWC measures, against popular beliefs (Khasiani, 1992; Ståhl, 1993; Tenge, et al., 2004). Therefore the cause for the current low motivation to increase and maintain the number of SWC measures might be due to adoption constraints, listed in this study, and others possibly not identified. With regard to land tenure security, most farmers in the study area have title deeds but still those who did not have were assured of security of ownership from the head of the family. Hence the lack of it would not hinder installation of SWC measures if one wished to do so. Studies in the Philippines and in Ethiopian highlands have shown that security of ownership was not always a necessary condition to adopt SWC measures as factors of kinship, rental contracts and share-cropping arrangements improved investment decisions (Lapar and Pandey, 1999; Kidanu, 2004).

Table 12 Observed constraints to adoption of SWC measures by farmers, and in relation to the number of SWC measures adopted.

Adoption constraints	Percentage (%)
Technology attributes	90
Small farm size	84
Property rights	80
Lack of tillage tools	63
Lack of money/capital	60
Lack of labour	26
Tenure security	0

6. Conclusions and Recommendations

6.1 Conclusions

Land availability often influences farming practices, and hence affects the land degradation process. Totally all the farmers cultivated all their land with no room for expansion except in marginal areas. Sloppy lands which used to be grazing areas or tree plots became under cultivation. Other alternatives which can reduce the pressure on land and provide livelihood for farmers such as non-farm employment were not present.

The overwhelming majority of farmers experienced soil erosion, a phenomenon they related to the widespread onsite erosion indicators. They are knowledgeable of the water erosion processes and the consequent on-site erosion impacts. They have clear understanding of various forms of erosion indicators spread over the landscape and which adversely affect their soils. Rill and gully were most often mentioned indicators, followed by sheet wash (runoff flow paths), root exposure and appearance of gravels in large proportion on crop lands. They attributed the formation of these indicators to factors as high rainfall, runoff from upslope fields, steep slopes and poorly designed or ineffective SWC measures, which they find themselves incapable to change. They however, did not see any linkage between the on-going erosion with overstocking, poor soil-cover and the excessive tillage practices. An observation that is contradictory to scientific evidence (Felipe-Morales *et al*., 1979).

Farmers understand the effects of erosion on crop productivity. They attributed soil fertility levels and crop yield potential to slope position. Fields on flat and gentle slopes were perceived to have highest potential for crop production. Fields on steep and very steep slopes were perceived to be eroded hence the likelihood of not realising high crop yields.

Similarly, farmers use a variety of indicators to interpret and explain the condition of their land fertility. Farmers mentioned indicators that used to perceive and interpret soil fertility decline identified by this study include reduction of crop yield, change in crop color or crop leaves, stunted growth, crops unable to cope with weed dominance, high amount of straw yield compared to crop yield and disappearance of grass and some local specific plant species. Some of biological as well as physical indicators, however, are local and site specific. Regarding indicators of level of soil fertility decline there is appreciable indigenous knowledge that can be tapped in developing plant species indicators. Future studies should focus on identifying the key local informants, particularly the elderly, and correlate the occurrence of a particular plant indicator species with the soil condition of the area.

Farmers perceived that increased crop yield could be realised, among other husbandry practices, through implementation of SWC measures. In addition to increased crop yield, SWC measures were perceived to improve soil fertility, and soil-water retention. Apparently farmers were knowledgeable about various SWC measures but implemented a few of them. Water diversion ditch, ridges and counter ploughing were the most popular and used traditional SWC practices. Low appreciation of the widespread agroforestry systems in the research area as a soil conservation measure implied that farmers were more interested in the tree by-products (wood fuel and construction timber), than its scientifically perceived effects on soil and water conservation. Even though farmers had knowledge of many types of SWC measures, constraints to ensure widespread adoption were still being experienced. The most important constraints to adopt SWC were decrease in farm size and its inconvenience during farm operations especially for free movement of oxen plough followed by lack of capital and tools, labour shortage and construction know-how.

6.2 Recommendations

1. Any conservation programme should consider farmers constraints for adoption

2. Farmers need to adapt their soil fertility management strategies to the considerable spatial and temporal variations in soil degradation, focusing on restoring and maintaining the fertility of outfields and degraded land on steep slopes

3. Extension services must create mechanisms to increase the capacity for independent innovation within farming communities, while working with farmers to develop appropriate technologies to combat soil degradation.

4. Minimization/control of soil loss due to water and/or soil erosion using physical and biological measures;

5. Increasing the organic matter content of outer fields through legume cover crops, application of manure, crop residues and the like;

6. Increasing the nutrient status of the soil (mainly the nutrient in question) through combination of judicious use of mineral fertilizers, farmyard manure, N-fixing legumes and the like;

7. Designing an effective crop rotation scheme that may rotate deep-rooted with shallow rooted, soil depleting with soil-enriching crops and cereal-legume intercropping.

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Appendices

HOUSEHOLD QUESTIONNAIRE TO ASSESS LAND DEGRADATION IN LIMU WOREDA, SNNPR ETHIOPIA

Kebele: ______________________________

Household head education level____, Sex___, Age___

Date of interview___________________________________

I. Household composition and demographic data

1.

Sex	Age (year)			Education			
	1-14	15-65	65<	01	02	03	04
M							
F							
Total							

01= No education, 02= Informal education, 03= primary school, 04 = Secondary school, 05= higher education

II. Land holdings

2. Do you own land?

(i). Yes (ii). No

3. What is the total area of your cultivated land? --------Ha

4. Are you cultivating all your land?

(i). Yes (ii). No

5. If no, what are the reasons?

6. Are all your fields in one unit?

(i) Yes (ii) No

7. What is the distance from your home to the most fertile plot? ---------------

8. What is the distance from your home to a less fertile plot? ---------------

9. Has the size of your cultivated land changed?

(i). Yes (ii). No

If yes, has it: (i). Increased (ii). Declined (iii). Remained the same

10. If it has decreased, what are the reasons?

11. How do you address this problem? (Solutions)

12. Do you have any off-farm employment?

(i). Yes (ii). No

13. If Yes above, what type of work do you do?

14. Overall, do you think land is becoming scarce or it is abundant in the community?

(i). Scarce (ii) .abundant

15. If you feel that land is becoming scarce, why?

16. Compared to the land needs of your household now, how do you rate your present land holdings?

(i). More than enough (ii). Just enough (iii). Too small

17. What type of labour is used on your farm?

1. Family labour2.Hired labour 3.Group labour

III. Agricultural Practices

18. What are the major crops grown on your farm in order of importance?

19. Do you grow each of these crops alone or do you mix them with other crops?

(i). Alone (ii). With other crops (name the most common combinations)

20. Do you plant the same crop every year or change to other crops or practice fallowing?

(i). Plant the same crop each year (ii). Change to other crops

(iii). Practice fallow (iv). Change to other crops and then practice fallow

21. Tillage practice used by farmer

(i). Hand labor-----family labor---- hired labor----- group labor---

(ii). Drought power-- owned------- hired-------

22. What do you do with your crop residue?

(i). Bum them (ii). Use them as feed (iii). Use them for cooking

(iv). others (specify)

23. Do you use improved seed? (i). Yes (ii). No

24. If yes, for which crops?

25. Your livelihood mainly depends on:

(i). Cropping only (ii). Both cropping and livestock (iii). Livestock only

(iv). Others (specify)

26. Do you observe change in the level of crop yield on your cultivated land?

(i).Yes (ii). No

27. If yes, has it been increasing or declining?

(i). Increased (ii). Declined

28. If increasing what are the major reasons?

29. If you feel that the general trend is declining, what do you think are the reasons? Probe by mentioning the following:

Failure of rains, Land degradation/ soil erosion, Small farm plot due to fragmentation, Drought in general, Lack of agricultural inputs, Overgrazing/too many animals, Less labour available in the household, Over cultivation, Other (specify)

30. How often have you experienced drought and famine in this area?

31. What measures do you take in times of drought and famine?

32. Have you received relief or food assistance from the government or other sources in times of drought or famine?

(i). Yes (ii). No

33. Which months of the year are often associated with food shortage?

34. Do you grow trees on your farm?

(i). Yes (ii). No

33. If yes, for what purposes?

(i). Fuelwood -------- tree type --------

(ii). Building materials ------- tree type --------

(iii). Fodder --------- tree type --------

(iv). Soil fertility maintenance ------ tree type --------

(v). Fruits or nuts ----- tree type --------

(vi). Shades ------ tree type --------

(vii).Others (specify) ----------- tree type --------

34. If you have livestock, indicate type and number?

	Type	No.	Use
(i). ---			
(ii). ---			
(iii). ---			

35. Do you have shortage of pasture or feed for livestock?

(i). Yes (ii). No

36. If yes, which are the critical months?
37. How do you deal with this problem?
38. If you have shortage of pasture, do you think that decreasing the number of livestock will help solve this problem?

(i). Yes (ii). No

39. In your village, are there sufficient water sources available during summer period for livestock?

(i). Yes (ii). No

40. Do you think that livestock contribute to land degradation?

(i). Yes (ii). No

III. Soil Erosion

41. Do you perceive the problem of soil erosion on your land?

(i). Yes (ii). No --

If yes, what are the causes?

1.___________________________

2.___________________________

42. How severe is the problem of erosion?

A. severe B. moderate C. minor

43. What indicators do you associate with soil erosion?
44. Do you observe appearances of plant species that signify the severity of erosion?

(i). Yes (ii). No

45. How you identified levels of soil loss, soil fertility and crop yields along different slope positions.

		soil loss	soil fertility	crop yields
i.	very step slope	high/mid/low	high/mid/low	high/mid/low
ii.	step slope			
iii.	gentle slope			

46. Are there any local methods used to prevent soil erosion?

(i). Yes (ii). No

47. If yes, which of the following measures do you practice?

(i). Cultivation along the contour (ii). Terracing (iii). Strip-cropping along the contour (iv).Bunding (v). Vegetative and crop cover (vi). Grassed waterways (vii).Tree planting (viii). Check dams (ix). Other (specify)

48. List the specific benefits of these methods.

49. Have you taken any of the following measures because of erosion?

(i).Abandoned your cultivated land? Yes No

(ii).Expanded to marginal land? Yes No

(iii).Have taken off-farm employment? Yes No

(iv). other (specify) ------------------------

50. Do you believe that erosion can be controlled?

A .Yes B. No

Iv. Soil Fertility

51. Do you perceive the problem of soil fertility decline on your cultivated land?

(i).Yes (ii).No

60. If yes, has it been:

(i). Increasing (ii). Decreasing (iii). Unchanged

61. What are the causes Soil Fertility decline?

62. What features leads you to believe that such problem exists?

63. Do you observe appearances of plant species that signify decline in soil fertility?

(i). Yes (ii). No

64. If yes, what are the names of these species?

Local Name Scientific Name

(i). --

(ii).--

65. Do you use some kinds of practices to maintain or enrich soil fertility of your cultivated land?

(i). Yes (ii). No

66. If yes, which of the following practices do you use?

(i). Use of fertilizer (ii). Use of manure (iii). Intercropping (iv). Mulch or compost (v). Agroforestry (vi). Others (specify) -----------------

67. If you use fertilizer, what kinds of fertilizers do you use and how many kilograms?

68. Has your fertilizer use increased, decreased, or remained the same?

(i). Increased (ii). Declined (iii). Remained the same

69. What are the reasons for this change?

70. Does investment in fertilizer use benefit you?

(i). Yes (ii). No

71. Is fertilizer readily available in your village?

(i). Yes (ii). No

VII. Availability of Household Energy

72. What is the primary source of your fuel?

(i). fuelwood (ii). Crop residue (iii). Dung (iv). Kerosene (v). Other (specify)

73. Indicate the time and distance you travel to collect the primary source of fuel?

(i). Time ------------(ii). Distance -----------

74. If you face fuelwood shortage, what are the reasons?

75. What measures are you taking to deal with this problem?

(i). Agroforestry (ii). Private tree planting (iii).Communal tree planting

(iv). Natural regeneration (v). Use of energy saving devices (vi). Other (specify)

76. What are the effects of SWC measures?

i. increased crop yield
ii. prevent soil erosion
iii. improved soil-water retention
iv. Assuring long term productivity of land

v. Others

77. If disagree what are your reasons for rejecting government soil and Water conservation technologies? Or what criteria need to be considered for adopting the technology?

INTERVIEW GUIDES PROTOCOL FOR FOCUS GROUP DISCUSSION

- Institutional relationships
- Household conditions and assets ownership
- Agriculture/ constraints in crop production
- Food security status
- Local participation in resource management
- Income and expenditure
- Coping strategies/ livelihood diversification
- Awareness of land degradation
- Trends in agricultural production
- Community participation in decision making.
- Indigenous knowledge