

Addis Ababa University

Colleague of Social Science

Department of Geography and Environmental Studies

Assessing Integration Indigenous Practices with Modern Technologies for Sustainable Land Management; the Case of Soil Conservation and Fertility Improvement in Debremitimak Kebele, East Gojjam.

BY

Adimew Admasie

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Adimew Admasie

Department of Geography and Environmental Studies

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Title

Assessing Integration of Indigenous practices with Modern Technologies for Sustainable Land Management: the Case of Soil Conservation and Fertility Improvement in Debremitmak Kebele, East Gojjam

BY

Adimew Admasie

Approved by the Board of Examiners

Faculty of chairperson

Signature

Advisor

External Examiner

Internal Examiner

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Acronyms

ARDO	Agriculture and Rural Development Office
ARNS	Amhara Regional National State
EARO	Ethiopian Agricultural Research Organization
FGD	Focus Group Discussion
ISC	Indigenous Soil Conservation
IK	Indigenous Knowledge
IPs	Indigenous Practices
SCRP	Soil Conservation Research Project
PHC	Primary Health Centers

Abstract

The population of Debremitmak kebelele performs traditional subsistence agriculture. But, agricultural practice has been affected by land degradation mainly through soil erosion and soil fertility decline. In this rural kebele the problem has become more severe since recent times. It is being aggravated by the nature of the slope and population pressure. Factors of the problems are manmade and natural which are interrelated. The magnitude of the problem is also severe. To solve the problem farmers of the study area have been practicing their own practices but fertility of the soil is declining. So the study had attempted to assess the widely implemented land management practices. So that the study had focused on the integration of indigenous and modern land management practices of the study area to solve the problem of land degradation. To address the objective qualitative research method had largely employed sublimated by quantitative figures to describe proportions in percentages.

To achieve this into effect 99 samples households were selected by using random cluster sampling from a total of 1080 households in the study kebele. From these 56 were non model male farmers, 22 were female farmers and 21 model male farmers. Primary and secondary data collection methods have been used among the primary data collection methods focus group discussion, interview, observation, and questioner has been used. From secondary sources different documents have been also used. The indigenous land management practices of the study area include traditional ditches, terrace, check dams, traditional cut-off drains; On the other hand modern land management practices were introduced to farmers by experts and development agents. The modern land management measures include modern cut –off drains, micro basin and forestation of indigenous plant, artificial fertilizers and compost. Even though these are applied the problem of land degradation has severely continued. As a result, its productivity is declining and people of the study area are not securing their food demand. The level of integration among indigenous and modern soil conservation practices is low in most villages of the study area. Factors that affect the integration of indigenous and modern measures include land fragmentation, decrease of cattle, limitations of modern land management measures and economic factors.

CHAPTER ONE

1. Introduction

1.1. Background

Incorporating farmers' indigenous practices (IP) with modern ones is an important component in the planning and implementation of successful land management practices (Yohannes, 1999). Indigenous practices have good role to play if it is properly linked with the science-based knowledge. It assists to maintain sustainable land management in the area. Nevertheless, there is a general feeling that most of the modern land management measures that are adopted in the country area are not making good use of indigenous practices (Yohannes, 1999).

Farmers have many indigenous practices in management of natural resources in their landscapes (Mathiui, 2000). Farmers have experimentation and ways of knowing, which allow them to be innovated in the local practices and systems. Recognizing, empowering and incorporating IPs in participatory rural development projects has been considered a means of ensuring socially, environmentally and economically sustainable natural resources management (Dixon,2002). There is a transferable indigenous practice (TIP) which has the potential to be applied to other sites (Shaw and Sharma, 2007). Recognition of local people as a potential resource manager is a solution to manage threatened ecosystem.

Sustainable land management is achieved by linking indigenous practices of the society with appropriate modern technologies (Michael, 2002). Sustainable land management promotes, participatory soil conservation practices and related land management strategies. The fear of losing soil and its fertility, which are the base for agricultural production has motivated experts, planners and researchers to make tremendous efforts in land management practices over the past years. Studies indicate that of the total agricultural land of the country which is about 60 million hectare, around 45% is significantly eroded (FAO, 1993).

It is generally recognized that IP plays an important role in sustainable management of ecosystem in Ethiopia; however, IP has its own limitations. IP is not in itself capable of

addressing sustainable development (Tripathi and Bhattarya, 2004). In the same agro-ecosystem, farmers' indigenous practices lead to co-existence of both sustainable and unsustainable management (Bellon 1995). Not all natural resource management strategies based on IP are sustainable (Dixon, 2002) and not all-indigenous practices are environmentally friendly (Kelbessa, 2005).

The Amhara region has complex environmental set up and holds natural resources of global importance. Most of these resources, however, are under high pressure of human interference and threatened by land degradation (Gete, 2000). It could, therefore, be more appropriate to initiate environmental sustainability issues in other sectors and sub-sectors. It is also important to incorporate indigenous practices (IP) with science based measures in the designing and implementation of sustainable natural resource management with emphasis on soil.

Integrating indigenous knowledge and practices of land users with newly introduced technologies promotes the sustainability of modern land management practices (Lakew, 2000). This is because farmers understand the importance of modern measures of land management after they use both measures in an integrated manner.

To address the problems of land degradation in the region there is a need to have a broader perspective, both in how the problem is occurred and in the set of possible solutions considered. Farmers are more concerned about short run benefits than long run advantages of the soil. These aggravate the soil erosion in the region. Therefore in this study, effort has been made to assess the integration of indigenous and modern land management practices in the study area.

1.2. Statement of the Problem

Limitation in the use of indigenous measures and lack of effective linkage between indigenous and modern ones have been identified as one of the major problems that hinder the effectiveness of the development of agriculture and the economy of the country in general (Michael, 2002). Among the natural resource soil is the most precious and limited resource. This is true especially for developing countries like Ethiopia where the economy is totally depends on agriculture. The fact that 55% of the GDP, 80% of the employment

and 60% of the foreign revenue of the country depend on agriculture often shows the economic importance of the agricultural sector (CSA, 2009).

Natural resource degradation has been a major environmental, socio-economic and policy challenge in Ethiopia. Specially, land degradation due to soil erosion, nutrient depletion has become serious environmental issue. The situation of land degradation has negatively affected the agricultural sector to a larger extent and the over- all economy as well as the livelihood of its people (Aklilu, 2001). Therefore, the country is facing serious problems of environmental degradation. This problem aggravated by lack of large scale participatory land management practices (Alemneh, 1993; Aklilu, 2001).

There is a high burden to the natural resource base (primarily, land and soil) and to ecological balance in the Ethiopian highlands. The highlands are the center of the economic activity of the country where more than 85 percent of the population lives (Alemneh, 1990). This is because land and soil are very basic in securing food and providing ecosystem services. There is severe problem of degradation in the Amhara region, related to intensive cultivation, overgrazing, deforestation, soil erosion, poor water management, shortage of livestock feed and fuel wood crisis. The rural poor peasants are highly dependent upon natural resources mainly on land to sustain their livelihoods. Thus, poverty eradication in rural areas is understood to be a matter of improving poor people's capacity to drive survival and mean of livelihood from better managed land resources. This may be achieved through integrated land management approach (Michael, 2002).

There are more indigenous land management practices. These practices already seek to harmonize with ecological benefits (minimizing soil loss and runoff, improving the fertility of the soil), economic benefits (sustaining and increasing production) and social benefits (preventing out-migration of land users to urban centers) However, some of indigenous soil conservation measures are ill-designed and may aggravate soil erosion unless they are linked with modern measures (Michael, 2002).

Most outsiders, colonizers, researchers and experts for a long time considered indigenous practices as primitive, backward, stationary and minor to scientific knowledge and practices (Yohannes, 1999). This attitude has contributed to a decline in local people's self-

confidence, and has made people dependent on external solutions which had its own negative impact upon sustainable land management efforts (Yohannes, 2000; Million, 2003; Bekele, 2007).

Sustainable land management needs active participation and co-operation between the farmers and the modern experts. It could be achieved through integration of indigenous practices with modern measures. However, in most parts of North West high lands there is miss-link of the practices in the process of bringing sustainable land management (Yilkal, 2007).

Therefore, the paper is designed to assess the link of indigenous and modern measures for achieving sustainable land management in the study area. This paper is on the argument that integration of the two measures brings sustainable land management and vice-versa. However sustainable land management is achieved if indigenous practices are taken in to account and linked with modern measures. This is because basing conventional measures on in indigenous practices gives sustainable solution for the problem of land degradation..

1.3. Objective of the Study

1.3.1. General Objective

The overall objective of the study is to assess the ways of achieving sustainable land management in the study area through integration of indigenous and modern land management measures in particular attention to soil.

1.3.2. The Specific Objectives

The specific objectives of the study are to;

1. Assess factors, level, types of soil degradation and the level of farmers' perception on soil erosion and fertility decline.
2. Assess indigenous and modern crop land management practices used by farmers in the study area.

3. Assess the overall strength and limitation of indigenous and modern land management practices on the basis of their cost, function, labor intensiveness, sustainability, and so on.
4. Assess level of integration among indigenous and modern soil conservation practices and discuss the factors that affect integration of indigenous and modern measures in the study area.

1.4. Basic Research Questions

This study was expected to find out answers for the following questions.

1. What are factors affecting soil degradation and how is its level in the study area? How is the level of farmers' perception on the problem of land degradation in their locality and on their farm plots?
2. What are the indigenous and modern land management practices in the study area?
3. What is the overall strength and limitations of indigenous and modern crop land management practices of the study area?
4. How is the level of integration among indigenous and modern land management practices? What are factors that affect integration of the two measures?

1.5. Significance of the Study

The result of the study could have importance to enhance the understanding of the society concerned with soil management. Soil management in turn has social, economic advantage. In addition to this the study used the farmers to announce the strength and limitation of soil conservation and fertility improvement practices. It may also assist the regional and district agriculture experts to plan well effective and participatory land management practices.

It also enhance the understanding of farmers` how the integration of indigenous and modern land management and fertility improvement practices are effective for sustainable land management of the study area. Therefore the result of the study may have some kind of contribution for successful land management of farmers in the study area mainly on crop

land. Improved land management that ensures better resource use will promote long-term sustainability for the economic welfare of rural communities. It is widely argued indigenous practices can enhance more sustainable agricultural production, especially if they are integrated with modern technologies.

1.6. The Delimitation of the Study

The study is limited to Debremitimak kebele in Sinan Woreda to assess the integration of indigenous practices with modern technologies to achieve sustainable land management the case of soil conservation and fertility improvement practices. Indigenous practice refers to all activities of local people to manage land particularly soil conservation and fertility improvement practices. Modern conservation measures are those adopted by farmers through development agents. Soil erosion caused by other agents except erosion by water is not the interest of the study.

1.7. Organization of the Thesis

The thesis is composed of five chapters. The first chapter is introduction that deals with the general background of the research, statement of the problem, objectives of the study, significance of the study and delimitation of the study. Chapter two deal with review of related literature. Chapter three focuses on materials and methods. Chapter four deals about results and discussion. The last chapter focuses with conclusions and recommendation.

CHAPTER TWO

LITERATURE REVIEW

2.1. Definition of Concepts and Terms

Conservation: - It is the protection of natural resource from degradation or damage. It is the purposeful act of securing the natural resources for the longer use and for the greatest number of people (Yilkal, 2007). Conservation in this study paper is limited and confined to the land management like soil and soil nutrients.

Land management:-Land management refers to soil conservation and fertility improvement activities. Soil conservation, soil fertility management, agricultural forestry practices, controlled-grazing and several others are typical examples of land management practices (Kelbesa, 2007).

Sustainable land Management (SLM):- is an approach that emphasizes on finding economically feasible, socially acceptable, economically viable and ecologically sound solutions at a local level. In this approach, attention is given to the use of indigenous practices with modern measures of the study area. Therefore sustainable land management approach can promote participatory land management solutions to the problem of land degradation and environmental deterioration (Kumela, 2007).

Indigenous knowledge: - can be defined as “A body of knowledge built up by a group of people through generations of living in close contact with nature (Kumela, 2007). It refers to the unique, traditional and local knowledge existing within and developed around the specific conditions of women and men indigenous to a particular geographic area. Indigenous knowledge contrasts with the international knowledge system produced by universities, research institutions and private firms (Warren, 1992). It is related to the ways members of a given community define and categorize natural, ecological, social and economic situations according to their lives. Indigenous knowledge is the knowledge that is an indigenous (local) to a given community over generations of living in a particular environment. Moreover, for most cases this form of knowledge may be stored in peoples’

memories, activities and is expressed in stories, songs, folklore, proverbs, cultural values, beliefs, agricultural practices and equipment.

Indigenous knowledge is also characterized as dynamic and continuously adapted to the changing conditions as well as passes from generations to generations (Kruger-et al 1996). IK is stored in peoples' memories and activities and it is expressed in the form of stories, songs, folklore, proverbs, dances, myths, cultural values, beliefs, rituals, community laws, local language and taxonomy, agricultural practices, equipment, materials, plant species and animal breeds (Warren, 1995).

Indigenous knowledge is shared and communicated orally by specific examples and through cultures. Indigenous forms of communications are vital to local level decision-making process and to the preservation, development and spread of IK, i.e., indigenous knowledge has broader meaning (Grenier, 1998). Such knowledge evolves in the local environment so that it is specifically adapted to the requirements of local people and conditions. It is also creative and experimental, constantly incorporating outside influences and inside innovations to meet new conditions. Thus, it is usually a mistake to think of indigenous knowledge as 'old-fashioned; 'back-ward', static' or unchanging' (Warren, 1992).

Indigenous Soil Conservation (ISC); this is conservation strategy of soil which greatly practices local knowledge of local farmers to minimize the effect of land degradation, i.e., soil erosion and soil fertility decline (Kruger, 1996).

Local people: local people are the inhabitants of a particular geographic location who have a culture and belief system, distinct from the international system of knowledge (e.g. the tribal, native, first or aboriginal people of an area (Kelbesa, 2007).

Indigenous Soil Management Practices: refers to any activity of local people to conserve soil resource and improve soil fertility (Waren, 1992).

Modern Land Management Practices; Modern land management practices are studied and identified by universities research institutions and other organizations which are introduced to local farmers in the process of top down approach (Michael, 2002).

Adaptation: the incremental change and modification of technologies to meet local conditions (Yilkal, 2007).

Adoption: the process of transferring and implementing modern technologies to the users of an area through experts for better land management practices (Michael, 2002).

Appropriate technologies: refers to a technology that best fits a given land use system which may not be equally important for land use systems elsewhere. It is a technology that ecologically productive, economically effective and reduces risk as well as better responds to the respective land use systems (Kelbesa, 2007).

Model farmers: - They are those farmers in the study area who have been rewarded by Sinan woreda ARD Offices for their better land management and agricultural productivity. They are able to produce better yields than the rest of the farmers (Sinanworeda ARD Office, 2014).

2.2. Managing soil Fertility: Different inputs used

Manure, compost, household waste is clearly critical to the final nutrient balance found in particular farm land. Fertility management refers to replacing the nutrients whenever lost or consumed by plants. Nutrients could be eroded or leached to the ground. The table below shows how farmers apply different inputs on their farm lands.

Table. 2.2. Different Inputs to Maintain Soil Fertility

Types of inputs	Advantage	Disadvantage
Chemical fertilizer	Crop mature earlier Makes plants strong Good growth of plants Enables to produce better yield. Easy to apply	Crop burn if rains is poor Expensive
Manure	Big grains produced Improves soil fertility	Crop burn if rains poor Increase weeds Labor intensive production and application
Household waste	Good for reclamation of degraded soil Promotes water retention capacity Easiest and cheapest	Crop burn if rains is poor Small amounts produced
Compost	Good yield result Structure and fertility of soil improved good for vegetables	Crop burn if not well rotted and rain is poor First year effect may be poor

Source: Developed by the researcher on the basis of review literature

2.3. Integrating Indigenous practices with Modern Technologies for Sustainable Land Management

It is an approach based on the ecological and socio-economic understanding of the environment and the local farmers and their relationship. The central idea to this way of sustainable land management is the need for active participation and co-operation between the farmers and the modern experts. Sustainable land management could be achieved through the increased recognition of the contribution of indigenous practices of the farmers (Michael, 2002). It is also encompasses the mechanisms through which IP is linked in to introduced or conventional technologies in land management (De Walt, 1994). This is an approach based on the ecological and socio-economic understanding of the environment and the indigenous (local) people and their relationship (Lakew, 2000).

2.4. The Role of Indigenous practices in Modern Conservation and Sustainable Development

Integrating IP with modern development projects can contribute to local empowerment and development, increasing self-sufficiency and strengthening self-determination (Thrupp, 1989). Incorporating IP in development projects and management plans gives it legitimacy and credibility in the eyes of both local people and outsiders. It increases cultural pride and thus motivation to solve local problems with local resources (Warren, 1991). Local capacity building is a crucial aspect of sustainable development (Michael, 2002).

2.5. The Significance of Indigenous practices for Sustainable Agriculture in Amhara Region.

Farmers can provide valuable input about the local environment to effectively manage natural resources sustainably. Most literature indicates that local people can manage the environments where they have lived for generation. This happened without significantly damaging the local ecologies (Kumela, 2007). Thus, they feel that farmers can provide a powerful basis from which alternative ways of managing resources can be developed. In some instances, indigenous technologies and know-how have advantages over introduced ones. They rely on locally available skill and materials and are therefore, more cost-effective than introducing exotic technologies from outside sources (warren, 1992). Besides that, local people are familiar with them.

It is widely agreed that subsistence agriculture in the Amhara region is based on the bio-physical potentials of the region, the socio-cultural conditions of the community and the farmers' traditional agricultural practice and knowledge. The farmers living in the highlands have established their indigenous agricultural practices over many generations. This is in contrast to the global agricultural technologies, mainly generated by modern research institutes in the last hundred years. Indigenous land management measures can take the form of structural or physical measures, biological and agronomic measures. The main objective of indigenous agronomic practices is maintaining soil fertility and crop yields. They are also effective against erosion. Furthermore, the main objective of the indigenous structural conservation measures is to reduce run off and soil removal. However, it is also effective in maintaining soil fertility (Belay, 1998; Yohannes and

Herweg, 2000). Therefore, the indigenous soil conservation methods also in one way or another are mechanisms of maintaining the fertility of the soil. Similarly, maintaining the fertility of the soil means in other way increasing the capacity of the soil to resist soil erosion.

Undoubtedly, the indigenous agricultural land management practices are the base for the development of modern or conventional technologies. Hence they are socially appropriate. Thus, indigenous practices are relevant for the sustainable agricultural development. This is due to the fact that such practices have been developed within the scope of the farmers' culture and technical capacity (Dewalt, 1994; Tivy, 1995). Hence, they can best fit in to the existing physical, socio-economic and cultural environment.

2.6. The Role of Indigenous practices in Development Process

Indigenous practices have a considerable degree of sustainability with the local environment. It is because they have been developed in line with the laws of natural ecological systems. They are within the scope of the farmers acquired or inherited culture, traditions and knowledge (Belay, 1998).

Indigenous practice is important on three levels for the development process. Firstly, it is obviously important for the local community in which the bearers of such practices live and produce. Secondly, development partners such as NGOs, private sector initiatives, government, donors and local leaders need to recognize it in the interaction with the local communities before incorporating IP in their approaches. They need to understand it and critically validate it against the usefulness for their intended objectives and lastly, IP forms parts of the global practices. In this context, it has value and relevance in itself. IP can be preserved, transferred or adopted to ecological, social cultural and economic conditions of a particular community (Grenier, 1998).

2.7. The strength of Indigenous Land Management practices

There was the consideration by many scholars, foreigners, nationals, researchers and experts that indigenous practices are primitive, backward, static and supportive to modern technology (De Walt, 1994; Dejene, 2000). This negative attitude has contributed a lot to

the decline of local farmers' self-confidence. It has also brought high dependency on foreign scientific knowledge to seek for land degradation problems to solve. Another issue to be considered is that being considerate of indigenous practice will help to win the 'emotional will' of the local people which in turn will contribute to be more perceptive to learn new idea technologies.

Now days, it has been increasingly recognized that the farmers themselves have valuable environmental practices in their localities (Dewalt, 1994). In addition, the indigenous practice of farmers is understood as a basis for sustainable land management, particularly in the soil and soil nutrient enhancement practices. Indigenous land management system is usually adopted within the given rural community. Therefore, they are culturally more appropriate and environmentally friendly. Besides, the local rural community develops land management measures that are suitable to the biophysical properties and fit in to the socio-economic conditions (Hurni, 1997).

Indigenous practice (IP) forms the basis on which sound agricultural land management measures can be achieved and it is the beginning of sustainable resource management. Indigenous practices of rural people in the process of land management have largely been ignored by policy-makers and researchers by depending on the top-down approach of technology transfer (Yohannes, 1999). The indigenous practices of farmers' have rarely accepted as the main stream of agricultural development and land management measures (Warren, 1991; Dewalt, 1994). But, indigenous practice of farmers should not be considered as they are without constraints (Warren, 1991).

Indigenous practices have little or no cost and it is readily available. Indigenous technologies are found to be socially desirable, economically affordable and sustainable (Dewalt, 1994). They involve minimum risk to rural farmers and producers and above all, they are widely believed to conserve resources. Hence, they should appropriately be linked in the conventional measures. There are situations in which modern science is not appropriate, and the use of simpler technologies and procedures are required (Warren, 1992). Consequently, indigenous practices provide the basis for the problem solving strategies of local communities.

2.8. Agricultural Land Degradation in the Highlands of Ethiopia with particular emphasis On the North-western highlands.

Land degradation in the Ethiopian highlands (i.e. areas above 1500m.a.s.l) has been a concern for many years. The problem occurs in the form of soil erosion, nutrient depletion and deforestation. Vast areas of these highlands have been classified as suffering from severe to moderate soil degradation. Though the extent varies from place to place, the northern and the central highlands of the country are most seriously affected (Solomon, 1994). The human-Induced soil erosion and soil fertility deterioration are mainly considered as serious problems. Soil erosion by water is a serious problem as well as threat to agricultural productivity in the highlands.

According to (Gete, 2000) the highlands of Gojjam are the main supplier of surplus cereals to the rest of the country. They are believed to be “the traditional ‘breadbasket of Ethiopia,’ known for abundant cereal production and export of surplus to major Ethiopian cities’ (Hurni 2001). However, the current land degradation problems (soil erosion and soil fertility decline) are undermining this potential. That is, given the current trends of land degradation, these highlands will no longer be able to supply surplus agricultural products to the rest of the country and will soon fail to satisfy even the food demand of their own population (Hurni 2001). Despite all these, the highlands of Gojjam are still considered to be an area of great agricultural potential. Therefore, sustaining this potential is a crucial step that must be undertaken in order to secure the food supply of the country.

Severity /Extent of Land Degradation

The rate of land degradation in the highlands of Gojjam, is reported to be exceptionally high, and is also considered as a threat to its agricultural potential. It is reported that the soil loss rate from the cultivated areas of these highlands is higher than in the rest of the country and soil productivity is decreasing very fast (Gete, 2000). The long-term average soil erosion rates from cultivated plots are reported to be the highest among nation-wide monitored sites. As it is noted the current soil erosion rate in these areas, especially on cultivated lands, is extraordinary and exceeds the soil formation rate by a factor of 10 to 15.

This rate is rather very alarming and deserves serious recognition before the soil potential is degraded beyond recovery (Gete, 2000).

Causes of Land Degradation

Bio physical factors

The factors contributing to land degradation are varied, complex and interrelated. They can be human, physical, and socio-economic. Of the natural factors causing land degradation, high intensity of rainfall and relief with steep slope are considered to be the major ones. The most important natural factor that causes land degradation in the north-western highlands is probably 'high intensity of rainfall'. The impact of raindrops, with tremendous amounts of energy, on the bare unprotected soil starts the process of erosion by water (Hudson 1981; Morgan 1986). Rainfall with high intensity is particularly responsible for sheet erosion, i.e., the removal of the surface soil in thin layers, or "sheets," or more or less uniformly from a broader area of soil. Soil particles are detached primarily by raindrops impacting the soil and are transported mainly by sheet flow of water. While sheet erosion is the least spectacular in the field, it is the most extensive and probably the most damaging kind of erosion worldwide (Frye 1987).

The other important biophysical factor determining vulnerability of soils to erosion is the slope gradient. Particularly, the steep slopes encourage erosion by increasing the volume and the velocity of the runoff and by encouraging the down slope movement of soils due to tillage. When run off falls on steep slopes and hence only a limited proportion of the rainwater can infiltrate into the soil, whereas on gentler slopes the slower flow on the surface allows percolation of a large proportion (Belay, 2002).

Socio-economic and Institutional Factors

Lakew Desta et al (2000) identified different socio-economic and institutional factors that affect land degradation in the region through their impacts on farmers' decision with respect to land use and land management practices, such as ploughing, fallow, use of manure and other sources of organic matter, fertilizer use, and adoption of soil and water conservation measures.

Population Pressure

The need to expand crop or grazing land mainly through deforestation leads to land degradation. Farmers' used to clear natural vegetation in order to get cropland for crop cultivation and cope up with the growing population's demand for food and cultivated land. This situation, therefore, aggravates the land degradation problem and causes high loss of soil productivity. But currently due to almost complete conversion of all areas in to croplands in this region these practices are no more important. In addition, population growth increases the demand for fuel wood, which in turn leads to the destruction of forests as well as increase in the use of crop residues and dung for fuel rather than as a source of organic fertilizer to improve the already degraded or poor soils of the region.

Excess removal of forests is contributing to land degradation. Forest has degraded in Amahara Region for fuel wood, logging and construction purposes. Since harvested trees are not replaced adequately by tree planting, soils are exposed to high intensity of rainfall (Lakew, 2000).

2.9. Global Perspectives of Indigenous practice for Soil Conservation

Conservation of soil and other natural resources over a long period of time has been made possible because of the cultural, spiritual and other social institutions that guide relationship of the local communities with resources. IP holds potential for preserving not only ecological function but also cultural diversity. Even in a context where deforestation is high, there are forests, streams, old trees and lakes that have been conserved by the people extremely well. IP provides a foundation for ecologically sustainable development and food security (Ranjay, 2006, Bekele, 2007).

IP is harmonizing phenomenon essential to human development. Of equal concern to many world citizens is the uncertain status of the IP that reflects many generations of experience and problem solving by thousands of ethnic groups across the world. Very little of this knowledge and practice has been recorded, yet it represents and immensely valuable data base that provides human kind with insights on how numerous communities have interacts with their changing environment including its floral and faunal resources (Michael, 1992). Over centuries, people have developed strategies to protect and rehabilitate the land, most

of which proved effective. In the course of history, attitudes towards indigenous knowledge and practice have undergone a significant transformation from positive to negative.

However, with the current world wide threat of resource degradation, there is an increasing interest being shown to IP in the context of sustainable resource management. The recognition of the potential of IK and practice to development is a result of the failure of reductionist technological fix of the west. IK based on many years of experience integrates ecological, economic and social goals, even though it was not always possible to satisfy all three simultaneously. The harmonization of these goals is also a fundamental aim of sustainable land management and sustainable development (Yohannes, 2000).

International and National development agencies have recognized the value of participatory approaches to decision-making for sustainable development. During the last decade a rapidly growing set of evidence indicates a strong relationship between IP and sustainable development (Bekele, 2007). Many scientific and social researchers have begun to recognize the positive role that IP plays for sustainable natural resource management.

Globally, there is an increasing acknowledgement of the relevance of IP as an invaluable and underused practice which presents in developing countries, particularly African countries, with a powerful asset in environmental conservation and natural disaster management. Specifically, from time immemorial, natural disaster management in Africa has been deeply rooted in local communities who apply IPs to achieve and monitor natural resource management. IP is therefore, an essential element in the development process and the livelihood of many local communities. A major challenge that African countries continue to face is how to reconcile IPs and modern measures without substituting one with the other, respecting the two sets of values, and building on their respective strengths.

2.10. National Perspectives of the Indigenous practice for Soil Conservation

Of course when we came to Ethiopia situation, long ago, when there were comparatively fewer people in the country, the indigenous farming systems and technology enabled them to make a living without seriously depleting the natural resources base. In the past

environmental degradation occurred around settlements, where communities could always move to new land, which was abundant. There was little need for conservation, the landscape was generously covered with trees, bushes and grasses, and a higher proportion of rain was percolating in to the soil. Erosion was, therefore, held in check and fuel would be plentiful, easily obtained and inexpensive (Zewudie, 1999).

The Ministry of Agriculture (MoA) undertook the first study on indigenous conservation practices in Ethiopia in 1988. It was an inventory work carried out by consultants based on short field visits to selected areas of the country with known indigenous conservation practices. The study identified different types of indigenous soil and water conservation as well as agro forestry practices that have been used by the local farmers.

For many years back, the Ethiopian high lands soils have been cultivated with little thought to the malpractices of traditional technology. The resulting miss-use of resources together with physical erosive forces has been catastrophic which is reflected in crop failure due to droughts. The latter have thought farmers a lot about the causes of resources degradation and its consequences. They feel more about its effect when production is less than expected. Therefore, they use various traditional conservation measures to protect the soil from erosion (Kumela, 2007).

2.11. Conceptual Framework

Good soil is potential to sustain agriculture and improve productivity, hence, the way to food security. Therefore maintaining soil fertility for long run, given the productive potential of the farm land as determined by water availability and other climatic factors, is thus essential to sustain agriculture. Most of the farmers in the study district are food insecure. The single most striking activity is struggle for food. The ever-growing condition of the population at the area increases the gap between demand and supply of food from cultivated land. A number of factors are contributing to the soil fertility decline and agricultural failure at the area. It has been because of socio-economic, physical and policy related factors. For instance, soil erosion has a multiple effects, including the burial/death of young seedlings, removal of soil organic matter, decrease soil depth and reduce soil fertility. And rapid population growth, being underlying cause, had been reducing the

average farm land holding per house hold. Four decades ago, it was estimated to be that the size of farmland holding per house hold was about 3-4ha. However, currently, it is rapidly falling to 1ha or less. As a result, land is subjected to high population pressure, over cultivation, over grazing hence, no longer fallow period that inevitably led to continuous cultivation. Therefore, farmers are forced to continuously cultivate their respective farmland. Due to this fact, the fertility of soil on farmland continuously decreases.

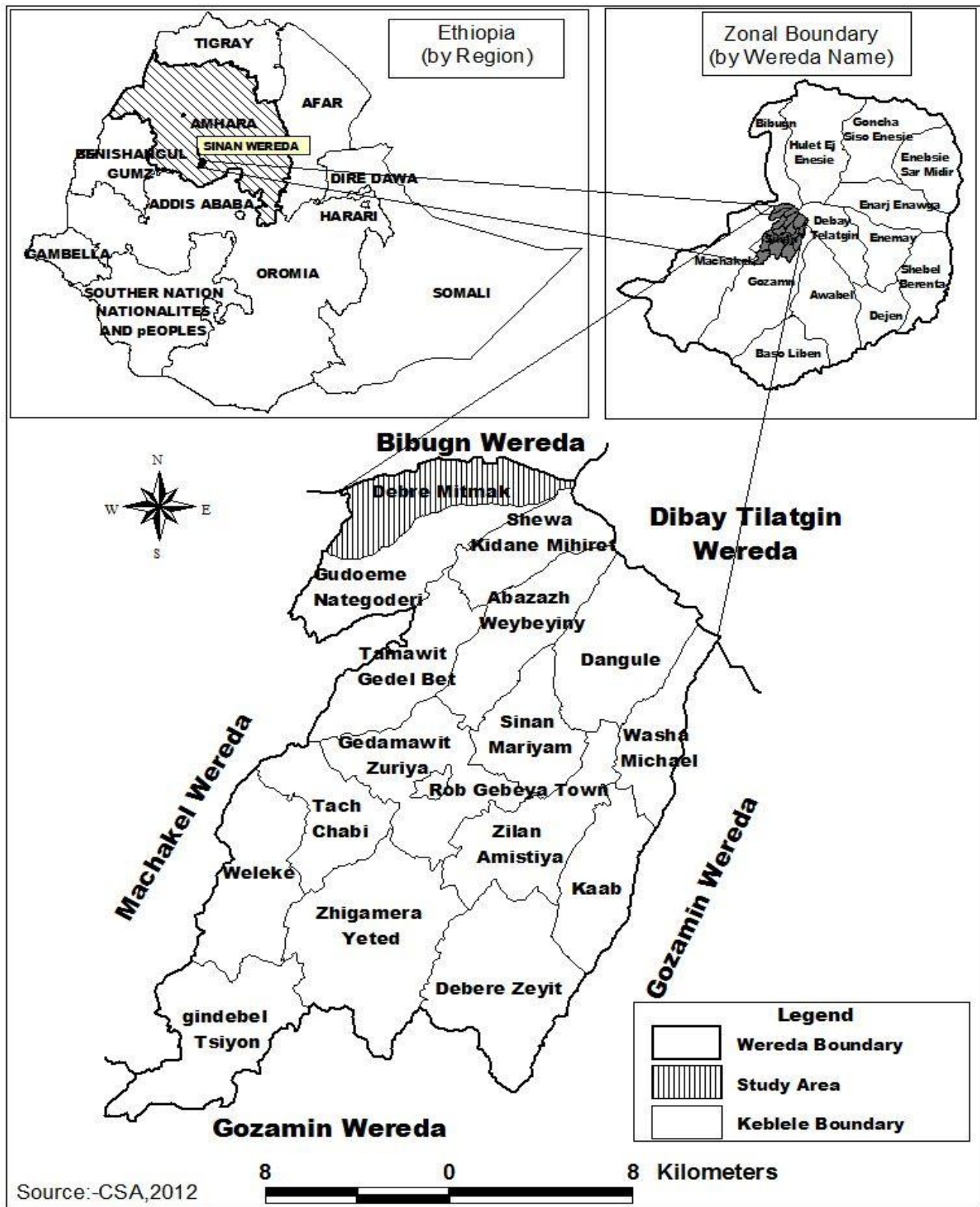
CHAPTER TREE

MATERIALS AND METHODS

3.1. Descriptions of the Study Area

3.1.1. Location of the Study Area

Debremitimak is one of the 16 kebeles in Sinan Woreda. It is located 15km in the north-east parts of Debremarkos, the capital of East Gojjam in the Amhara National Regional State (ANRS). This kebele has total area of one thousand six hundred sixty four kilometer square and total population of 9635 and total house hold of 1080 (Sinan Woreda ARDO, 2014). Debremitimak is a rural kebele found at the Northern tip of the Sinan woreda. As it has been observed in figure 3.1.3, the study area is found at the North West part of Ethiopia. Debremitimak is bounded by Bibugn woreda in the North and Northwest, Gudom ena Tegodari kebele in the south west and Shewakidanimiret kebele in the South east part.



Figure, 3.1.3. Map of the Study Area.

3.1.2. Climate

The study area can be classified under traditional agro climatic zone of dega, having an altitude ranges from 2800m to 3110m (sinanworeda ARDO, 2014). However, the climatic condition slightly varies from place to place due to the impact of vegetation cover, altitude, and the shadow of the great mountain of Aratmekeraker (the greatest point of East Gojjam). Especially villages of Kesarwuha and Dobe are affected by the shadow of the mountain. However, Deber and Weizazer are relatively hotter than the other villages.

3.1.3. Soil

As it has been indicated by the woreda agriculture and rural development office, the types of soil commonly found are cambisols (borebor), ashalema (less fertile), merere (moderately fertile) and black soils (fertile soil).

3.1.4. Economic Activity

All most all population in the study area are dependent on mixed agriculture (animal rearing and crop production).The common animals that are reared in the study area are horse, sheep, cattle, got, and commonly produced crops are wheat, barley, bean, pea, crops are produced ones a year since there is uni-modal rail fall distribution, but vegetables such as potato and onion are produced two times of the year by using none modernized irrigation techniques (Sinanworeda ARDO, 2014)

3.2. Research Method and Approach

The research was based on case study method. Furthermore, Qualitative research approaches were largely used with quantitative data to show proportions in percent. Data gathered from primary and secondary sources were analyzed qualitatively supplemented by some quantitative figures to show proportions in percentages. Thus, the type of research used is exploratory type through qualitative description and in-depth narration. The interview and questionnaire was written in English, but it was translated in to Amharic depending on the primary language of the respondents.

The researcher selected Debremitimak kebele from other kebeles since soil erosion was more severe than other kebeles of sinan woreda according to the information from the

woreda soil conservation experts. Therefore, the researcher would like to assess the factors affecting soil degradation, the integration of indigenous and modern land management practices and attempt was also made to assess factors that hinder integration of the two measures. The study kebele was divided in to seven villages. They are Wefi, Gult, Dobe, Weizazer, Kesarwuha, Gibgod, Debir.

3.3. Nature of Data

Data was collected from primary and secondary sources. The data which have been gathered incorporated information about the cause of soil erosion and soil fertility decline, farmers' perception on soil degradation, level and forms of erosion. The data also include the limitation, strength, type and integration of indigenous and modern soil conservation measures. Furthermore, the data include factors that hinder the integration of these land management measures of the study area.

3.4. Sources of Data

Data was collected from primary and secondary sources. The primary data sources include farmers, development agents of the kebele and soil conservation experts of sinan woreda. Secondary data was collected from published and unpublished materials which were available in different libraries and research centers of Addis Ababa University and other institutions which have direct and related relevance to the study. The source materials are various journals, magazines, newspapers, workshop proceedings, thesis, dissertation and relevant books. Primary data was collected by using the following primary data collection tools.

3.4.1. Questionnaire

Open and close ended questions were prepared and distributed to 99 household farmers who have been selected by using random cluster sampling techniques from total of 1080 household farmers. From these 56 non models male farmers were selected by using systematic random sampling method by using their list from the kebele administration. Eight non model male farmers were selected from each of the seven villages. In addition all 22 female farmers (female household leaders) as well as 21 model male farmers found in the area were proportionally selected from seven villages and included in the sample. Since

both males and females were participating in the construction of modern land management practices in group and they already practiced indigenous land management practices, valuable data were collected for assessing the two measures. Since model farmers had better land management practices, they had been given more attention in the process of selecting samples. Furthermore, attention was given to female headed households (Household leaded by female farmer) since they had relatively a better practice for both land management measures.

3.4.2. Field Observation

Direct observation was done to the type farmer's indigenous and modern land management practices and their integration on their farm lands, topographic situations, the level and forms erosion were observed. It was mainly emphasized to have clear information about the integration of modern and indigenous soil conservation practices, their effectiveness on land management and time of application on farm land. The observation has become practical with the assistance of chairman of the kebele and development agents through what is called participatory field-observation.

3.4.3. Focus Group Discussions (FGD)

Focus Group Discussions were made by using the 56, randomly selected farmers. Eight farmers were selected from each village for one focus group discussion. Hence a total of 7 focus group discussions were carried out in each of the villages which had eight members. All of the members of the discussion were males.

Almost all farmers had good knowledge and experience about the two land management practices. Attractive discussion were made over the questions which states about the cause of soil erosion, their perception on land degradation, the type of modern and indigenous land management practices of the area, and the strength, limitation and integration of both measures.

3.4.4. Key Informant Interview

In depth interview were made with elderly farmers, chairman of the kebele, and development agents of the kebele and soil conservation experts of sinan worda. So that

seven elderly farmers, two development agents, two soil conservation experts and one chairman of the kebele were interviewed. Elderly farmers had more information about the indigenous and modern land management practices. These farmers expressed their ideas concerning land degradation and effects in comparison with the previous.

Interview with development agents and soil conservation experts focuses on the strength and limitation of the indigenous and modern land management practices, the cause of land degradation, farmers' perception on land degradation and the level of integration of the two measures. Furthermore it has been tried to indirectly evaluate the attitude of development agents towards indigenous practices.

3.5. Methods of Data Presentation and Analysis

The data collected from both primary and secondary sources have been displayed through a predominant qualitative description and discussion. The data obtained through different methods and levels of the research process were, discussed, described and analyzed using qualitative methods. Furthermore, Quantitative figures were also used to show proportions in percentage. Tables were used to present quantitative figures. Furthermore, different data analysis measures like Z-test, chi-square-test and location quotient were used as it was necessary. Z-Test was used to test the level of soil fertility decline. In addition, chi-square test was used to check the relationship between literacy level and effective land management and to assess the distribution of modern cut-off drains in relation to the number of household farmers in each village of the study area. Furthermore, location quotient was used to compare the relative distribution of modern cut-off drains in relation to traditional ditches in different villages of the study area.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1. Demographic Characteristics of Respondents

The following respondents were actively participating in the process of data collection efforts as shown on the table below.

Table 4.1 Demographic characteristics of respondents

	RESPONDENTS											
	Farmers				Development agents				Chair man		Total	
	Model farmers		Non model farmers		Kebele level		Woreda		No	%	No	%
No	%	No	%	No	%	No	%					
Sex												
Male	21	20.2	56	53.8	2	1.9	2	1.9	1	1	82	78.8
Female	2	1.92	20	19	-	-	-	-	-	-	22	21.2
Total	23	22.1	76	73.1	2	1.9	2	1.9	1	1	104	100
Age 21-30	8	7.6	21	20.2	2	1.9	2	1.9	1	1	34	32.6
31-40	8	7.6	36	34.6	-						44	42.3
>40	7	6.7	19	18.3	-						26	25
Total	23	22.1	76	73.1	2	1.9	2	1.9	1	1	104	100
Level of education												
Illiterate	6	5.7	57	54.8							63	60.6
Primary 1stcyc	15	14.4	19	18.3							34	32.7
Primary 2nd cycle	2	1.9	-	-	-	-	-	-	-	-	2	1.9
Diploma	-	-	-	-	2	1.9			1	1	3	2.9
Degree	-	-	-	-	-	-	2	1.9	-	-	2	1.9
Total	23	22.1	76	73.1	2	1.9	2	1.9	1	1	104	100

4.2. The Economic Activity of Farmers in the Study Area

As it was understood from the field observation, the economic activity of farmers in the study area is entirely dependent on agriculture; both rearing of animals and crop cultivation is dominantly practiced. Animal rearing and crop production are interrelated one another. Animal rearing is source of income and practiced mainly to sustain family's livelihoods in the case of crop failure. The dung collected from animals has used for house decorating purpose in addition to using for fuel.

4.3. The Factors, level and Type of Soil Degradation in the Study Area

In this part of the study, attempt has been made to describe the factors of land degradation (soil erosion and fertility decline), level of fertility decline and the types of water erosion in the study area.

4.3.1. Factors Affecting Soil Degradation in the Study Area

Factors that aggravate soil degradation in the North West highlands are both man made and physical factors which are complex and interrelated (Michael, 2002). Likewise during the discussion with development agents and soil conservation experts, the factors of soil degradation in the study area categorized as manmade and natural factors. According to them, the major manmade factor which degrades the condition of soil resource is population pressure, creating heavy burden on soil resource. For example, the influence of population growth in the study area is through deforestation, over grazing of lands. It is also manifested through over-cultivation of crop lands without fallow. In addition, an elderly informant described the problem of rapid population growth as follows. "When I was age of twenty there was fertile and sufficient land for crop production. At that time population density was low and there was sufficient grazing land for our cattle. The mountainous areas of weizazer and wefi were covered by forest, however, currently population density is high and soil productivity is declining." From the informant it was easy to consider the seriousness of the problem of soil fertility decline because of rapid population growth which creates more influence on the land resource. This negatively affects the local environment and the goal of achieving sustainable land management.

According to development agents and experts, rapid rural population growth is another reason which affects soil degradation by expanding crop lands to infertile mountainous areas and into uncultivated forest covered areas. They said the main purpose of farmers to expand their crop lands into forest areas is to search additional crop land to respond the food demand of rapidly growing family members. It is the most serious problem in the woizazer and Dobe villages where there are hill slope areas.

The other man made factor for land degradation is lack of farmers effective interaction and communication with development agents in the process of managing soil erosion and soil fertility problems. As development agents informed most farmers of the study area were not motivated to perform their agricultural activities in collaboration with development agents of the area. Most farmers were not more committed to get current information about land management strategies from development agents.

Evidences from soil conservation experts indicate, natural factors such as topography aggravate soil erosion coupled with rapidly growing population pressure. For instance, in the village named woizazir and Gult the problem of run-off erosion is the most sever due to the steepness of the area. Compared to other villages; these have more steep slopes with a lot of ups and downs in which the soil is exposed to run off. However, it has been observed during the field observation several farm plots are located around steep slopes in almost all villages of the study area. During the discussion with farmers they were asked when soil erosion becomes higher. They said soil erosion becomes more severe in summer due to the maximum amount of rain fall and repeated plough of the land for cultivation at this time. Repeated ploughing followed by damaging of furrows at the seeding time decreases infiltration capacity of the soil, which in turn increases run off and finally accelerates soil erosion (Gete, 2000).

Table, 4.3.1. The Response of Farmers on the Dominant Natural Factors Affecting Soil Erosion in the Study Area.

Which is the dominant natural factor aggravating soil erosion in your farm plot?	Number of respondents	Percentage respondents
Rainfall intensity	25	25.3%
Land steepness	52	52.5%
Soil character	14	14.1%
Lack of vegetation cover	8	8.1%
Total	99	100%

Source; survey data, 2014

As it has been indicated on the above table, almost more than half of the farmers, (52.5) acknowledged that the steepness of the land is the dominant factor of soil erosion in the study area. In addition, (25.3%) farmers acknowledged as rainfall is the main agent of soil erosion in the area. However, (14.1%) of farmers believed that soil character is the dominant factor of soil erosion in the area. Very small number of farmers (8.1%) responded that lack of vegetation cover is the dominant factor affecting soil erosion in the area. The data indicates that topographical steepness of the land is the dominant factor which aggravates soil erosion in most plots of the study area.

4.3.2. Level of Soil Fertility Decline in the study Area

Fertility decline is caused by soil erosion, over cultivation and land degradation in general. This is simply because, by the time when the top soil is removed, all the essential plant nutrients that are available in the soil are either washed away from farm plots or deeply in filtrate in to the ground (Hurni,2000). This reduces the productive capacity of the soil to a larger extent.

Most of the cultivated plots in the study area are left with poor soil fertility. The most important and tangible evidence was the productivity decline of the land. Accordingly, almost all focus group participants of the area confirmed that the natural fertility of the soil on their farm lands was getting depleted. They said, the productivity of the soil, its capacity

to grow variety of crops and the yield per unit of land has been declining from year to year. Even the lands near to their home had decreased its productivity.

Table, 4.3.2.1. The Response of Farmers on the Situations of Soil Fertility.

How do you see the current soil fertility situations in your farm plot?	Number of respondents	Percentage respondents
Increasing	8	8.1%
Decreasing	69	69.7%
the same as before	22	22.2%
Un known	-	-
Total	99	100%

Source survey data, 2014

From the above table, almost two third of the respondents (69.7%) described as the fertility situation of the soil is decreasing. Only (8.1%) of respondents acknowledged as soil fertility has been increasing, however; others (22.2%) perceived that soil fertility is as before. But any of the farmers did not respond by saying unknown. From the table it is easy to understand as soil fertility decreases in most plots of the study area. In addition a seventy years old man informant from weizazer village said “currently the amount of crop produced from the same plots of land is decreasing from year to year.” Additional data was collected from the house hold survey concerned the level of fertility decline as follows.

Table, 4.3.2.2. The Response of Farmers on the Level of Soil Fertility Decline in the Study Area.

How do you measure level of soil fertility decline?	Number of Respondents	Percentage
Low/less severe	6	6.1%
Medium/moderate	18	18.2%
High/ severe	75	75.7
Total	99	100%

Source; household survey, 2014

From the above table (75.7%) of the respondents' acknowledged as fertility decline of the soil is severe. However, (18.2%) described as fertility decline of the soil is moderate. (6.1%) of the respondents described as soil fertility is less severe.

The above data is an interval scale analyzed by using Z- test as follows at 0.05 significance level.

Table, 4.3.2.3. Z- Test for the Level of Soil Fertility Decline.

Response (x)	Frequency (f)
1	6
2	18
3	75
Total	99
Sample mean= 2.7	
Sample standard deviation= 0.61	
Standard error of the mean= 0.06	
Hypothesized population mean=2(Medium)	
Critical limit=1.88-2.12	

The sample mean (2.7) is not inside the critical limit. It is more than the upper critical limit. Therefore the level of fertility decline in the study area is high/ severe.

4.3.3. Type of Soil Erosion by Water in the Study Area

Various types of erosion can be seen everywhere in the high lands. For example sheet, rill and gully erosion (Lakew, 2000). Similarly, from the field observation it has been understood the existence of sheet, rill and gully erosion. For example in the mountainous areas of Weizazer, Wefi and Dobe villages rill and gully erosions were clearly visible. Even in the plot lands of these areas gullies were formed and farmers were constructed terrace to stabilize the gullies. It is clearly known that gully erosion is the final result of sheet and rill erosion (Lakew, 2000). However, sheet and rill erosion are most extensive to agricultural production (Esayas, 2000). During the discussion farmers also described as

large ditches (gullies) were observed in their farm plots, especially when the run off damages the ditches and flows down ward in the steep slope lands.

Generally, sheet, rill and gully erosions are forms of erosion in the kebele causing land degradation at a growing scale, Even though the impact of sheet erosion was not clearly visible for local farmers. This results the degradation of land in general and soil erosion and fertility decline in particular. Indeed, once gullies are formed, the tendency to farther expand is so high. Therefore, there is lower opportunity that this phenomenon can be reversed unless integrated as well as big scale soil conservation measures are taken. As a result, sustaining gullies demands much cost, labor and time. As well as the motivation and participation of farmers is vital.

4.4. Perception of Farmers on Soil Erosion, Fertility Decline and Local Environment

As the data from the group discussion, farmers of the study area have good perception over the problem of soil degradation. They have local methods of describing the fertility conditions of their cultivated fields. For example, farm plots around their homes with excessive amounts of animal dung, ash and domestic wastes, they name it as “keliz” which means fertile land. Moreover, during the group discussions, most farmers have described that the main cause of fertility decline in their agricultural lands is soil erosion caused by runoff. Farmers said that over cultivation, absence of practicing fallow due to diminished land holding size, lack of vegetation cover and shortage of manure or “fig” and the use of limited manure for fuel consumption) also accelerates soil erosion and fertility decline. This is an indicator as farmers of the area had good understanding about the causes of soil fertility decline.

Farmers have indigenous methods of soil category. It is based on color of soils, amount of yield per hectare, workability of soils, fertility of soil and several other criteria. Thus, farmers categorize and describe soils “Bisle”or “Bonda” based on their fertility, therefore, “bisle” means fertile soil far from home and “bond” means infertile red soil. This indicates that farmers had good perception on the local environment in which they live.

As it has also realized in the focus group discussion, the criteria of farmers for classifying soils as fertile or infertile is based on the color of the soil, productivity, workability and depth of soil. According to them, soil with black color is mostly fertile and a soil with red color is infertile. In addition, they said the basic criteria for classifying soils as fertile or infertile is based on productivity potential of the land. However, soil depth was not good indicator of soil fertility situations. Their evidence was the deepest red soil in some parts of the study area which cannot be cultivated without artificial fertilizer and shallow black soils in other areas which can be cultivated without chemical fertilizer. This indicates as farmers of the study area have their own knowledge to identify the fertility of soil.

Farmers were asked about the types of soils in their environment. They described the types of soil and their fertility level. These are Borebore soil (less fertile soil), Ashalma (less fertile soil), merere (moderately fertile) and Black soil (fertile soil). This is also another indicator about the good perception of farmers about the types of soil in their local environment.

Table, 4.4.1. The Response of Farmers How Farmers Know the Fertility Level of Their Farm Plot.

Which is the basic indicator for fertility of soil in your farm plot?	Number of respondents	Percentage respondents
By depth of soil	14	14.1%
By color of soil	28	28.3%
By productivity of soil	41	41.4%
By its easiness to plough	16	16.2%
By other criteria	-	-
Total	99	100%

Source survey data, 2014

Almost forty two percent (41.4%) of the farmers confirmed the basic indicator of fertility is based on its productivity. However, (28.3%) of the respondents acknowledged as they identify fertility of the soil by its color. Furthermore, (16.2%) of the respondents described

as they identify fertility of the soil by its easiness to plough. The remaining (14.1%) of the respondents, confirmed as they identify fertility of the soil by its depth. Therefore, color and workability of the soil are the main indicators of soil fertility for majority of farmers in the study area. Generally, this data shows as farmers have their own criteria to understand (perceive) soil fertility conditions. Furthermore, data was collected from the house hold survey concerned with how farmers understand the presence of erosion on their farm plots.

Table, 4.4.2. Response of Farmers on the Identification of Soil Erosion in Study Area.

Which is the basic indicator of soil erosion in your farm plots?	Number of respondents	Percentage
Rills and gullies are observed	9	9.1%
Soil productivity decrease	40	40.4%
Decrease of soil capacity to produce variety of crops	30	30.3%
Decrease the depth of soil	20	20.2%
Total	99	100%

Source survey data, 2014

As it is indicated on table, 4.4.2 (40.4% the respondents acknowledged as they understand soil erosion by the decrease of its productivity. However, (30.3%) of the respondents identified soil erosion by the decrease of soil to produce a variety of crops. Furthermore, (20.2%) of the respondents identified erosion when the depth of soil decreases but only (9.1%) of the respondents identified soil erosion when rills and gullies are observed in their farm plots. Generally, majority of farmers identify soil erosion by the decrease of soil productivity and its capacity to produce variety of crops.

Table, 4.4.3. Perception of Model and Non-model Farmers on Soil Degradation

Can the problem of soil erosion managed?	Model	%	Non-model	%	$X^2 = 1.18$ Tabulated value= 3.84
Yes	19	19.2	54	54.5	
No	4	4.04	22	22.2	
Total	23	23.2	76	76.7	

Source, Household survey, 2014

The statistical test is insignificant at 0.05 levels.

As Hurni (1985) argues, when the farmers awareness and perception of soil erosion is high, it must be that soil degradation has reached critical level. This is because soil erosion is a gradual process which cannot be easily noticed. Farmers in the study rural area seem to have realized that their agricultural lands are being degraded by soil erosion. This indicates the land becomes a problem of agricultural production and there was reduction of agricultural production per hectare.

Farmers' perception of soil erosion as a problem in general is a precondition for farmers themselves, development agents, and agricultural experts as well to design, implement and follow-up appropriate soil conservation technologies. After having the awareness and willingness to adopt soil conservation technologies greatly depends on the availability of resources such as material and labor supply (Michael, 2002). These are the determinant factors to successfully accomplish soil conservation measures.

As it was discussed with farmers, even most of them were not willing to construct modern soil conservation measures because the indigenous conservation measures of local famers had little or no value for development agents in the process of constructing modern soil conservation measures. For example, during the construction of modern conservation measures like modern cut- off drains, the indigenous already existing terraces and water ways were rejected due to the command and instruction of development agents. This in another hand decreased the motivation and friendship of farmers in the process of constructing modern land management measures.

As a result, it can also be described that the connection between soil erosion and decline in land productivity has become clear for farmers. This is because; the magnitude of water erosion in the area has been growing out at a higher rate. In other words, they generally agree that there has been a decreasing trend in fertility status of their farm plots. They attributed this to the serious soil degradation on the bare and unprotected lands. In general, farmers in the study area are informed about the problem of soil erosion and the associated soil fertility decline in their cultivated fields.

4.5. Indigenous Land Management practices of the Study Area

An attempt was made to collect data from the house hold survey concerned with indigenous land management practices of the study area as follows.

Table, 4.5. Response of Farmers on the current Use of Indigenous Soil Conservation practices in the Study Area.

Are you currently using indigenous soil conservation practices in your farm plot?	Number of respondents	Percentage
Yes	81	81.8%
No	18	18.2%
Total	99	100%

Source, Household survey, 2014

As shown on the table 4.5, (81.8%) of the respondents acknowledged as they have been using indigenous soil conservation practices in their farm plot, but (18.2%) of target groups respond as they have not been used indigenous soil conservation practices in their farm lands. In addition farmers were asked about the most important indigenous soil conservation practices. They confirmed that traditional ditch locally called (feses) was one of the most important indigenous soil conservation practices. Other traditional household level crop land management measures include crop rotation, contour plough, manuring (maklez), cultivating leguminous crops, fallowing etc.

In the study area, there are also indigenous land management practices that are prepared, constructed, managed and maintained by a group of farmers. These farmers have

neighboring crop lands. Different peasant households usually own the crop lands. These indigenous land management measures are mainly conservation-oriented that were implemented on the basis of the common understanding of neighborhood cropland owners in the area. Such measures include un-ploughed grass-strip, traditional check dam and traditional cut-off drains.

As it has been expressed by an elderly model farmer and further supplemented by development agents and chairman of the area, the main purpose of implementing indigenous land management measures in groups was to get sufficient labor force. The implication is that farmers have tremendous labor potential and motivation to carry out indigenous land management practices, particularly soil conservation in a coordinate manner. This could be taken as one valuable social asset of farmers of the study area.

4.5.1. Indigenous Soil Conservation Practice of the Study Area

According to the focus group discussion, interview of development agents' further cross checked by field observation the following traditional soil conservation measures were practiced in the study area.

4.5.1.1. Traditional Waterways (Feses)

During the field observation the already prepared water ways were observed in almost all areas of the study area to protect soil erosion. In areas where the land is steep more water ways has been constructed than gentle slope lands. During the discussion with farmers, it has been understood, the structure was widely practiced throughout the study area to reduce soil loss by runoff. It is a common practice in the study area to protect soil erosion. From the discussion, it has been generalized that almost all farmers in the study area have long years of experience in preparing the water ways due to the nature of topography. This indigenous soil conservation measures have been made mostly by the individual house hold members.

In addition farmers were asked about the most important indigenous soil conservation practices. They confirmed that traditional ditch locally called (feses) was one of the most important indigenous soil conservation practices. It has also confirmed during the discussion held with development agents, that the practice of water ways differ from farmer

to farmer, farm plot to farm plot, from crop type to crop type to crop type and from slope type to slope type that means ditches differ in terms of gradient, spacing, depth, width and number in a given farm plot.

4.5.1.2. Traditional Check Dams (Kilter)

From the researcher filed observation, local check dams were constructed in areas where large gullies were observed to halt the deepening and expansion of gullies to the nearest crop lands. The check dams were constructed from sticks and small stones to hold back fertile alluvial soil. Then the already eroded soil accumulated in areas where local check dams are constructed. To stabilize the gullies and increase sustainability of dam's farmers used to grow plants like eucalyptus, which give additional advantage for them.

During the discussion, farmers said that they mobilized their local recourses (material, time and labor) to minimize the expansion of gullies. Local check dams were constructed by neighboring farmers during the dry season locally known as "bega" after harvesting season. During the group discussion farmers, from Weizazir, Dobe and Gult also confirmed their courage to construct the structures in the areas where gullies were observed.

One of the informants, chairman of the kebele, pointed out that farmers had good motivation to work together in the process of constructing local check dams in areas where gullies were observed. The informant also said that, the main objective was to rehabilitate gullies formed by powerful run off either around farm plots or far away from plots anywhere in the kebele. This implies that farmer's perception on soil erosion and soil fertility decline have been showing a remarkable progress. It also shows the high magnitude of soil erosion in their village.

4.5.1.3. Traditional Cut-off Drains (Tars- boy)

This is a large dish constructed at the top of a plot land to protect the land from erosion coming from the upper marginal lands. This indigenous land management practice needs more labor force that is why it is constructed in group with farmers having neighboring plot lands. As it was described by farmers during the focus group discussion these measures were commonly constructed at the boundary between plot and grazing lands. Farmers also

described that the structure is currently substitute by modern cut off drains which is made by a large number of farmers with the guidance of development agents.

4.5.1.4. Terraces Built from Stone (Erken)

This is the most labor demanding physical measure constructed by a house hold members or by a group of farmers either inside a plot land or at boundary between neighboring crop lands. During the discussion farmers pointed out that this structure was sustainable and dependable to protect soil erosion. Farmers said that this structure was constructed in winter season since the land is dry to transport the stone easily as well as at this time most farmers has more free time to construct terraces.

4.5.1.5. Contour ploughing (Agidem mares)

Even though farmers may not understand the use of counter ploughing concerned with soil conservation, it is a must to plough horizontally in the study area because the land is difficult to plough up and down since most plots are steep slope. Counter ploughing is another traditional practice of soil conservation measure which is widely used in almost all villages of the study area.

It is the cultivation of hill sides following the contours. To establish the structure, the farm plots are ploughed horizontally, following contours so that those contour furrows are created with the help of iron-plough. As it was discussed with the woreda expert, the furrows that are formed along contours function to retain (hold) the water until infiltrates in to the ground and hence reduce the damaging or erosive effect of surface runoff on plots of lands. It also implies that the structure has the capacity to conserve the water resource of the area. According to DAs counter plough prevents the downward flow of water and checks soil loss.

4.5.1.6. Traditional Vegetative Fences.

Trees are planted around their home or around their farm plots to protect their plots from erosion. The common plant that is planted around their homes is commonly eucalyptus tree. During the discussion farmers pointed out that the trees planted around the farm plots had multiple advantages. First, it uses as a protection for soil erosion, second, it uses as

fuel, third, it could be sold for additional income. This also indicates as most of indigenous soil conservation measures are multi- functional in addition to soil conservation.

4.5.1.7. Un-ploughed Grass strips (Dinber)

It is a long strip of grass between or within farm plots. As it has become clear in the farmers' group discussion, the strips serve dual-function i.e. serve as boundary between different farm plots owned by different farmers and also used to minimize soil erosion. Hence, it protects the soil from erosion or reduces the magnitude of runoff-erosion. Farmers also leave piece of un- plough lands inside their plots while ploughing which in turn helps to reduce the effect of erosion by intensive rain. Moreover, according to the informant model farmer of fifty years old from weizazer, described as grass strips used for minimizing boundary related conflicts among farmers having neighing crop lands.

4.5.2. Indigenous Soil Fertility Improvement Practices of the Study Area

According to the information from development agents, low and declining soil fertility is a major production constraint in the study area and it is becoming increasingly critical to secure sustainable soil productivity. Intensification of crop production due to population pressure, deforestation and soil erosion are the main factors involved in declining soil fertility (Sinan woredaARD Office, 2014).

There are several soil fertility improvement mechanisms which are commonly practiced by farmers of the study area. In the discussions, farmers were asked to identify their own indigenous methods of improving the fertility conditions of the soils on crop lands. Thus, farmers have described their practical farming experiences with regard to traditional fertility improvement practices. Furthermore, the discussion was enriched from the interviews conducted with the experts and development agents.

4.5.2.1. Farmacyard Manuring (Maklez)

Manure that is applied by farmers in their farm plots is a source of nutrients such as nitrogen and potassium which serve as good ingredient in increasing productivity (Michael, 2002). Animal manure is a widely used and common at the study area. However, most of the manure is added at farm land near the residence that they locally call "Tegan" i.e.

around their residence. According to the information from group discussion, this kind of manure is produced from a wide range of organic materials including ashes, plant residues and animal droppings are accumulated and directly added to the plot land. This indigenous practice is mostly practiced by females commonly every day after cleaning their homes. However, males participate if manuring is practiced far from homesteads.

During the discussion farmers described that currently farmers has faced shortage of cow dung due to several factors. The first factor is decrease of cattle because of the shortage of grazing land. The other factor was the use of it for fuel. These factors minimize the application of manuring in the study area.

4.5.2.2. Crop-Rotation

It is one of the most widely used indigenous practices to improve soil fertility on crop lands of the study area. It is the cultivation of different crops alternatively. Growing the same crop in the same field for successive years, exhaust one particular kind of soil nutrients. For instance, potato requires much potash but wheat requires nitrates (Belay, 1998). It is a method through which the nutrient content of the soil is improved by cultivating different crops on the same plot of land interchangeably. This method again becomes more important when leguminous crops are part of the rotation system to improve the nitrate content of the soil (Yilkal, 2007).

Although farmers are not aware of the scientific reasons of growing legume crops, they are well aware that legume crops are good for enhancing and maintaining fertility of the soil. They believe that after harvesting leguminous crops, the productivity of crops is high. Farmers are traditionally well aware of the fact that rotating crops can improve the productivity potential of their lands. The woreda experts also share this idea and say that different crops require different nutrients both in amount of intake and type.

Farmers at the study area have been using crop rotations that were applied for many years. Farmers have good understanding of why to rotate crops and well aware that crop rotation can improve soil productivity. The degree and pattern of rotation highly influenced by choice of the farmer depending on which crops to be grown in rotation are also largely based on their personal preferences as well as suitability of the soil. Here what have to be

noticed is that, over all endeavors of the farmers is not only targeting to maintain soil fertility but also mostly emphasized on increasing productivity and feed their ever increasing number of family members (development agent of Dedremitimak kebele, 2014). Moreover, crop rotation has the capacity to improve the fertility status of the soil so as to resist to pest and plant disease (Michael, 2002). Crop rotation is traditionally practiced on farm plots located away from homesteads and dispersed each other. From the experts, it was further clarified that farmers' choice of crops to cultivate in rotation largely depends on the interest of the farmers and type of soil conducive for crops. The main crops involved in the rotation system are cereal crops and legumes.

Most farmers think that starting the rotation with any crop and then planting legumes improves crop productivity, so that crop rotations in the study area are dominated by legumes like pea and bean. Traditionally, farmers practice this system on their crop lands. However, they have no scientific knowledge about the importance of legumes plants, without using and transferring it as a traditional knowledge from generation to generation. So it can be more convincing if assisted by experts for certain technical cases, so they may have better awareness about nutrient cycle and the scientific reason of rotation as well as the nutrient content of legumes plants.

4.5.2.3. Cultivating Leguminous crops

Farmers cultivate leguminous crops which are extensively practiced in the study area. It is a kind of practice that provides farmers with multiple benefits (the discussion with Development Agent). In the first place, cropping leguminous like bee and pea do not demand repeated-ploughing, Secondly, it can easily fix nitrogen from the air in to the soil.

The leguminous plant having root nodules with some microorganism in their root can fix atmospheric nitrogen and convert it in to a form that can be absorbed by plants. Such organisms are termed as bio-fertilizers. Most important among these microbes are Rhizobium bacteria (Tandon, 1999). During the discussion farmers have pointed out as cultivating leguminous crops has a potential to improve the productive capacity of the soil in the next cropping year.

4.5.2.4. Multiple or Inter-cropping

It is an indigenous practice on crop lands. Farmers in the study area traditionally allocate multiple crops at a time or two crops or more which can grow well with no or minimum competition for light, water and nutrient. Farmers described this practice as a coping mechanism against effect of diseases, insect, pest or drought. This aged-old practice has importance in terms of soil fertility improvement, increasing yield and ensuring income in time of disaster. The practice is rarely applied in the area. Common intercropping practice in the area involves growing of potato with cabbage.

4.6. Modern land Management Practices of the Study Area

Modern land management practices are studied and identified by universities research institutions and other organizations which are introduced to local farmers in the process of top down approach (Michael, 2002). According to the focused group discussion with farmers they were enforced by chairman of the kebele and development agents to construct modern soil conservation measures. From this it could be understood modern soil conservation strategies were not fully accepted by local farmers in the process of constructing and using it for a long time. Without active participation of farmers, it is impossible to minimize the problem of soil erosion (Hurni, 2002).

As (Hurni, 2000), the awareness of farmers about the problem of soil erosion, is the standing point for the application and expansion of modern soil conservation measures. However the situation in the study area differs from this. According to the focus group discussion with farmers and interview with the chairman of the kebele most farmers participate in the construction of modern soil conservation strategies which are made in group by fearing the punishment if they got absent. From this it is possible to generalize that sufficient awareness were not given for farmers of the area about the use of modern soil conservation strategies that are made in group.

Table, 4.6.The Responses of Farmers on the Current use of Modern Soil Conservation Measures in the Study Area.

Are you currently using modern soil conservation practices in your farm plot?	Number of respondents	Percentage
Yes	25	25.3%
No	74	74.7%
Total	99	100%

Source, household survey, 2014

From the above table, only one fourth of the respondents (25.3%) have been using modern soil conservation strategies that were made in group effectively, however the remaining (74.7%) were not using these measures effectively even they were not happy to construct modern conservation measures on their land. As it was crosschecked from development agents of the kebele some farmers were even damaging the already constructed artificial water ways rather than effectively using them. He said most farmers believe that their land is miss-used by using indigenous soil conservation measures. This indicates that there is procedural error in the adoption of modern soil conservation measures. That means creating sufficient awareness should come first and then the application and active friendship of farmers follow. There are more modern land management practices but only few are applied in the study area.

4.6.1. Modern Soil Conservation Practices of the Study Area

From the researcher field observation the following modern soil conservation were observed in different villages of the study area.

4.6.1.1. Modern cut-off Drains (Diversion Ditches)

Modern cut off drains which are open and graded diversion channels are constructed in a similar way as traditional cut of drains. These structures were constructed across the slope to divert run off coming from the upper part of the slope, which is finally transmitted in to natural water ways. The difference between the modern and traditional cut-off drains is in terms of improved gradient, spacing, strength and direction of modern one. This structure constructed between cultivated and uncultivated lands. During the discussion farmers had

confirmed about the labor intensiveness of modern cut-off drains, therefore farmers had constructed small number of cut-off drains in each village.

In this case an effort was made whether the distribution of small number of modern cut-off drains in each village was proportional to total house hold leader farmers as follows by using chi- square test at 0.05 significance levels.

Table, 4.6.1.1. The Proportion of Modern Cut-off Drains with Household leader Farmers in Different Villages of the Study Area.

No	Villages	Total number of modern cut-off drains	Total number of house hold leader farmers
1	Weizazer	141	161
2	Gult	125	145
3	Wefi	139	120
4	Dobe	176	192
5	Kesarwuha	152	170
6	Gibgod	140	154
7	Debir	121	138
Total		994	1080

Source, Survey data, 2014

Village	1	2	3	4	5	6	7
Observed frequency (O)	141	125	139	176	152	140	121
Relative no of farmers	0.15	0.13	0.11	0.18	0.16	0.14	0.13
Expected frequency(E)	149	133	110	179	159	142	127
O-E	-8	-8	29	3	-3	-2	-6
$\sum((O-E)^2 \div E)$	0.43	0.48	7.65	0.05	0.31	0.03	0.28
Calculated value=9.23							
Critical value=12.59							

Since the calculated value is (9.23) less than critical value (12.59), the hypothesis is accepted. That means the distribution of small number of modern cut-off drains in each village were not proportional to the number of house hold farmers living in these villages.

4.6.1.2. Artificial Water Ways (Drainage ways)

Artificial water ways are manmade channels used to collect run off from the farm plots in the rainy time of the year. It diverts the water in to natural drainage system from the interior of the farm plot. According to the development agents the drainage ways are more or less similar with traditional water ways. However, artificial water ways posses' sufficient embankment from the side and bottom to protect its expansion in to large gullies and it possess sufficient dimensions to transport excessive run off generated during the rainy months of the year.

The DA informant also said that artificial waterways or channels were stabilized by planting grasses or need to be paved with wider stones to strength it. In addition he described the relative proportional distribution of artificial water ways with number of farmers who construct it. During the focus group discussion farmers were pointed out three reasons why they are demotivated to construct artificial water ways. First, labor intensive nature of it, second, space taking nature, third, doesn't made according to their decision and interest. Most farmers agree over this idea.

4.6.1.3. A forestation of Indigenous Plants

As the researcher observed from the field trip with development agents degraded and mountainous places in kesarwaha village were covered by indigenous plants like aluma, koso, kilambae e.t.c. Afforestation has the importance of balancing environmental atmospheric conditions in addition to conserving environmental soil resource. According to the development agent informant planting indigenous plants is motivated since they can conserve as well as improve the fertility of environmental soil at the same time.

4.6.2. The Modern Soil Fertility Improvement Measures of the Study area

4.6.2.1. Compost

During the focus group discussion farmers appreciated the role of compost to improve fertility of the soil and productivity. It is also one of the modern soil fertility improvement measures practiced in the area. The preparation of compost involves the use of ash, leaves, grasses, cow dung etc. In the study area, this measure has been introduced recently by the rural development agents. However, in spite of its recentness, it is quickly adopted by farmers due to the relatively lower cost of the inputs. For instance, it is prepared at homesteads with lower materials cost.

According to the key informant model farmer from weizazer village further strengthens the idea that farmers were interested to prepare and apply compost. But, the major constraint which was raised in the issue was the shortage of animal dung. Since the largest portion of it is used as source of fuel. In any way compost as part of manure had got relatively wider acceptance on the side of farmers. It has been playing an important role in improving the fertility level of crop lands which eventually helps to increase crop productivity.

4.6.2.2. Chemical Fertilizer

Farmers were asked whether they were using chemical fertilizer or not. Only (13.8%) of the respondents used chemical fertilizer. However, the rest of respondents (86.2%) didn't use chemical fertilizer. Farmers were also asked the type of fertilizer they used, majority of the farmers described as they were using urea and dap. Similarly, during the discussion with farmers only some of them used chemical fertilizer in their plots even though the fertility of soil is rapidly declining. They said that fertilizer is expensive, even those farmers who used chemical fertilizer in steep slope plot lands were not benefited by applying fertilizer rather using compost is more advantages at this time. The DA informant also described even those farmers who were applying chemical fertilizer used bellow what is recommended.

4.7. The Strength and Limitation of Indigenous Land Management Practices of the Study Area

It is mostly argued that indigenous land management is the most important practice in the use of land by farmers of a given area (Hurni, 2000). It is therefore very indispensable to consider the strength as well as limitation of farmers' indigenous land management practices. This mainly focuses on soil conservation and soil fertility improvement measures.

4.7.1. Strength of Indigenous Land Management Practices of the Study Area

During the discussion farmers have pointed out that their indigenous practices are more effective compared with scientific ones. Their reasons were that indigenous practices need low financial input, doesn't need trained man power, they can easily change from one site to another in the same plot, they have multi- benefits and can be made from local resources.

As the information from an elderly informant, they described the importance of indigenous land management practices as follows. "Indigenous land management practices can be easily made by an individual farmer from the locally available materials such as stone, stick, cow dung, ash. In addition to that these practices enabled me to effectively use the small plots of land that I have."

From the informant, it is easy to understand that the indigenous land management practices had advantage over the modern ones since they are mostly constructed from locally available materials. In addition it had also the advantage to be constructed by an individual man power without seeking development agents for help.

In addition, during the discussion farmers emphasized on the adaptability of indigenous land management practices. They said indigenous practice like traditional ditches could be constructed by changing its position every year. Therefore, farmers prevent the expansion of ditches into gullies. This indicates the adaptability nature of it. The other advantage that farmers express in relation to indigenous practices was its easiness to construct by themselves without the help of external skilled man power.

Furthermore, farmers described the multi purposefulness of indigenous practices by raising examples. For example, crop rotation helps them by improving soil fertility and by controlling weeds and pests. The other manifestation was traditional ditches having multipurpose like to protect the soil from erosion, to decrease water logging problems on their farm plots and to save space on their farm plots.

The other multipurpose practices were vegetative fences planted around their plots which served as a primary soil conservation function, source of food for their cattle and as a means of income. The other most important characteristics which make traditional land management practices selective were their low or no financial requirement. Since indigenous practices were made from locally available materials they have little or no cost.

Table, 4.7.1. The Response of farmers on the Evaluation of their Indigenous Practices in Terms of Coast.

How do you evaluate indigenous land management practices in terms of coast in relation to modern measures?	Number of Respondents	Percentage
Less coasty	79	79.8%
More coasty	16	16.2%
Unknown	4	4%
Total	99	100%

Source, household survey, 2014

From the above table, (79.8%) of the respondents acknowledged as indigenous land management practices are less coasty, however, (16.2%) respondents described as indigenous land management practices are coasty but, 4% the respondents 'did not know whether indigenous practices are coasty or not.

From the whole information above, it could be generalized that indigenous land management practices of the study area are less coasty, flexible, dependable on local resources and multi-functional.

4.7.2. Limitations of Indigenous Land Management Practices of the Study Area.

During the discussion farmers also described the limitations of indigenous land management practices of their villages. For example, farmers had difficulty to transport manure towards farm plots which are located far from their homesteads. They also described the limitations of local check dams as it has no sufficient strength to hold back alluvial soil, when the amount of run-off increases in summer.

Table, 4.7.2. The Response of Farmers with Regard to Limitations of Indigenous Land Management Practices.

Do you think that you indigenous land management practices need some kind of improvement?	Number of respondents	Percentage
No need of upgrading	20	20.2
Needs upgrading	76	76.8
Unknown	3	3%
Total	99	100%

Source, house hold survey, 2014

From the above table (76.8%) of the respondents acknowledged, as their indigenous land management practices need some kind of improvement. However, (20.2%) of the respondents believed that their indigenous land management practices don't not need any improvement. However, (3%) of the respondents do not know whether upgrading is needed or not. From the table majority of the respondents understand the limitation of indigenous land management practices. Development agents of the area described indigenous land management practices as follows. "Soil conservation measures such as traditional ditches, traditional cut of drains, traditional water ways and traditional check dams may aggravate the problem of soil erosion if they are not properly implemented. Especially, soil type, soil conditions, erosive power of the runoff are not taken in into consideration by majority of farmers during construction of indigenous soil conservation practices."

Furthermore, soil conservation experts described that the run off produced within the farm land combined with the run off coming from the upslope areas is a major cause for damaging ditches. This in turn becomes a major cause of rill erosion. According to them

damage of ditches is basically a result of ill-designed structures. In addition, they have confirmed, indigenous land management practices like traditional water ways and cut-off drains used mostly for one cropping season, hence not sustainable.

4.8. The Strength and Limitation of Modern Land Management Practices of the Study Area

Like indigenous practices modern measures of soil conservation have also their own strengths and limitations.

4.8.1. Strength of Modern Land Management Practices of the Study Area

As information from development agent of the kebele, modern land management practices of the area constructed by considering the slope, the amount of runoff and soil type. In this case, modern measures are more dependable for land management activities. In addition to that one elderly informant described the strength of compost as follows. “The introduction of compost has improved the production capacity of many poor farmers. Rather than using chemical fertilizer using compost has more advantages because it is made from locally available resources such as, animal dung, ash, and grass. In addition it is not costly.” The information indicates as compost is cheaper and used for relatively longer period of time.

Table, 4.8.1. Response of Farmers on Sustainable Soil Conservation Measures of the Study Area.

Which soil conservation measures are more sustainable?	Number of respondents	Percentage
Indigenous soil conservation measures	35	35.4%
Modern soil conservation measures	59	59.5%
Unknown	5	5.1%
Total	99	100%

Source, household survey, 2014

From the above table (59.5%) of the respondents acknowledged as modern soil conservation measures were sustainable. However, (35.4%) of respondents responded as indigenous soil conservation measures are sustainable. In addition, (5.1%) of the

respondents don't know which measure is sustainable. This evidence shows as modern soil conservation measures are relatively sustainable. That means modern cut-off drains and artificial water ways are functional relatively for longer period of time than the complimentary indigenous measures. Furthermore, development agents described modern soil conservation measures as they are constructed by considering the slope of the plot land, soil conditions and the amount of runoff to be transported. Therefore, they are more effective to overcome the problem of soil erosion.

4.8.2. Limitation of Modern Land Management Practices of the Study Area

Although modern land management measures have strength, they have also many limitations. For example during the group discussion farmers had pointed out that modern soil conservation measures were not easily flexible to construct again in another site of the farm plot. In addition farmers said that the development agents and chairman of the area enforces them to construct modern soil conservation measures in group since the modern cut-off drains need much labor force. In connection to this one elderly informant said, "I am a 60 years old patient man but I have been enforced by the development agents and chairman of the kebele to construct modern land management measures, such as cut-off drains in group with my 50 years old wife. Not only that, they have also damaged my terrace, which I was built it before 5 years when artificial waterways were made on my land."

From the informant, it was easy to understand as development agent and chairman of the kebele didn't fully create awareness and motivation for local farmers in the process of constructing modern land management measures. Damaging the already existing indigenous land management measures discouraged farmers to construct modern ones. Finally, it could not achieve the goal of effective land management (Michael, 2002). The information also indicates as modern land management practices were labor intensive which needs the participation of many farmers.

Farmers were asked about limitations of modern measures, they described the basic limitation of modern land management measures as they mostly need external inputs. That may be either material or educated man power like development agents. The other

limitation concerned with modern measures was unable to use most farmers of the local area as active partners and lacks sustainability upon implementation.

4.9. Level of Integration among Modern and Indigenous Land Management Measures and Factors Affecting Integration in the Study Area.

In this topic an effort has been made to describe the level of integration among the two measures of land Management practices and factors that affect integration of the two measures.

4.9.1. Level of Integration among Indigenous and Modern Measures of Land Management measures.

As it has been already discussed, farmers of the study area were not effectively using modern measures even though they had good experience in indigenous ones. Integration refers to the use of both indigenous and modern practices which have the same function for soil conservation and fertility improvement (Michael, 2002). As it was noted in earlier discussion both measures have limitations. Therefore, either of them couldn't effectively overcome the problem of soil erosion and fertility decline in the study area. However, both of them due have common features that can be integrated and developed in to more sustainable practices.

For example, traditional manuring and artificial fertilizers, traditional cut of drains and artificial water ways, modern cut off drains and traditional dishes are complimentary i.e. can be applied together for effective soil conservation and fertility improvement practices respectively because the limitation of one measure could be compensated by the strength of the other measure. An attempt was made to collect data from the house hold survey concerned with the integration of the two measures as follows.

Table, 4.9.1.The Response of Farmers on the Integration of Indigenous and Modern Soil Management Measures.

Are you currently integrating your Indigenous soil management practices with modern measures?	Number of respondents	Percentage
Yes	20	20.2%
No	79	79.8%
Total	99	100%

Source house hold survey, 2014

The above table indicates as only (20.2%) of the respondents integrated both indigenous and modern measures of soil management practices, but (79.8%) did not integrate the two measures. The data indicates as there was a miss link between the two measures of soil management. This data also shows as there were farmers who use only modern measures because in table 4.6, (25.3%) of the respondents were acknowledged as they were using modern measures effectively but only (20.2%) of them integrate the two measures. That means (5.1%) of the respondents were given priority for modern soil conservation measures. However, it was easy to generalize as the link between the two measures of soil management was low.

The distributions of modern cut-off drains in relation to traditional ditches in different villages of the study kebele were analyzed by using Location quotient (LQ) as follows.

Table, 4.9.2.The Distribution of Modern Cut-off Drains and Traditional Ditches in Different Villages of the Study Area.

Villages of the kebele	Number modern cut-off drains	Number of traditional ditches
Weizazer	141	805
Gult	125	725
Wefi	139	600
Dobe	176	960
Kesarwuha	152	850
Gibgod	140	770
Debir	121	690
Total	994	5400

Source, survey data, 2014

The relative distribution of modern cut-off drains among the different villages of the study area in comparison to total traditional ditches computed as follows using Location quotient index (LQ) as following.

Table, 4.9.3. The Relative Distribution of Modern – cut-off Drains in Relation to Traditional Ditches by Using Location Quotient.

Villages of the kebele	Number modern cut-off drains(xi)	Number of traditional Ditches (yi)	$(xi \div \sum xi)$	$(yi \div \sum yi)$	$LQ = ((xi \div \sum xi) \div (yi \div \sum yi))$
Weizazer	141	805	0.14	0.15	0.93
Gult	125	725	0.12	0.13	0.92
Wefi	139	600	0.14	0.11	1.27
Dobe	176	960	0.17	0.18	0.94
Kesarwuha	152	850	0.15	0.16	0.93
Gibgod	140	770	0.14	0.14	1
Debir	121	690	0.12	0.13	0.92
Total	994	5400			

The distribution of modern cut-off drains in relation to total traditional ditches was higher ($LQ=1.27$) in the village wefi in comparison with other villages. Hence, relatively better integration of the two measures in relation to other villages. In addition, in the village of Gibgod there was moderate distribution ($LQ=1$) of modern cut-off drains in relation to total number of traditional ditches in comparison to other villages. Hence there was relatively moderate integration of modern cut-off drains with traditional ditches. However, in the rest of five villages (Debir, Kesarwuha, Dobe, Gult and weizazer) the relative distribution of modern cut-off drains in relation to total number of traditional ditches was lower ($LQ < 1$). Hence the integration of modern cut-off drains in relation to total traditional ditches was lower in these villages.

4.9.2. Factors Affecting Local farmers to Integrate indigenous and Modern Measures of Land Management.

According to the discussion with development agents and soil conservation experts further crosschecked during focus group discussion, the following points are factors which affect the integration of the two measures for local farmers.

4.9.2.1. Land Holding Size

As it has been explained during the focus group discussion, almost all farmers have currently smaller plots of land. Therefore, farmers were not willing to apply complimentary land management practices, since farmers believed as their land miss used by applying both measures especially the modern measures in a given plot of land. For example, modern cut-off drains could be integrated with traditional water ways and traditional cut-off drains could be integrated with artificial water ways. However, farmers of the study area ignored either of the two measures most probably modern ones to save the plot land for crop production. This is the basic reason for farmers to ignore modern measures in general and integration of both practices in particular.

Modern soil conservation measures are space taking by their nature so farmers of the study area were not willing to construct space taking structures in their land, however, they would like to apply space saving indigenous measures. This resulted the miss- link between the two land management practices. To the contrary, indigenous soil fertility improvement practices such as fallowing were impossible since farmers had small plot of land.

4.9.2.2. Livestock Size

During the discussion farmers pointed out that the amount of cattle per household has rapidly decreased. This was because of lack of grazing land for their cattle. This results the miss-link between traditional manure and compost because farmers could not apply both measures since there was shortage of animals' dung which was the result of decreasing of animals in the study area. They said currently using indigenous manuring decreases due to lack of cow dung. Hence integration of the two measures lags behind. Not only integration but also applying either of the two was difficult in the study area.

4.9.2.3. Limitations of Modern Land Management Measures

As it has been discussed earlier one of the limitations of modern measures was labor intensiveness. As it has been confirmed during the discussion with farmers the basic problem to apply modern measures was that they need more labor force. For example, during the focus group discussion farmers were pointed out three reasons why they dislike modern soil conservation measures. First labor intensive nature, second space taking

nature, third doesn't made according to farmers participation and interest. Most farmers agree over this idea. Therefore, farmers would like to use their indigenous measures which are relatively easy to apply and space saving; therefore miss link occurs among indigenous and modern measures.

4.9.2.4. Economic Factors

As it has been described earlier, farmers were asked whether they used chemical fertilizer or not. Majority of the farmers confirmed as they did not use chemical fertilizer because of its expensiveness. Therefore, this was a factor to integrate artificial fertilizers with complimentary indigenous measures. Generally, as it has been discussed earlier majority of modern measures were costly. Therefore, farmers of the area were unable to fully apply these measures because of their relative high cost. Hence, it affects integration of the two measures.

4.9.2.5. Literacy Level

Most of the farmers in the study area are illiterate therefore; they were unable to apply modern measures. The DA informants described as more effort was made to construct artificial water ways almost in all villages, however, some of the farmers were damaging water ways due to illogical reasons as it was explained earlier. This indirectly indicates as there was misunderstanding for majority farmers concerned with modern land management measures. In this case effort has been made whether literacy level had relation or not with effective (integrated) land management in the study area by using chi-square test (χ^2) as the following. At 0.05 significance level and $(r-1)(c-1)$ degree of freedom.

Table, 4.9.5. Analysis of the Relation among Literacy level and Integrated land Management by Using Chi-square test.

Level of education	Effective land management- education wise				Total
	Frequency on those who integrate the two measures		Frequency on those who didn't integrate		
	Observed	Expected	Observed	Expected	
Literate	17	7.27	19	28.72	36
Illiterate	3	12.72	60	50.27	63
Tabulated value= 3.84					
Calculated value=25.63					

The tabulated value (3.84) is less than calculated value (25.63). Therefore, the conclusion is the opposite of the premise hence, effective land management and literacy has relation. That means the more the farmers are educated the greater the chance to integrate indigenous and modern land management measures and vice versa. However (63.7%) of farmers were illiterate.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATION

5.1. Conclusions

The economic activity of the farmers in study area is very dependent on subsistence agriculture, which includes rearing of livestock and cultivation of crops. The overall farming system is strongly food crop production oriented that operated manually by use of oxen for land preparation.

A number of factors contribute to soil fertility decline, which generally classified as physical and human related factors. Though most of the causes of soil fertility losses at the study area are significantly from the socio-economic condition of the rural population, high intensity of rainfall combined with slope gradient maximizes soil erosion in most parts of the study area, especially at summer due to high intensity of rainfall. Continuous cultivation, lack of effective communication among farmers and development agents concerned with land management and un-controlled grazing are the most manmade factors identified at the study area. With the ever increasing of population at the study area, land is continuously cultivated.

The level of soil degradation had rapidly increased which is going to be severe for agricultural productivity. Fertility of the soil and soil erosion were also rapidly declined which resulted decline of agricultural productivity. Sheet, rill and gully erosions were visible in the farm plots of farmers of the study area.

Majority of farmers at the study area had good perception of the problem of soil erosion and fertility decline. Farmers understood soil erosion and fertility decline by continuous decrease of quality of soil, productivity decrease, difficulty in preparing agricultural land and depth of soil. However, productivity and color of soil were good indicators for majority of the farmers. Farmers have also developed their own traditional methods of describing and classifying soil as fertile and infertile. All of which were indicators as farmers had their own perception to their farm plot. The study has also confirmed that farmers have valuable perception about the type of slopes, soil conditions, vegetation cover

and socio-cultural settings of their local environment which is contained in their traditional practices. However, their practices need some kind of improvements.

Farmers use both indigenous and modern method of soil fertility improvement practices. Chemical fertilizer and compost are among the conventional methods to maintain soil fertility. Manuring, crop rotation, inter cropping weed heaping and cultivating legumes plants are the main indigenous soil fertility improvement measures of the study area. However, the indigenous soil conservation measures include traditional water ways, traditional check dams, counter ploughing, and terraces made from stone, non-ploughed grass strips. The modern soil conservation measures of the area also include modern cutoff drains, artificial water ways and a forestation of indigenous trees.

Even though some farmers at the study area are now using chemical fertilizer, the extent and amount of fertilizer used in a farm plot is less than what is recommended. Farmers in the study area were using and practicing both indigenous and modern land management measures at a macro and micro level respectively, the degree of maintaining soil fertility and conservation practices in comparison with the fertility declining rate is very low. The indigenous practices of farmers were more or less adapted to the local conditions. On the other hand, the modern measures are those that have been introduced to the area through conservation experts and development agents. Farmers are currently implementing different traditional land management practices with some modern ones but there is no change on its productivity.

Indigenous land management measures have such strengths as flexibility, dependence on local resource, having multiple benefit and functions, compatibility to the prevailing farming, and so on. However, the limitations of indigenous land management practices are ill-designed which didn't consider the soil type and the amount of runoff to be produced.

Modern land management practices had strengths such as considering soil type, slope and runoff produced. In addition modern soil conservation measures are relatively sustainable after construction. However, their limitations include space taking nature, labor intensive and were not designed according to the interest and participation of local farmers.

Even though the modern land management technologies were introduced to the area, the fertility of soil was not improved since modern land management practices were not adopted by majority of the farmers. Nevertheless, it has been found out that the outcome has not been as expected and the problem of soil degradation has continued. As result, land productivity has been declining. Based on the study, one of the major reasons for the problem is the lack of effective integration of farmers' indigenous practices with modern land management measures. This is because most of the farmers discouraged to use and construct modern measures for several reasons.

Land management practices of the two systems were not well integrated. Therefore, although farmers apply different soil fertility management practices since long-time; the problem of fertility decline has not been solved. Literacy level, lack of adequate and organized trainings for farmers, limited input, fragmented land holdings, decrease of cattle, limitations of modern soil conservation measures and economic problem were the major factors affecting integration of the indigenous and modern land management practices.

5.2. Recommendations

To achieve sustainable land management in the study area, the following basic points should be taken in to consideration.

- A. High external input dependent land management technologies should be minimized. Therefore, more local resource dependent technologies should be expanded. For example, applying compost widely instead of completely depending on artificial fertilizers may reduce the cost implications of fertilizers.
- B. Farmers' indigenous conservation practices should be appreciated and recognized particularly on the side of the experts and development agents. As a result farmers may develop self-confidence and sense of belongingness to the newly introduced technologies.
- C. To achieve sustainable land management, the integration of indigenous measures with modern conservation technologies through modifying indigenous ones in

accordance with the prevailing modern technology of the study area may have a significant contribution since both measures have their own limitation.

- D. Awareness creation and enhancing farmer's motivation should be the greatest task for development agents and chairman of the kebele rather than enforcing them to apply modern land management measures.
- E. An effort should be made to increase the number of modern conservation measures. What are practiced now are very minimal.
- F. The construction and use of modern conservation measures should be sustainable rather than a onetime obligatory activity.
- G. Training educated farmers minimizes the dependency of farmers on external man power during the construction process of modern land management measures.
- H. Farmers perception of the problem of soil degradation, environmental deterioration and knowledge about their local conditions should be taken as an opportunity to design and implement appropriate conservation technology in the study area.
- I. Introducing multi-functional, non- labor intensive modern land management practices may encourage farmers to construct and use these measures for a longer period of time.

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DEPARTMENT OF GEOGRAPHY

Appendix 1

Questionnaire on

Assessing Integration of indigenous practices with modern technologies for sustainable land management; the case of soil conservation and fertility improvement practices in Debremitmak kebele, East Gojjam.

The objective of the study

The overall objective of the study is to assess the integration of indigenous and modern land management practices of the farmers in Debremitmak kebele, EastGojjam. It has also the objective of discussing the role of farmers' traditional practices in modern conservation strategies. Emphasis will be given on soil conservation and fertility improvement practices to achieve sustainable land management. To put this in to effect your honest and kind cooperation in providing valid data has great value.

Thank you for your cooperation

The data will not be used for other purposes without the academic purposes.

Part I General information

Sex _____

Age _____

Specific place_____

Educated _____

Uneducated _____

Model farmer _____

Non model farmer _____

If educated what is your grade level _____

Durations of time in the kebele _____

Total number of family members' _____

Part II Detailed Information

1. Which is the main natural factor aggravating soil erosion in your farm plot?

Rainfall intensity 1 soil character 3

Land steepness 2 lack of vegetation cover 4

2. Does your farming have any negative or positive impact on your land management practice?

Positive 1 negative 2 unknown 3

3. How do you describe the impact of manmade factors for soil degradation?

Low 1 Medium 2 High 3

4. How many types of soils do you know in your area? Could you list?

5. What conditions helped you to produce better yields other than better soil?

6. How do you know the fertility level of your farm land?

By depth of soil 1 By color of soil 2 By productivity of soil 3 By
Easiness of plowing 4 By Other criteria 5

7. How do you understand the presence of soil erosion on your farm plot?

- Rills and gullies are observed? 1
- Soil productivity decreases 2
- Decrease soil capacity to produce variety of crops 3
- Decrease the depth of soil 4

8. How do you see soil fertility situations in your farm plots?

- Increasing 1
- Decreasing 2
- the same as before 3
- Unknown 4

9. How do you measure the level of soil fertility decline?

- High /very server 1
- medium/moderate 2
- low /less server 3

10. Can the problem of soil erosion be managed or minimized?

- Yes 1
- No 2

11. What traditional land management measures practiced in the area? Could you mention them? _____

12. Are you currently using indigenous soil conservation measures in your farm plots?

- Yes 1
- No 2

13. Which traditional soil conservation practices are more important in managing soil in your farmland?

14. Could you list the limitation and strength of indigenous land management measures?

15. How do you evaluate the effectiveness of your indigenous soil conservation practice in comparison to modern measures in managing erosion?

- They are more effective 1
- they are less effective 2
- unknown 3

16. How do you evaluate you evaluate indigenous land management practices in terms of coast?

Less coasty 1 more coasty 2 Unknown 3

17. Are you currently using modern soil conservation measures in your farm plot?

Yes 1 No 2

18. Are you currently using chemical fertilizer?

Yes 1 No 2

19. If you say yes could you list the type and amount you apply?

Type of fertilizer_____

Amount per hectare_____

20. How do you get chemical fertilizer?

By credit 1 by cash 2 other means 3

21. What kind of modern soil conservation methods do you apply could you mention?

22. Which modern soil conservation measure is more important in managing soil in your farmplot?

23. Could you list the limitations of modern soil conservation practices?

24. What factors that affect you to integrate indigenous and modern measures of land management? _____

24. Are you currently integrating your indigenous soil management practices with modern measures?

Yes 1 No 2

25. How many modern cut-off drains are constructed in your farm plot?

26. How many traditional ditches do you construct in this year?

27. Do you think that your indigenous soil conservation practice needs some kind of improvement?

No need of upgrading 1 needs upgrading 2 unknown 3

28. If yes how? _____

29. If No why? _____

30. Which soil conservation measures are more sustainable?

Indigenous soil conservation measures 1

Modern soil conservation measures 2

Unknown 3

Appendix 2

General Guideline for key informant Interview

A. For Development agents (DAS) and soil conservation Experts

1. What is the level of farmer's perception about the problem of soil erosion?
2. What are the factors affecting for soil degradation? How each factor affects soil erosion?
3. Which form of soil erosion is dominant in the area?
4. What are the indigenous soil conservation methods that are practiced in the area?
5. What are modern soil conservation methods that are practiced in the area?
6. What are the limitation and strengths of indigenous soil conservation method?
7. What are the limitations and strengths of modern soil conservation methods?
8. What is the importance of integrating indigenous and modern land management strategies?
9. What is the level of farmers' motivation for integrating indigenous and modern land management practices?
10. How do you see the contribution of development agent workers in the process of creating awareness for the adoption of modern conservation strategies?
11. What are indigenous soil fertility improvement practices in the kebele?
12. What are manmade factors that affect soil erosion problems?
13. How do you describe the impact of topography for soil erosion problems?
14. How do you see farmers' participation and friendship in the process of modern soil conservation adoptions?
15. Do you think that integrating indigenous and modern conservation methods has more importance than using one of them?
16. What are factors that hinder integration of indigenous and modern land management practices?

B. For chairman of the kebele

1. How do you see the participation of farmers in meetings concerned with the adoption and implementation of modern soil conservation technologies?
2. How do you evaluate the communication between the kebele administration and farmers for land management activities that are made in group?
3. How do you evaluate your effort in the expansion of model farmers land management activities for non-model farmers?
4. What are factors that affect integration of indigenous and modern land management practices?

C. For Elderly Farmers of the Kebele

1. What factors affecting soil degradation in your farm plot?
2. How do you describe the level of soil degradation in your area?
3. How do you know the problem of soil erosion and fertility decline?
4. What are the modern land management practices of the area?
5. What are indigenous land management activities of your area?
6. What are the strengths and limitations of modern and indigenous land management activities?
7. What are strengths and limitations of indigenous land management practices?
8. What are factors that hinder you to apply modern land management activities?
9. Are you currently using both indigenous and modern land management activities in your farm plot?

Appendix 3

General Guideline for Focused group discussion of farmers

1. What are factors affecting soil degradation? How each aggravates soil degradation?
2. How do you describe the level of soil erosion and fertility decline?
3. What is the dominant form of soil erosion in your area?
4. How do you know soil erosion and soil fertility decline?
5. How do you see the fertility situation of soil in your area? .
6. What are traditional and modern land management practices of your area?
7. What are the strengths of indigenous soil conservation practices?
8. What are limitations of indigenous land management practices?
9. What are strengths of modern land management practices?
10. What are limitations of modern land management practices?
11. What is the level of integration among indigenous and modern land management practices?
12. What are factors that affect integration of indigenous and modern land management practices?

Declaration

I, the undersigned, declare that the thesis is my original work, has not been presented for a MA in any other university and that all sources of material used for the thesis have been duly acknowledged.

Name-----

Signature-----

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

Advisor

Signature

Date