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Title

Integrating Indigenous Knowledge with Modern Technologies for Sustainable Land Management: The case of Soil and Water Conservation and Soil Fertility Improvement Practices in Enerata KPA, East Gojjam.

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Abstract

The population of Enerata kebele performs traditional subsistence Agriculture. But, the 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, land fragmentation and population pressures. In addition, the cause of the problem is multi-faceted and interrelated. The magnitude of the problem is also severe. To manage this, farmers of the study area have been practicing their own knowledge for several generations. So, the study has attempted to explore the widely implemented land management practices of the study area. It has focused on soil and water conservation and soil fertility improvement practices. Moreover, the study has involved both the traditional and modern land management practices. To address the objectives, qualitative research methods have largely been employed through qualitative descriptions. Various tools of data collection such as household surveys(out of 1545 peasant households, 90 of them were randomly selected, using simple random sampling procedure and 5 model farmers were proportionately included, 1 from each village), field observations, focus group discussions and key informant interview were used. Accordingly, the traditional land management measures identified during the study include traditional ditches (`feses`), traditional cut-off drains (`tekebekeb`), traditional check dams (`bahilawi kitir`), crop rotation, cultivating Lupines lupine (`gibto`), traditional manuring, etc.

On the other hand, the modern land management technologies were introduced to the farmers via conservation experts and development agents. These are diversion ditches, agro-forestry practices, chemical fertilizers, compost and the like. Nevertheless, it has been found out that the outcome has not been as expected and the problem of soil degradation has continued. As a result, land productivity has been declining. Based on the study, one of the major reasons for the problem is the lack of appreciation and recognition of farmers` traditional knowledge in modern land management efforts. The indigenous knowledge of farmers in the area has not yet been fully considered in the design and implementation of modern conservation technologies. The study has also confirmed that farmers have valuable knowledge 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. It has also been investigated that both the traditional measures and the modern land management technologies of the study area have strength and limitation. Therefore, considering the traditional measures in the design and implementation of modern land management technologies may reduce the severity of the problem. This could help to achieve better results.

Acronyms:

a.s.l	above sea level
AFAP	Amhara Forestry Action Plan
ANRS	Amahara National Regional State
ARDO	Agriculture and Rural Development Office
BoA	Bureau of Agriculture
BoAR	Bureau of Agriculture and Rural Development
CBO	Community Based Organization
CEDEP	Consultants for Economic Development and Environmental Protection
CSAERAR	Commission for Sustainable Agriculture and Environmental Rehabilitation for Amhara Region
CSA	Central Statistical Authority
DA	Development Agent
DAP	Di-ammonium Phosphate
ESSS	Ethiopian Soil Science Society
EMA	Ethiopian Mapping Authority
FAO	Food and Agriculture Organization
FDRE	Federal Democratic Republic of Ethiopia
FGD	Focus Group Discussion
GDP	Gross Domestic Product
IIRR	International Institute for Rural Reconstruction
IK	Indigenous Knowledge
IKS	Indigenous Knowledge System
ISWC	Indigenous Soil and Water Conservation
ITK	Indigenous Technical Knowledge
KPA	Kebele Peasant Association

Acronyms (Contd.):

NGO	Non-Governmental Organization
PHC	Primary Health Care
SLM	Sustainable Land Management
SPSS	Statistical Package for Social Sciences
SWC	Soil and Water Conservation
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environmental Program

Glossary of Local Terms:

Agdime marese Contour ploughing

Ashalima Cambisols

Bahilawi boyi Traditional water way

Bahilawi kitir Traditional check dam

Bahilawi yewuha mekelbesha Traditional cut-off drain

Bahilawi yedingay erken Traditional stone terrace

Bega Dry season

Belg spring

Beray Soil trampling

Beret Traditional kraal

Borebore Cambisols

Chincha Infertile and degraded soil with stony character

Dega In Ethiopia, Altitude between 2500-3500 m a.s.l

Dinber Border between different land owners

Engido *Avena Fatua*

Feses Traditional ditch

Feses Mekeded The process of constructing traditional ditches

Fig Manure (animal dung)

Fig mafises Manuring

Gelmeret Eroded and depleted land

Gezem eske gezem From one side of the farm plot to the other

Glossary of Local Terms (Contd.)

Gibto Lupines lupine

Got Village

Gulegualo Traditional manual weeding on croplands

Hibir Colorful

Hura Traditional animal parking on farmlands

Idir Traditional social institution with some kind of purpose

Katikala Traditional alcoholic drink

Kebele The lowest unit of administrative hierarchy in the Ethiopian government structure.

Keliz meret Soil rich in manure

Kiremit Rainy season

Kolla Altitude between 500-1500m a.s.l

Leqow Local naming of rainy season in the study area

Maklez Manuring

Maresha Traditional iron-plough

Merere Vertisols

Meret makinat Preparing new land for cultivation

Semereta Local naming of barely production of the study area

Shembeko Aroundinaria

Teff Eragrotis tef

Tekebekeb Traditional cut-off drain

Timad Local measurement for land/*1timad*=0.25ha

Tinbuko meret Less eroded land or fertile land

Glossary of Local Terms (Contnd.)

Trass boyi Traditional cut-off drain

Woina dega Altitude between 1500-2500m a.s.l

Wonfel Traditional mutual exchange of labor especially during harvesting season

Woreda District

Yergibater Pigeon pea

Yegibto areke Traditional alcohol drink prepared from Lupines lupine

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CHAPTER-I

1. INTRODUCTION

1.1. Background

Land degradation can be human induced or natural process which negatively affects the capacity of land to function effectively within an ecosystem. Desertification is one manifestation of land degradation occurring in arid, semi-arid as well as dry sub humid areas of the world. Those susceptible dry lands cover approximately 40 percent of the earth's surface and put at risk more than one billion people who are dependent on these lands for survival (http:// en. wikipedia.Org/.Land degradation).Land degradation causes losses to agricultural productivity in many parts of the world. The causes of land degradation are mainly anthropogenic and agriculture related, including land clearing and deforestation, depletion of soil nutrients, urban conversion, irrigation and pollutions (UNEP, 1993).

Ethiopia is a large country having a total area of 1, 224, 000 km^2. It is endowed with diverse topography and climatic conditions, resulting in the presence of diverse natural resources, flora and fauna (FDRE, 1997). This is true, particularly in the Ethiopian highlands where there is high diversity in many aspects including climate, soils, biological and social life (Yohannes and Herweg, 2000). It is, therefore, very difficult to expect any standard solutions and technology which could solve a problem such as land degradation.

The highlands of the country occupy a huge land mass of Africa. Out of the Ethiopia's population, the largest proportion of it lives in these highlands with 85 percent of the population depending on agriculture. The Ethiopian highlands cover about 50 percent of the total area, generate 90 percent of the economy and produce around 95 percent of the regularly cropped land (Gete and Hurni, 2000).

Natural resource degradation has been a major environmental, socio-economic and policy challenge in Ethiopia. Specifically, land degradation due to soil erosion, nutrient depletion and deforestation has become serious environmental issue. The situation of land degradation has negatively affected the agricultural sector to a larger extent and the overall economy as well as the livelihood of its people (Aklilu, 2001). Therefore, the country is facing serious problems of environmental degradation. This problem involves population growth and agricultural stagnation because of soil erosion and nutrient depletion (Alemneh, 1990; FAO, 1993; Aklilu, 2001).

Over many decades, the problem of land degradation has continued to be a serious environmental and economic problem in the country. For instance, a total of about 1.5-2 billion tons of soil is being lost every year in the country (ESSS, 1998). As it has been indicated in the Ethiopian Soil Science Society (1998), it is only about 20 percent of the highland which is relatively free from the risk of soil erosion.

There is enormous threat posed by human activity to the natural resource base (primarily, land and soils) and to ecological balance in the Ethiopian highlands. The highlands are the centre of the economic activity of the country where more than 85 percent of the population lives (Alemneh, 1990). This is because land and soils are very basic in securing food and livelihood 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 (FAO, 1993).

The Amhara Region has a complex environmental setup 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 knowledge (IK) in the designing and implementation of sustainable natural resource management with emphasis on soil and water.

To alleviate the problem of land degradation, many scholars and researchers suggest the adoption of sustainable land management. This is realized through the application of appropriate technologies. Sustainable land management promotes participatory soil and water conservation practices and related land management strategies. Hence, the main issue is how land can be managed sustainably and how the participation of farmers can be enhanced and appropriate technologies can be developed. The fear of losing soil and its fertility, which are the basis 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 percent is significantly eroded, and 23 percent reached the point of no return (Kruger et al, 1996).

Loss of arable land due to soil erosion is a widespread phenomenon in the highlands, which accounts for about 66 percent of the total land area of Amhara Region. On steep hillsides, soil losses exceeding 200 tons per hectare per year have been recorded (Kappel, 1996). The potential threat of land degradation on the region's economy and food security has been emphasized by several publications (Abegaz, 1995; Kappel, 1996; BoA, 1997; Hurni, 1997, Lakew, 2000). The threat is valuable since about 90 percent of the population of the region lives on the highlands.

The problem of land degradation is more severe in the highlands of Ethiopia, especially in the Amhara region. Soil erosion is a major problem in the region with the land estimated to be eroded is at a very rapid rate of about 16-50 ton per hectare per year (Lakew, 2000). Because of erosion, the region accounts for more than 50 percent of the estimated annual soil loss in Ethiopia (Abegaz, 1995; ESSS, 1998).

With very few exceptions, researches undertaken on land degradation in the Amhara region have not focused on the economic, social or demographic factors that affect how farmers manage their land. This is to say that, the bio-physical aspect of the problem has been favored. Consequently, policy response to the land degradation has focused on the technical areas, promoting the adoption of specific modern soil and water conservation technologies. These conservation technologies involve modern terraces and modern water harvesting technologies (Lakew, 2000; Yohannes and Herweg, 2000).

So far, various attempts have been made to manage land resources in the region. These have been achieved by employing modern land management measures through reforestation, terracing, and water harvesting, applying artificial fertilizers and so on. However, the outcome has not been as expected (Gete, 2000). One of the reasons the author proposes is the failure to consider indigenous knowledge (IK) of farmers in the designing and implementation of modern land management strategies. This is true, particularly for soil and water conservation and soil fertility improvement practices.

To address the problem of land degradation in the region, there is a need to have a broader perspective, both in how the problem is defined and in the set of possible solutions considered. For example, despite the report of high soil erosion rates in the region, farmers may be more concerned with productivity in the short-run rather than benefits of soil and water conservation in the long run (Hurni, 2000). Therefore, in this study, effort has been made to explore integration of indigenous and modern land management practices of the study area. In addition, the role of integrating indigenous knowledge in modern technologies for sustainable land management has also been considered.

1.2. Statement of the Problem

Small holder farmers in Ethiopia produce most of the agricultural output. The country's population pressure on land is evident from the disproportionately high contribution of the agricultural sector. It accounts for 80 percent of the export revenue and 45 percent of the GDP (CSA, 1998b). Much of the pressure is found in the highlands above 1500 m.a.s.l. This pressure, coupled with many other physical, socio-economic and demographic factors, has led to a serious degradation of land. Among the forms of land degradation, soil erosion by water is the biggest problem in the study area.

Ethiopia is one of the Sub-Saharan African countries where soil degradation greatly obstructs socio-economic development. In some areas of the country, the land degradation which resulted from soil erosion, deforestation and soil depletion are extensively higher than they can be replaced (Belay, 1998). The situation is getting worse in the highlands of the Amhara region where the highest share of the population performs agricultural activities. Specifically, in the study area, agricultural lands are under heavy stress due to land degradation. Soil erosion and soil fertility decline have become serious problems.

The rural poor are highly dependent upon natural resources most particularly 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 derive survival and means of livelihood from better managed land resources. This may be achieved through effective land management practices. In the study area, agriculture is the main source of livelihood for about 98.6 percent of the population. Furthermore, peasant households, representing the largest segment of the population in the area are directly dependent on the use of land resources for their livelihood (Gozamen *Woreda* ARDO, 2007).

Land degradation due to soil erosion, nutrient depletion and deforestation constitutes a major constraint to increasing agricultural production in the Amhara Region (BoA, 1998a; Lakew, 2000).It is also learned from the existing information that soil erosion by water (running water and runoff) is a serious environmental and socioeconomic problem in the region. According to FAO (1993), about half of the highlands of the region are already significantly eroded, of which about 27 percent are seriously eroded and have been left with relatively shallow soils. Soil fertility decline has also been another problem in the region as a whole and in the study area in particular. Several studies reveal the fact that the region has the highest rate of nutrient depletion (Stoorvogel, 1993; Lakew, 2000).

Evidently, the extent of soil erosion and soil nutrient depletion justify the severity of the problem of land degradation in the study area. The destruction of natural vegetation cover contributed to the intensification of soil erosion and the declining trend of soil fertility. Forests have been cleared in the study area mainly for firewood, securing agricultural land and house construction (Gozamen *Woreda* ARDO, 2007). This is either for own consumption and/or market. It was also described that the problem is being further aggravated by other factors such as population pressure. Therefore, in order to tackle the problem, the designing as well as adoption of holistic and participatory land management approach is vital. To put this into effect in the study area, considering farmers` traditional practices in modern land management endeavors has a paramount significance. In addition, it is also the beginning of participatory technology development in the area of agriculture (Yohannes, 1999).

To bring about sustainable land management, soil and water conservation as well as soil fertility improvement measures have become major tasks for farmers, policy makers, experts and researchers. In this case, the role of linking indigenous knowledge (IK) with modern technologies would be significant. However, the severity of soil erosion has often led to the premature conclusion that indigenous know-how of farmers about land management doesn't exist or is not sufficient (Yohannes and Herweg, 2000).

Unfortunately, it has frequently been assumed that land users are not aware of soil erosion, or that they are too poor to invest in soil and water conservation. Therefore, from the very beginning one has been trying to look for external solutions and technologies that could help to minimize the effect of erosion and achieve successful land management (Aklilu, 2001).

In the rural community of the Amhara Region involving the study area, there is a tremendous pool of indigenous land management practices. These practices already seek to harmonize with ecological benefits (minimizing soil loss and runoff, improving the fertility of croplands), economic benefits (sustaining and increasing production) and social benefits (preventing out-migration of land users to urban centers). These are said to be fundamental characteristics of land management practices (Warren, 1992; Yohannes and Herweg, 2000).

Incorporating farmers' indigenous knowledge in modern technologies forms an important component of the on-going grassroots involvement in the planning and implementation of successful land management practices (Yohannes, 1999). Indigenous knowledge (IK) may have some 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 study area are not making good use of indigenous knowledge.

1.3. Objectives of the Study

1.3.1. General Objective

The overall objective of the research is to explore the integration of indigenous and modern land management practices with special reference to soil and water conservation and soil fertility improvement practices of the study area.

1.3.2. The Specific Objectives

The specific objectives of the study are to:

1. describe the cause, magnitude and form of soil erosion by water in the area and discuss the level of farmers` perception on the problem of soil erosion and soil . fertility decline.
2. identify the indigenous and modern land management practices of farmers in connection to soil and water conservation and soil fertility improvement practices.
3. assess the overall strength and limitation of indigenous and modern land management practices on the bases of their cost, function, flexibility or adaptability, sustainability, and so on and
4. describe the role of integrating indigenous and modern land management practices for sustainable land management of the study area.

1.4. Basic Research Questions

The research questions are derived from the specific objectives which are mentioned above. The research questions which have been addressed by the researcher include:

1. What are the causes of land degradation and how is the magnitude of the problem in the study area? How is the level of farmers' awareness on the problem of soil erosion and soil fertility decline in their locality and on their farm plots?
2. What are the indigenous and modern land management practices of farmers of the study area?

3. What are the over all strengths and limitations of indigenous and modern land management practices of the study area?
4. What is the role of integrating indigenous land management practices with modern measures?

1.5. Significance of the Study

The study could have significance in the process of linking indigenous knowledge (IK) with modern technologies for more effective land management and sustainable utilization of natural resources. Improved land management that ensures better resource use will promote long-term sustainability for the economic welfare of rural communities. It is widely argued that indigenous knowledge systems can enhance a more sustainable agricultural production if they are well integrated with modern technologies.

It is widely known that Ethiopian farmers have long been aware of the problem associated with land degradation and have traditionally been conservation-minded. Different indigenous land management practices are still being carried out by farmers. In Ethiopia, however, these practices have been undermined and not properly studied. Thus, they are less integrated with the modern land management measures to a greater extent. Therefore, the result of the study may have some kind of contribution for successful land management practices of farmers in the area. In addition, the output may also have policy implications in the designing and implementation of improved and modern land management measures. This may assist the Regional and *Woreda* Agriculture and Rural Development Offices to design more successful land management practices. Eventually, it may also add some valuable inputs in the effort to manage natural resources, such as land, sustainably.

1.6. Scope of the Study

The paper focuses on the role of integrating indigenous knowledge (IK) with modern technologies for a sustainable land management. The study emphasizes on soil and water conservation and soil fertility enhancement measures. Indigenous knowledge here is confined to the local knowledge of the study area which is directly or indirectly linked to soil and water conservation and soil fertility improvement practices. Other IK practices of the study area other than soil and water conservation and soil fertility improvement practices are not the concern of the study.

In addition, soil erosion caused by other agents except erosion caused by water is not the interest of the study. Thus, the primary focus of the research is soil degradation. Focus has also been given to water erosion and soil fertility decline of the study area. Moreover, indigenous and modern land management measures practiced by farmers of the area have also been considered.

1.7. Limitation of the Study

The main limitation of the study is that it is not dealing with the detail technical aspects of each land management measure. Rather, attention has been given to identifying indigenous and modern technologies in land management practices. In addition, general or detailed land use map of the study rural kebele has not been prepared since there is no land use map at *woreda* level. Since the study area is located in the rural part of Gojjam, transport difficulty was the other limitation in undertaking the research. The unavailability of farmers during the working and market days were also other serious constraints. Meeting *woreda* experts was sometimes difficult as they frequently go for field visits in different sites.

1.8. Organization of the Paper

This thesis has been organized in to nine sections (chapters) and related topics under each section. Chapter one deals with the introduction of the study; Chapter two deals with the description of the Amahara Region including the study area; Chapter three is the literature review part; Chapter four deals with the materials and methods; Chapter five discusses about the problem of land degradation in the study area and the level of farmers` perception on the problem; Chapter six describes the indigenous land management practice; Chapter seven describes the modern land management practices; Chapter eight assesses the strengths and limitation of both practices and finally, chapter nine deals with the conclusions and recommendations. There are also ten tables and one figure. In addition, three maps and five photos have been incorporated to further supplement the thesis. The last section has contained the Appendix. It contains house hold survey questionnaires (Appendix1), guideline for key informant interviews (Appendix 2) and guideline for focus group discussions (Appendix 3).

CHAPTER-II

2. DESCRIPTION OF THE AMHARA REGION

2.1. Description of the Amhara Region: An overview

The Amhara National Regional State (ANRS) is located in the northwestern part of Ethiopia. Geographically, it is located between latitudes 9^0-13^0 45`N and longitudes $36^0$- $40^o$ 30`E (BoA, 1997). The region is bounded by the Afar, Benshangul, Oromiya and Tigray regions in the east, southwest, south and North, respectively and by the Sudan in the west. The total area of the region is estimated to be 170,152$Km^{2,}$ which is about one–sixth of the total area of the country (EMA, 1994).

The region's elevation ranges from 600m a.s.l at Metema, North Gondar to 4520m a.s.l. at Ras Dashen, North Gondar, which is also Ethiopia's highest point. The wide range of altitude is a major factor in determining the temperature range of the region. Lowland areas (<1500m a.s.l) experience hot temperatures while highland areas (>1500m a.s.l) experience relatively cooler temperatures (CEDEP, 1999).

Amhara Region is made up of four rivers basins. These are Abay, Tekeze, Danakil, and Awash. It is comprised of seven physical units. This includes the eastern escarpments and lowlands, North Gondar and Welo steepy areas, the Gojjam and North Shewa plateaus, the Tana Plains, the Abay and Tekeze gorges, the Western lowlands and the mountainous Afro-Alpine zones consisting of Ras Dashen, Guna Abune Yosef and Amba Ferit (BoA, 1998a; Lakew, 2000).The western part of the region is characterized by high rainfall and high agricultural potential areas, with precipitation exceeding 1200mm annually. However, low rainfall and low agricultural potential areas are found in North Welo and Waghemra Zones. The Amhara Region experiences both uni-modal and bi-modal rainfall patterns in the west and east, respectively (Co SAERAR, 1999).

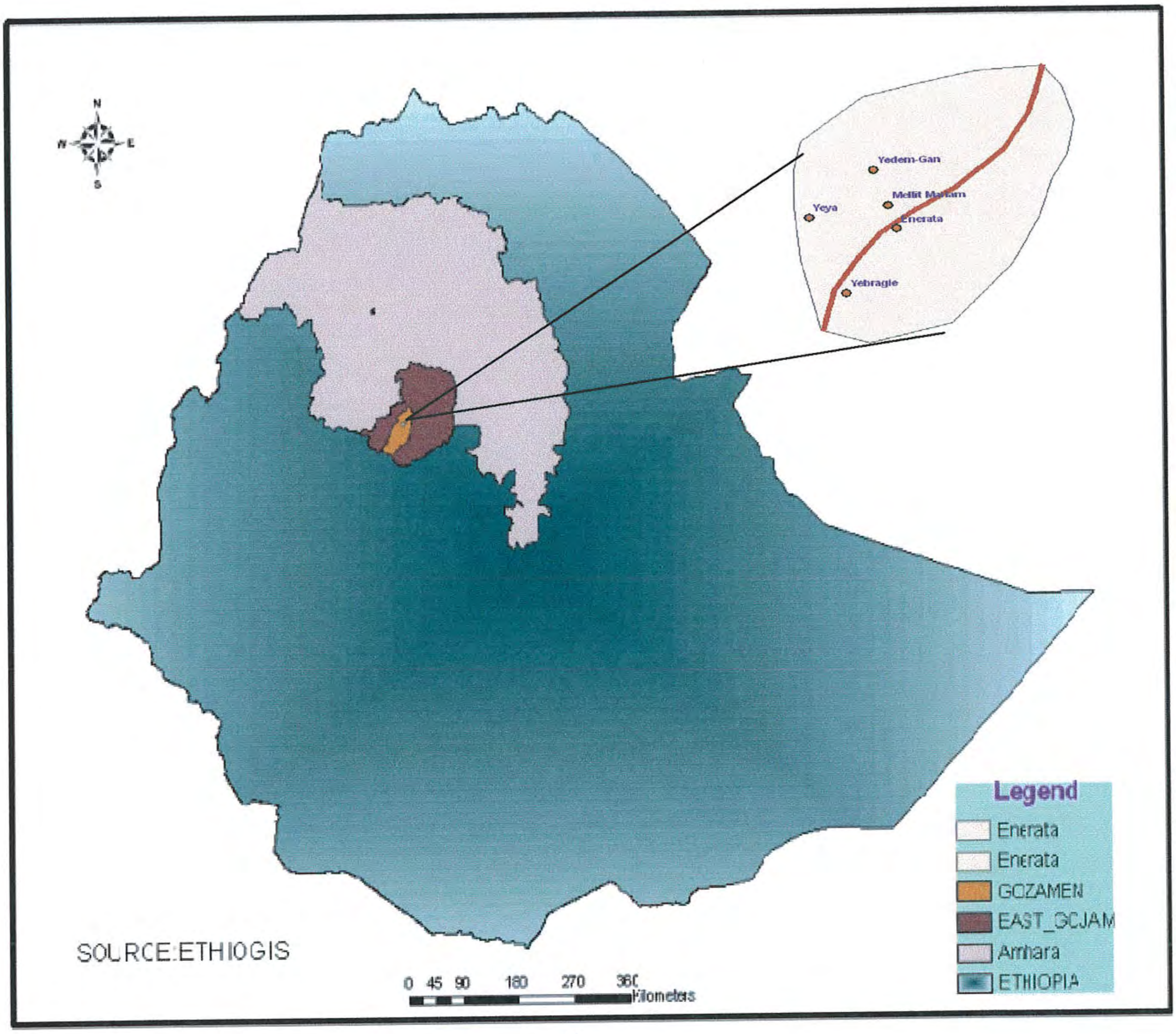
The total population of the Amhara Region in 2004 was estimated to be 22.5 million, with close to 90 percent employed in agriculture and living in rural areas (*Hibir*, 2006).The economically active population (people in the age of 15-64years) is around 52 percent. The average farmland holding is around 1.3ha, which varies from 0.5 ha in North and South Welo to 2.1 ha in west Gojjam (Lakew, 2000). Cereals, pulses, oilseeds, spices, vegetables and fiber crops are cultivated annually. Eragrotis teff (*`teff*) is the leading crop (32 percent) of the area of cultivated cereals, followed by sorghum and barely (13 percent each), wheat (11 percent) and maize (7 percent) (BoA, 1999a).

2.2. Description of the Study Area

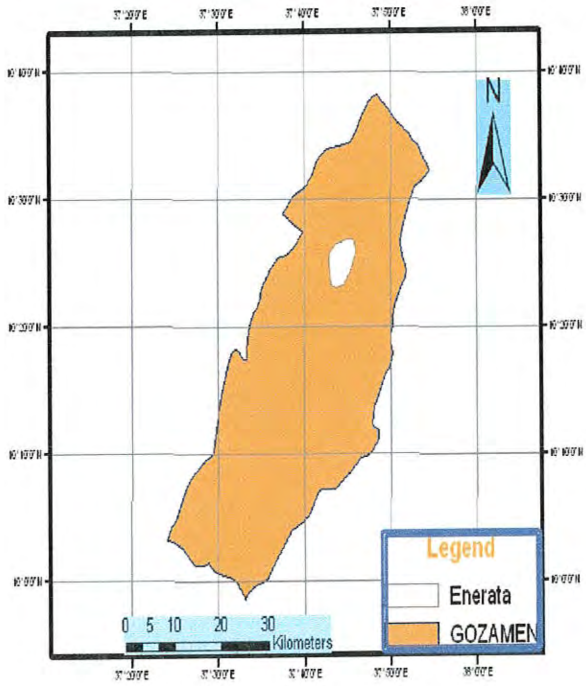
2.2.1. Location

Enerata is a rural kebele approximately 308 Km North West of Addis Ababa. It is found in Gozamen district (*Woreda*), East Gojjam Administrative Zone, under the Amhara National Regional State. The area is located at about 8kms North West of Debre Markos, the capital of East Gojjam. It is linked to the town by all weather gravel road which leads to Erebu Gebeya i.e. a small town 27 kilometers North West of Debre Markos. The area is, therefore, situated close to urban centre (Gozamen *Wereda* ARD Office, 2007). The kebele has five villages locally known as *`got`* with a difference in the type of slope, type of soil, etc. These are *Yeya, Mellit Mariam, Yedem Gan, Yebragie* and *Enerata.* However, *Yedem Gan* and *Mellit* have significantly different relief structure i.e. have steeper slopes than the rest of the villages. The relative location of *Enerata*, the locational map of *Enerata* in *Gozamen woreda* and the locational map of *Enerata`s* villages (*got*) are shown on maps 2.2.1a, 2.2.1b and 2.2.1c, respectively.

Map 2.2.1a: RELATIVE LOCATION OF ENERATA



Map 2.2.1b :LOCATIONAL MAP OF ENERATA IN GOZAMEN WOREDA



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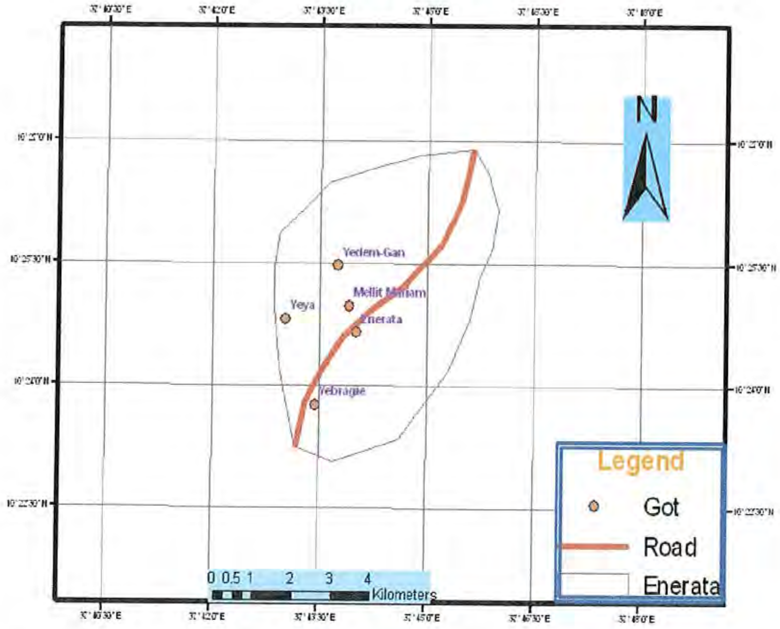
Map 2.2.1c :LOCATIONAL MAP OF ENERATA'S VILLAGE ('GOT')



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SOURCE:ETHIO-GIS

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2.2.2. Area and Population

Enerata has a total area of about 2750ha (27.5 km^2) with a total population of 7725(3865 males and 3860 females).There are 1545 peasant households who are officially registered by the Administration Office with only one female headed household. The population density of the study area is around 280 person/Km^2 (Enerata Kebele Administration Office, 2007).The average family size is about 6 children per household, indicating increasing trend of population growth (Enerata Kebele Health Extension Office, 2007).

2.2.3. Climate

The study area can be classified under the traditional agro-climatic zone of *woina dega*. It has an average altitude of 2425m above sea level. In Ethiopia, traditionally, areas that are found between altitudes of 1500-2500m a.s.l are classified under the *woina dega* agro-climatic zone (EMA, 1981). However, the climatic condition slightly varies from village to village due to a difference in the relief condition, vegetation cover and other physical factors. Generally, *Enerata* is found in the Northwestern Highlands of Ethiopia (Gozamin *Woreda* ARD Office, 2007).The highest point is at *Mellit* (2500m a.s.l) and the lowest point is at *Yebragie* (2350m a.s.l).

2.2.4. Soil

As it has been indicated by the *Woreda* Agriculture and Rural Development Office, the types of soil commonly found in the area are cambisols, which are locally known as *Borebore/Ashalima* (degraded and less fertile soil). Others include vertisols or '*Merere*' with proportionally silt (moderately fertile) and '*chincha,* (highly degraded and infertile soil).

2.2.5. Natural Vegetation

The major indigenous trees in the area include Acacia (*Girar*), Olive tree (*Woira*), Fig (*Warka*), Sycamore Fig (*Shola*),Morus Mesozoygia (*Injori*), Croton Macrostachys (*Bisana*), Strawberry tree (*Kosheshila*), Cordia Afrcana (*Wanza*) and African Pencil Cedar (*Yabesha Tid*) (Azene et al, 1993). There are also other indigenous plants which have adapted themselves to the local climatic conditions. We also find grasses and various short trees. The vegetation cover in the area varies from one village to the other with *Mellit* being relatively in a better status. However, in general, the vegetation cover of the area is very minimal and insignificant (Enerata Kebele Administration Office, 2007).

2.2.6. Economic Activity

More than 98.6 percent of the population living in the study rural kebele is engaged in mixed agriculture (crop and livestock production), i.e., sedentary agriculture. The main crops grown in the area include cereals such as wheat, *Eragrotis Tef (`Teff, `)*, Avena Fatua *(Engido),* maize, oilseeds and barely production locally known as `*Semereta*`. Crops are produced only once a year because of the uni-modal rainfall distribution. They are produced using traditional subsistence agricultural system. The study area is part of what is commonly known as `*kiremit* growing areas` of Ethiopia (Gozamen *Woreda* ARD Office, 2007).

CHAPTER- III

3. LITERATURE REVIEW

3.1. Conceptual Framework

3.1.1 Definition of the Main Concepts and Terms

Adaptation: - The incremental change and modification of SWC technologies to meet local conditions (Yohannes and Herweg, 2000).

Adoption:-The process of transferring and implementing modern soil and water conservation technologies to the farmers of an area through experts and development agents for better land management practices (Yohannes and Herweg, 2000).

Appropriate Technology: - 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 is ecologically productive, economically viable and productive and reduces risk as well as better responds to the respective land use systems because any technology may not be applicable every where(De Walt,1994).

Conservation: - It is the wise use of natural resources. It is the purposeful act of securing the natural resources for the longer use and for the greatest number of people (Geography Curriculum for Grade Ten, MoE, 2001). Conservation in this paper is confined to the land resources like soil, soil nutrients and water.

Indigenous /Traditional 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" (DeWalt, 1994). 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 (Grenier, 1998). 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 (Kajembe and Routatora, 1999).

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, 1991).

Indigenous knowledge is shared and communicated orally by specific examples and through culture. Indigenous forms of communications and organizations 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`, 'backward', 'static' or 'unchanging' (Warren, 1992). Indigenous knowledge (IK), indigenous knowledge system (IKS) and indigenous technical knowledge (ITK) are interrelated concepts (Warren, 1993).

Indigenous Soil and Water Conservation (ISWC)

This is a conservation strategy of soil and water which greatly practices local knowledge of indigenous people/ farmers to minimize the effect of land degradation, i.e., soil erosion and soil fertility decline (Kruger et al, 1996).

Indigenous People: Indigenous people are the original 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) (Johnson, 1992).

Indigenous Knowledge Based Sustainable Land Management

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). As it is indicated in several studies, this is based on common understanding of the land and the knowledge developed by the local people through years of continuous land use (Hurni, 2000). 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 cooperation between the farmers and the modern experts. It could be achieved through the increased recognition of the contribution of indigenous knowledge of the farmer. It also encompasses the mechanisms through which IK is linked into introduced or conventional technologies in land management (DeWalt, 1994).

Land Management: - is a broader concept that refers to an activity on the ground, using appropriate technologies in the respective land use system (Hurni, 2000). Soil and water conservation, soil fertility management, agricultural forestry practices, controlled-grazing and several others are typical examples of land management practices.

Local Knowledge: - is a broader concept which refers to the knowledge possessed by any group living off the land in a particular area for a long period of time (DeWalt, 1994). Under this approach, it is not necessary to know if the people are the original inhabitants of an area. The important idea is that how people aboriginal or non-aboriginal, in a particular area view and interact with their environment so that their knowledge can be mobilized for appropriate planning and intervention. For the sake of this research, indigenous knowledge, traditional and local knowledge have been employed interchangeably.

Model Farmers:-They are those farmers in the study area who have been rewarded by the Amhara Region Bureau of Agriculture and Rural Development and Gozamen Woreda ARD Offices for their effective implementations of modern and modified agricultural technologies. They are able to produce better yields than the rest of the farmers (Gozamen *Woreda* ARD Office, 2007).

Sustainable Land Management (SLM):- is an approach that emphasizes 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 appropriate technologies (Hurni, 2000). Hence, Sustainable land management approach can promote participatory land management solutions to the problem of land degradation and environmental deterioration.

Top-Down Approach of Technology Transfer: - It is an approach characterized by the transfer of modern agricultural conservation technologies from agricultural research and development institutes through experts and extension agents to the local people (farmers). The technologies developed in areas with totally deferent bio-physical conditions are moved from the centers to locality (Aklilu, 2001).

3.1.2. Categories of Indigenous Knowledge

Indigenous knowledge (IK) is considered to be cultural knowledge in its broadest sense. It includes the entire social, political, economic and spiritual aspects of a local way of life (Emery, 1996).Sustainable development researchers have found the following categories of IK: Resource management, knowledge and the techniques, practices and rules related to pastoralism, agriculture, and agro-forestry and water management. Classification systems for plants, animals, soils and water, empirical knowledge about flora, fauna, etc. It also involves the world view or way the local group perceives its relationship to the natural world (Warren, 1991; Emery, 1996).

3.1.3. Causes of Land Degradation in Amhara Region

One could argue that soil conservation represents the underlying problem of land degradation. Soil erosion and nutrient depletion are two of the most critical manifestations of unsustainable land management (Lakew et al, 2000).There are proximate and underlying causes of land degradation which negatively affect land management practices while the policy arena is the other factor. The causes of land degradation in the region are interrelated and thus can best be represented by the following figure (Figure 2.1).

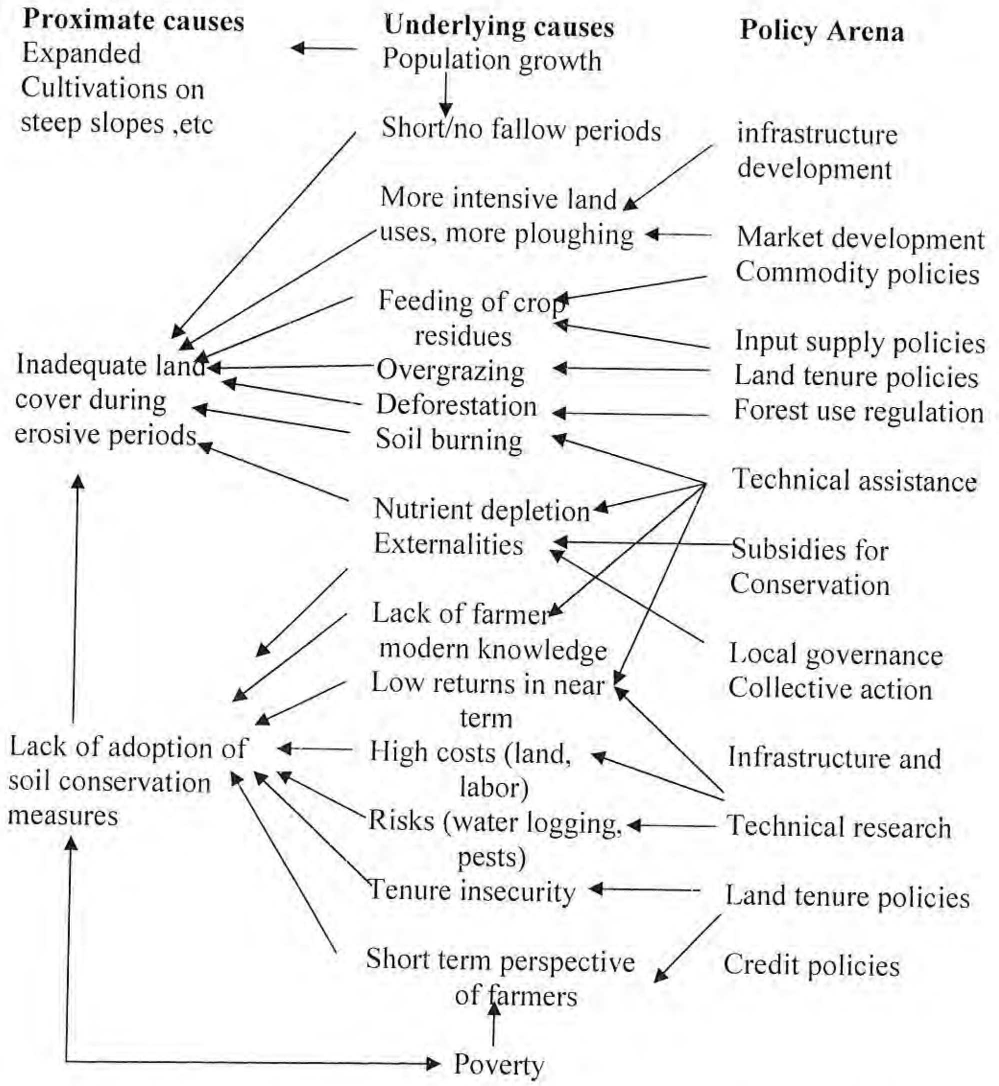

Fig 2.1. The Causes and Interrelations of Land Degradation in Amhara Region.

Source: Adopted from Lakew Desta, page 32.

Note: The causes of land degradation in the region in general and the study area in particular are complex and interrelated.

Proximate and Underlying Causes of Soil Erosion in the Region

As it has been demonstrated in the figure (Figure 2.1), the proximate or direct causes of soil erosion and soil fertility decline in the Amhara region are diverse and multi-faceted. However, some of the direct causes of the problem in the region in general involve expansion of farmlands into steep slope and fragile soils, inadequate investment on soil conservation ,inadequate vegetation cover, declining use of fallow, limited use of dung and crop residues to the soil, deforestation, over-grazing and so on(Abegaz, 1995; Lakew, 2000).

From the figure (Figure 2.1), one can easily observe the fact that many interrelated factors underlie these proximate causes. These include population pressure, poverty, high cost and limited access to agricultural inputs and credit facilities. The others are fragmented land holdings, short-term perspective of farmers and farmers' lack of information about the appropriate alternative technologies (Abegaz, 1995; AFAP, 1997; Azene, 1998; Lakew, 2000). Many of these factors are affected by government policies related to infrastructural development, market development, input and credit supplies, land tenure, agricultural research and extension, conservation programs, land use regulation, local governmental and non-governmental programs (Abegaz, 1995; Lakew, 2000).Hence, the causes and responses to soil erosion can be categorized into natural, socio-economic and demographic factors.

From the above discussion, it is clearly indicated that the problem of soil erosion has been a complex issue incorporating many interrelated factors. As the severity and scope of the problem has been deep-rooted, the solution to the problem is also multi-dimensional and holistic. However, some of the coping strategies for land degradation in general and soil erosion in particular are sustainable land management technologies (Lakew, 2000) These encompass integrating farmers` indigenous knowledge in modern conservation technologies, participatory agricultural development by considering the local socio-economic and cultural conditions, adjusting institutional set-ups and good governance (Herweg, 1993; Abegaz, 1995; Azene, 1998; Lakew, 2000).Here, emphasis is given to the role of indigenous knowledge of the farmer in the land management. It supports to minimize the severity of the problem of soil erosion in the region. This would pave the way to the development and adoption of what is called `appropriate technologies` in a participatory approach.

a/ Natural Factors

Several literature on causes of land degradation in the Amhara region verify that high intensity of rainfall and steep slopes are one of the major contributing reasons for soil erosion and nutrient depletion (Hudson, 1981; Herweg, 1997; Lakew, 2000). The impact of rain drops on bare lands causes a splash, which seals off infiltration as the soil process get plugged with fine particles. Splash erosion grows into sheet erosion and then rill erosion. Eventually, the rills form large gullies which accelerate the process of erosion. The impact of the rain drops depends on the level of soil cover. Vegetation cover is often lacking in the highlands of Gojjam and the Amhara Region in general due to such problems as deforestation, over-grazing, population pressure, etc (Lakew, 2000).

Loss of top soil through runoff is increased by the absence of soil cover, steep slopes and intrinsic soil properties. The problem is more serious in the highlands of Gojjam where the cultivated fields and their surroundings are without vegetation cover (CEDEP, 1999).Cropping of cereals, particularly *`teff`*, aggravates the situation since the farmland requires repeated ploughing before sowing. Therefore, it remains bare at the onset of the rainy season (BoA, 1997). On the contrary, *`teff`* is the staple and cash crop for the largest proportion of the population in the region, more importantly in Gojjam.

Topography is another factor greatly contributing to soil erosion in the region as it is indicated in (BoA, 1997). The region is characterized by flat to gently slopping plateaus. There are also dissected valleys and gorges like the Abbay gorge connected by steep and long slopes up to half a kilometer in length. Here, it is on these steep slopes below the escarpment that gullies originate and extend down to the plain fields (Lakew, et al, 2000).

b/ Socio-Economic and Demographic Factors

Poverty

Poverty is very likely to contribute to land degradation for many reasons. When people lack access to alternative sources of livelihood, there is a tendency to exert more pressure on the limited resources available to them. There is intensified pressure on the natural resources. One of such pressures is land degradation. The situation has led to drought and reduced household assets (Shiferaw and Holden, 1999). As a result, deforestation, burning of dung and crop residues is increased due to people's inability to afford or lack of alternative fuel sources. For example, electricity and kerosene are expensive and in most cases not available for the rural people. Even households with electricity supply avoid using it except for lighting at night. For cooking, most house-holds prefer the three-stone open fire. This is believed to be only about 10 percent efficient in the overall thermal energy production and use. Improved stoves such as improved bio-mass, fuel-saving stove, etc are believed to be around 45-82 percent more efficient than the three-stone open fire. However, they are not used since they are not affordable by rural households (Lakew, 2000).

Without adequate alternative sources of energy, population growth increases the demand for fuelwood, which inturn leads to the destruction of forests. It also contributes to the use of crop residues and dung for fuel rather than using them as source of organic fertilizer to improve the poor soil. This situation is true in the highlands of the region whereby about 94 percent of the peasant households meet their principal energy demand from fuelwood and dung (Lakew, 2000). The consequence is that around 64 percent of the peasant households in the region do not use manure on their farmlands (UNECA, 1996; Azene, 1998; Lakew, 2000).Therefore, unless alternative energy sources are exploited and become available, the rate of degradation of forest resources will continue. As the population grows, the consequent demand for energy also increases.

Population Pressure

The population of the region is increasing at an alarming rate. In the next quarter of the century, the number of people in the region is expected to reach around 32.7 million of whom, nearly 26.8 million (82percent) will be living in rural areas (CSA, 1998b). The population growth has also an increasing trend in the highlands of Gojjam. It is generally agreed that population growth can have and has had a deleterious effect on agricultural production, resource management and poverty in general (BoA, 1997; Lakew, 2000).

Nevertheless, population pressure can also have positive impact on land improvement and soil management. By increasing the value of land relative to labor, population growth may induce farmers to make labor-intensive investments in land improvement and soil management. These include planting trees, constructing terraces, composting and mulching, etc (Pender, 1998).

The other issue to be considered is the land fragmentation. Land redistribution in recent years has become the only means of formally acquiring access to land to accommodate new households in the region. This has led to severe fragmentation of plots, reduction of crop fields and insecurity. Reduction of cropland per household and insecurity inturn led to reduction in activities such as fallowing, planting trees and investing in soil conservation structures. A reduction in cropland has caused cropping and grazing practices to be shifted to hillsides and ecologically fragile areas (UNECA, 1996; Lakew, 2000; Desalegh, 2001).

In general, population growth, land fragmentation and poverty in the Amhara region have negatively been affecting the management of land resources. The main reason is the exceeding rate of population growth beyond the carrying capacity of land resource. This inurn is aggravating the problem of land degradation in the highlands of the region.

3.1.4. The Role of Indigenous Knowledge in Modern Conservation and Sustainable Development

There are two basic reasons why it is important to consider IK when carrying out modern development projects. First and for most, integrating IK with modern development projects can contribute to local empowerment and development, increasing self-sufficiency and strengthening self-determination (Thrupp, 1989). Incorporating IK 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.

Secondly, indigenous people can provide valuable input about the local environment and how to effectively manage natural resources sustainably. Most literature indicates that indigenous people can manage the environments where they have lived for generation. This happens without significantly damaging the local ecologies (Emery, 1996). Thus, they feel that indigenous knowledge 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 forms. They rely on locally available skill and materials and are therefore more cost-effective than introducing exotic technologies from outside sources (IIRR, 1996a). In addition, local people are familiar with them.

3.1.5. Integrating Indigenous Knowledge in Modern Technologies as a Potential for Successful Land Management

Several studies indicate the contribution of using indigenous knowledge in conventional natural resource management (Reij, 1991; Warren, 1991; Scoones and Thompson, 1994 ; Dejene, 2000).The modern transfer of technological processes in which recommended technologies are taken from agricultural and research development institutes by advisors and extension agencies into farmers has not become effective as expected (Critchley, 1999). At present, the mere designing and implementing of modern conservation measures do not necessarily change the problem of land degradation. Therefore, the maintenance and integration of modern conservation measures with traditional practices is appropriate. Besides, farmers' involvement in the process has become one of the preconditions for effective land management activities (Dudal, 1981). Consequently, in different agricultural research centers, Universities, government agencies and NGOs, there has been a growing acceptance of the need to involve local people as active partners. This is true in all spheres of research and development process (Scoones and Thompson, 1994).There is also increased awareness of the need to a paradigm shift from a narrow technical focus on conservation technologies to more flexible and participatory approach. This involves farmers' indigenous knowledge to the changing resource-base and other external, internal, environmental and socio-economic pressures (Donald and Brown, 2000).

Nevertheless, experiences in the Amhara Region and in Gojjam reveal that indigenous knowledge of farmers and their participation in decision-making process has not been considered significant. Instead, solutions to the problems of land degradation were sought only through the introduction of externally-developed conservation technologies (Yohannes, 1989; Lakew, 2000). Implementation was thus uniform irrespective of local, agro-climatic, socio-economic and cultural variations (Kruger et al, 1996).

3.1.6. The Significance of Indigenous Knowledge Systems for Sustainable Agriculture in Amhara Region

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 knowledge and practice (Belay, 1999). The farmers living in the highlands have established their indigenous agricultural knowledge system over many generations. This is in contrast to the global agricultural technologies, mainly generated by modern research institutes in the last hundred years (Dejene, 2000; Lakew, 2000). These indigenous agricultural knowledge systems incorporate much information on the local ecosystem, type of soil, type of crops and land management practices. For example, farmers have indigenous knowledge related to crop management and are rich in information about poor seed quality, diseases, pests, natural disasters such as drought, etc.

Indigenous knowledge possessed by farmers also involves the methods of seed selection and storage which are well-adapted to the socio-cultural and environmental conditions of their localities. Farmers' indigenous knowledge related to land include information on site and soil characteristics and therefore effectively guide the farmer as to where and which crops to cultivate and how land be managed (Ruthenberg, 1998; Belay, 1999).The other most significant role of indigenous knowledge of farmers for sustainable agriculture is the information base of farmers about land management practices (Lakew, 2000).

Indigenous land management measures can take the form of structural or physical measures, biological and agronomic measures. The main objectives of indigenous, agronomic practices are 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 runoff 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 water conservation methods, which mainly are also 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 knowledges are relevant to the sustainable agricultural development. This is due to the fact that such knowledges have been developed within the scope of the farmers' culture and technical capacity (DeWalt, 1994; Tivy, 1995). Hence, they can best fit into the existing physical, socio-economic and cultural environment. This doesn't mean that indigenous land management practices such as soil and water conservation practices are perfect. They have their own constraints in many aspects.

3.1.7. The Overall Role of Indigenous Knowledge in Society

In the emerging global knowledge and economy, a country's ability to build and mobilize knowledge capital is equally essential for sustainable development as the availability of physical and financial capital. The basic component of any country's knowledge system is its indigenous knowledge system. It encompasses the skills, experiences and insights of people applied to maintain or improve their livelihood (Rajasekaran and Warren, 1990).

Indigenous knowledge is developed and adapted continuously to the gradually changing environments and passed down from generation to generation. It is closely interwoven with people's cultural values (DeWalt, 1994). IK is also the social capital of the poor, their main asset to invest in the struggle for survival, to produce food, to provide with shelter or to achieve control of their own lives. Most literature argues that IK is part of the lives of the rural poor; their livelihood depends almost entirely on specific skills and knowledge important for their survival. Thus, for development process, indigenous knowledge is of particular relevance in the following sectors and strategies: agriculture, animal husbandry, veterinary medicine, use and management of natural resources, primary health care (PHC), saving and lending, community development, poverty alleviation and so on (Rajaskaran and Warren, 1990; Grenier,1998).

Indigenous knowledge is also considered as the basis for local-level decision making in agriculture and natural resources management. It is the information base for a society, which facilitates communication and decision making. Indigenous information systems are dynamic and are continuously influenced by internal creativity and informal experimentation by contact with external systems (Warren, 1992).The rationale for understanding certain traditional practices among others is the recognition of problems by the local people. Indigenous practices are aimed at arresting the local priority problems.

Although they survived the challenges of the changing bio-physical and socio-economic environments through a continuous responsive changes and adaptations, indigenous practices are not perfect (DeWalt, 1994).One major problem among others is that they have a lot of problems in terms of effectiveness.

There are some scholars who still argue that indigenous knowledge deserves little emphasis since it cannot any longer go with the dynamics of the environment (Azene, 1998).It is modernization rather than the local practices which need to be pushed further. It is, however, believed that indigenous knowledge certainly fit into the local socio-economic situations and might easily be managed by farmers and the resources at their disposal (Kruger et al, 1996).

3.1.8. The Role of Indigenous Knowledge 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, tradition and knowledge (Belay, 1998).

Indigenous knowledge (IK) is important on three levels for the development process (Rajasekaran and Warren, 1991; DeWalt, 1994; Grenier, 1998). Firstly, it is obviously important for the local community in which the bearers of such knowledge live and produce. Secondly, development partners such as CBOs, NGOs, private sector initiatives, governments, donors and local leaders need to recognize it in their interaction with the local communities. Before incorporating IK in their approaches, they need to understand it and critically validate it against the usefulness for their intended objectives and lastly, IK forms part of the global knowledge. In this context, it has value and relevance in itself. IK can be preserved, transferred or adopted and adapted to ecological, social, cultural and economic conditions of a particular community (Grenier, 1998).

For many decades, agricultural policies and practices have taken the view that farmers are mismanagers of soil and water (Pretty and Shah, 1997 cited in Aklilu, 2001). Therefore, they are considered as either adopters or rejecters of technologies. However, they are not considered as originators of agricultural knowledge and practice (Scoones and Thompson, 1994).This assumption has been leading to the external development of technologies without incorporating indigenous knowledge into the technologies. There has been a consolidated tradition of accepting imported technologies and a total rejection of experience and know-how of farmers in Ethiopia (Desalegh, 2001).This is true, in particular to land management practices in the country. Thus, a lot of debate emerged about the importance of what has been called `indigenous knowledge` (IK) in recent times and the need to combine it in modern science-based knowledge (Warren, 1991; Biot et al, 1995; Dejene, 2000).

3.1.9. The Relevance of Indigenous Knowledge for Land Management Practices

Nowadays, it has been increasingly recognized that the farmers themselves have valuable environmental knowledge found in their IK (DeWalt, 1994). In addition, the indigenous knowledge of farmers is understood as a basis for sustainable land management, particularly in the soil and water conservation and soil nutrient enhancement practices (Dejene, 2000).

Indigenous land management systems are usually adopted within the given rural community. Therefore, they are culturally more appropriate and environmentally friendlier. Besides, the local rural community develops land management measures that are suitable to the biophysical properties and fit into the socioeconomic conditions (Hurni, 1997).

Indigenous knowledge (IK) forms the basis on which sound agricultural land management measures can be practiced. It is also the beginning of sustainable resource management. Indigenous knowledge of the rural people in the process of land management has largely been ignored by policy-makers and researchers by depending on the top-down approach of technology transfer (Yohannes, 1999).The indigenous knowledge of farmers is rarely accepted as knowledge in the main stream of agricultural development and land management measures (Warren, 1991; DeWalt, 1994). Here, indigenous knowledge of farmers should not be considered as knowledge without constraints (Warren, 1991).

The increasing awareness of the integrating nature of indigenous land management practices to modern ones has motivated agricultural and conservation experts to consider IK as untapped source of knowledge. This promotes sustainable land management practice and then developing sustainable agricultural productivity (Johnson, 1992).It also makes the farmers of a given locality to be recognized as the ones who are able to combine indigenous knowledge with modern land management practices. Through time, attitudes towards IK have been changing from negative view to increasingly positive one (Yohannes and Herweg, 2000).

There was the consideration by many scholars, foreigners and nationals, researchers and experts that indigenous knowledge is primitive, backward, static and supportive to modern technology (DeWalt, 1994; Dejene, 2000; Desalegh, 2001). This negative attitude has contributed a lot to the decline of local farmers' self-confidence. It has also brought high dependence on foreign scientific knowledge to seek for land degradation problems. Another issue to be considered is that being considerate of indigenous knowledge will help to win the `emotional will` of the local people which in turn will contribute for their being more perceptive to learn new ideas and technologies in land management efforts.

Indigenous knowledge has two powerful advantages over outside knowledge. These are: It has little or no cost and it is readily available. Indigenous knowledge systems and 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, 1993). Consequently, indigenous knowledge system provides the basis for the problem solving strategies for local communities, especially for the poor. It happens through facilitating preconditions for developing sustainable land management technologies.

Learning from IK can improve understanding of local conditions and offer a productive context for activities designed to help the farmer. Furthermore, the integration of indigenous practice assures that the final user of specific agricultural development projects are involved in applying technologies appropriate to their needs (Warren, 1993).

However, indigenous knowledge is still less integrated and underutilized resource in the development activities. It needs to be intensively and extensively studied and be incorporated into the formal research and extension practices. This makes agriculture and rural development strategies more sustainable (Scoones and Thomson, 1994). Hence, special efforts are needed to understand, document and disseminate indigenous knowledge for its preservation, transfer or adoption elsewhere. It is also widely argued that indigenous technologies will ensure a more affordable and sustainable solution if they are integrated to modern technologies (DeWalt, 1994). For instance, understanding the indigenous land management systems may reveal important clues for the development of alternative, sound and sustainable land management systems. The argument is based on the need to create more appropriate and environmentally friendly technologies. It is also based on empowering farmers to have greater control over their destinies and creating technologies which will have fairer socio-economic implications (DeWalt, 1994; Desalegh, 2001).

3.2. Population, Environment and Agriculture Relationship (Theoretical Frame work)

There is a multi-faceted and complex interrelationship between population, agriculture and the environment. As a result, there has been a growing debate on population-environment relationships for more than half a century. In many parts of the world, however, this relationship is becoming a detriment to the environment. This leads in to the conclusion that environmental degradation to a large extent is human-induced

Of the various forms of environmental degradation, the degradation of agricultural land has been a major global issue during the 20th century. It has also remained high on the international agenda in the 21st century (Eswaran, 2001).This is because of its adverse impacts on agronomic productivity, the environment and its effects on food security and quality of life.

Soil erosion is one of the most common forms of land degradation. The problem is critical in developing world resulting in a substantial productivity decline on approximately 16 percent of the agricultural land. It is especially true on croplands in Africa (Scherr, 1999). If it is left unchecked, the trend indicates that the problem is likely to cause severe declines of agricultural income in most of the developing countries in the future.

On the other hand, there were considerable efforts put in place on degraded areas of the developing world. The intention is to reverse the problem and its effect on agriculture and the environment. In many cases, however, these efforts have largely failed to reverse the situation. Several theories are posted to explain the failure. Among others, the approaches followed in the design and extension of conservation technologies are major issues.

The way the technologies are developed and the socio-economic and policy environment within which the farmers operate have been the other issues of criticisms and debate. Therefore, various perspectives that describe the failure to redress the land degradation problems have come into existence. There are three sets of theories on issues of land degradation and conservation in developing countries (Biot et al, 1995 cited in Aklilu, 2001).

Firstly, the extent of and solution to the problems of land degradation are well known, but the problem is how to get people to implement them. Secondly, the nature and extent of land degradation are imperfectly understood. Local farmers often reject conservation technologies for some reasons and infact implement their own individual and collective approaches and thirdly, appropriate technologies presently exist or can readily come into existence. The problem is how to link them with indigenous practices by understanding the present structure of incentives that prevent farmers from adopting them. It also involves the design of incentives that will induce adoption by considering the socio-economic and cultural conditions of the land users.

However, today a growing number of African governments and development agencies are recognizing that local-level knowledge and organizations provide the foundation for participatory approaches. They are focusing on development that is both cost effective and sustainable (Warren, 1992; Dejene, 2000). This paradigm shift questions the common belief that local farmers are ignorant and that their knowledge should be replaced by scientific knowledge. As a result, indigenous knowledge has become important particularly, in the land management efforts in recent years (Warren, 1991; Dejene, 2000).

CHAPTER-IV

4. MATERIALS AND METHODS

This research paper is based on a case study method. In addition, it has used primarily qualitative research method, supplemented by quantitative data that employ data obtained from primary as well as secondary sources. However, simple quantitative figures have also been used to show comparisons and proportions wherever appropriate.

The purpose of the research is to identify both indigenous and modern land management practices being implemented by farmers in the study area and to evaluate their effect. Attempt has also been made to describe the role of integrating indigenous practices in modern land management measures. Thus, the type of research used is exploratory type through qualitative description and narration.

4.1. Nature of Data

Data that have relevance for the study were collected during the site visit. The data have focused on indigenous and modern technologies that are important for land management practices of the study area. Furthermore, the data which have been gathered incorporated information about the problem of soil erosion and soil fertility decline. The data also included information about the farmers' knowledge on the problem of land degradation, identification of indigenous and modern land management measures and evaluation of these measures. Data on the role of combining indigenous knowledge in modern technologies in land management practices have also been gathered.

4.2. Sources of Data

Primary data have largely been employed for the research work. However, secondary sources have also been used in some cases to further triangulate the data. The primary data were obtained from peasant households, elderly farmers and chairman of the kebele, development agents as well as *woreda* soil and water conservation experts. Secondary data were also collected from various documents of BoARD, East Gojjam ARD Department, *Gozamen Woreda* ARD Office, books, journals, bulletins and other published and unpublished sources that are related to the study.

4.3. Research Method and Approach

In the process of organizing the thesis, qualitative research method has largely been employed through qualitative description, discussion and narration. However, quantitative figures are also used simply to indicate proportions and comparisons such as percentages.

Data describing the relationship between indigenous and modern land management practices (soil and water conservation and soil fertility improvement practices) have been given focus of attention. In addition, data that have relevance for the study were collected during the field work by the help of different research tools.

A Land management practice, which applies both indigenous and modern conservation activity, was identified. Therefore, one kebele from within Gozamen *Woreda* kebeles was selected purposely. Based on the information obtained from the Woreda ARDO, the selected study area has relatively better performances in land management practices; particularly in soil and water conservation. The kebele has been applying both indigenous and modern land management practices in an integrated manner. Therefore, it could be easier for the researcher to consider the role of linking farmers' indigenous knowledge in modern technologies in land management practices. Furthermore, for the sake of comparison, data were collected from five villages or *got* in the kebele: *Enerata, Mellit, Yebragie, Yedem-Gan and Yeya*. All of them are being administered under Enerata kebele peasant association (KPA).

4.4. Tools of Data Collection

To address the specific objectives of the research, the following tools of primary data collection have been applied.

i. Questionnaires

Questionnaires (close and open-ended) were designed and filled by peasant households (farmers) through a household survey. Accordingly, ninety peasant households were randomly selected out of 1545 peasant households (using simple random sampling procedure) from within the list of the kebele (eighteen peasant households from each village or `*got*`).These peasant households are those who have been implementing indigenous and modern land management practices in an integrated manner so that comparison can be made between the practices. The households are those who have been earning their livelihoods in one way or the other from agriculture. Furthermore, model farmers who have practiced successful land management measures in soil conservation have also been incorporated; proportionately in each village (one model farmer from each village).This raises the total number of household questionnaires to ninety five.

ii. Field Observation

To generate the required data, field observation was carried out. Soil and water conservation works of farmers such as modern check dams were observed in the two villages (*Mellit* and *Yedem Gan)*. The observation has become practical with the assistance of chairman of the kebele and development agents through what is called participatory field-observation.

iii. Focus Group Discussion (FGD)

Focus Group Discussion (FGD) has been conducted with farmers who have been applying indigenous and modern land management practices. The farmers have certain experience, knowledge and practice in the combined use of land management measures in their locality. For this purpose, forty peasant households (eight peasant households from each village or *got*) were randomly selected. These farmers obtain their livelihood from agriculture and agricultural activities. Eight peasant households from each village were organized to form one focus group. All households had the same sex. They are male (since there is only one female-headed household in the kebele i.e. the rest of the women in the area are married), age wise (above 18 years) and all of them practice agricultural activities. Accordingly, the forty peasant households were organized into five groups, with each group consisting of eight household members. As a result, five focus group discussions were conducted to generate the required data from the whole kebele. The households have similar socio-economic and cultural characteristics with the rest of the peasants.

Photo 4.1a: Participants in one of the focus group discussions.

iv. Key Informant Interview

This was carried out by interviewing informants in connection to traditional and modern land management practices. Seven key informants were included in the interview. The key informants were community leaders like kebele chairman and elderly farmers. Other key informants included soil and water conservation experts and development agents. Usually, elderly farmers in the area have a profound experience and knowledge about land management practices. Moreover, they play a great role in the leadership of traditional social institution established for some kind of purpose (example, *idir*), religious association of orthodox followers (example, *senbetie and mehayber*) and traditional mutual exchange of labor especially in harvesting season (*Wonfel*) and so on.

Moreover, they are also highly respected by the local community. The participation of development agents and experts has brought a crucial contribution to assess the strength and limitation of indigenous and modern land management measures. In addition, it has enabled to indirectly evaluate their attitudes and motives towards the farmers` traditional knowledge on soil and water conservation and soil fertility improvement methods. They have also provided indispensable information about the overall technical aspects of modern and traditional land management measures.

The discussion with the *woreda* experts and site development agents has focused on issues related to soil and water conservation works. The discussion emphasized on the farmers utilization of indigenous knowledge towards soil and water conservation and soil fertility improvement practice. The discussion also continued on farmers' perception of the problem of land degradation in their locality and at farm level. In addition, attempt has been made to discuss the outcome of the use of farmers' traditional land management practices and their linkage with the modern measures.

v. Participatory Transect Walk

Transect walk with members of the farmers who have adopted indigenous and modern land management measures was made. It has focused mainly on the observation of physical characteristics of SWC works and related land management practices, degraded or well conserved areas and individual activities at the farm plot. The participatory transect walk has involved some-structured interviews with the local farmers about their indigenous knowledge on soil and water conservation and soil fertility improvement measures.

4.5. 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. Some quantitative descriptions have also been employed to indicate proportions in percentages. In addition, data are also presented with the help of tables. Photographs, maps and figure are also used in order to supplement the study.

All the data obtained through different methods and levels of the research process were, discussed, described and analyzed using the following methods: Qualitative method of data analysis through narrations, descriptions and discussions, Simple quantitative methods of data description using percentages, logical arguments, exploratory method of data analysis, triangulations i.e. cross-checking the data through different sources. In addition, Statistical Package for Social Sciences (SPSS) has also been used to analyze the questionnaires, especially for the closed questions.

CHAPTER- V

5. THE PERCEPTION OF FARMERS ON LAND DEGRADATION

In this part of the thesis, attempt has been made to describe the causes of land degradation in the study area, the forms of water erosion as well as the magnitude or extent of the problem. Moreover, effort has also been made to discuss the level of farmers' perception regarding the problem.

5.1. The Cause, Magnitude and Forms of Soil Erosion in the Study Area

5.1.1. Causes of Soil Erosion and the Magnitude of the Problem

As the discussion with the experts and development agents indicate, soil degradation due to water in the study area is caused by several interrelated factors. Some of these are bio-physical while some others are socio-economic as well as demographic. Among the bio- physical factors that contributed to the problem of water erosion in the area include lack of vegetation cover or minimal vegetation cover, the nature of the topography itself and the rainfall characteristics i.e. nature of rainfall or in simple terms, high rainfall intensity. Evidences from the *Woreda* ARD office and in the field indicate that the nature of the topography of the kebele, which varies from village to village, can be an important reason contributing to the existing problem. For example, in one of the villages named *Yedem Gan* the problem of runoff erosion is the most severe due to the steepness of the slope of the area. This is demonstrated by a photo (photo 5.1a, on page 44).

Compared to other villages, it has rugged terrain with a lot of ups and downs in which the soil is exposed to runoff and intensive rain. This has been observed during the field observation in which several farm plots are located around steep slopes. The evidence from on-field observation also indicates that gullies are observed widely in the village. The steepness of the slope is also a cause for soil erosion in the village known as *Mellit* where there is the highest point of the study area i.e. 2500 m.a.s.l (Gozamen *Woreda* ARD Office, 2007). However, the problem is less severe in *Mellit* than *Yedem Gan* since it has relatively better vegetation cover. In addition, gullies are rehabilitated by the unreserved efforts made in the soil and water conservation by farmers in conjunction with the development agents. Such efforts have incorporated the construction of modern check dams where there are large size gullies, modern waterways, reforestation, area closure and many others.

(Photo 5.1a): Large size gully in *Yedem Gan* village (Photo: By the researcher)

The other physical factor which causes soil degradation in the study kebele is the high intensity of rain that falls during the rainy season commonly known as '*kiremit*'. This has been generalized from the survey whereby farmers were asked the season in which soil erosion becomes more severe on their farm plots. Accordingly, about 84.3 percent of them have responded that their farm plots are more severely eroded in the rainy months of June, July and August.

The impact of rain drops with tremendous amount of energy on the bare unprotected soil begins being eroded by water (Morgan, 1986). Rainfall with high intensity is particularly responsible for sheet erosion because the soil particles are easily detached basically by the rain drops affecting the soil arrangement and are transported by sheet flow of water. As it has been confirmed in the discussion with development agents during the interview, sheet and rill erosions are the most extensive kinds of erosion in farm plots of the study area. It is also manifested by a decrease in the depth of soils of crop lands. The rainfall of the area is concentrated in the three months of the year i.e. June, July, and August *(kiremit)*. This intensive rain greatly accelerates erosion on bare crop lands not only by detaching soil particles but also by generating excessive runoff which transport the particles. Furthermore, seed bed preparation and cultivation in the area is usually practiced during the heavy and torrential rainy months of July and August (especially for '*teff*').The situation leads to plant nutrients and finer soil particles to be washed away from the cropping fields.

Based on the type of slope, from among the five villages in the kebele, *Yedem Gan* and *Mellit* have steeper slopes than the three villages (*Enerarta, Yeya* and *Yebragie*).This implies that they are under high risk erosion category where as the other three are within the moderately significant erosion category. Therefore, the intensity of rain fall has its own share in contributing for accelerated soil degradation in the area.

Photo 5.1b: Large size gully in *Mellit* village (photo by the researcher)

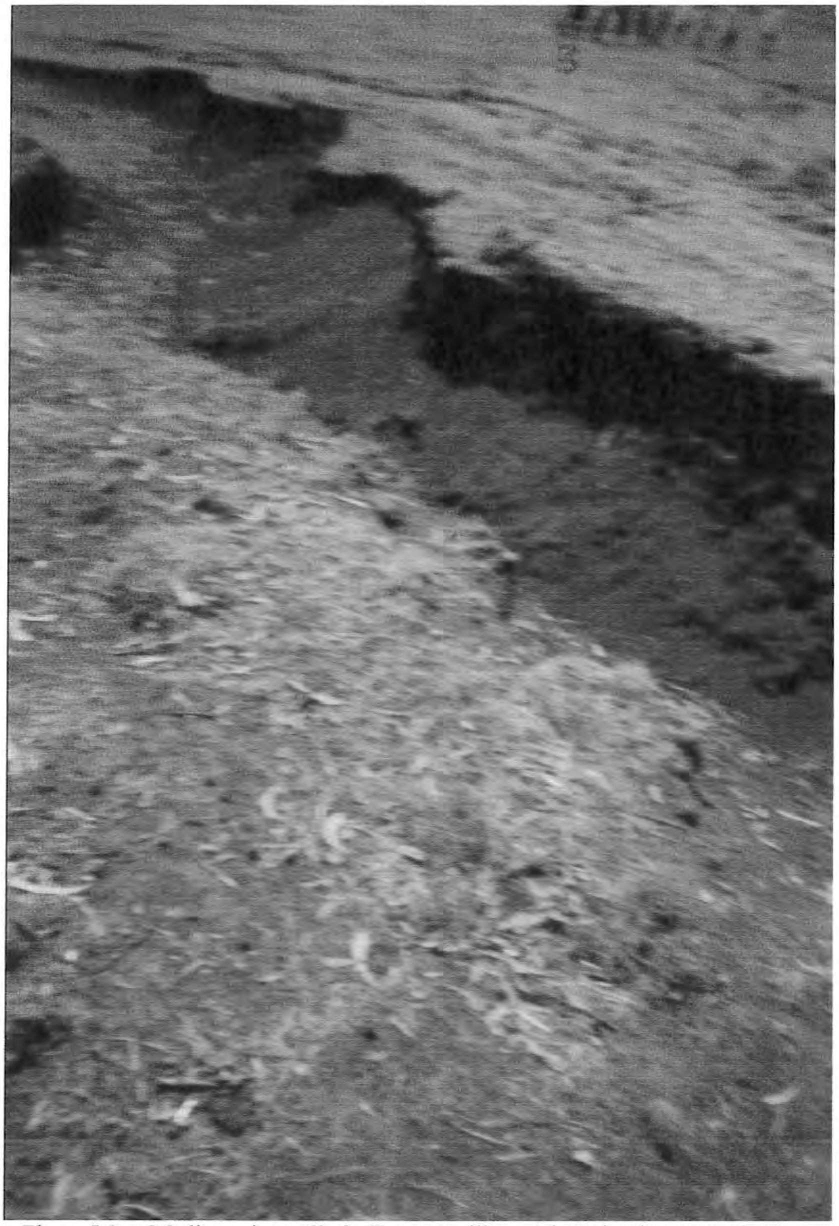

Photo 5.1c: Medium size gully in *Enerata* village (photo by the researcher).

On the other hand, there are some socio-economic and demographic factors that exacerbate soil erosion in the study area. They exert their influence on the farmers' role and decision with regard to land use and land management activities. The major reason which affects the condition of land resource (the prime resource of the farmer) is understood to be population pressure, creating heavy burden on land resource, its management and landholding size.

The influence of population growth in the study area is manifested through frequent land redistributions, excessive deforestation and expansion of croplands to marginal areas and grazing grounds. It is also manifested through over-cultivation of croplands without fallow, diminished agricultural land size, decline in soil fertility and eventually decrease in agricultural productivity.

In this regard, attempts are made to discuss the issue of population growth in the area with an elderly farmer who has been living in the kebele for many years. As a result, the problem has become a serious threat to the existing natural resources, particularly to land. The sixty-seven year old informant explicitly put the problem as follows:

> *Even thirty years before, Enerata kebele was thickly covered with natural for Forests, especially around Mellit, each peasant household had larger farm land with fertile soil resources, adequate pasture land for the cattle. However, now we are left with bare land as you are observing, small-size plots for cultivation, the soil has become infertile due to removal by runoff, no adequate land for cropping leave alone for grazing.*

From the informant, one can easily consider the seriousness of the problem. As population expands, it has high pressure on the natural resources (e.g. land resources). This adversely affects the local environment and the goal of achieving sustainable land management. The rural population of the study area has been growing at an alarming rate especially since the 1980s. There are various socio-economic and cultural reasons for the case. The main factor is the fact that children in the study area are considered as source of socio-economic assets and a means of old-age security.

Poor farmers in the area see their children as sources of social pride. Those farmers who have large number of children in the kebele enjoy high social status by the rural community. The other main reason that was described by the informant is the reason that as the number of children increases, there could be high labor potential to perform agricultural practices in an adequate manner. Currently, the informant himself has nine children. That means, according to him, the labor supply of the family for carryingout agriculture (grazing animals, ploughing, seed bed preparation, sowing, manual weeding, protecting crops from rodents, harvesting and so on) can be practiced more sustainably. To the reverse, most researchers and experts in the field of population study and other social sciences argue that rapid population growth which can not keep pace with economic development, could have a negative effect on land distribution and resources management(Lakew,2000).This may further complicate the poverty situation in a developing country like Ethiopia. This situation has become true for the study area.

The other negative consequence of rapid rural population growth in the study area is reflected through land fragmentation. As a result, the average land holding size of each peasant household has dropped to 0.5 to 1.00 hectare i.e. 2 *'timad* 'to 4 *'timad'* (Gozamen *Woreda* ARD Office, 2007). The pattern is very similar to the situation of the average land holding size of the northern highlands and with that of the national level reality. According to the Central Statistical Authority (CSA, 1995), some 80 percent of the Ethiopian farmers in the highlands (above 1500m a.s.l) cultivate less than one hectare of farm land. The other most important evidence for the land fragmentation in the study area has been the frequent land redistributions made. In addition to small scale land redistributions, two major land-redistributions were implemented in the region in general and in the study kebele in particular. These are the 1970s and the 1997 land redistribution (Lakew, 2000). This has resulted in the fragmentation of farm plots. It has brought a reduction of land size and dispersion of the plots. Moreover, it has also created a sense of land insecurity on the side of farmers. The situation in turn has its own adverse implication on the proper management of land resources including forests, soil and water conservation practices in a sustainable way.

The reality has been further assured from the discussion made with an expert in soil and water conservation who has been working at Gozamen *Woreda* for the last three years. He greatly underlined the 1997 land redistribution by the Amhara National Regional state. According to the expert, the condition has brought attitudinal change on the part of farmers i.e. with regard to their participation and investment in conservation of natural resources such as soils, which have long-run returns.

Moreover, when land holdings are seriously fragmented and dispersed, much time and energy are lost in moving from one plot to another. Reduction of croplands per household and insecurity of land tenure further have led to reduction in agricultural performances. They have also led to reduction of land management practices such as soil and water conservation, afforestation, reafforestation and soil fertility maintenance works (Yerasework, 2000). All of them aggravate the problem of land degradation in the study area.

On the other hand, in connection to rapid rural population growth, there is another reason which significantly contributed for severe soil degradation in the area. That is the expansion of farmers' croplands into environmentally fragile areas with rugged terrain and steep slopes. This is particularly true in the study area where the agricultural system is largely based on demanding more lands for cultivation in opposite to increasing agricultural yield per unit of land just like the remaining high land parts of the region (Lakew, 2000).This situation demands further expansion of croplands into marginal areas of the kebele. The need to further expand crop or grazing lands usually through clearing and burning may exacerbate the problem of soil erosion and soil fertility decline (land degradation). Farmers of the study area clear and burn the remaining minimum vegetation cover and expand their farm land in to the steepest areas. It is the most serious problem in the *Yedem Gan* village where there are hills, steep slopes and river valleys.

Moreover, there has been a wider, old and traditional agricultural practice in the study area. It incorporates clearing, burning and preparing land for cultivation, locally called '*meret makinat*'. This kind of agricultural practice is also widely carriedout in other highlands of Gojjam (Gete and Hurni, 2001). The main aim of such practice in the area is to have access to additional agricultural land for crop cultivation for the rapid expansion of the rural population. This has its own adverse implications on the environmentally fragile areas of the kebele.

The other main cause of soil degradation in the study kebele is the farming system which is predominantly characterized by traditional, rainfed, subsistence agriculture. It is practiced by simple and backward methods of agricultural production, dominated by oxen-plough. This has its own contribution to the problem as traditional farming method largely employees backward technology that further broadens the magnitude of the problem. For example, some cereals like '*teff*' need repeated ploughing and intensive land preparation before sowing, using oxen-plough. Hence, the cropland is left bare with little or no groundcover during the start of the rainy season. The situation has further accelerated the rate of soil erosion. The reason is very clear i.e. the cropland is left even with out grass cover.

5.1.2. Forms of Water Erosion

Different forms of water erosion are observed in agricultural plots of land and in several parts of the study area. For example, rill and gully erosion are the most common forms of erosion clearly observed in several plots of farmers in the kebele. Gullies of various sizes are tangible evidences for the problem particularly in *Yedem Gan, Mellit* and *Enerata* villages. It is mainly due to their rugged terrain and steep slopes. In addition to the rill erosion, many parts of these villages are dominated by large, medium and small size gullies. These gullies are mainly observed around crop fields and grazing grounds.

Therefore, gully erosion is a form of erosion in the kebele causing land degradation at a growing scale. The expansion of gullies has a lot of negative impacts since it involves loss of enormous amount of soil. Indeed, once gullies are formed, the tendency to further 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.

5.2. The Problem of Soil fertility Decline in the Study Area

The problem of soil fertility decline is closely linked to soil erosion by water, 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 infiltrate into the ground (Hurni, 2000). This reduces the productive capacity of the soil to a larger extent.

Soil fertility can be explained in terms of the soil's capacity for long-term productivity, permeability, water retaining ability, drainage capacity, and tillage and manure requirements. It may also include the easiness of the soil for farming (Pimentel et al, 1995). Most of the cultivated plots in the study area are left with poor soil fertility. The most important and tangible evidences are the farmers themselves whose livelihood is more or less totally dependent on soil resources. Accordingly, around 76.9 percent of the farmers' respondents during the survey have confirmed that the natural fertility of the soil on their farmlands is getting depleted (Table 5.2.1). Hence, 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. One of the main reasons is that all forms of water erosion are observed in the area and on farmlands. On the contrary, there were respondents who have replied that the fertility status of their croplands is increasing (18.3%). Such responses could be in connection to the use of artificial fertilizers without considering the natural fertility status of croplands. The response of farmers about the natural fertility situation of their farm plots has been organized from the household survey in Table 5.2.1.

Table 5.2.1. The Response of Farmers on the Fertility Situation of their Farm Plots

Fertility situation	Percentage (%)
Increasing	18.3
Decreasing	76.9
The same as before	3.1
Total	98.3*

Source: Own survey, 2007

As it was further discussed with the development agents, the problem of soil fertility depletion in the area is more severely aggravated by over-cultivation, using animal dung for fuel, shortage of grazing grounds, forest degradation and traditional tillage methods. The issue of decline in the fertility of the cultivated fields of the study area can be more complemented from the discussion held with the seventy one year old informant. According to the informant, around 1960s we were able to produce excess cereals like *teff*, supplying to the nearby urban market, Debre Markos. He indicated that the soil was in good condition (in terms of its fertility) and he didn't use fertilizers on his farm land. However, he has continued to say, at present, farming without the use of fertilizers is unthinkable.

It can, therefore, be generalized that soil fertility is depleted and productivity potential is getting lower in the farm plots of the study area. The other implication is that the problem of soil erosion and the related soil fertility depletion has become more and more serious in the kebele since recent times, in connection to several environmental, socio-economic and demographic factors.

5.3. Farmers Level of Perception on the Problem of Soil Erosion and Soil Fertility Decline

Farmers who are living in the study rural kebele do have their own localized way of naming and characterizing soils of their plots of land. They really have traditional methods of soil category. It is based on their farming experience, knowledge of the local environment, potential of soils for cultivation, color of soils, potential of soils for yields, workability of soils, fertility status, and several other reasons. Thus, farmers categorize and describe soils as *Borebore/Ashalima*, *Merere* and *Chincha*, which can be taken as one manifestation among others that farmers in the area possess traditional knowledge about their immediate local environment (land, water, climate, soil, etc).It has disproved the idea that farmers are ignorant, having little or no knowledge on the local environment in which they live.

Table 5.3.1. Indigenous/Local Soil Categorization Methods, Main Characteristics of Soils in the Study Kebele and Soils` Dominant Location by Village

Soil Characteristics	Soil type and their dominant location in the study area		
	Ashalima/Borebore (Enerata)	*Merere*(Mellit and Yedem-Gan)	*Chincha*(Yedem Gan)
Color	Light red	Partly gray and black	grayish
Soil depth	Shallow	Moderately shallow	Shallow and stony
Fertility status	Infertile/degraded soil	Moderately fertile	Infertile/highly degraded soil
Relief condition	Hilly area	Plateau area	Steep slope

Source: Own Survey, 2007

Farmers of the study area have good perception of the problem of soil erosion. Traditionally, they have local methods of describing the fertility condition of their cultivated fields. For example, for highly eroded and depleted land they call it `*gel-meret*`. Whereas, for less eroded or fertile land they call it `*tinbuko-meret*` or `*yedelebe meret*`. In addition, for farm plots around their homesteads with excessive amounts of animal dung, ash and domestic wastes, they name it as `*keliz meret*`. All of them imply that farmers have better perception regarding soil fertility on farm lands. Attempt has also been made to collect data through the household survey regarding the level of farmers' perception on the problem of soil erosion in the study area. Therefore, asked whether soil erosion is a problem on farm plots of the study area, 91.5 percent of the farmers have acknowledged soil erosion as a problem in almost all of their farm plots. It indicates the level of farmers' perception on the problem. The other implication is that if they are well informed about the problem, it could be easier for the adoption of more appropriate and effective soil and water conservation technologies in the area. Therefore, this is one valuable input towards finding sustainable solution to the problem. Similarly, farmers of the study area also have good perception on the degree or magnitude of the problem. This has become obvious from the survey conducted for the study. The response of farmers on the magnitude of the problem of soil erosion in the area is organized in the table (Table 5.3.2).

Table 5.3.2.The Response of Farmers with regard to the Magnitude of Soil Erosion on Farm Plots in the Study Area

How do you evaluate the magnitude of soil erosion in your farm plots?	Percentage (%)
High /severe	79.2
Medium/ moderately severe	10.5
Low/less severe	3.4
The same as before	1.8
Unknown	0.9
Total	95.8*

Source: Own Survey, 2007

Note: Percentages may not sum up to 100 due to repeated responses.

As it is indicated above, framers were asked whether the magnitude of soil erosion is high, medium or low on their farmlands. Thus, about 79.2 percent of the respondents acknowledged that the magnitude of erosion is high or severe on their lands. This shows the fact that farmers in the area are well aware of the problem of soil erosion. It also shows the severity of the problem. Moreover, during the group discussions, most farmers have pointed out that the main cause of fertility decline in their agricultural lands is that of soil erosion caused by runoff. Framers list out such reasons as over cultivation, absence of practicing fallow (due to diminished land holding size), lack of vegetation cover and shortage of manure or `*fig*` (due to the decrease in the number of livestock and the use of limited manure for fuel consumption). Farmers' perception of soil erosion as a problem for crop production and sustainable agriculture is the most important precondition for the effort in undertaking modern conservation measures in a participatory approach.

The understanding and recognition of soil erosion as a problem, its causes and impact on crop yields could be taken as the first phase towards searching for and adoption of modern conservation measures. Farmers' level of perception of the problem of soil erosion and their need for soil and water conservation measure is crucial. The process of soil erosion is gradual which continues on unnoticed manner and is recognizable only after reaching some threshold levels (Hurni, 1985a). In the study area, farmers are well-informed about the problem and its negative impact on their crop yields.

As Hurni (1985a) 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 can not easily be noticed. Farmers in the study rural kebele seem to have realized that their agricultural lands are being degraded by soil erosion. It has already become a severe problem of agricultural production. Concerning this, farmers were also asked to rate the influence of soil erosion on yields. Therefore, about 81.5 percent of the farmers have responded that soil erosion has negative influence on their agricultural yields (Table5.3.4). For the sake of simple understanding, Table 5.3.4 can best describe the response of farmers regarding the influence of soil erosion on crop yields.

Table 5.3.3. The Response of Farmers on the Influence of Soil Erosion on Crop Yields of the Study Area

What is the influence of soil erosion on your crop yields?	Percentage (%)
Positive	0.4
Negative	81.5
Unknown	14.3
Total	96.2*

Own Survey, 2007

As a result, it can be concluded that soil erosion in the study area has become a threat to boost crop production in order to feed the rapidly growing population. It can also be described that the connection between soil erosion and decline in land productivity has become clear for farmers since recent times This is because, the magnitude of water erosion in the kebele 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 plots. They attributed this to the serous soil degradation on the bare and unprotected lands. In general, farmers in the study area are well aware and informed about the problem of soil erosion and the associated soil fertility decline in their cultivated fields.

The finding also suggests that farmers` perception of soil erosion as a problem in general is a precondition for farmers themselves, development agents, agricultural experts as well as Agricultural research and development centers. It is a necessary condition to design, implement and follow-up appropriate soil and water conservation technologies. After having the awareness coupled with their willingness to adopt soil and water conservation technologies, the capacity of farmers to practically implement them becomes the most crucial issue. This implies that the ability of farmers to adopt soil and water conservation technologies greatly depends on the availability of resources (material, labor supply and financial requirement). These are the determinant factors to successfully launch soil and water conservation measures in the selected study area where 98.6 percent of the farmers are leading themselves through subsistence agriculture (Gozamen *Woreda* ARD Office, 2007).

CHAPTER- VI

6. THE INDIGENOUS LAND MANAGEMENT PRACTICES OF THE STUDY AREA

There are pools of indigenous land management measures that are practiced by farmers in the study area. As it has been attempted to discuss in the conceptual literature section, land management is a broader concept involving a lot of activities which are carried out to protect land from degradation.

Nevertheless, land management in this study is confined to soil and water conservation and soil fertility improvement measures (both indigenous and modern) that are practiced by farmers of the study area. Furthermore, effort has also been made to identify indigenous soil and water conservation and soil fertility improvement measures implemented in the area.

In the highlands of Gojjam particularly in the study area, there are indigenous land management practices. These practices have adapted themselves to the existing local, environmental, socio-economic and cultural settings. Accordingly, two major approaches (levels) of implementing indigenous land management practices have been identified. These are individual household level land management practices and group level land management practices.

a/ Individual Household Level Indigenous Land Management Practices

The individual household land management practices of farmers in the area are those practices that are managed by a single peasant household including the family labor. The main targets of such practices are to increase agricultural yields and to conserve the natural environment. For example, soil, water, land, etc. Thus, the practices are production as well as protection-oriented. Based on the data collected during the household survey (from the farmers) and data collected during the informant interviewing (from development agents), it has been established that most of the farmers have dispersed farm plots in different areas of the kebele i.e., far away from homesteads. They have several bio-physical characteristics like relief, soil, vegetation, and so on. As a result, each individual farm plot has its own specific opportunities and problems. Therefore, each farmer makes different decisions and adopts various land management strategies for the implementation of indigenous measures. This depends on the physical reality prevailing in crop fields and agricultural lands such as type of soil, type of slope or relief condition, vegetation cover etc. The individual household level land management practices are partly soil and water conservation and partly soil fertility improvement measures which in one way or the other are interrelated to each other.

As it has been discussed with farmers and complemented by the development agents, traditional ditches (*`feses`*) are one of the most important traditional or indigenous soil and water conservation practices of farmers. They are performed by all individual peasant households. Other traditional land management measures include manuring through animal parking (for nearby farm plots), crop rotation, cultivating Lupines lupine *(`gibto`)*, contour ploughing, (*`agdime marese`*), manuring (*`figmafises`*) and constructing traditional vegetative fences (hedgerows).

b/ Group Level Indigenous Land Management Practices

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 croplands. Different peasant households usually own the croplands. These indigenous land management measures are mainly conservation-oriented that are implemented on the basis of the common understanding of neighborhood cropland owners in the kebele. Such measures include un-ploughed grass-strips (*dinber*), traditional waterways (*`bahilawi boyi`),* traditional check dams (*`bahilawi kitir'*), traditional cutoff drains (*trass boyi*, also known as *`tekebekeb`),* traditional stone terraces (*`bahilawi yedingay erken`*), and manuring through animal parking by constructing temporary kraal (locally known as *chichet* or *hura`*).

As it has been indicated by the sixty-seven year elderly farmer and further supplemented by the development agents, the main purpose of implementing indigenous land management measures in group is to mobilize sufficient labor. This enables to overcome challenging conditions in adopting the measures and minimize conflict risks among different landowners while constructing the measures. The implication is that farmers have tremendous labor potential and motivation to carryout land management practices, particularly soil and water conservation in a coordinated manner. This could be taken as one valuable social asset of farmers of the study area.

6.1. Indigenous Soil and Water Conservation Practices of the Study Area

In the study area, farmers have been practicing various indigenous soils and water conservation measures. Most of these practices are structural, vegetative and some times biological or agronomic. The classification of indigenous soil and water conservation measures into structural, vegetative and agronomic or biological is arbitrary (Yohannes, 1999) since they are not mutually exclusive. In other words, they overlap and complement to each other. For example, contour ploughing is structural, agronomic and it is also vegetated.

Hence, the classification has been used to facilitate the discussion and analysis in a systematic manner. These practices of farmers in the area are the result of a gradual learning process and emerged from a knowledge base, accumulated by farmers, through observation and informal experimentation. It is a process of handing down generations of their experience. They are also shaped by the local conditions and are thus modified to the changing socio-economic and ecological factors (Kruger et al, 1996).

I. Physical/Structural Indigenous SWC Practices

a/ Traditional Ditches (*'feses boyi'*)

Traditional ditches (*'feses'*) are the most extensively practiced structural soil and water conservation measures in the area. The process of constructing these measures is locally known as *'feses-mekeded'*. All farmers in the area practice traditional ditches in almost all of their farm plots on individual household level. The structures are established with the help of oxen-plough deep into the ground. It implies that traditional ditches (*'feses'*) are prepared deeper than the normal furrows (structures created on the farm plot with the help of iron-plough or '*maresha*' during ploughing). This kind of practice has been used by farmers since longer times. During the group discussions, it has been identified that they have been implementing this traditional conservation method widely on their farm plots to minimize the problem of seed loss after sowing. It is particularly true for fine seeds like '*teff*'. In addition, it also minimizes water logging problem as well as soil erosion. The discussion was more clarified while observing the ditches ('*feses*') in a participatory transect walk.

During the field-observation, it was discussed that these structures are usually built when the land is being prepared for sowing. They are implemented from March to May, commonly known as '*belg*' and at the beginning of the rainy season every year. These measures are constructed using iron-plough ('*maresha*') which is pulled by oxen during land preparation for cultivation. They are established using a household labor, which in other words means that they do not demand much labor and cost.

It was also confirmed during the interview held with the development agent that the practice of the ditches *('feses')* differ from farmer to farmer, farm plot to farm plot, crop type to crop type and from slope type to slope type. That means, they differ in terms of gradient, spacing, depth, width, number and sometimes function. Typical evidence which indicates this fact is the practice of the measures varies from village to village depending upon the physical realities at the farm level. For example, in the group discussions, farmers underlined the fact that the width and depth of the ditches vary from cropland, to cropland based on soil depth and slope type or topographic conditions.

The discussion was supplemented by the *woreda* soil and water conservation experts. They said that the spacing between the structures depends to a larger extent on the steepness of the slope (gradient) under ploughing. In other words, farm plots located around steeper slopes have more number of ditches than those plots located at gentler slopes. The implication is that the number and spacing of ditches is determined by the topography of the area. Accordingly, these structures vary in function, spacing, number, etc. in the two villages of *Mellit* and *Yedem Gan* and in other villages like

Enerata, Yebragie and *Yeya* as they differ in the type of slope they have. Furthermore, the length and /or width of the ditches are more or less proportional to the length and /or width of the croplands. It also implies that the conservation structures extend from one side of the plot to the other which farmers locally describe it as '*gezem eske gezem*'.

b/ Traditional Waterways ('*Bahilawi Boyi*')

In the study kebele, group of two or more farmers who possess neighbor farm plots, prepare waterways at the top of the slope in a traditional way. It looks like cutoff drains but, it relatively covers wider area at the top of a hillside to drain runoff coming from any direction to the nearest riverbank. It is a common practice in the area to protect crop fields from being damaged by powerful run-off that comes from certain direction. From the discussion, it has been generalized that farmers from *Mellit* and *Yedem Gan* have long years of experience in preparing the waterways.

Here, it is practiced due to the relative steepness of the villages and for the reason that most farm plots are located around steeper slopes or surrounded by the near-by steep slope. The structures are constructed mainly by neighborhood peasant households who own neighbor farm plots with the family labor as an input or by the farmers in group in the form of campaign. In the group discussions, farmers also emphasized the advantage of working in groups so that the constructed structure can serve for at least one cropping season. By doing so, they protect their farm plots from the damaging effect of runoff.

Like the traditional ditches ('*feses*'), traditional water ways (`*bahilawi boy*i`) do also vary in length, width, depth and gradient of the waterways, which greatly depends on the type of slope in which the farm plot is located. Therefore, farmers in the area have developed their own traditional method of diverting the direction of runoff into riversides and valleys to protect their farm plots from damage.

c/ Traditional Cut-off Drains (*'tekebekeb'* or *'trass boy'*)

It is another most important structural indigenous soil and water conservation measure, which is practiced by the farmers in the study area. In the discussions, farmers were asked on how to construct the structure. They said that the structure is constructed across the traditional waterways which are prepared on farm plots parallel to the slope. The idea is to change the flow of powerful runoff coming from one known direction at the top of the farm plot. Because of this, farmers describe the structure as traditional cutoff drain or *'bahilawi yewuha mekelbesha'*. The structure is constructed at the top of farm plots. Hence, farmers call it locally as *'trass boy'* or *'tekebekeb'* (Group Discussions with Farmers).Generally speaking, the name *'trasboyi'* implies to the ditch constructed along one side of the plot commonly at the top of the plot parallel to the slope. It is particularly true for those plots of land which are threatened by strong runoff.

In the discussion, farmers have also put the point that the preparation of the structure greatly demands high labor-input. Therefore, it is practiced by group of peasant households with their families sometimes being involved in the work. The structure is production as well as conservation–oriented. Farmers have the intension of avoiding seed loss, i.e. to increase yield per unit area (production-oriented) and to conserve soil from the erosive power of runoff (protection-oriented). Farmers of all villages whose farmlands are threatened by runoff do practice this traditional soil and water conservation method.

d/ Traditional Check Dams (*`Bahilawi Kitir`*)

Farmers of the study area mobilize their local resources (materials, time and labor) to construct traditional type of dams to halt the expansion of gullies. The dams are constructed in areas where gullies are widely observed. They are practiced by the rural community during the dry season commonly known as *'bega`* after the harvesting season. One of the informants, the chairman of the kebele, pointed out that farmers have good motivation to work together in the construction and maintenance of traditional check dams in areas where gullies are observed. The main objective is to rehabilitate gullies formed by powerful runoff either around farm plots or far away from plots anywhere in the kebele.

During the focus-group discussions, farmers from *Mellit* have also confirmed their courage to construct the structures in the form of campaign. The reason is that there are several gullies that are observed in the village. It implies that their perception on soil erosion as well as soil fertility decline has been showing a remarkable progress. It may also reveal the magnitude of the problem of water erosion in their village. Moreover, to stabilize the gullies and increase the sustainability of the dams, farmers used to grow vegetations with multi-functions. Example, animal fodder, additional sources of income, etc. Such vegetations involve Alpha-Alpha, Sesbania Sesban, Akacha Saligina, Grevillea Robusta, *Aroundinaria* or '*Shembeko*', Eucalyptus, and the like. In the field observation, one of the largest gullies which have become rehabilitated by farmers with the help of traditional check dam was demonstrated. In this regard, a good example is '*Goshu-Gedel'* (*Mellit* village).

e/ Stone Terraces (`*bahilawi yedingay erken*`)

Stone terraces are constructed in areas where construction material (stone) is available. It is soil and water conservation practice in a few plots of '*Yedem Gan'* village of the study kebele. The construction of stone terracing is labor demanding. Therefore, farmers of the area construct the structure in groups mainly during the dry season or '*bega*'. This is because during this time farmers have relatively more free time to work in groups along with their families. These structures are not widely practiced by farmers of the study area. The most practical reason obtained from the farmers themselves during the discussion has been the problem of the availability of larger stones around their locality. The other reason was the labor-intensive nature for the construction and maintenance of the structure.

f/ Contour Ploughing ('*agdime marese'*)

The other traditional soil and water conservation measure which is widely used by farmers in the kebele, in almost all villages is what is known as contour-ploughing ('*agdime marese'*).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 (*'maresha'*). As it was discussed with the *woreda* expert, the furrows that are formed along contours function to retain (hold) the water until it 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.

Nevertheless, *'agdime-marese'* is also effective in areas where there are no long steeper slopes and in areas where there is no much intensive rain. However, it has been generalized from the experts that contour furrows are finally destroyed when land is ploughed for the last time. It happens during the seed-bed preparation or soil trampling locally known as *'beray'* for sowing very fine-seeds like *'teff'*.

g/ Soil Trampling (*'beray'*)

It is again another traditional practice of compacting the farm plot by using large number of livestock. The major intension is not directly to protect the soil (it is production-oriented). The purpose behind is to prepare the seedbeds for sowing i.e. to protect the seeds from removal. This is practiced for sowing fine seeds like *'teff'*. However, it has also been found out from the discussion with the development agents that such kind of practice may contribute to conserve the topsoil from removal. Farmers practice soil trampling (*'beray'*) in groups assisted by more livestock during land preparation for sowing. It is particularly true for *teff* in the heavy rainy months of July and August locally known as *'leqow'*. Soil trampling has also another adverse implication. It potentially reduces the water percolation capacity of the soil which again affects the underground water resource of the area. It may even aggravate runoff erosion on farm plots.

II- Vegetative Indigenous SWC Practices

a/ Un-ploughed Grass Strips (Border Strips or *'dinber'*)

It is a common conservation practice of farmers in the area. This is a relatively longer strip of grass that extends from one border of the plot to the other. As it has become clear in the farmers` group discussion, the strips serve dual-functions i.e. serve as boundary between different farm plots owned by different farmers and also serve to reduce the effect of the intensity of rain. Hence, it protects the soil from erosion or reduces the magnitude of runoff-erosion. Farmers also traditionally leave piece of grass lands inside their plots while ploughing which in turn helps to reduce the effect of erosion by intensive rain.

It is implemented during land-ploughing and mainly it is the responsibility of men. But, later on, women also actively participate in the maintenance work by adding removed-weeds like grasses to the strip (*'dinber'*) i.e. removed from the farm plots. Locally, it is known as *'gulegualo'*. The development agent greatly underlined the fact that the structure is clearly marked by different landowners to minimize conflicts arising from land disputes. Hence, it is implemented in groups. It implies that farmers have the tendency to avoid conflicts due to the unclear farm borders.

b/ Traditional Vegetative Fences (Hedgerows)

In the study area, farmers most commonly construct a row of small trees forming a hedge around their farm plots to protect the land from torrential and stormy rain. In the group discussions, farmers were asked the type of vegetation use to grow to form rows surrounding their plots of land. Accordingly, they described that most of the vegetations use to grow are those plants that provide farmers with multiple-benefits and functions. They include Alpha-Alpha, Akacha Saligna, Grevillea Robusta, Pigeon-pea (*'yergibater'*), Eucalyptus, etc. They can be used as source of food, fuel wood, animal fodder, additional source of income, etc.

Hedgerows are constructed around farmlands by individual peasant households some times together with family labor. Such kind of vegetative conservation measure has multiple-benefits. First, it minimizes the degree of soil erosion on the plots. Secondly, the vegetation grown can have additional benefits. Thirdly, trees like the one mentioned above are shallow rooted with nodules. Therefore, they have the capacity to improve the nitrate content of croplands. Lastly, the vegetation cover may have a moderating-effect on the local climatic condition. The soil and water conservation expert has further underlined the role of the measure. The expert has said that hedgerows are planted and maintained by the farmers themselves with low cost and minimum labor input. Therefore, they are widely implemented by farmers in the study area.

III/ Agronomic Indigenous SWC Practices

6.2. Indigenous Soil Fertility Improvement Practices

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 traditional methods of up-grading or improving the fertility conditions of the soils on croplands. This is in addition to the various soil and water conservation measures which in one way or another are also soil fertility improvement measures. 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.

a/ Manuring through Animal Parking (*chichet'* or *'hura'*)

Manure is used to be important input for promoting the fertility status of the soil. It is practiced in the area through animal parking, locally known as *'chichet* or *'hura`*. The practice involves the process of keeping large number of livestock overnights by constructing temporary kraal (*'beret'*). Here, farmers keep livestock animals such as cattle the whole night in-groups so that farm plots receive dung as manure to improve the fertility condition of the soils. It is practiced by farmers in rotation in order to cover farmlands in the village before the start of the rainy season.

Today, this kind of practice has been declining in the area. According to the farmers` discussion, one possible reason is the decrease in the number of livestock per household by selling and the other is the theft situation, i.e. cattle are being stolen in the night from the temporary kraal. These two main reasons forced farmers to keep live stock animals around individual farmer's homestead. This may adversely affect the process of maintaining the fertility of farm plots located for away from homesteads.

b/ Farmyard Manuring (*'figmafises'*)

Manuring *('fig mafises'*) raises the nutrient level of the soil, increases infiltration and reduces soil erosion (Yohannes and Herweg, 2000).Currently, farmers in the study area use only limited amounts of manure (*'fig'*). In other words, cow dung manuring on farmlands has been decreasing from time to time as the number of livestock per household has been decreasing significantly for various reasons. The other contributing factor is the fragmentation of farm plots (farm plots are located dispersed far-apart) that makes the transporting of the manure to farmlands more difficult. Because, it requires much labor and time (Discussion with the Seventy-One year Old Informant).

The other factor confirmed by the elderly informant is the use of cattle dung as source of fuel for cooking. It implies that farmers burn dried cattle dung as source of energy and sometimes for market for the urban areas in the form of dung cake instead of using it as organic-fertilizers. There is also widespread shortage of fuel wood in the area resulted from the bareness or minimum vegetation cover of the area.

Nevertheless, from the informants' discussions (elderly farmer and development agent), it may be inferred that manuring (*'figmafises'*) improves the fertility of soils. Farmers have also pointed out the fact that *'keliz-meret'* means land with higher amount of manure *('fig')* in the soil. On the contrary, *'yetebela-meret'*, means land whose nutrient is depleted and lacking sufficient amount of manure in the soils. The implication is that when much manure is added into the soil, it increases the fertility status of the soil. It also increases the capacity of the land to infiltrate water into the ground. That means it eventually reduces the effect of soil erosion. Besides, it indicates farmers' level of awareness on fertility status of their croplands.

c/ Cultivating Lupines lupine (``*gibto*`)

Lupines lupine (*'gibto'*) is a leguminous crop which is extensively cultivated in the study area. From the household survey, it has been sorted out that farmers of all villages traditionally cultivate '*gibto*' when the productive potential of a given farmland declines. It is a kind of practice that provides farmers with multiple benefits (Communication with the Development Agent). In the first place, cropping '*gibto*' does not demand repeated-ploughing and land-preparation unlike other cereals such as *'teff'*. Secondly, it can easily fix nitrogen from the air into the soil because '*gibto*' is a leguminous plant having root nodules. Thus, it has the potential to improve the fertility of the soil (nitrate) and thirdly, it is the source of food to the farmer and his family.

In addition, it has also been discussed with the development agent that cropping '*gibto*' benefits the family by generating extra-income. It is supplied to the nearby market for food. Moreover, women sometimes process alcoholic drink from '*gibto*' which is locally known as '*yegibto areke* or '*katikala'*. It again helps to generate further income for the household. In general, Lupines lupine ('*gibto*') provides farmers of the area with multiple benefits. However, the main benefit is its capacity to improve the fertility condition of crop lands. Hence, it is one of the most important indigenous practices of farmers in the area.

d/ Crop-Rotation

As it has been inferred from the survey, crop-rotation is one of the most important traditional methods of improving soil fertility as well as conserving soils on cultivated fields. 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 (Belay, 1998). Farmers are traditionally well aware of the fact that rotating crops can improve the productivity potential of their lands. The *woreda* experts also share with this idea and say that different crops require different nutrients both in amount of intake and type.

Moreover, crop rotation has the capacity to improve the fertility status of the soil so as to resist to pest and plant disease (Yohannes et al, 2000). 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 cereals, oilseeds and less commonly legumes. For example: cereal to cereal (wheat-*Avena Fatua* or *Engido-`teff'*) or cereal to oilseeds (barely-*'teff'*–nigger/*nug*) or cereal to legumes (wheat-*'teff'*-Lupines lupine or *'gibto'*), and so on.

Traditionally, farmers practice this system on their croplands. However, they have failed to provide proper justification for their practice. They are also knowledge-able about the relationship between crops and soil types. The evidence is that farmers during the discussion have indicated the idea that some types of crops greatly affect the soils of their plots which in turn affect the potential of the soils to grow certain types of crops. It implies that farmers in the study area have the awareness on the fact that some crops use certain kind of mineral nutrients in the soil to a larger extent while others do not.

e/ Weed Heaping (`*Maklez*`)

In the study kebele, farmers add weeds such as grasses which are removed from different lands into their croplands. The intension is to enrich the fertility of the soils in the plots of land. As a result, the removed weeds and grasses are decomposed in the soil. Thus, they improve the humus content of the croplands. Nevertheless, discussion with farmers reveals that this traditional soil improvement practice is applied in few areas of the villages where there is grazing ground (e.g. in some parts of *Mellit*, *Yebragie* and *Yeya*). In others, it is not widely practiced since most of the removed weeds and grasses are used as fodder for animals. The important lesson to be drawn here is the shortage of grazing lands in the study area since grazing lands have already been turned into croplands. It is because of population pressure and its adverse implication on the local environment.

CHAPTER-VII

7. THE MODERN LAND MANAGEMENT PRACTICES OF THE STUDY AREA

In this section of the study, modern land management measures which have been introduced to the study area are identified. In the process of identifying the widely applied modern land management technologies, different data generating tools have been employed.

7.1. The Modern Soil and Water Conservation Practices

The modern soil and water conservation practices are those measures that are conventional and interventional. They are newly introduced conservation technologies through researchers, experts, scholars, policy makers, and so on. In addition, they are measures that are related to natural resource management (Kruger et al, 1996). Traditional soil and water conservation practices were used and still being used in the area for many generations. However, most of the modern soil and water conservation measures have been introduced recently. This has been confirmed from the discussion conducted with the seventy-one year old informant. According to him, modern soil and water conservation technologies have been introduced and practically implemented to the area in not more than 25 years before i.e. around the early1980s. They have relatively shorter ages as compared to the generations of traditional farming experiences of the indigenous land management practices. The coverage, implementation and adaptability of indigenous soil and water conservation practices in the area are in better status than that of modern conservation measures.

There are different conventional soil and water conservation measures which are widely implemented in the study kebele. These include artificial water ways or drainage ways, modern cut-off drains or diversion ditches, modern check dams and soil and *fanya juu* bunds. Others include area closure and modern agro-forestry practices. The measures were introduced into the area with the advice and support of trained personnel at different level in the field concerned. They were introduced though a process known as `top-down approach of technology transfer`. Example, trained personnel in soil and water conservation at regional, *woreda* and kebele levels of administration.

a/ Artificial Water Ways (Drainage Ways)

These are man-made channels used to collect run-off from hill slopes, cut-off drains and soil and *fanya juu* bunds. It diverts the run-off safely into natural drainage systems where it can empty into streams or rivers. According to the development agent, the water ways are more or less similar with the traditional water ways (`*bahilawi boyi*`).However, artificial water-ways possess sufficient dimensions to transport excessive runoff generated during the rainy months of June, July and August. In addition, the water ways or channels need to be stabilized by planting vegetation like grasses or need to be paved with wider stones so as to protect the expansion in to gullies.

Farmers in the study area have the tendency of constructing one big water way instead of constructing several small water ways. The main reason as it was explained by the development agent has been that they have the intension to save space for cultivation. The structure is practiced in many of the farm plots of the study area.

b/ Modern Cut-off Drains (Diversion Ditches)

The modern cut-off drains are open and graded diversion channels with a supporting embankment on their down slope position (Woldeamlak, 2003). They are constructed in a similar way as the traditional cut-off drains ('*tekebekeb*').These structures are constructed across the slope to divert runoff coming from the upper part of the slope which is finally transmitted into the natural or artificial water ways. Therefore, the purpose of the embankment in the lower part of the slope is to protect runoff which overflows the ditch so as to protect the cultivated fields down the slope from damage. The important lesson to be learnt here is that there is a similarity in the design and implementation of both traditional and modern cutoff drains. It may assist to introduce a better conservation technology.

The modern cut-off drains have been practically more observable in '*Mellit*' and '*Yedem Gan*' villages as they have steeper slopes than the others. During the field-observation, it was demonstrated that most cultivated fields in the villages are located down the slope. As a result, they are seriously exposed to run-off coming from up the slope.

The structures have more sustainability compared to the traditional cut-off drains ('*tekebekeb*'), which are constructed mainly for one cropping season. The most important reason provided by the experts has been the reality that these structures adopt improved methods in their design in terms of outlet, gradient, spacing, direction, etc. The modern cut-off drains are used to protect cultivated fields or croplands from excessively powerful runoff and to divert water away from gully heads. Hence, it is intended to protect croplands against runoff from the adjoining uncultivated land. Besides, it also serves as a boundary between cultivated and uncultivated lands.

A discussion held with the development agents also indicate that farmers particularly in '*Mellit*' and '*Yedem Gan*' prefer the structures since they are similar with the traditional measures in their function. In addition, the two villages have more plots of land which are located around steep slopes than other villages in the area.

c/ Modern Check Dams

Gully erosion is a serious form of erosion in the study area, especially around villages like '*Mellit*', '*Yedem Gan*' and some parts of '*Enerata*'. There are big unsustained gullies created as a result of powerful runoff coming from up the slope. So, in order to minimize the severity of the problem and rehabilitate the gullies, modern check dams have been constructed in '*Mellit*', '*Yedem Gan*' and '*Enerata*' villages.

In the interview conducted with the development agent, it has become obvious that the structures are built across gullies to provide structural barrier for the flowing runoff. They are also built to assist and initiate the process of sedimentation. This implies that check dams encourage the growth of vegetation in the gully-floor providing protection against further erosion and stabilizing the gully itself. Like other measures, modern check dams are more or less similar to the traditional ones. But, in the case of the modern measures, the length and dimension of the check-dam greatly depends on the size of the gully e.g. the width of the gully to be checked or rehabilitated which again depends on the slope of the area and the amount of runoff generated during raining (Woldeamlak, 2003). On the contrary, traditional check dams do not take all these points in to consideration. They are simply constructed by farmers alone with the help of locally available resources. Moreover, the construction and maintenance of modern check dams are closely assisted by the experts and developments.

On the other hand, the participation of farmers in the construction and maintenance of big scale check dams has not been encouraging. The basic reason according to the development agent is that the process of constructing, maintaining as well as stabilizing the gully requires huge labor and much time. Farmers sometimes prefer short-term benefiting activities. Nevertheless, efforts have been exerted to mobilize resources with the support of governmental offices such as the *Woreda* Agriculture Rural Development Office. Effort is also being underway to increase the level of farmers' perception of the long term benefits of such structural conservation measures.

(Photo 7.1a): A modern check dam in *Mellit* village (Photo: By the researcher)

d/ Soil Bunds

As it is defined in Woldeamlak (2003), modern soil bunds are earth embankments, constructed across the slope with the ditch on their upslope side and the earth material excavated thrown down the slope. They have more or less similar function with that of the *fanya juu* bunds i.e. they slow down the velocity of runoff by reducing slope gradient so as to reduce the erosive power of the run off. However, soil bunds differ in the way they are constructed. In addition, *fanya juu* bunds are commonly practiced in gentler slopes with lower gradient unlike soil bunds which can be applied more or less in all slope types with soils of less stony character.

In the study area soil bunds are widely implemented in villages like *Enerata, Mellit, Yedem Gan*, *Yebragie* and *Yeya*. One of the development agents, explained about the labor requirement of soil bunds. Consequently, soil bunds demand less labor as compared to the labor intensiveness of other modern conservation structures such as *fanya juu bunds*. But, they are less effective than other bunds e.g. stone bunds and *fanya juu* bunds. The most important reason is that they can easily be damaged by powerful runoff. In the discussion with the expert, it was also stressed on the idea that soil bunds can serve better if they are stabilized by vegetations like grass.

e/ *Fanya Juu* Bunds (Converse Bunds)

Fanya juu bund is a structural type of soil and water conservation measure adopted from Kenya (in Swahili, *fanya* means `throw` while *juu* means 'up'). Hence, it means 'throwing up the slope' in contrary to 'throwing down the slope' in the modern soil bund construction) (Lakew, 2000). Therefore, these structures are made by digging a ditch and throwing the excavated earth material up the slope to form embankment (Woldeamlak, 2003). As a result of this, up the slope, the embankment functions as a barrier to runoff by providing storage space for soil sediments and nutrients.

A further discussion with the expert has also indicated that the main function of these structures is to break slope length and angle. Thus, when the slope length is shortened the slope gradient is minimized. Therefore, there will be an opportunity to slowdown the rate of runoff. It consequently reduces the erosive power of the runoff. In the discussion, it was also pointed out that *fanya juu* bunds are the most preferred modern soil and water conservation structures by farmers of *Enerata*, *Yeya* and *Yebragie.* The fundamental reason for their preference is that they are more effective in conserving the soil and moisture compared to other modern structures. In addition, the villages are physically located around gentler slopes that are relatively more appropriate for the construction of the bunds than other villages.

Moreover, *fanya juu* bunds are planted with vegetations like grass to increase their sustainability. According to the experts, the bunds are very effective in conserving moisture and plant-nutrients and they are more applicable in areas where the soils are shallow for level bench terracing and in moderately steeply slopes. The implication is that farm plots which are found around plain area with shallow soils are more suitable for the construction of *fanya juu* bunds than those of steeply slope area with stony soils.

f/ Area Closure

Farmers in the study area have adopted conservation measures to protect gullies on which check dams are constructed so as to stabilize the gullies sustainably. One of such measures which are widely implemented in the area is area closure. It also involves the reservation of ecologically fragile areas such as steep slopes and gullies from human and animal intervention. In villages like *Yedem Gan, Mellit* and *Enerata* where large and medium gullies are observed, this measure has become a remedy to halt the enlargement of gullies and stabilize them properly.

It was learnt from the discussion of the development agents that the measure is more effective when the fragile area e.g. gullies are fenced by locally available materials and by vegetations of multiple benefits e.g. grass, trees etc. The main intension is to prohibit human and animal intervention into the fragile area. The lesson learnt here is the lesser the intervention into the ecologically fragile environments, the lesser the degree of environmental degradation i.e. the higher the opportunity for the environment to be protected.

g/ Agro-Forestry Practices

Agro-forestry is practiced in the study area to stabilize structural soil and water conservation measures like check dams, ditches, water ways, soil bunds, *fanya juu* bunds, etc. It has also the purpose of rehabilitating the ecologically degraded as well as deforested environments.

This kind of practice includes the process of transplanting seedlings into bare lands and degraded areas to cover them with variety of indigenous and other trees. It also includes the practice of planting and management of trees in crop and/or pasture lands to generate economic and/or ecological benefits. Hence, it has been widely implemented by the farmers at both household level as well as group level. Therefore, it has been showing fruitful results in the conservation of the environment of the study area (Communication with the *Woreda* Experts). Moreover, close support and follow-up is also provided by the experts in conjunction with the development agents though their number is not sufficient to cover all villages in the kebele.

7.2. The Modern Soil Fertility Improvement Measures of the Study Area

a/ Artificial Fertilizers

Farmers of the study area widely apply chemical fertilizers on their cultivated plots of lands. They have also positive attitude towards the use of artificial fertilizers. This has become true from the household survey confirming that around 93.3 percent of farmers of the area use chemical fertilizers in their plots (Table 7.2.1). In addition, they practice traditional soil fertility improvement measures such as manuring (*'figmafises'*), crop rotation and so on.

Table 7.2.1. The Response of Farmers on the Application of Artificial Fertilizers on their Crop Lands

Are you currently applying fertilizers on your farm plots?	Percentage (%)
Yes	93.3
No	4.1
Un known	0.9
Total	98.3*

Source: Own survey, 2007

Table 7.2.2. The Response of Farmers on the Mechanisms of Obtaining Artificial Fertilizers

How do you obtain the artificial fertilizers?	Percentage (%)
On cash basis	24.6
On credit basis	68.7
Unknown	2.1
Total	95.4*

Source: Own survey, 2007

Table 7.2.3. The Response of Farmers on the Adequacy of Using Fertilizers on Farm Plots.

Do you think that using fertilizer alone is enough to improve soil fertility on your farm plots?	Percentage (%)
Yes	21.3
No	71.9
Unknown	3.5
Total	96.7*

Source: Own survey, 2007

From the survey, it has also been learnt that farmers obtain fertilizers either on credit-basis (68.7 percent of the peasant households) or on cash basis (24.6 percent) (Table7.2.2). However, they raised the issue of the price of fertilizer which has been consistently increasing since the 1990s. The development agents also have stressed the price increase of fertilizer. It has become economically unaffordable to most subsistent farmers of the area. Some farmers try to generate income by seasonally migrating into the commercial farm centers like Humera and Dansha (border areas of Gondar and Tigray) to work as daily laborers. The money generated in this way is used to repay debts of fertilizers. Those who are able to afford to have the fertilizer on cash basis have obtained the money from the sale of the grain, livestock, poultry, bee hives, etc.

It is the result of the adverse impact of the high price of fertilizers on the livelihood of farmers of the study area. On the other hand, around 71.9 percent of the respondents have indicated that using fertilizers alone is not sufficient to sustainably maintain soil fertility on crop lands (Table 7.2.3). In other words, farmers of the area have indicated the contribution of indigenous soil fertility improvement practices e.g. cropping Lupines lupine or *gibto* in combination with modern fertility enhancement measures like artificial fertilizers. Those who have responded `yes` (21.3%) could be due to the fact that either they have wide access to use fertilizers or have additional sources of livelihood besides the crop farming.

Development agents have also pointed out that DAP and Urea are the two most important types of modern fertilizers. They are extensively applied by farmers of the kebele. To minimize the price effect, farmers have proposed alternative solutions to the problem i.e. the use of compost on croplands instead of totally depending on fertilizers parallel to the use of traditional soil fertility improvement practice. Compost is a kind of manure which has been recently introduced to the area. It is a modified soil fertility improvement technology.

b/ Compost

Compost is the other modern soil fertility improvement measure introduced to the area. It has gaining more acceptances on the side of farmers. The preparation of compost involves the use of ash, leaves, grasses, cow dung, etc. Basically, there are two ways of preparation (this is on the basis of whether the compost is prepared on the surface or in the ground). Compost prepared on the surface is termed as 'heap'. The other which is prepared inside the ground by digging a hole is termed as 'pit' (communication with the *Woreda* Expert). The difference lies in the place where it is processed and the amount of sunshine it receives. In the '*dega'* agro-climatic areas, heap is a common way of compost preparation. But, in '*Woinadega'* and '*Kolla'* areas, 'pit' are commonly used since it is processed with in short period of time (around 3 months). Therefore, pit is a widely practiced method of preparing compost in the study area. In the study kebele, this measure has been introduced very recently. However, in spite of its recentness, it has been widely adopted by farmers due to the relatively lower cost of the inputs. Example, lower labor and material costs.

Discussion with the seventy-one year old key informant also further strengthens the idea that farmers have keen interest to prepare and apply compost. But, the major constraint which was raised in the discussion was the shortage of animal dung since the largest portion of it is used as source of fuel. Moreover, sometimes dung-cakes are also prepared for sale to the near-by urban areas. The same issue was raised in the sixth chapter with regard to the use of manure on crop lands. Therefore, it can be concluded that compost as part of manure has got wider acceptance on the side farmers of the of the study area. It has been playing an important role in improving the fertility level of crop lands which eventually helps to increase crop productivity.

In general, the introduction and implementation of modern land management measures in the study area has brought a change in the livelihood of significant number of farmers. It is particularly true in the intervention of modern physical soil and water conservation measures like modern check dams, diversion channels, etc. The same thing is true for soil enhancement measures such as the application of fertilizers on croplands. However, if these measures are properly adapted to the prevailing local conditions and if they are well integrated with the farmers' traditional land management knowledge, it may bring more meaningful changes on the living conditions of the farmers of the study area.

CHAPTER-VIII

8. THE STRENGTH AND LIMITATION OF INDIGENOUS AND MODERN LAND MANAGEMENT PRACTICES OF THE STUDY AREA.

In this part of the thesis, focus has been given on assessing the strength and limitation (problem) of both indigenous as well as modern land management practices. In other words, the indigenous land management practices of farmers i.e. soil and water conservation and soil fertility improvement practices do have their own positive-sides (strengths) and negative-sides (limitations) when they are assessed by different people at various levels. Example: by the experts, development agents and by the farmers themselves. So, in the following section, attempt has been made to consider the strength of indigenous and modern or conventional measures. On the contrary, the limitations of indigenous and modern land management measures have also been considered. For this purpose, in addition to the primary data, secondary sources have also been consulted to triangulate the analysis.

Neither the indigenous practices nor the modern measures in land management endeavor are perfect. Both of them have strengths and problems in terms of cost, function, implementation, adaptability, sustainability, etc. Therefore, an overall assessment has been made in which traditional and modern conservation practices are assessed. For that reason, all the appropriate data were generated from experts, development agents and farmers. Moreover, secondary sources are also consulted for triangulation.

It is an over all assessment process that mainly revolves around cost, function, implementation, adaptability, compatibility and sustainability of both conservation measures. Finally, effort has also been made to describe the role of integrating indigenous knowledge with modern technologies for sustainable land management practices of the study area.

8.1. The Strength and Limitation of Indigenous Land Management Practice of the Study Area

It is mostly argued that 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 system. This mainly focuses on soil and water conservation and soil fertility improvement measures. Above all, considering the strength and problem of indigenous and modern land management measures of farmers may have some kind of advantage. Therefore, it may provide valuable hints for the designing, adapting and implementing of alternative sound and more sustainable conservation technologies. Hence, it is important to rationally assess both their strength and limitation of the measures on the basis of the data obtained from the experts, development agents and the farmers.

8.1.1. The Strength of Indigenous Land Management Practices of the Study Area

Most of the traditional land management practices, i.e. both soil and water conservation and soil fertility improvement practices implemented by farmers of the study area can be characterized by several strengths. The major strength involves flexibility/adaptability, high dependence on local resources, environmental sustainability, having multi-purpose and multiple benefits, relative efficiency in labor utilization, compatibility to the prevailing traditional farming systems, need no specialized training and low financial requirement. In the foregoing discussions, effort has been made to deal with them one by one.

a/ Flexibility/Adaptability

One of the most important characteristic of the indigenous land management practices of farmers is the flexible nature of most of their practices (Lakew, 2000). Indigenous soil conservation and soil fertility enhancement practices are more flexible in that they can easily be adapted to the changing physical, biological and socio-economic conditions of the area. For example, farmers commonly change the position of traditional ditches (*feses'*) in order to avoid a gradual widening and deepening of the structure through time. In that way, the ditches will not develop into gullies. Moreover, as it was indicated in the sixth chapter, the gradient, number, spacing, depth and even function of the ditches on crop lands differ in various conditions. They differ from farmer to farmer, from plot to plot and sometimes from crop type to crop type even though they are not treated very well like the modern measures. The other examples are the vegetative fences which are practiced by different farmers differently depending on the type of slope, type of vegetation and labor supply. The same is true for animal parking which is practiced through *'chichet'* or *`hura`* which again depends on seasons, the type of temporary kraal to be constructed and so on. The type of kraal to be constructed also depends on the availability of local labor supply and material resources.

In general, small scale subsistent farmers of the kebele are confronted with scarcity of resources. Therefore, they have developed specific and local strategies to address various problems at the same time. These strategies and practices are usually flexible and adaptable to the existing realities.

b/ High Dependence on Local Resources

Traditional land management practices don't require the import of material resources since they depend only on locally available resources and materials (Dejene, 2000). Thus, they may not need external inputs. The construction and maintenance of soil and water conservation structures is usually undertaken using locally available materials such as oxen-plough, wood, traditional farming tools and with the existing local human labor. Example, traditional ditches (*'feses'*); traditional cut-off drains (*'tekebekeb'*), etc. In addition, indigenous soil fertility maintenance practices like manuring *('figmafises`)*, cropping Lupines lupine *('gibto')*, crop-rotation and others may not demand external resource (Discussion with *Woreda* SWC Experts).

c/ Environmental Sustainability

Indigenous soil and water conservation as well as soil fertility promoting measures are more of environmental friendly (DeWalt, 1994). In other words, it means that they are more appropriate for the sustenance of the local physical environment because they have minimal effect on it. Hence, they do not cause a serious damage to the local ecological settings as they have already adapted themselves to the physical realities at local and farm levels.

d/ Multi-purposes with Multiple Benefits

Conservation experts agree on the idea that most of the indigenous agricultural land management practices of farmers of the study area do have multi-purposes and multiple benefits. The multi-purposive nature of these practices is the result of farmers' response to the changing conditions of the bio-physical, socio-economic as well as cultural environments in their locality (Belay, 1998). For instance crop-rotation, one of the most widely applied soil fertility promoting measures has a number of purposes and benefits to the farmer. It improves the fertility of the soil, controls the spread of weeds and pests like insects.

Moreover, the indigenous structural conservation measures, for example, traditional ditches (*'feses'*) do have multiple functions and benefits. In the first place, they have been used since long ago as a measure to minimize seed loss, to protect the soil from erosion, and to decrease water logging problems on farm plots. Secondly, they are also considered as space-saving and therefore are easily adapted to the type of topography under cultivation.

The other example of indigenous soil fertility enhancing measure with multiple benefits and functions is cropping Lupines lupine *('gibto')*. It is cultivated on farm plots which do not require much preparation. In addition, it doesn't require intensive labor in sowing, weeding, harvesting and so on. The crop is also adaptable to the prevailing local, bio-physical, socio-economic and cultural settings.

In a similar way, traditional water ways (*'bahilawi boyi'*) do also have several benefits in terms of adoptability, function and adaptability to the physical features at the farm level. Accordingly, this structural soil and water conservation practice varies depending on type of slope or topography of the area where the farm plots are located. In other words, it largely increases the function and adaptability of the structure in that particular plot of land. Moreover, it has also cultural implication to the farmer since it has been practiced and still being practiced for generations of time in the area (Discussion with Development Agents). Another good example is the construction of vegetative fences or hedgerows planted at farm plots again have multiple benefits and functions. In addition to their primary conservation function, they serve as sources of food, animal fodder and source of income. Above all, it functions as a measure to improve the nutrient level of the soil.

e/ Relative Efficiency in Labor Utilization

Low skilled labor requirements as well as efficiency in labor utilization are the most important characteristics of traditional land management practices of the study area. For example, in small scale traditional farming systems, structural soil and water conservation practices are not constructed and maintained by farmers at one time but gradually through time. However, this is not always true in all cases. The skill and labor required for the construction and maintenance have been developed on an 'incremental basis' over several generations. Hence, this leads to the distribution of labor requirements throughout time which again helps to reduce labor shortage for the task at one time.

The Development Agents strongly believe that structural soil and water conservation practices for example traditional ditches (*'feses'*) are the integral part of the on-going traditional farming system of the locality. This implies that they do not need additional labor input. Furthermore, they have indicated the idea that some of the structures like traditional water ways (*'bahilawi boyi'*) and traditional cut-off drains (*'tekebekeb'*) are mainly constructed and maintained by the neighbor land owners in groups. This means, the additional labor burden on individual peasant holds will be reduced significantly. It also further promotes cooperation and facilitation to avoid shortage of labor in the process of construction and maintenance works. This in turn promotes social and cultural integration among the farmers and their families or the rural community of the study area in general.

f/ Compatibility to the Traditional Farming System of the Area

Among others, one of the important features of indigenous land management practices of the area is their compatibility to the prevailing traditional farming system (Belay, 1998). The process of developing traditional land management practices clearly reflects the degree of integration of these practices into the farming systems in different aspects. It includes physical, socio-economic and cultural aspects. (Example: physical-type of slope, type of soil and type of climate, etc. socio-economic-labor demand, resource availability, traditions and norms of the rural community, etc).That means, the use of indigenous soil and water conservation as well as soil fertility improvement measures may not happen apart from the on-going traditional farming system of the area. For instance, the construction and maintenance process of traditional land management practices such as traditional ditches (*'feses'*), traditional cut-off drains (*tekebekeb*), traditional check dams (*'bahilawi kitire'*), cropping *'gibto'*, crop-rotation, etc are part of the traditional farming system of the area. They have already adapted themselves to the various bio-physical, socio-economic and cultural conditions of the local environment.

g/ Need no Specialized Training

According to the experts, conventional measures need exposure, training and professional support before and/or during implementation. However, indigenous land management practices need only gradual training. Farmers have already developed their own traditional knowledge on land management which they have been implementing for generations. These indigenous practices have adapted themselves to the local conditions. Hence, they don't require further training unless there is a need for improvement and integration with the introduced modern conservation technologies.

h/ Low Financial Requirement

Another most important characteristic which makes traditional land management practices attractive to farmers is their lower financial requirements. For example, cropping Lupines lupine or *`gibto`* doesn't cost farmers too much. Moreover, it provides farmers with multiple benefits. Therefore, around 73.7 percent of the farmers` response has shown that their indigenous land management measures are less costly compared to the modern ones (Table 8.1.1.1). The table clearly presents the evaluation of indigenous land management practices by farmers of the study area in terms of cost.

Table 8.1.1.1. The Response of Farmers on the Evaluation of their Indigenous Land Management in Terms of Cost

How do you evaluate your traditional land management practices in terms of cost?	Percentage (%)
Less costly	73.7
More costly	20.1
Unknown	4.1
Total	97.9*

Source: Own survey, 2007

Note: Cost in the above table refers to labor, financial and material resource.

8.1.2. Limitation of Indigenous Land Management Practices of the Study Area

Although not all, most of the indigenous soil conservation and soil fertility improvement practices of the study area have limitations. The limitations can be revealed in their function, implementation and effectiveness and so on. This has been confirmed partly from the farmers themselves during the survey. As a result, around 71.2 percent of the farmers have responded reflecting the fact that most of the traditional land management practices need some kind of up-grading or improvement (Table 8.1.2.1). The implication is that they are less effective in their function in comparison to conventional measures. For example, soil fertility enhancement practices like traditional manuring (*'figmafises'*) demands more labor force to transport the manure (*'fig'*) to agricultural plots which are located far away from homesteads. This is true for many of the farmers in the area since their plots are fragmented. It implies that the task is beyond most farmers` capacity unless some other alternative solution is sought. Another example is the traditional check dam which is mainly constructed without considering the amount of run-off to be generated and the size of gully rehabilitated. The situation may eventually lead into the collapse of the structure affecting its sustainability. The general effectiveness of traditional land management practices has been considered by farmers during the survey. It is, therefore, organized in the following table (Table 8.1.2.1).

Table 8.1.2.1.The Response of Farmers with regard to the Effectiveness of their Indigenous Land Management Practices

How do you evaluate your traditional land management practices compared to the modern measures?	Percentage (%)
More effective/need no up-grading	18.6
Less effective/ need up-grading	71.2
Unknown	6.4
Total	96.2*

Source: Own survey, 2007

In a similar development, the structural soil and water conservation measures such as traditional ditches (*'feses'),* traditional cutoff drains (*'tekebekeb'*), traditional water ways (*'bahilawi boyi'*) and traditional check dams (*'bahilawi kitire'*) may aggravate the problem of erosion. This may happen if they are ill-designed and not properly implemented. In other words, if the types of slope, soil conditions, erosive power of the runoff, etc are not taken in to consideration in the construction and maintenance process, they may lead to the dis-functioning of the measures. The situation even may aggravate the problem of soil erosion in a given plot of land. In this regard, lesson has been learnt from the discussion with the experts about the structural problems of traditional ditches (*'feses`*) when in some cases get damaged.

According to the experts, the runoff produced within the farm land combined with the one coming from the up-slope areas is a major cause for the damaging of the ditches.

It was also discussed to be a major cause of rill-erosion. The damage of the ditches is basically, a result of ill-designed dimensions and sedimentations (siltations). They also lack maintenance of the structures after being damaged at the beginning. In addition, the constructions of these structures consider only the type of slope. Therefore, breaking and over-flowing of the *'feses'* is a common happening after every intensive and stormy rain of the rainy season in the area. The experts have further underlined on the limitation of the structure with emphasis on silt-depositions. This is especially true for plots of land in the lower parts where the runoff spreads out over a wider area and forms silt-deposition.

The other traditional land management practice which was explained to have some kind of problem is what is known as 'soil trampling` (locally known as *'beray'*). In fact, this practice is not directly meant for conserving the soil. Rather, it has the purpose of avoiding the removal of fine seeds like *'teff'* by runoff. That means it is production-oriented practice. However, the problem with this practice is that it inhibits the percolation of water into the ground. It could further aggravate the problem of runoff in amount and rate on a given plot of land. Therefore, it reduces the amount of under ground water resource in the area. Moreover, some of the structural indigenous soil and water conservation measures lack proper outlet to river banks, drainage systems or water ways. This might further create a threat to the flooding of the lower neighbor farmlands. In connection to this, the traditional measures do not properly treat the depth, spacing, gradient, dimension, etc. It stresses the idea that indigenous conservation measures are sometimes ill-designed.

On the other hand, the issue of the sustainability of most of the traditional conservation practices (their duration of service) is very crucial. As the data obtained from farmers, development agents and experts indicate the measures are commonly adopted for a single cropping year. Example: traditional ditches (*'feses'*) and traditional water ways (*'bahilawi boyi'*). But, if the measures are well-stabilized or rehabilitated by vegetation and if they are consistently maintained and properly constructed they may serve for more years.

8.2. Strength and Limitation of Modern land Management Practices of the Study Area

Like indigenous land management practices, introduced or conventional land management measures do also have their own strength and limitation even though they are considered to be the result of modern research and experiment. The strength and limitation of these modern soil and water conservation as well as soil fertility improvement measures have been considered in a similar situation to the traditional practices. It has been done mainly in comparison to traditional practices. Nevertheless, modern measures are more difficult to assess critically than traditional ones. One possible reason may primarily be due to their effectiveness. The other is that most of the modern conservation measures are more or less similar with the traditional practices. This again would make the assessment of modern measures more difficult. Nevertheless, attention has been given to consider the major problems in connection to their design, approach, adaptability, implementation and maintenance of the measures.

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

Most of the modern structural soil and water conservation measures, which have already been introduced to the area are more effective in their function, sustainability (time), adoptability, etc. For instance, the modern diversion ditches are similar in function with that of the traditional cutoff drains (*'tekebekeb'*). Thus, the introduced land management technologies are more or less similar in function with the traditional practices. This has been more confirmed during the household survey in which around 76.8 percent of the farmers have responded showing their similarity in function, adoptability, and so on (Table 8.2.1.1).The implication is that due to the similarity of both measures, farmers will have positive perception and motivation towards the introduced modern measures. In addition, they may give hints for the introduction of more appropriate conservation technologies in the study area. The response of farmers regarding the relation between traditional and modern land management measures is clearly reflected in following table (Table 8.2.1.1).

Table 8.2.1.1. The Response of Farmers regarding the Relation between Indigenous and Modern Land Management Measures

How do you relate your traditional land management practice with the modern measures?	Percentage (%)
They are more similar	76.8
They are less similar	13.1
They are different	6.2
Unknown	2.1
Total	98.2*

Source: Own survey, 2007

Likewise, most of the modern soil and water conservation technologies are more sustainable in their duration of services than most traditional practices. For instance, according to the development agent, who has been working in the area since 2003, modern check dams are mainly constructed depending on the dimension and depth of the gully to be checked. This inturn depends on the type of slope, amount of run-off to be generated (erosive power), etc. All of them are considered in order to increase the sustainability of the measures. When the dams are covered with vegetation such as grasses and trees, they will become more sustainable.

On the other hand, in spite of their constraints, modern soil fertility enhancement measures also have their own contribution in up-grading the nutrient level of the soils. A good example is the use of compost by farmers of the study area. It is a recently introduced and modified soil fertility improvement technology.

As it has been tried to describe in the seventh chapter, this modified technology has got wider acceptance among farmers of the study area. Firstly, compost is prepared with the locally-available resources (animal dung, ash, grasses, leaves, etc). This could increase its function and adoptability compared to other conventional soil fertility enhancement measures such as chemical fertilizer, which is imported in exchange for a foreign currency. Secondly, it requires minimum cost, labor input as well as shorter period of time for its preparation. The situation has contributed to the wider acceptance and application of compost among the majority of farmers of the area. Eventually, it has brought a contributory share in the relative increase of crop yields. In general, evidences have clearly indicated that modern structural soil conservation and soil fertility improvement measures have roles to sustainably manage agricultural lands if they are adapted to the local conditions.

8.2.2. Limitation of Modern Land Management Practice of the Study Area

In a similar manner to the indigenous land management practices, there are also some conventional land management measures that have considerable limitations. They are expressed in terms of their cost, adaptation or flexibility, approach and the like. Evidences from the group discussion has revealed the fact that development agents sometimes implement the modern soil and water conservation measures without taking the real-field situations into consideration. Hence, they simply follow guidelines of manuals prepared in reference to slope inclinations which are categorized by agro-ecologies. The implication is that referring to agro-ecologies only is unfavorable and insensitive to the micro-scale, bio-physical, socio-economic and cultural realities. Typical examples in this regard are *'fanya juu'* bunds. Though they are preferred by the majority of the farmers for their effectiveness in conserving the soil and moisture, considerable number of farmers expressed their concern on the way they are applied and adapted. In the discussion, farmers were asked about why they are dissatisfied about the measures. They said that the structures create obstacle to the movement of yoked-pair of oxen when they turn back during the ploughing. Furthermore, they are not designed to fit into the local traditional farming system (type of farm tools, type of slope, land holding size, etc). Besides, farmers who have small plots of land plough up to and sometimes including the conservation structures.

The other issue which was raised in the discussion was that these structures relatively take more space (they are not space-saving). As a result, farmers are forced to lose certain part of their plots. It adversely affects small-size land holders. Therefore, they may not be willing to implement the structures on their plots. The over all implication is that *fanya juu* bunds are not sometimes compatible to the prevailing traditional farming system in some villages of the locality. Besides, they are not appropriate to steeply slope villages like *Yedem Gan*.

Farmers also underlined on the fact that the process of adopting this structure is labor-intensive which may not be practiced by a single peasant household. In addition, in the discussion, they have also described their concern about *fanya juu* bunds and other conventional soil conservation measures. Accordingly, modern measures like *fayna juu* bunds may facilitate grounds for conflict between and/or among neighbor farmland owners. It is because; they are not established and maintained by the neighbor farmers for common benefits on the basis of their mutual consensus. But, this is not true for traditional water ways (*'bahilawi boyi'*) or traditional cut-off drains *'tekebekeb'*, for which farmers agree on how and where to drain the runoff. As a result, they construct the structures together.

Nevertheless, the design of the structural conventional soil and water conservation measures is commonly made by experts and development agents mostly without the consultation of farmers. Moreover, many farmers have the assumption that the establishment and maintenance of the structures should be done by the government since they consider experts and DAs as government agents. That means significant number of farmers lack sense of belongingness to some of the introduced modern conservation measures. It is the result of the less participatory approach of land management strategies in general and soil and water conservation program in particular.

Though the expert and development agents claimed that participatory procedures were followed, facts on the ground did not support this idea. The other point which has been raised in the discussion with the expert is the long-term benefits of the soil conservation measures. Farmers prefer to cultivate farm plots exhaustively without leaving part of their plots for constructing the structures for short term benefit. For example, the need to increase crop yields in that specific season.

Some of the conventional land management technologies may not have multiple benefits and functions. They are mainly designed to mean for a specific function or benefit unlike the traditional measures which have multi-purposes and multiple-benefits. In addition, conventional measures may not also be adaptable to the socio-economic and physical environment of a particular locality.

They, in most cases, are designed in such away as to be adopted at all environments irrespective of the local conditions. Example, chemical fertilizers. This implies that being a standard solution to the problem of soil erosion and nutrient depletion, they are considered to be less flexible in their application. Hence, they are mainly incompatible to the current land use and traditional farming systems. It is partly a reflection of the problem in the approach followed in planning and implementation of the technologies. Moreover, the introduced land management measures are mostly labor-intensive which require excessive labor force in a given time for the establishment and maintenance works. They cannot largely be implemented by a single household. Example, the construction of big size check dams, diversion channels, large scale agro-forestry practices, etc.

The modern soil fertility improvement measures like chemical fertilizers have some limitations in terms of financial requirement, timely availability and in their implementation. As it has been discussed in the previous chapter, the price of artificial fertilizers has been remarkably increasing. It has brought an adverse impact on the purchasing capacity of farmers although credit opportunity is facilitated. They have also expressed their compliance about the timely supply of fertilizers. There is delay in the supply of fertilizer for various reasons. The problem has created difficulty in making it ready before the start of the rainy season.

The other issue raised was the inadequate professional support and follow-up on how to implement artificial fertilizers in the amount of usage, coverage, etc at farm level. It reflects the shortage of trained development agents in the study area. The main problem observed at various levels of discussion concerning the introduction and implementation of the modern conservation technologies is the approach problem. The modern conservation technologies are directly transferred from *woreda* experts through development agents to the farmers with minimum or no participation. This kind of technology transfer usually does not consider the local realities. On top of this, it is less participatory. Consequently, it negatively affects the farmers' potential to be innovators of agricultural technologies instead of being receivers. Example, *fanya juu* bund is inappropriately introduced in few plots of *Yedem Gan* village in the kebele. As it has been discussed in the fifth chapter, this village is located around steeply slope with a lot of ups and downs.

However, generally, the newly introduced soil and water conservation structures as well as soil fertility improvement mechanisms have got relatively better acceptance by the local farmers than the earlier times. They have been acknowledged as being more effective measures in tackling the problem of soil erosion and soil fertility decline. Therefore, they have tremendous potential to improve agricultural land productivity. But, they cannot be considered as the only effective measures to achieve sustainable land management in the study area. The adaptation of the introduced measures to the micro-scale local context is the most important issue to be considered.

8.3. The Role of Integrating Indigenous and Modern Technologies for Sustainable Land Management

Different authors highlight the role of IK in land management practices (Warren, 1991; DeWalt, 1994; Hurni, 1997; Dejene, 2000; Yohannes and Herweg, 2000). Therefore, considering the traditional practices of the study area in the modern land management technologies through integration may have a significant role in managing the problem of soil erosion and soil fertility decline. As it has been discussed so far, there are several indigenous land management practices which are implemented by farmers of the study area. This has become evident from the discussion in the sixth chapter. The practices have well-adapted to the local conditions and are widely implemented by the farmers.

Farmers in the study area have valuable traditional knowledge. They have knowledge about the local bio-physical setting involving the type of slope, type of soil, vegetation cover, type of climate, type of crops, pests, weeds, etc. It could be either about their locality as a whole or about the individual farm plots.

The discussions which were conducted at different levels with (experts, development agents and farmers) justify this fact. Several other documents also substantiate the finding. So, it means that the opportunity to link farmers' indigenous knowledge with modern technologies in land management efforts is wider. The different traditional land management practices adopted by farmers have some kind of benefits to the on-going modern land management endeavor. It is particularly important for soil and water conservation and soil fertility improvement practices.

From the discussion, it has been found out that most of the indigenous agricultural land management practices of the area have the tendency to resemble the modern measures. This is true in such aspects as function, implementation, etc of the measures. Example, traditional cut-off drains (*'tekebekeb'*) and modern diversion ditches, traditional and modern check dams, traditional manuring and compost and so on. The implication is that their similarity may put a clear ground to introduce integrated and participatory modern land management technologies. Therefore, their similarity can be taken as an opportunity to design, introduce and implement several other modern conservation technologies. However, it should be born in mind that modern soil and water conservation technologies are not exactly the same with that of traditional ones. It is because they differ in some of the technical aspects.

Most of the traditional and conventional land management measures have complementary character. It implies that this character could be taken as an indication of the effectiveness of indigenous knowledges if they are properly linked in modern technologies. In concrete terms, indigenous practices can further promote conventional measures so as to be more effective in soil and water conservation as well as soil fertility enhancement practices of croplands. Examples, traditional manuring and artificial fertilizers, traditional cutoff drains and modern diversion ditches, etc. Furthermore, from the analysis of the earlier chapters, traditional land management practices are also complementary to each other within a given plot of land. As a result, different structural, vegetative, agronomic or biological conservation measures that are practiced on a particular plot of land are complementary. For example, contour ploughing (structural), crop-rotation (agronomic) and hedgerows (vegetative).

As it was noted in the earlier discussions, both measures have limitations. Therefore, all of them cannot effectively overcome the problem of soil erosion and soil fertility decline in the study area. However, both of them do have common features that can be linked, integrated and developed into more sustainable practices.

The traditional conservation practices can be improved and linked with the modern measures in the plots of land to manage soil erosion and minimize the problem of soil nutrient decline (land degradation). Accordingly, for example, traditional ditches (*'feses'*) can be complemented with the *fanya juu* bunds in order to minimize the magnitude of runoff erosion. The first is considered to be space-saving while the second one is space-taking. Thus, integrating the strong features of both measures will benefit farmers better. Due to the complementary characteristic of indigenous conservation practices, they may provide a kind of guide and clue for the development of alternative, sound and environmentally sustainable soil and water conservation technologies. Consequently, they can be more appropriate (compatible) for the physical, socio-economic as well as cultural conditions of farmers in the area.

Improved land management practices that ensure better resource use as well as promote long term sustainability are the base for the future food production and for the economic welfare of land users. From the study, it has been found out that improved land management needs looking for an approach that emphasizes on finding feasible, acceptable, viable and ecologically sound solutions at local level. So, based on the finding, sustainable land management can be achieved through integrating farmers' indigenous knowledge with modern technologies in a participatory approach.

Theoretically, both groups i.e. the experts and development agents mainly agree on the idea that effective, sound and sustainable land management programs can be achieved through packages which take farmers indigenous knowledge into account. This is particularly true in soil and water conservation and soil fertility improvement practices.

CHAPTER-IX

9. CONCLUSIONS AND RECOMMENDATIONS

9.1. Conclusions

Agriculture is the main source of livelihood for the highlands of Gojjam in general and the study kebele in particular. The study kebele is known for its high potential in crop production. The whole farming system in the area is traditional which is directed towards cereal production. It is dependent on the use of livestock and human labor for land preparation and for other agricultural practices. Nevertheless, the performance of the agricultural sector is severely affected by land degradation through soil erosion and soil fertility decline. The anthropogenic soil erosion due to the traditional farming system is also serious obstacle as well as threat to land productivity in the study area.

There are several factors that contribute to soil degradation in the study kebele. These factors are complex and interrelated. They involve bio-physical, socio-economic and demographic factors. Among the bio-physical factors causing soil degradation in the area lack of vegetation cover, the nature of the relief and high rainfall intensity are found to be the major ones. Population pressures, traditional farming system, poverty, and so on are among the most important socio-economic and demographic factors. These factors could affect land degradation through their impacts on farmers' attitude, motivation and decision with regard to land use and land management practices. In addition, ill-designed traditional conservation structures are also identified to be potential causes of soil erosion in the study kebele.

It has also been discussed that farmers of the study area do have valuable level of perception on the problem of soil erosion, soil nutrient depletion, deforestation (environmental deteriorations). This has become clear from the data collected during the household survey, field observation, focus-group discussions, and key informant interviews.

The problem of soil degradation in the area was perceived and described in different ways. Some of these include decline in agricultural productivity, expansion of farmlands into ecologically fragile areas, deforestation and shortage of grazing ground and in several other ways. Farmers have also developed their own traditional methods of describing the deteriorated farm plots and environments.

To tackle the problem, various indigenous and modern land management practices have been implemented. It is implemented through soil and water conservation and soil fertility enhancement practices. The indigenous practices of farmers are 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.

The traditional land management practices in the study area are structural, vegetative, biological and agronomic though they overlap and complement to each other. These practices have to a certain extent adapted themselves to the local traditional agricultural performances. Farmers have been implementing different traditional land management practices for generations of time. However, the problem of soil degradation has not been yet managed or minimized. Instead, it has becoming more severe through time.

The modern land management measures which have been widely introduced to the area involve soil and *fanya juu* bunds, modern check dams, drainage ways, diversion ditches, etc. Among the soil fertility enhancement measures, fertilizers and compost are the most important ones. Farmers have still continued practicing their traditional measures parallel to the modern measures. However, the problem of soil degradation has continued and agricultural productivity is declining. The problem is aggravated by multi-faceted and interrelated factors. Some of these factors are physical while the others are socio-economic and demographic.

In spite of their limitations, indigenous land management measures are characterized by such strengths as flexibility, dependence on local resource, having multiple benefits and functions, compatibility to the prevailing farming system, and so on.

Similarly, the modern measures do also have their own roles in protecting the environment and promoting agricultural productivity. However, they are also found to be costly, less adaptable, incompatible to the traditional farming system, labor intensive, etc.

The complementary nature of the indigenous practices between themselves and sometimes with modern measures is another important issue to be considered in land management effort. This reality may provide a clue for the design, development and adoption of alternative and sustainable land management technologies.

From the analysis, it can be concluded that the integration of farmers' indigenous knowledge in modern or conventional technologies could promote sustainable land management. This may also assist at least to reduce the negative influence of soil degradation and improve crop productivity in the study area.

9.2. Recommendations

To realize the goal of achieving sustainable land management in the study area in the future, the following important points should seriously be taken into consideration. From the analysis, it has been investigated that farmers have valuable knowledge about their local environment. Moreover, they are also well aware and informed about the problems associated with their environment such as soil erosion, soil fertility depletion, deforestation and so on.

Therefore, in response to the prevailing problems, farmers have been practicing their own measures. These measures have adapted themselves to the local and micro-scale bio-physical conditions and socio-economic circumstances. These traditional soil conservation and soil fertility improvement practices should be considered as they have valuable information about the local environment. From the study, it has also been established that traditional land management practices by themselves are less effective. But, they may be more effective if they are properly incorporated in modern conservation technologies.

On the other hand, modern science-based land management measures that are introduced to the area also have pivotal roles in minimizing the problem of soil-degradation. They also enhance land productivity. However, in order to attain sustainable land management in the study area, the designing and implementation of conventional soil conservation and soil fertility improvement measures alone is inadequate. Rather, it could be more appropriate, environmentally sound and sustainable to mingle farmers` own land management practices in the conventional measures. This is because both of them have strength and limitation. Considering the farmers indigenous practices may provide initial ideas for the development and implementation of alternative conservation technologies. For this reason:

1. 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 technologies in the study area.
2. It would be indispensable to consider the strength and limitation of traditional land management practices to learn from their strength and combine them with the modern measures to achieve better results in the study area.
3. The modern soil conservation and soil fertility improvement measures should be designed in such a way that they can fit into the local physical, socio-economic traditions of farmers. In other words, introducing modern conservation technologies such *as fanya juu* bunds is not a sufficient condition to achieve the intended objective. Therefore, attention should be given to the adaptability and sustainability of the technologies to specific situations of the study area. In addition, site-specific conservation measures should be introduced to the study area.
4. 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.
5. Most of the modern conservation technologies are designed for specific functions and benefits. Hence, modified land management measures that provide farmers with multi-functions and multiple benefits should be

introduced at lower costs so as to bring meaningful change in livelihood of the farmers of the study area.

6. Participatory, flexible and less labor intensive conservation measures should be designed and implemented. More importantly, the participation of farmers at the grass root level before designing and implementing the measures has a paramount contribution for their sustainability. It is also part of the commencement of good governance and decentralization in the study area.
7. Ill-designed traditional land management practices of the study area should be modified and integrated in the modern measures. Example, traditional check dams (*bahilawi kitir*) which don't consider the size of gully to be rehabilitated and the amount of runoff generated; this may further exacerbate the problem.
8. High external input dependent land management technologies should be minimized. Therefore, more local resource dependent technologies should be introduced and adapted. For example, applying compost widely instead of completely depending on artificial fertilizers may reduce the adverse cost implications of fertilizers.
9. Short-term incentive structures that benefit farmers of the area should be designed and introduced. The main reason is that most of the modern conservation technologies do have long-term benefit to the farmers. Hence, farmers may lack motivation and participation to implement and maintain the technologies. Example, the supply of selected seeds at reasonable prices.
10. To alleviate the shortage of trained personnel in the kebele, grounds should be facilitated for a short-term training from within the farmers themselves who have better level of education. This as part of capacity building could pave the way to promote self-empowerment in the agricultural practices.
11. To achieve sustainable land management, the integration of indigenous measures with modern conservation technologies through modifying the indigenous measures in accordance with the prevailing modern technologies of the study area may have a significant contribution.

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Appendix1.

Household Survey Questionnaire on:

Integrating indigenous Knowledge with modern Technologies for Sustainable Land Management: The Case of Soil and Water Conservation and Soil Fertility Improvement practices in Enerata KPA, East Gojjam

Interview Date_______________

Time_______________________

Objective of the Survey:

The overall objective of this survey is to explore the integration of indigenous and modern land management practices of farmers in *Enerata* rural kebele, East Gojjam. It has also the objective of discussing the role of farmers' traditional practices in modern conservation technologies. Emphasis will be given on soil and water conservation and soil fertility improvement practices. Hence, to achieve more sustainable natural resources management particularly land. To put this into effect, your honest and kind cooperation in providing appropriate responds to the interview questionnaire is vital.

Sincerely, I want to assure you the fact that your personal information will be kept confidentially and your information will be used purely for academic purposes.

I. Socio-economic and Demographic Characteristics of the Sample Peasant Households of *Enerata* KPA, East Gojjam

Personal Information (please mark `X`):

Household head:

Name ___________________

Sex ___________________

Age___________________

Place of Birth: ___________________

Region___________________

*Woreda*___________________

Kebele___________________

A. Peasant Household's Educational Level (please mark 'X`):

Illiterate ___________________

Read and w rite _______________

Primary 1^{st} cycle ______________

Primary 2^{nd} cycle ______________

Primary school completed ________

Secondary school ______________

Preparatory ________________

Tertiary level _________________

B. General Information on Household Family:

1. Duration of stay at the kebele (in days, months or years).________________
2. Total Number of household's member _____ Male ______ Female _____
3. How many children do you have?

   None 1 one 2 two 3 three 4 four 5 more than five

4. Do you want to have more children?

   Yes 1 No 2

5. If yes, how many? ____

   Why? ____

6. If no, why not? ____

____

7. Do you think that your family labor is enough to manage your agricultural land?

Yes 1 No 2

8. If no, how do you get additional labor force to handle your land?

____

____

C. Crop Cultivations (please encircle your choice)

9. How do you cultivate your agricultural land?

Using one's own pair of oxen	1
Using shared oxen	2
Using hired oxen	3
Using household member alone	4
Using hired labor	5

Other, specify____

____

10. Does your tillage system have any positive/negative impact on your land management practices?

Positive 1 Negative 2 Unknown 3

11. If positive, could you list down some of the impacts?

____

____

12. If negative for No 10, could you list down some of the impacts?

____

____

Part II. Land Management Practices:

A. Knowledge of Farmers on Soils

13. How many types of soils do you practice in your Kebele?

____

____

14. What are their names?

Types of soil (local name)	Color	Fertility status	Depth

	Color	Fertility status	Depth
	Black	Very Fertile,	Deep
	Light red	Moderate	Moderate
	Gray	Less Fertile	Shallow
	Etc.		

15. Which types of soils provide you with better crop yield?

Soil type (local name)	Types of crop/s	Estimated yield (quint./ ha)

16. What condition helped you to produce better yield other than better soils?

____

____

B. The Problem of Land Degradation(soil erosion & soil fertility decline)

17. Is soil erosion a problem on your agricultural plot of land?

Yes 1 No 2

18. If yes, how do you understand the presence of soil erosion on your plot of land?

Rills and gullies are observed	1
Soil productivity decreases	2
Decrease in the soil capacity to grow variety of crop	3
Decrease in the depth of top soil	4
Decline in yield from the farm	5

Other, specify ______________________________

____

19. How do you evaluate the influence of soil erosion on farm plots?

Positive1 negative 2 Unknown 3

20. How is the magnitude of soil erosion in your farm plots?

Increasing 1 Decreasing 2 the same as before 3 Unknown 4

21. If it is increasing, how do you measure the magnitude of the problem?

High/very severe 1 Medium / moderately Severe 2 Low/ less severe 3

Unknown 4

22. What are the main causes of soil erosion on your farm plots?

(Land steepness, rainfall intensity, soil character, tillage system, others mention.)

____

____

23. Which form of water erosion is appearing in your farm plots?

Sheet erosion 1 Rill erosion 2 Gully erosion 3 All forms 4

Other form, specify ____

____

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

Yes 1 No 2 Unknown 3

25. If yes, how? ____

____

____

26. If no for No.24, why not?

____

____

27. Which natural factor aggravates soil erosion more on farm plots in?

Your village or *got?*

High rain fall intensity 1

Low vegetation covers 2

Location of farm plots around steeper slopes 3

Erodable type of soil 4

Others Specify ____

____

28. What is your reason for your choice? For question No 27. Could you mention?

____

____

29. When does soil erosion become more severe on your farm plots?

Rainy season/Kiremit	1
Autumn season/Tseday	2
Dry season/ Bega	3
Spring season/Belg	4
Unknown	5

30. Why for question No 13. Mention

____

____

____

Part III. Indigenous Soil and Water Conservation Practices:

31. Do you practice indigenous soil conservation measures to minimize the rate of soil erosion on your farm plot of land?

Yes 1 No 2

32. If yes, could you give me more details?

Types of indigenous soil and water practiced	Number of farm plots treated	Area in ha/*timad*	problems encountered

33. Which indigenous soil conservation practices are more effective in managing the magnitude of erosion? Would you put them in order of effectiveness?

_________________________ 1

_________________________ 2

_________________________ 3

_________________________ 4

_________________________ 5

34. What strengths do your indigenous soil conservation practices have?

____

____

35. What limitations do your indigenous soil conservation practices have?

____

____

36. How many years of practical experiences do you have in the practice of indigenous soil and water conservation?

0-10 1 10-20 2 above 20 3

37. How do you evaluate the sustainability of using indigenous SWC practice?

High 1 Medium 2 Low 3 Unknown 4

38. How do you evaluate the effectiveness of your indigenous conservation practices in comparison to modern measures in managing erosion?

They are more effective 1 they are less effective 2 Unknown 3

39. How do you evaluate the cost of your indigenous land management practices? in terms of finance, labor and material?

Less costly 1 more costly 2 Unknown 3

40. What type of relationship do you consider between the your local environment and indigenous SWC measures?

Positive (friendly) 1 Negative (unfriendly) 2 Unknown 3

41. If negative for question No. 40 what type of negative relation? Could you state?

____

____

Part IV. Modern Soil and Water Conservation Practices:

42. Are you currently using modern soil and water conservation measure in your farm plots

Yes 1 No 2

43. If yes, starting from when?

1-5 years 1 5-10 years 2 above 10 years 3 Unknown 4

44. What kind of modern soil and water conservation measures do you apply? Could you mention?

____

____

45. Which modern soil and water conservation measures do you think are more effective in managing soil erosion?

____

____

46. Could you identify the major limitation of modern soil conservation measures?

____

____

47. If you are applying modern SWC practices, how did you learn about them?

____

____

48. Have you been given an opportunity to participate and make decision concerning modern soil and water conservation measures?

Yes 1 No 2

49. If yes, on which of the following processes?

Identification of modern conservation technologies	1
Selection of modern technologies	2
Prioritizing of modern technologies	3
Implementation of modern technologies	4
In any other process. Mention.	5

____

____

Part IV. Indigenous and Modern Soil Fertility Improvement Practices

50. How do you consider the fertility situation of your farm plots?

Increasing 1 Decreasing 2 the same as before 3 Unknown 4

51. If it is increasing, why?

Due to the application of chemical fertilizers 1

Manuring 2

Crop rotation 3

Following 4

Damping soils wastes, ash, etc. 5

If any other,

Specify____

____

52. If it is decreasing, why?

Due to Deforestation 1

Over cultivation 2

Over-grazing 3

Lack of manure 4

Run off erosion 5

If any other, specify ____

____

53. Which soil type requires deep soil fertility management?

____

____

54. Why for Question No 53?

____

____

55. Are you currently practicing indigenous soil fertility improvement measures?

Yes 1 No 2

56. If yes for Question No 55, why do you choose the measures?

Easy to apply 1

Demand less labor 2

Cannot afford chemical fertilizers 3

More efficient than modern ones 4

Less costly or affordable 5

Other, Specify ______________________________

____

57. From among indigenous soil fertility improvement practices, which ones do you think are less effective?

____

____

58. Could you identify their main limitation?

Yes 1 No 2

59. If yes for Question No 58, what are their main limitations? Mention.

____

____

60. Are you currently using artificial fertilizers on your farm plots?

Yes 1 No 2

61. If yes for Question No 60, could you tell the type and amount you apply?

Type of fertilizer ______________________________

Amount per ha/*Timad* ______________________________

62. How do you get the chemical fertilizer?

On credit basis 1 on cash basis 2

Through other means,

specify______________________________

____

63. Do you think that the application of chemical fertilizer alone is a sustainable solution for fertility decline in your farm plots?

Yes 1 No 2

64. If yes, why?

____

____

65. If no, for question No. 63, what is the sustainable solution to the problem?

____

____

66. Have you tried to use both indigenous and modern soil fertility improvement practices in your farm plots in an integrated manner?

Yes 1 No 2

67. If yes, how?

____

____

68. If no, for question No.66, why not. Explain.

____

____

69. If you do so, for question No 16. How do you evaluate the result of integrating your traditional and modern fertility improvement practices? Explain.

____

____

Part V. Integrating Indigenous and Modern Land Management Practices:

70. Do you think that indigenous soil conservations measures are inferior to modern measures in managing the soil?

Yes they are 1 No they are not 2

71. If yes, in what aspect? ____________________

____

72. If no for Question No70, why not?

____

____

73. Is there any similarity between your practice and the modern measures?

Yes 1 No 2 Unknown 3

74. If your answer yes, in what aspects?

____

____

75. If your answer is no for Question No. 73, why not?

____

____

76. Do you think that your indigenous soil conservation practices need some kind of improvement or upgrading?

Yes 1 No 2 Unknown 3

77. If yes, how? ____________________

____

78. If no for question No.76, why not?

____

____

79. Do you think that integrating your indigenous practice with modern conservation measures will bring sustainable land management?

Yes 1 No 2 Unknown 3

80. If yes, how? ______________________________________

____

81. If no for Question No79, why not?

____

____

82. Which conservation measures do you think need integration?

____

____

83. Which modern soil conservation measures do you think are more effective?

Modern conservation measure	Reason

84. How do you evaluate modern conservation technologies in relation to the traditional ones?

More important 1 less important 2 Unknown 3

Thank you indeed.

Appendix 2.

General Guideline for Key Informant Interviews:

A. For Development Agents(DAs) and Soil and Water Conservation Experts

1. Do farmers have serious problem of soil erosion on their farm plots?
2. If there is serious soil erosion in the area, what could be the most practical reasons? Deforestation? Soil depletion? Runoff? Over cultivation? Any other?
3. Do farmers have the awareness of soil erosion and soil fertility decline in their farm plots?
4. Do farmers practice their own traditional land management practices in Enerata Kebele?
5. Do you think that farmers have good initiative to manage their farm plots?
6. Do you think that farmers in the kebele accept and implement modern land management practices as expected? If yes why? If no, could you explain the reason?
7. How do you evaluate the soil and water conservation efforts of farmers in the kebele?
8. Do you think that farmers in the area have adequate knowledge on how to conserve their land?
9. How do you evaluate the effectiveness of farmers indigenous practices in comparison to the modern measures?
10. Which conservation practices are more effective? The indigenous or the modern ones?
11. Which conservation measures do you think are more acceptable and applicable by the farmers in the kebele?
12. Do you think that farmers are implementing both indigenous and modern technologies successfully? How do you valuate the result of these two technologies?
13. What are the limitations of indigenous soil conservation practices?
14. What are the major limitations of modern conservation measures?
15. What are the traditional soil fertility measures used by farmers?
16. What do you think about the preference of farmers in the use of soil fertility measures? Do they prefer the traditional measure?

17. What is the attitude of farmers towards modern conservation measures?
18. How do you assess the farmers' indigenous knowledge regarding land management?

B. For *Enerata* Kebele Elderly Farmers

1. Is there a problem of soil erosion in your kebele?
   How do you recognize the problem? What are the manifestations?
2. What other environmental problems are there in your kebele?
3. If there area such problems, what are the causes of these environmental problems?
4. How do you tackle the problems?
5. Do you have your own traditional soil and water conservation measures?
6. How do your traditional soil and water practices differ from the modern measures?
7. How many years of experience do you have in the use of traditional soil and water conservation measures?
8. Do you think that you are successful in the use of indigenous practices?
9. What strength do you observe in the use of these indigenous practices?
10. What limitation do you observe in the use f modern soil and water conservation measures?
11. What is your attitude towards the use of modern conservation measure? positive? Negative?
12. If positive, why?
13. If negative, why?
14. How do you evaluate the natural fertility situation of your crop lands?
15. Is it increasing? Or decreasing?
16. If it increasing, why?
17. If it decreasing, what are the reasons?
18. If the fertility situation crop lands are decreasing, what measures are you taking to improve their fertility?
19. Do you have your own traditional practice?
20. If yes, what are they?

21. Are you currently using artificial fertilizer in crop lands? How do you get the it?
22. Do you think that fertilizer alone can solve the problem? If, no what other methods should be included?
23. Are you currently using traditional soil fertility improvement measures?
24. Could you mention them?
25. How do evaluate your traditional measure compared tomodern measures such as fertilizers?

Appendix 3.

General Guideline for Focus-Group Discussions (FGD)

1. Is soil erosion a problem in your farm plots? If yes, how do you understand the presence of soil erosion in farm plots?
2. How do you consider the fertility situation farm plots?
3. Is it increasing or declining?
4. If it is declining, what measures are you taking to manage the problem of soil fertility decline?
5. Are you currently implementing the traditional conservation measures in agricultural lands?
6. What are these traditional soils and water conservation practices?
7. How do you see the local physical environment such as vegetation cover, soil conditions, etc?
8. Do you practices modern soil and water conservation measure in your land?
9. Could you mention the most widely practiced modern land management measures in your kebele?
10. Do you have adequate support from agricultural experts such as Development Agents in implementing these modern measures?
11. Which measures are more effective in conserving your farm plots from erosion the traditional or the modern measures?
12. Which modern conservation measures are more effective in protecting the soil from erosion?

13. Which traditional measures are more effective in protecting the soil form erosion?
14. Could you explain as to how you traditionally maintain the fertility of your crop lands?
15. Do you think that your traditional measures alone are sufficient to enhance soil fertility in farm plots?
16. If yes, why? If no, what other measures should be implemented?
17. What major limitations do you observe when you use modern measures?
18. Did you try to use your traditional practice in combination with the modern conservation measures in your farm plots?
19. How do you evaluate the effectiveness of integrating both measures?
20. Which conservation measures do you think is less costly or more affordable to implement? Why?
21. Do you observe any relation between traditional and modern conservation measures?
22. How many years of practical experience do you have in using modern soil conservation measures?
23. How do you evaluate the labor requirement of your traditional soil conservation practices in comparison with the modern ones?
24. Which measures do you prefer in your soil conservation and soil fertility improvement practice?
25. Could you explain the reason for your preference?

Addis Ababa University

School of Graduate Studies

Institute of Development Research

Appendix1.

Household Survey Questionnaire on:

Integrating indigenous Knowledge with modern Technologies for Sustainable Land Management: The Case of Soil and Water Conservation and Soil Fertility Improvement practices in Enerata KPA, East Gojjam

Interview Date_______________

Time_______________________

Objective of the Survey:

The overall objective of this survey is to explore the integration of indigenous and modern land management practices of farmers in *Enerata* rural kebele, East Gojjam. It has also the objective of discussing the role of farmers' traditional practices in modern conservation technologies. Emphasis will be given on soil and water conservation and soil fertility improvement practices. Hence, to achieve more sustainable natural resources management particularly land. To put this into effect, your honest and kind cooperation in providing appropriate responds to the interview questionnaire is vital.

Sincerely, I want to assure you the fact that your personal information will be kept confidentially and your information will be used purely for academic purposes.

I. Socio-economic and Demographic Characteristics of the Sample Peasant Households of *Enerata* KPA, East Gojjam

Personal Information (please mark `X`):

Household head:

Name ________________

Sex ________________

Age________________

Place of Birth: ________________

Region________________

*Woreda*________________

Kebele________________

A. Peasant Household's Educational Level (please mark 'X`):

Illiterate ________________

Read and w rite ____________

Primary 1st cycle ____________

Primary 2nd cycle ____________

Primary school completed _______

Secondary school ____________

Preparatory ________________

Tertiary level ______________

B. General Information on Household Family:

1. Duration of stay at the kebele (in days, months or years).______________

2. Total Number of household's member _____ Male ______ Female _____

3. How many children do you have?

   None 1 one 2 two 3 three 4 four 5 more than five

4. Do you want to have more children?

   Yes 1 No 2

5. If yes, how many? ________________________________

   Why? ________________________________

6. If no, why not? ____

____

7. Do you think that your family labor is enough to manage your agricultural land?

Yes 1 No 2

8. If no, how do you get additional labor force to handle your land? ____

____

C. Crop Cultivations (please encircle your choice)

9. How do you cultivate your agricultural land?

Using one's own pair of oxen	1
Using shared oxen	2
Using hired oxen	3
Using household member alone	4
Using hired labor	5

Other, specify____

____

10. Does your tillage system have any positive/negative impact on your land management practices?

Positive 1 Negative 2 Unknown 3

11. If positive, could you list down some of the impacts? ____

____

12. If negative for No 10, could you list down some of the impacts?

____

____

Part II. Land Management Practices:

A. Knowledge of Farmers on Soils

13. How many types of soils do you practice in your Kebele?

____

____

14. What are their names?

Types of soil (local name)	Color	Fertility status	Depth

	Color	Fertility status	Depth
	Black	Very Fertile,	Deep
	Light red	Moderate	Moderate
	Gray	Less Fertile	Shallow
	Etc.		

15. Which types of soils provide you with better crop yield?

Soil type (local name)	Types of crop/s	Estimated yield (quint./ ha)

16. What condition helped you to produce better yield other than better soils?

____

____

B. The Problem of Land Degradation(soil erosion & soil fertility decline)

17. Is soil erosion a problem on your agricultural plot of land?

Yes 1 No 2

18. If yes, how do you understand the presence of soil erosion on your plot of land?

Rills and gullies are observed	1
Soil productivity decreases	2
Decrease in the soil capacity to grow variety of crop	3
Decrease in the depth of top soil	4
Decline in yield from the farm	5

Other, specify ____

____

19. How do you evaluate the influence of soil erosion on farm plots?

Positive1 negative 2 Unknown 3

20. How is the magnitude of soil erosion in your farm plots?

Increasing 1 Decreasing 2 the same as before 3 Unknown 4

21. If it is increasing, how do you measure the magnitude of the problem?

High/very severe 1 Medium / moderately Severe 2 Low/ less severe 3
Unknown 4

22. What are the main causes of soil erosion on your farm plots?

(Land steepness, rainfall intensity, soil character, tillage system, others mention.)

____

____

23. Which form of water erosion is appearing in your farm plots?

Sheet erosion 1　　Rill erosion 2　　Gully erosion 3　　All forms 4

Other form, specify ______________________________

____

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

Yes 1　　No 2　　Unknown 3

25. If yes, how? ______________________________

____

____

26. If no for No.24, why not?

____

____

27. Which natural factor aggravates soil erosion more on farm plots in?

Your village or *got?*

High rain fall intensity 1

Low vegetation covers 2

Location of farm plots around steeper slopes 3

Erodable type of soil 4

Others Specify ______________________________

____

28. What is your reason for your choice? For question No 27. Could you mention?

____

____

29. When does soil erosion become more severe on your farm plots?

Rainy season/Kiremit 1

Autumn season/Tseday 2

Dry season/ Bega 3

Spring season/Belg 4

Unknown 5

30. Why for question No 13. Mention

___

___

___

Part III. Indigenous Soil and Water Conservation Practices:

31. Do you practice indigenous soil conservation measures to minimize the rate of soil erosion on your farm plot of land?

Yes 1 No 2

32. If yes, could you give me more details?

Types of indigenous soil and water practiced	Number of farm plots treated	Area in ha/*timad*	problems encountered

33. Which indigenous soil conservation practices are more effective in managing the magnitude of erosion? Would you put them in order of effectiveness?

______________________________ 1

______________________________ 2

______________________________ 3

______________________________ 4

______________________________ 5

34. What strengths do your indigenous soil conservation practices have?

____

____

35. What limitations do your indigenous soil conservation practices have?

____

____

36. How many years of practical experiences do you have in the practice of indigenous soil and water conservation?

0-10 1 10-20 2 above 20 3

37. How do you evaluate the sustainability of using indigenous SWC practice?

High 1 Medium 2 Low 3 Unknown 4

38. How do you evaluate the effectiveness of your indigenous conservation practices in comparison to modern measures in managing erosion?

They are more effective 1 they are less effective 2 Unknown 3

39. How do you evaluate the cost of your indigenous land management practices? in terms of finance, labor and material?

Less costly 1 more costly 2 Unknown 3

40. What type of relationship do you consider between the your local environment and indigenous SWC measures?

Positive (friendly) 1 Negative (unfriendly) 2 Unknown 3

41. If negative for question No. 40 what type of negative relation? Could you state?

____

____

Part IV. Modern Soil and Water Conservation Practices:

42. Are you currently using modern soil and water conservation measure in your farm plots

Yes 1 No 2

43. If yes, starting from when?

1-5 years 1 5-10 years 2 above 10 years 3 Unknown 4

44. What kind of modern soil and water conservation measures do you apply? Could you mention?

____

____

45. Which modern soil and water conservation measures do you think are more effective in managing soil erosion?

____

____

46. Could you identify the major limitation of modern soil conservation measures?

____

____

47. If you are applying modern SWC practices, how did you learn about them?

____

____

48. Have you been given an opportunity to participate and make decision concerning modern soil and water conservation measures?

Yes 1 No 2

49. If yes, on which of the following processes?

Identification of modern conservation technologies	1
Selection of modern technologies	2
Prioritizing of modern technologies	3
Implementation of modern technologies	4
In any other process. Mention.	5

____

____

Part IV. Indigenous and Modern Soil Fertility Improvement Practices

50. How do you consider the fertility situation of your farm plots?

Increasing 1 Decreasing 2 the same as before 3 Unknown 4

51. If it is increasing, why?

Due to the application of chemical fertilizers 1
Manuring 2
Crop rotation 3
Following 4
Damping soils wastes, ash, etc. 5
If any other,
Specify____

____

52. If it is decreasing, why?

Due to Deforestation 1
Over cultivation 2
Over-grazing 3
Lack of manure 4
Run off erosion 5
If any other, specify ____

____

53. Which soil type requires deep soil fertility management?

____

____

54. Why for Question No 53?

____

____

55. Are you currently practicing indigenous soil fertility improvement measures?

Yes 1 No 2

56. If yes for Question No 55, why do you choose the measures?

Easy to apply 1

Demand less labor 2

Cannot afford chemical fertilizers 3

More efficient than modern ones 4

Less costly or affordable 5

Other, Specify ____________________

____

57. From among indigenous soil fertility improvement practices, which ones do you think are less effective?

____

____

58. Could you identify their main limitation?

Yes 1 No 2

59. If yes for Question No 58, what are their main limitations? Mention.

____

____

60. Are you currently using artificial fertilizers on your farm plots?

Yes 1 No 2

61. If yes for Question No 60, could you tell the type and amount you apply?

Type of fertilizer ____________________

Amount per ha/*Timad* ____________________

62. How do you get the chemical fertilizer?

On credit basis 1 on cash basis 2

Through other means,

specify____________________

____

63. Do you think that the application of chemical fertilizer alone is a sustainable solution for fertility decline in your farm plots?

Yes 1 No 2

64. If yes, why?

____

____

65. If no, for question No. 63, what is the sustainable solution to the problem?

____

____

66. Have you tried to use both indigenous and modern soil fertility improvement practices in your farm plots in an integrated manner?

Yes 1 No 2

67. If yes, how?

____

____

68. If no, for question No.66, why not. Explain.

____

____

69. If you do so, for question No 16. How do you evaluate the result of integrating your traditional and modern fertility improvement practices? Explain.

____

____

Part V. Integrating Indigenous and Modern Land Management Practices:

70. Do you think that indigenous soil conservations measures are inferior to modern measures in managing the soil?

Yes they are 1 No they are not 2

71. If yes, in what aspect? ______________________

____

72. If no for Question No70, why not?

____

____

73. Is there any similarity between your practice and the modern measures?

Yes 1 No 2 Unknown 3

74. If your answer yes, in what aspects?

____

____

75. If your answer is no for Question No. 73, why not?

____

____

76. Do you think that your indigenous soil conservation practices need some kind of improvement or upgrading?

Yes 1 No 2 Unknown 3

77. If yes, how? ______________________

____

78. If no for question No.76, why not?

____

____

79. Do you think that integrating your indigenous practice with modern conservation measures will bring sustainable land management?

Yes 1 No 2 Unknown 3

80. If yes, how? ______________________________________

____

81. If no for Question No79, why not?

____

____

82. Which conservation measures do you think need integration?

____

____

83. Which modern soil conservation measures do you think are more effective?

Modern conservation measure	Reason
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________

84. How do you evaluate modern conservation technologies in relation to the traditional ones?

More important 1 less important 2 Unknown 3

Thank you indeed.

Appendix 2.

General Guideline for Key Informant Interviews:

A. For Development Agents(DAs) and Soil and Water Conservation Experts

1. Do farmers have serious problem of soil erosion on their farm plots?
2. If there is serious soil erosion in the area, what could be the most practical reasons? Deforestation? Soil depletion? Runoff? Over cultivation? Any other?
3. Do farmers have the awareness of soil erosion and soil fertility decline in their farm plots?
4. Do farmers practice their own traditional land management practices in Enerata Kebele?
5. Do you think that farmers have good initiative to manage their farm plots?
6. Do you think that farmers in the kebele accept and implement modern land management practices as expected? If yes why? If no, could you explain the reason?
7. How do you evaluate the soil and water conservation efforts of farmers in the kebele?
8. Do you think that farmers in the area have adequate knowledge on how to conserve their land?
9. How do you evaluate the effectiveness of farmers indigenous practices in comparison to the modern measures?
10. Which conservation practices are more effective? The indigenous or the modern ones?
11. Which conservation measures do you think are more acceptable and applicable by the farmers in the kebele?
12. Do you think that farmers are implementing both indigenous and modern technologies successfully? How do you valuate the result of these two technologies?
13. What are the limitations of indigenous soil conservation practices?
14. What are the major limitations of modern conservation measures?
15. What are the traditional soil fertility measures used by farmers?
16. What do you think about the preference of farmers in the use of soil fertility measures? Do they prefer the traditional measure?

17. What is the attitude of farmers towards modern conservation measures?
18. How do you assess the farmers' indigenous knowledge regarding land management?

B. For *Enerata* Kebele Elderly Farmers

1. Is there a problem of soil erosion in your kebele?
   How do you recognize the problem? What are the manifestations?
2. What other environmental problems are there in your kebele?
3. If there area such problems, what are the causes of these environmental problems?
4. How do you tackle the problems?
5. Do you have your own traditional soil and water conservation measures?
6. How do your traditional soil and water practices differ from the modern measures?
7. How many years of experience do you have in the use of traditional soil and water conservation measures?
8. Do you think that you are successful in the use of indigenous practices?
9. What strength do you observe in the use of these indigenous practices?
10. What limitation do you observe in the use f modern soil and water conservation measures?
11. What is your attitude towards the use of modern conservation measure? positive? Negative?
12. If positive, why?
13. If negative, why?
14. How do you evaluate the natural fertility situation of your crop lands?
15. Is it increasing? Or decreasing?
16. If it increasing, why?
17. If it decreasing, what are the reasons?
18. If the fertility situation crop lands are decreasing, what measures are you taking to improve their fertility?
19. Do you have your own traditional practice?
20. If yes, what are they?

21. Are you currently using artificial fertilizer in crop lands? How do you get the it?
22. Do you think that fertilizer alone can solve the problem? If, no what other methods should be included?
23. Are you currently using traditional soil fertility improvement measures?
24. Could you mention them?
25. How do evaluate your traditional measure compared tomodern measures such as fertilizers?

Appendix 3.

General Guideline for Focus-Group Discussions (FGD)

1. Is soil erosion a problem in your farm plots? If yes, how do you understand the presence of soil erosion in farm plots?
2. How do you consider the fertility situation farm plots?
3. Is it increasing or declining?
4. If it is declining, what measures are you taking to manage the problem of soil fertility decline?
5. Are you currently implementing the traditional conservation measures in agricultural lands?
6. What are these traditional soils and water conservation practices?
7. How do you see the local physical environment such as vegetation cover, soil conditions, etc?
8. Do you practices modern soil and water conservation measure in your land?
9. Could you mention the most widely practiced modern land management measures in your kebele?
10. Do you have adequate support from agricultural experts such as Development Agents in implementing these modern measures?
11. Which measures are more effective in conserving your farm plots from erosion the traditional or the modern measures?
12. Which modern conservation measures are more effective in protecting the soil from erosion?

13. Which traditional measures are more effective in protecting the soil form erosion?
14. Could you explain as to how you traditionally maintain the fertility of your crop lands?
15. Do you think that your traditional measures alone are sufficient to enhance soil fertility in farm plots?
16. If yes, why? If no, what other measures should be implemented?
17. What major limitations do you observe when you use modern measures?
18. Did you try to use your traditional practice in combination with the modern conservation measures in your farm plots?
19. How do you evaluate the effectiveness of integrating both measures?
20. Which conservation measures do you think is less costly or more affordable to implement? Why?
21. Do you observe any relation between traditional and modern conservation measures?
22. How many years of practical experience do you have in using modern soil conservation measures?
23. How do you evaluate the labor requirement of your traditional soil conservation practices in comparison with the modern ones?
24. Which measures do you prefer in your soil conservation and soil fertility improvement practice?
25. Could you explain the reason for your preference?

Declaration

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

Declared by:

YILKAL TARIKU

Candidate

Confirmed by:

Advisor