



ADDIS ABABA UNIVERSITY
COLLEGE OF SOCIAL SCIENCES
SCHOOL OF GRADUATE STUDIES
DEPARTMENT OF GEOGRAPHY AND ENVIROMENTAL
STUDIES

Farmers' practice and factors influencing the adoption of soil and water conservation measures in Wegdi Woreda, South Wollo, Ethiopia.

By

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A Thesis submitted to the department of geography and environmental studies in partial fulfillment of the requirements for the master degree in geography and environmental studies (specialization of Natural resource management)

BY

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LIST OF ACRONYMS

AMSL	Above mean sea level
BoA	Bureau of Agriculture
CSA	Central statistical agency
DAs	Development agents
FAO	Food and agricultural organization
FO	Field observation
FFW	Food for work
FGD	Focus group discussion
Hac	Hectares
HHs	Households
Km	Kilometer
LDCs	Less developing countries
MM	Millimeter
NGOs	None governmental organizations
PAs	Peasant associations
Qt	Quntal
SFLs	Slope of farmlands
SIDA	Swedish international development agency
SLM	Sustainable land management
SPSS	Statistical package for social science
SSA	Sub Saharan Africa

WoA	Woreda of agriculture
WCEs	Water conservation experts
SWCPs	Soil and water conservation programs
SWC	Soil and water conservation
WFP	World food program

ABSTRACT

Soil erosion is one of the major agricultural problems in the highlands of Ethiopia. Deforestation, overgrazing, and cultivation of steep slopes which is not suitable for agricultural activities together with bad farming practice that do not include induced conservation measures are the major causes for soil erosion in much of Ethiopia's highland areas. A survey was conducted on soil erosion and fertility decline were identified as top priority problems of farming practice in Wegdi woreda.

The main objective of the study was to assess farmers' practices and factors influencing the adoption of structural soil and water conservation (SWC) technologies for sustainable watershed management and planning in Wegdi district. To achieve the goal of the study, pre-tested questionnaires, field observation, focus group discussion and key informant interview were prepared for sample household heads. Numerical tools (SPSS) for data analysis comprised of descriptive statistics (frequencies, cross tabulation and percentages) were used to analyze the collected data. The main SWC measures found in Wegdi woreda were soil and stone bunds, tree planting, agro-forestry, strip cropping, inter cropping, cut-off drains, water ways, modern check dams and contour ploughing methods. It also came to light that household size, farmland size, labor, perception of soil erosion problem, and training service in soil erosion control, land tenure; access to institutional services, and farmland distance from homesteads had an impact on adoption of induced structural SWC technologies.

SWC measures should be adapted to the local physical conditions and protected the soil from being eroded. Farming productivity and purchasing power of the farmers will be expected to increase after applying SWC structures on farmlands. In conclusion, construction and implementation of induced structural SWC measures in the degraded highlands and stabilizing with multipurpose plant species is very important to conserve the soil and increase crops productivity as well as water harvesting power. SWC efforts need hand- in- hand cooperation with concerned experts while planning and implementation.

CHAPTER ONE

INTRODUCTION

1.1. Background of the study

Land degradation is one of the main causes of poverty in rural areas of developing countries. In many areas, farming populations have experienced a decline in real income due to demographic, economic, social, and environmental changes. Land degradation is a result of several factors of both physical and socio-economic origins. The immediate consequence of land degradation is reduced crop yield followed by economic decline and social stress. The integrated process of land degradation and increased poverty has been referred to as the "downhill spiral of unsustainability" leading to the "poverty trap" (Greenland et al., 1994).

Soil erosion is one facet of land degradation that affects the physical and chemical properties of soils. The physical parameters are primarily organic matter content, structure, texture, bulk density, infiltration rate, rooting depth, and water-holding capacity. Changes in chemical parameters are largely a function of changes in physical composition. The consequences of top soil erosion on soil productivity depend on the depth and quality of the topsoil relative to the sub soil. Wegdi district is located in south western part of South Wollo zone. It consists of several agro-climatic zones, mainly determined by altitude, rainfall and temperature. The population density in the district is relatively high, and large units of farmlands are extensively cultivated by subsistence farmers.

The severity of soil erosion in the Amhara region and in Ethiopia in general, is the result of the mountainous and hilly topography, torrential rainfall, and low degree of vegetation cover. According to Hamilton (1977), deforestation started already 2000 years ago. In many parts of Amhara region, soil erosion has made cultivation of old farmlands impossible. Farmers have been forced to constantly cultivate new and more marginal areas.

The objective of this presentation is to review soil erosion and water conservation research as well as conservation efforts made in Wegdi district. I have included both traditional measures and activities promoted by non-government organizations (NGO's) and government projects.

Main emphasis is placed on stone terracing and stone bunds since these are the most widely used soil conservation measures in the district. Relatively limited research has been made in Wegdi district. The researcher has therefore included some important findings from other parts of the Ethiopian highlands for comparison.

There are a number of factors that influence the adoption of different soil and water conservation practices and unsustainable technologies for integrated management and planning of agricultural activities (Barbier, 2000). It is in this light that Abegunde et al (2006) argued that by the year 2020, soil erosion may pose a serious threat to food production in rural as well as urban livelihoods what farmer personal characteristics and socio- economic particularly in poor and densely populated areas. The economic factors are influencing adoption of soil and water conservation in developing world. They further advocated for policies of water conservation technologies in Ethiopia that would encourage soil retention strategies and land sub-catchment.

Recent years have witnessed a rise of serious conservation practice and adoption is a multidimensional concern about the environmental risks associated with soil erosion process. Numerous factors determine farmers' willingness in modern agricultural practices such as accelerated soil erosion is forced them to use a conservation measures. Therefore, sustainable and renewed resource between them contributes to the complication in management practices need to address the widespread identifying features results of many adoption and structural factors related to the adoption of induced conservation measures of analyzing environmental innovations practices including farm size, income, farm profitability, and some studies identify farmer training through tenure etc., workshops and seminars as the major approaches to individual level characteristics of the farmers.

1.2. Statements of the problem

Soil erosion is a result of combination of natural factors such as topography, erratic erosive rainfall patterns and man's actions including destruction of vegetation cover, through deforestation, over grazing, and inappropriate agricultural practices that are not in harmony with environmental conditions. In this regard, dense population, primitive farming practices combined with intensive rains and rugged topography intensified land degradation. In an attempt to reduce soil erosion, farmers have developed their own conservation practices over the years. They have

been using various crop and land management practices as well as mechanical structures like drainage ditches and furrow until the introduction of induced soil and water conservation measures (Tilahun, 2003). The most affected parts are farmers and livelihoods generated from agricultural activities.

Since the 1970s, farmers' have started using the introduced structural soil and water conservation techniques. Currently these techniques are widely applied in Amhara region through Food for Work incentives and community voluntary participation. In spite of large scale soil and water conservation campaign in the Amhara region, the level of achievement is still far behind the actual need. Land degradation due to soil erosion, nutrient depletion and deforestation constitutes a major constraint to increase agricultural production in the Amhara region (BoA, 1998; Lakew, 2000, cited in Yilkal Tariku, 2007). It is also learned from existing information that soil erosion by water (run-off) is a serious environmental and socio-economic problem in Wegdi district.

According to FAO (1993), about half of the high lands of the region are already significantly eroded, of which about twenty seven 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 particularly. Several studies reveal the fact that the region has highest rate of nutrient depletion (Stoorvogel, 1993; Lakew, 2000).

South Wollo zone farmland is exposed to severe soil erosion, farmland fragmentation, deforestation and farmland pressure. As a result, the soils have become unable to satisfy the rapid growing demand of population. The Wegdi district of South Wollo zone has been exploited and degraded continuously. As a result, majority of rural residents have been facing food insecurity. In the area, erosion problems and poor water harvesting measures tackle is rarely investigated.

Adoption of induced structural soil and water conservation technology is commonly perceived to be slow. Consequently, severe soil erosion continues to influence the farmer's livelihoods in the study area. Recognizing soil erosion as a problem by farmers' is an important determinant of induced structural conservation practices. Furthermore, the farmers' attitude towards the structural soil and water conservation measures can be affected by different factors. Yet, factors influencing practices of structural soil and water conservation measures by farmers have not been strongly examined in Wegdi district and often poorly undertaken. Therefore, this study

assess farmers' practices on soil and water conservation measures and identify factors that influence the adoption of induced conservation techniques to conserve soil and water in the farmlands.

1.3. Objectives of the study

I. General objective; this study is aimed to assess factors that influence farmers' soil and water conservation technology adoption in Wegdi district of South Wollo zone, Ethiopia.

II. Specific objectives; having the above general objective, the study was geared to attain the following specific objectives.

1. To describe common soil and water conservation practices being used in the study area.
2. To identify factors that influence soil and water conservation structures adoption in the study area.
3. To identify major consequences of soil erosion in the study area.
4. To recommend approaches to minimize challenges farmers faced by adopting soil and water conservation measures.

1.4. Research questions

1. What are common soil and water conservation techniques practiced in the study area?
2. What are existing factors that influence the adoption of soil and water conservation measures in the study area?
3. What are the major consequences of soil erosion in the study area?
4. What measures should be taken to improve challenges faced by farmers in adopting soil and water conservation techniques?

1.5. Scope of the study

The study would be conducted in south western part of South Wollo and the generalization may be made based on the findings to be more applicable to the location of the study area. In addition, the result of this study may be applicable to other places in parts of the highlands where similar conditions may prevail. However, the result of this study could not adequately address the trade-off that emanate from the different costs and benefits accrued to different agents involved in soil and water conservation at different levels. Moreover, the study inclined towards house hold's

decisions on the technical issues, i.e. soil and water conservation without eliciting the position of the state and the community vis-a- vis in relation to that of households in the decision making processes of soil and water conservation practices which are often difficult when extension planning carried out.

1.6. Significance of the study

The farming system of small holder farmers is not only diverse and complex but also risk prone. Consequently, have a major challenge. Farmers need to undertake the diversity, not only as one moves across ecological zones and regions but also across diverse farming system to meet the diverse need with different customs, educational level and hopes even within a given ecological zones. Although, a lot of research works and proposed guide lines in combating and reversing soil degradation, it goes on to prove to be substantially adverse problem. And the rural poor find themselves trapped in a complicated cycle of poverty and soil erosion fuelled by shortage of sufficient knowledge and inappropriate technologies and chances to solve such problem and generate adequate income to their livelihoods. The determination of factors affecting decision on practicing soil and water conservation is crucial in taking measures to overcome factors affecting the adoption of soil and water conservation structures. Identification of factors that accelerate the adoption of technologies can increase the formulation and implementation of technology dissemination programs. Thus, this research work plays its own role for researchers and extension experts to utilize the result of this study in modifying research and extension services.

1.7. Limitation and Delimitation of the study

In some area of Wegdi district, farmers' practices and factors affecting soil and water conservation practices were not investigated in detail to control soil erosion. This issue needs immediate attention to control soil erosion and enhance agricultural productivity. The study is mainly concentrated in the issues mentioned above in Wegdi Woreda because it is not promising to investigate other problems at the same time due to time and financial constraints. The study also delimited to adoption of SWC measures and identifying factors that influencing implementation and adoption of structural conservation measures. But it will be impeded by land holding size, education level, access to extension services and dramatic population pressure.

Similarly, deforestation also aggravates poor farmland management in connection to adoption of SWC measures.

1.8. Organization of the thesis

This study paper is organized into six chapters. The first chapter provides with an overview and the issues which attempted to address and achieve at the end of the study. This is followed by related literature reviews in which the previous researches and thoughts related to farmers' practices and factors influencing the adoption of soil and water conservation practices are reviewed. The third chapter deals with the methodology which is used to collect relevant data and how collected data are analyzed. Chapter four illustrates the study area with its location, topography, soil resources, climate, water resources, land use pattern, crop production, and settlement patterns in the study area. The fifth chapter presents the result and discussion of the study. Finally, chapter six gives summary, conclusion and possible recommendations based on the results of the study findings. The last section of the study has contained the references and appendixes.

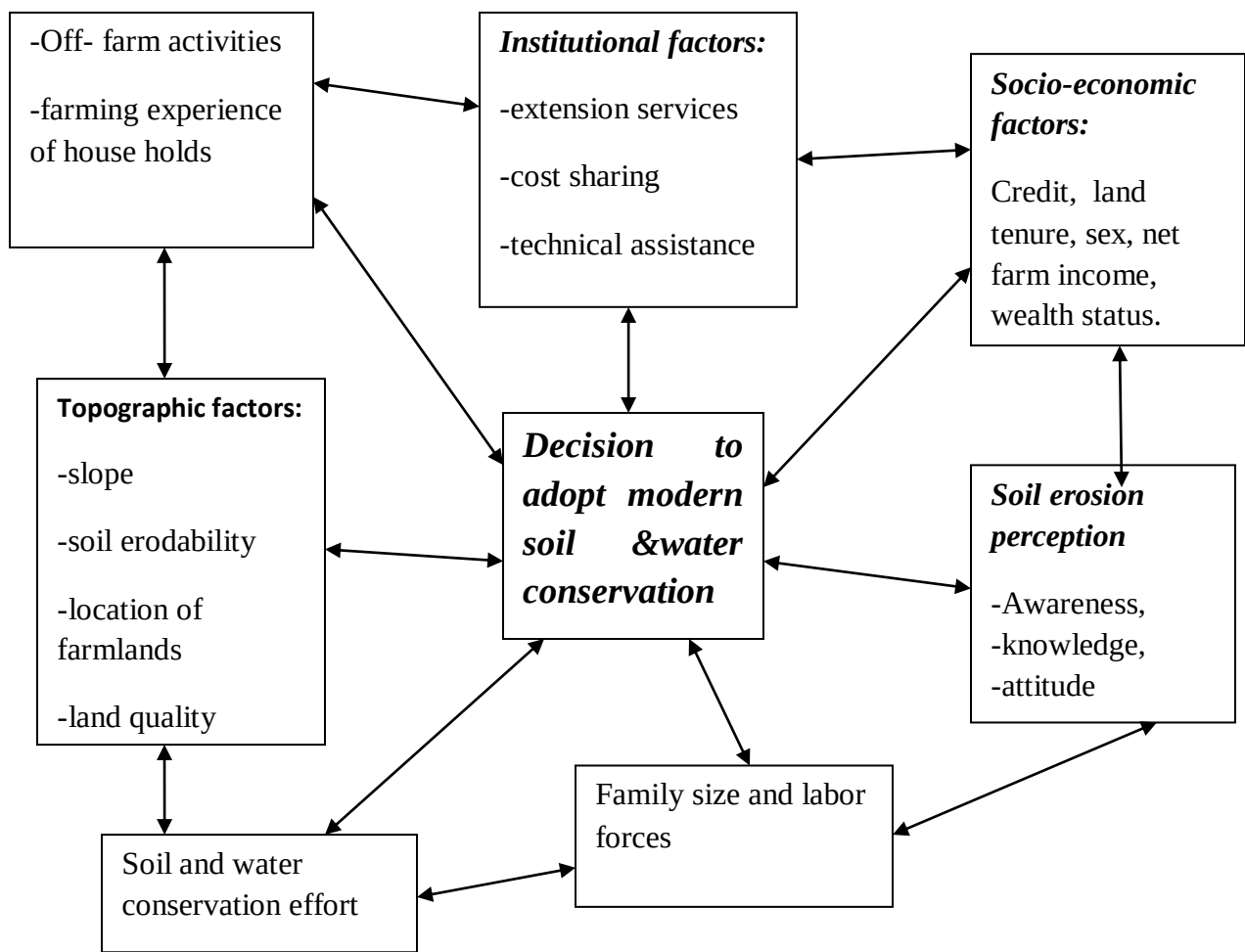
CHAPTER TWO

Review of related literature

This part of the study is used as under pinning conduit since it lays the theoretical framework for the study. Different books, journals, proclamations and land protection policies were used to strengthen the finding of the study based on the subsequent parts.

2.1. Conceptual frame work of the study

A schematic presentation of conceptual framework on farmer's practices and factors influencing the adoption of soil and water conservation which will guide this study is presented in fig.2.1



Source: Adapted from Ervin and Ervin, (1982)

Figure 2.1 Conceptualization of factors influencing soil and water conservation adoption.

This conceptual framework shows the inter linkages between the topographic factors and decisions to accept soil and water conservation structures in the study area and the cause-effect of each factors on soil and water conservation measures. While poor decision of acceptance may promote land degradation and the reverse would take place recover and increase agricultural productivity of farmlands. The aim of addressing such type of factors that influencing the adoption of soil and water conservation measures may enhance productivity of farmlands. In this study adopters are farmers who have a plot of land on which conservation practices have been put up. Thus, the dependent variable is a function of topographic, socio-economic, and institutional factors. Increasingly, the negative consequences of the above factors which are presented diagrammatically may have explored in this research work in detail.

2.2. The Innovation-Diffusion Theory

The innovation-diffusion theory as elaborated by Rogers (1983) provides the theoretical foundation for this study. Rogers (1983:5) defines diffusion as “the process by which an innovation is communicated through certain channels over time among members of a social system”. An innovation, according to Rogers (1983:11), is “an idea, practice, or object that is perceived as new by an individual or other unit of adoption”. For the purpose of this study, soil conservation practices such as stone / soil bunds are considered as innovation.

The innovation-diffusion model states that a technology is passed on from its source to end users through a medium of agents and its diffusion in potential users for the most part dependent on the personal attributes of the individual user. The model assumes that the technology in question is appropriate for use unless hindered by the lack of effective communication (Negatu and Parikh, 1999:208). According to Rogers (1983), a number of factors act together to influence the diffusion of a certain innovation. The four major factors that influences the diffusion process are the innovation itself, how information about the innovation is communicated, time and the nature of the social system into which the technology is being introduced (Rogers, 1983). Diffusion / adoption research analyses how these factors and a number of other factors act together to ease

or obstruct the progress of the adoption of a specific technology among its final user (Surry, 1997)

2.3. Concepts of soil and water conservation

Soil and water conservation refers to a set of various management methods and measures used to regenerate or rehabilitate, preserve and sustainably use of the renewable soil, water and plant resources to enhance the communities' livelihoods and environmental protection (Pender, 2005).

Moreover, SWC is the prevention of soil erosion on cultivated farmlands and on other lands depends essentially on the reduction of soil detachment and run-off and on the maintenance of adequate vegetation ground cover. Soil and water conservation is preventing at least reducing the effects of soil erosion and maintaining the soil quality. SWC consists of any set of measures and practices in order to ensure the soil functions for long-term use by humans and nature and obtain a sustainable agricultural production (Tiffen et al., 1994).

Nevertheless, when introducing soil erosion control and flood prevention measures in a certain watershed, best management practices are mostly able to decrease erosion rate but unable to restrict a surface run-off substantially. For this reason it is necessary to apply a whole system of soil and water conservation measures. In places with long slope technical and biotechnical soil erosion control practices are necessary. These biotechnical measures are broad base terraces and channels. These biotechnical measures together with the implementation of grassed causeways of concentrated surface run-off (grass water ways) create an appropriate network of new hydro lines as permanent barriers or obstacles for run-off and are designed in order to determine by their location, and the ways of land management system (Nyssen et al., 2009).

Furthermore, soil and water conservation structure construction demands huge resources (finance, labor, material and equipment), adoption and recommendation of SWC intervention should be challenges to implement SWC measures (Graff, 2004). Moreover, the food-for-work incentive used to develop SWC measures tends to create dependency syndromes and undermine people's effort to implement SWC measures. The dependency links with the role of the state

farmers develop a feeling of paternalistic dependency that they are unable to practice or manage SWC without artificial incentives and continuing assistance (Bunch, 1999).

The integration of different SLM practices and technologies to make SWC measures more effective and enhance soil productivity is seldom consideration (Tiffen et al, 1995). Moreover, technical requirement of the measures are often forgotten. The purpose and usefulness of different SLM components are miss-understood. Often SWC measures, mainly physical conservation are confused with SLM and many think the problem is solved simply by constructing these structures. SWC structures mainly reduce soil loss and run-off and enabling environment for further soil improvements (Graaff, 2007).

2.4. Soil erosion in Ethiopia

Natural resource degradation is the main environmental problem in Ethiopia. The degradation mainly manifests itself in terms of farmlands where the soil has either been eroded away and / or whose nutrients have been taken out to exhaustion without any replenishment (Million and Kassa, 2004). The majority of the farmers in rural areas of Ethiopia are subsistence-oriented, cultivating impoverished soils on sloppy and marginal farmlands that are generally highly susceptible to soil erosion and other degrading forces / factors.

The Ethiopian highlands have been experiencing declining soil fertility and severe soil erosion due to intensive farming on steep and fragile farmlands and other factors attributed to population pressure (Hurni, 1993). Soil erosion is a phenomenon, which mainly occurs in the highlands of Ethiopia (areas > 1500 meters above sea level) which constitute about 46% of the total area of the country, support more than 80% of the population, and account for over 95% of the regularly cultivated farmlands and about 75% of the livestock population (Bekele and Holden, 1999).

2.5. Extent of soil erosion

During the last 40 years, nearly one-third of the world's arable farmland has been lost by erosion and continues to be lost at a rate of more than 10 million hectares per year (Pimentel et al., 1995). Although many countries of the world suffer from the problem of accelerated soil erosion, the developing countries suffer more. This is because of the inability of their farming populations to replace lost +soils and nutrients (Erenstein, 1999, Cited in Selamyihun, 2004).

Ethiopia is one of the third world countries affected by soil erosion severity and is one of the most environmentally troubled countries in the sub-Saharan Africa (Fitsum et al., 2002). In Ethiopia, the largest proportion of the degraded farmland is situated in the woinadega agro-climatic zone where about 72% of cultivated farmland of the country is concentrated (Zewdie, 1999). The living conditions of the rural poor in Ethiopian highlands have been worsening because of drought and increasing deterioration of the quality and quantity of natural resources, which are the main basis of subsistence agriculture (Yitayew et al., 2006). The same study predicted that serious soil erosion is estimated to have an impact on twenty five per cent of the area of the highlands to the extent that they will not be economically productive again in the foreseeable future. The capacity of the highland farming communities to sustain production is, therefore, under serious pressure. Wood (1990) described severity of soil erosion in Ethiopia and indicated that erosion reduces the countries food production by one up to two percent annually.

2.6. Causes of Soil Erosion

Soil erosion is a natural process and worldwide phenomenon. Today soil erosion has increased to the point where it far exceeds the natural formation of new soil. As the demand for food climbs, the world is beginning to mine its soils, converting a renewable resource into a non-renewable one (Brown and Wolf, 1984). The problem of soil erosion is not only the threat for the developing countries, but also it is the threat for agriculturally sophisticated world. For instance, Brown and Wolf (1984) describe that even in an agriculturally sophisticated country like the United States; the loss of soil through erosion exceeds tolerable levels on some forty four percent of the croplands. The ceaseless growth demand for agricultural products contributes to soil erosion in many ways. Thus, throughout the Third World, farmers are pushed onto steeply sloping, erosive land that is rapidly losing its topsoil. In other areas farming has extended into semiarid regions where farmland is vulnerable to wind erosion when plowed (Brown and Wolf, 1984).

In Ethiopia the severity of soil erosion can be attributed to intense rainfall and rugged and dissected nature of the topography with nearly 70 percent of highlands having slopes exceeding 30 percent. Rapid population growth, cultivation on steep slopes, clearing of vegetation, and overgrazing are the main factors that are accelerating soil erosion in Ethiopia (Lulseged and Paulos, 2008). In the highlands of Ethiopia, deforestation has reduced tree cover to 2.7 % of the

surface area. About 50–60% of the rainfall is estimated to be lost as run-off, carrying 2–3 billion tons of the top soil away annually (Hurni, 1988). The annual rate of soil loss in the country is higher than the annual rate of soil formation. Hence, the underlying cause for the excessive rate of soil loss is the unsustainable exploitation of the farmland resource which is manifested by extensive de-vegetation for fuel wood and other uses and expansion of cultivation and grazing into steep land areas (Kibrom and Lars, 2000; Woldeamlak, 2003; Aklilu and de Graaff, 2006).

Besides, despite the considerable efforts made to develop and promote different types of soil and water conservation technologies, acceptance, adoption and sustained use by the farmland users have not been widespread for various reasons (Bekele and Holden, 1998; Aklilu and de Graaff, 2006; Alemayehu, 2007; Woldeamlak, 2007; cited in kibemo, 2011). Soil erosion is as well caused by lack of efforts in conservation and largely remains a problem to be tackled at ensuring food security, poverty reduction and environmental sustainability. According to Paulos (2004), soil erosion has led to the degradation of agricultural farmlands and consequent reduction in agricultural production thus exposing the population to food insecurity.

2.7. Consequences of Soil Erosion

According to Brown and Wolf (1984), the loss of topsoil affects the ability of farmland to grow food crop in some ways. It reduces the inherent productivity of farmlands, both through the loss of nutrients and degradation of the physical conservation structures. Erosion results in higher fertilizer requirements, and lower yields. When there is a loss of topsoil, they may increase farmland productivity by substituting energy in the form of fertilizer, or through irrigation to offset the soil's declining water absorptive capacity. A loss of topsoil may experience either a loss in farmland productivity or rise in costs of agricultural production and conservation.

Moreover, Brown and Wolf (1984) stated as the apparent increase in soil erosion over the past generation is not the result of a decline in the skills of farmers but rather the result of the pressures on farmers to produce more. Throughout the Third World Countries, increasing population pressure and accelerating loss of topsoil seem to go hand in hand. This is true to Ethiopia, particularly, in its highlands. As stated by Hurni (1993); Sutcliffe (1993); MoARD and World Bank, (2007), soil erosion by water constitutes a severe threat to the national economy of Ethiopia. To this end, Stoorvogel and Smaling (1990) reported that Ethiopia has among the

highest estimated rates of soil nutrient depletion in the Sub Saharan Africa which reduces productivity and increases vulnerability to drought. Moreover, [FAO \(1986\)](#) estimated soil erosion to cost Ethiopia on average 2.2 percent of land productivity annually from that of the 1985 productivity level. In addition, [Sutcliffe \(1993\)](#) also estimated that erosion costs Ethiopia two percent of its GDP between 1985 and 1990. Besides to these, [Sonneveld \(2002\)](#) discussed that the cost of erosion in Ethiopia is very high and it accounts more than anticipation per year. This shows that the trend of the impact of erosion is increasing from time to time rapidly in the country.

2.8. Practices and Implications of Soil and Water Conservation in Ethiopia

Soil and water conservation practices exist as indigenous knowledge in some areas of Ethiopia (Nyssen et al. 2007; Watson and Currey 2009). For instance, the Konso people in southern Ethiopia are known for traditionally well developed terraces, where the terrace practices are registered by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as a world heritage. The Konso terraces are estimated to be older than 400 years. Some rudimentary and poorly established terraces and lynes depicted on older aerial photographs and physical remnants can also be observed in different parts of the northern highlands. For example, Nyssen et al. (2007) reported old lynes in the Tigray region (northern Ethiopia). This is an indication of indigenous knowledge on SWC practices, and terracing is not only limited to the Konso area but is also found in other parts of the country. However, the SWC in Ethiopia covered very few areas and most of them, except those in Konso, have limitations in layout and construction quality (Nyssen et al. 2007; Watson and Currey 2009).

Since soil degradation is a major threat for agricultural yield it is also threat economic growth of developing countries like Ethiopia (this is because the economy of LDCs is highly dependent on agriculture. One way of controlling the adverse effect of soil erosion is adopting the appropriate technology which prevents soil erosion. That is soil and water conservation technology. SWC, therefore, technology is one which is implemented since the mid 1970s in Ethiopia (Alemu, 1999). Typical SWC technologies used in Ethiopia include soil bunds, stone bunds, grass strips, waterways, trees planted at the edge of farmlands, contour ploughing, and irrigation (chiefly water harvesting) (Kato, et al 2009).

2.9. Farmers' perception on indigenous and modern soil and water Conservation technologies

Indigenous knowledge is one of the inherited and transferred from generations to generations. As reality indicated that it is still continuously and widely practiced activities across different agro-ecological and socio-economic parts of the country. One of its silent features of indigenous technology has provided short, medium and long term benefits to the farmers' (Yohannes, 1999).

The indigenous conservation measures such as contour ploughing & drainage ditches can be made at time of normal field operation. This leads to discourage farmers to practice local technology and was under estimated its activities (Yohannes, 1999). The most perceived and preferred indigenous technologies by the farmers are drainage ditches, animal manures, fallowing and crop rotation and contour ploughing (Bahru, 1993). Another study was under taken in southern Ethiopia (Gununo), indicated that farmers' have perceived process and effect of soil erosion and they have also a very good indigenous working knowledge of the different conservation practices & maintaining fertility of soil on farmlands. They revealed a positive attitude towards soil conservation and preference as well as implementation of field ditches using of manuring (Belay, 1992). Indigenous technology is not always contributing positively. It has its own shortcomings. The limited experience of farmers' in appropriate crop rotation pattern, fallowing practices, inability of farmers' to apply conservation based on farmers' practices, improper use of crop residue and the demand of manure changes to fuel wood are some of the problems associated with the technology (Shawel,1989).

On the other hands to modern conservation practices, since 1970's the introduce SWC technologies have been introduced through the government extension systems and aid of world food program (WFP), food for work (FFW) & campaign approaches (Yohannes,1999). These technologies were brought from abroad & tried to transfer to the Ethiopian farmers' to solve the problems of land degradation. The department of SWC was given the responsibilities to implement as to local condition (Million, 2001). However, these technologies have been

encountered and saw negatively rather than the sight of the positive importance. Many farmers' have identified that the technology do not always suit for their specific desires & needs to solve their immediate problems (Mulugeta, 1992; Million, 2001; and Yohannes, 1999). The induced technologies have long term benefits & importance but the farmers' were thought to be less motivated and interested to practice on farmlands. They usually resist without understanding the strength and weakness of each conservation for last long. The hope and desire of the farmers' was to get immediate benefits and to increase the production from treated farmlands in order to continue the practical application of new technology (Aklilu, 2000).

Moreover, Yohannes (1999) added poverty & lack of awareness on land degradation and marginalization of farmers' at time of decision making contribute to fail. Another research viewed ignorance and lack of education of farmers as contributing to fail. The majority of farmers' in Ethiopia revealed that they are reluctant to materialize new technology to maintain the damaged structures, to keep animal tramping, frequent encroaching and seedling without the reinforcement of the government (Mulugeta, 1992; Bahru, 1993). Different studies at different time reached and pointed out that farmers' have blamed the majority have revolted against the acceptance of modern conservation technologies. The complains of farmers' are associated with the following draw backs: Its narrowness for ploughing , losses of the substantial farmlands (out of use) , the demands of much labor and encourage formation of water logging at flat, land solidness at steep slope and artificial water way to form gullies (Yohannes,1999; Berhe,1996; Woldeamlak, 2003; and Belay,1992).

In the contradictory, the study in the southern Ethiopia (Guraghe highlands) revealed that majority of farmers' considered new technologies as to be effective in arresting soil, increasing water holding capacity of soil, increasing or stabilizing crop production and have potential of productivity (Bahru,1993). Another study in wolayita (Kindo Koisha), farmers' perceived the new technology positively and the views of one farmer as indicated below (Eyasu,2002,166). "The fertile top soil of my farmlands used to in Omo River. But now I am able to retain the top soil on my farmlands and carefully maintaining the bunds in addition to traditional soil conservation practices."

2.10. Factors affecting adoption of soil and water conservation measures

Understanding why small-scale farmers' adopt SWCPs is complex. Biophysical and socio-economic factors are important in this process. The literature indicates that such factors include age, education level, gender, cultural influence and practices, household income, farm size, farm slope, land tenure, access to extension information, distance to markets, access to labor, attitudes and perceptions, and population density. Berger (2001) examined innovation adoption dynamics and concluded that cost-benefit analyses or household-decision models alone could not explain the patterns here observed.

2.11. Socio- economic factors

Age is one of the demographic variables which can affect the adoption of soil and water conservation practices (Lapar and Pendey, 1999; Wogayehu and Drake, 2003). A study made by Tengete et al, (2004) in Tanzania showed as both the oldest and youngest households showed low adoption rate of recommended conservation measures. However, Bekele (1998), Wogayehu and Drake (2003), in their studies in different parts of Ethiopia found negative association between existence of conservation measures (adoption) and age of households. Habtamu (2006), also confirmed that older household heads had little tendency to adopt soil and water conservation. The same result was found in Philippines by Lapar and Pendey (1999).

On the other hand, younger farmers would be more accommodative to new ideas and would invest in new and long term innovations. For these reasons, the influence of age on adoption could not be determined a priori. However, in the analysis for this study, age took a positive sign and was not significant. Thus, older farmers are likely to adopt SWC technologies than their younger counterparts. This can be explained by the fact that older farmers have more farming experience as compared to the younger counterparts

Land tenure is also one of the factors constraining the adoption of rainwater harvesting technology and soil conservation measures. For instance, one of the reasons for low adoption of rain water harvesting technology in the coastal province of Kenya has been that people do not want to invest on land which may in the future belong to somebody else (Muthamika, 2003). Daniel (2007) contends that secured land tenure rights are essential to induce farmer investment in rainwater harvesting technology and maintenance. Other factors constraining the adoption of technology in the sub-Saharan Africa include low level of awareness and sensitization,

inappropriateness to the local needs, institutional and socio-cultural impediments among other things (Ngigi, 2003).

The adoption of technology is influenced by multiple factors. Workneh (2005) states that adoption decisions of farmers are influenced by farmers perception on the suitability of technology, economic profitability of its net economic return, contributions of the technology to various needs, goals of farmers (for example risk minimization food security, cash need etc.) and farmers perception whether adoption of the technology is to achievement of these goals as well as poor institutional services like extension, credit marketing and resource tenure.

CHAPTER THREE

Research Methodology

This study focused on assessing farmers' practice and factors affecting the adoption of induced SWC measures / technologies in Wegdi Woreda and to put some applicable solutions that need to forward practices. Thus, to rich at this goal, descriptive survey design was employed to collect the study data. Descriptive survey design is appropriate to gather several types of data on conditions that exist, practiced and employed structural SWC measures by farmers on their farmlands and trends regarding its practices.

3.1. Sampling techniques and procedures

By considering the characteristics of population segments (female, male, different wealth status and position groups) the researcher considers purposive proportionate sampling techniques to obtain adequate data. This research paper is based on a case study method. In addition, it has used primarily qualitative research method and supplemented by quantitative data obtained from primary sources 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 factors that influence the adoption of induced SWC measures which is being implemented by farmers in Wegdi woreda and to evaluate their effects. Attempt was made to recognize adopted structural soil and water conservation measures. Thus, the type of research used is exploratory through qualitative description and narration. Wegdi district has a total population of 151,257 and structured with 34 rural kebeles and one urban kebele. Out of this total kebeles, the researcher selected three kebeles named lencho, Tungni and Taye. The three selected kebeles were comprised with a total population of 15,033. The sample size of 123 household heads were selected out of 2,316 household heads for this research work and covers 5.3% of the total households in the three sample kebeles. The sample household heads of the

three kebelles were selected purposely from the available list. The criterion which is used in selecting the sample households of the three kebelles were farming experiences of farmers, farmland holding size in hac, and capability of farmers to adopt modern structural SWC technologies in their local areas. The three kebelles were selected by purposive proportionate sampling techniques. They were selected based on the severity of soil erosion, topographic nature / slope /, implementation of induced modern structural SWC measures and population pressure on the farmlands.

Table 3.1 Distribution of sample households by kebele and farmland holding size

Sample kebelles	Farmland holding in hac	Number of farmers	Sample size	Percent
Tungni	≤ 0.5	279	15	26.7
	0.5-1	167	9	
	1-1.5	98	5	
	1.5-2	59	3	
	≥ 2	16	1	
	Total	619	33	
Lencho	≤ 0.5	295	16	34.2
	0.5-1	187	10	
	1-1.5	128	7	
	1.5-2	118	6	
	≥ 2	64	3	
	Total	792	42	
Taye	≤ 0.5	307	16	39.1
	0.5-1	291	15	
	1-1.5	153	8	
	1.5-2	110	6	
	≥ 2	45	3	
	Total	906	48	
Total		2,316	123	100

Source: field survey, 2013

3.2. Sample size determination

From the three kebeles, 123 (5.3%) peasant households would be taken by simple random sampling techniques for this research work. The reason why the researcher considered simple random sampling technique in the research work was to avoid partiality among farmers who are practicing and implementing induced structural SWC measures. Here also, the researcher would use stratified sampling technique to involve male headed households and female headed households, rich households and poor households as well as moderate income households.

3.3. Nature of data

Data that have relevance for the study were collected during the site visit. The data focused on farmers' practices and factors influencing the adoption of induced SWC practices in Wegdi Woreda. Furthermore, the data which were gathered include information about the problem of soil erosion and soil fertility decline. The data encompass information about farmers' practice to adopt induced techniques of SWC measures and determinant factors in connection with adoption and implementation of structural SWC measures.

3.4. Type and source of data

Both qualitative and quantitative data were collected through various methods. Such as field observation, focus group discussion, questionnaires, key informant interview, and participatory transect walk. These include both primary and secondary data sources. The importance of collecting and considering both primary and secondary sources through qualitative and quantitative methods of data collection complemented and supplemented the diverse data which were generated from different sources which in turn used to make the data and the result of the research reliable. The primary data were obtained from peasant households, elder farmers, and chairman of kebeles, development agents (DAs) as well as district soil and water conservation experts. While secondary sources were collected from various documents from Bureau of Agriculture and Rural development, Agriculture and Rural development office, Wegdi Woreda Agriculture and Rural development office, books, journals and other published and unpublished sources which are related with the research work. To address the specific objectives of the research, the following tools of primary data collection techniques were used in the research work.

A. Questionnaires

Questionnaires incorporate both close and open ended design questions and filled by peasant households through household survey. Prepared questionnaires were filled by selected sample households who were selected by lottery random sampling technique from the list of villages or 'gots'¹. These peasant households have adopted induced SWC measures on their farmlands. Model farmers were taken in to consideration with regard to factors affecting adoption of SWC measures and their practices on farmlands and around their villages. They are taken proportionally, from each villages or 'gots'. This raises the total number of household questionnaires.

B. Field observation (FO)

To generate required data, field observation should be carried out. Soil and water conservation works of farmers such as modern check dams, waterways, soil bunds and stone bunds were observed in the three kebeles (Lencho, Tungni, and Taye kebeles). The observation was practical with the assistance of administrator of each kebeles and Development Agents (DAs) through what is called participatory field observation.

C. Focus group discussion (FGD)

Focus group discussion was conducted with farmers who have been practicing induced structural soil and water conservation measures and non adopters of induced structural conservation measures. The farmers have certain problems which is influencing their day-to-day practices of structural conservation measures to reduce soil loss in their locality. For this purpose peasant households from each villages or 'gots'¹ were selected randomly. These farmers obtain their livelihoods from agriculture and agricultural activities. Every peasant households from each village was organized in to one focus group. All households have the same sex .They are male (since there are some female headed households in the kebele. Accordingly, 12 selected peasant households were organized into groups. After organizing in to groups, two focus group discussions were conducted in the three kebelles to generate the required data from the whole sample kebeles. The selected households have the same socio-economic and cultural characteristics within the rest of the peasants.

¹***Got*** is the lowest administrative unit of the study kebelles



Source: own field survey, 2014

Figure 3.1: focus group Discussion with sample households in the field

D .Key informant interview

This was carried out by interviewing informants in connection to factors influencing the adoption of induced SWC measures. 16 key informants were included in the interview. The key informants were community leaders like kebele chairman and elder farmers. Other included key informants were soil and water conservation experts and development agents. Usually, elder farmers have a profound experience and knowledge about soil and water conservation measures.

E. Participatory transect walk

Transect walk with members of the farmers who have adopted induced SWC technologies would be made. It has focused mainly on observation of physical characteristics of soil and water conservation works and related practices in relation to degraded or well conserved areas as well as activities on farmlands. The participatory transect walk have involve some structured interviews with the local farmers about their practices and factors influencing adoption of soil and water conservation measures on their farmlands.

3.5. Methods of data analysis and presentation

The data which generated from different sources were analyzed using both qualitative and quantitative methods. The finding of the study was presented in tables, figures, graphs and charts. Some structured household survey data were analyzed quantitatively and qualitatively using percentages, frequency, cross-tabulation and descriptive statistics (by using statistical package for social science (spss) for the version of window 20) and MS excel.

Discussion was held with development agents, key informants and selected local people on soil erosion problems, & practices of induced structural soil and water conservation measures were also analyzed descriptively. Comparison between structural induced soil and water conservation techniques and other conservation measures would be made using descriptive frequency and multiple responses frequencies.

CHAPTER FOUR

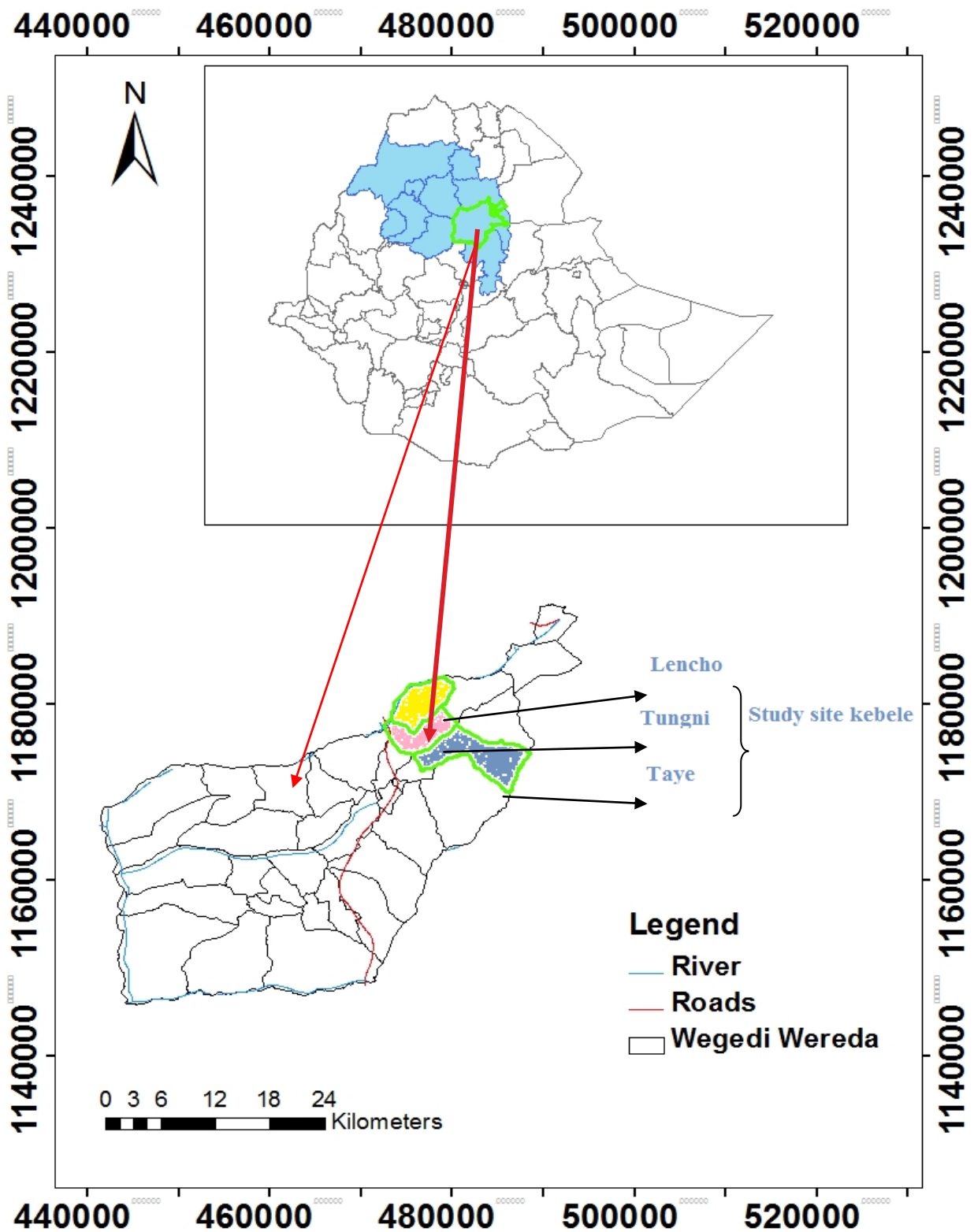
Description of the study area

4.1. Location, Topography and Soil Resources

Wegdi district is located in Northern central part of Ethiopia & its topographic feature includes mountains (12%), rugged lands / hills (27%), and plains (50%) as well as valleys (11%). Wegdi district is one of the 22 district in south Wollo zone which is located at 10⁰ latitude (North) and 38⁰ longitude (South west) tip of South Wollo zone & it is bordered by Kellela district in the east ; Mekane selam district in the west; Oromyia regional state in south & Legambo district in the north (fig 4.1). The altitude of the district ranges from 1,800 m to 2,400 m. A.M.S.L. The administrative capital city of Wegdi district is Wegdi town; it is far away 586 km from Addis Ababa and located North of it and also it is far away 185 km from Dessie town and located south west of Dessie town; the capital city of south wollo zone. The total area of the district covers 11,121.87 km². (Based on oral information obtained from the district finance office).

The wide diversity of climate, topographic situation, vegetation species coverage in the study area has bring to rise marked diversity of soil and animals in the area. In the district no detail study of soil was made. Based on the farmers' classification the dominant and major soils of the district are black-brown vertisol to white sand soils in woina dega and kolla areas respectively. The black-brown vertisol soils are more fertile and productive than grayish soil types which is located in the low land areas of the district. The soil nature of the woina dega has high water holding capacity and susceptible to erosion and gradually decline its productivity. In addition to this, the soils of the area also characterized by sticky and crack during wet and dry seasons respectively. Whereas, the soils which is found on the flat slopes are more grayish and leaning to water logging during rainy seasons but less susceptible to erosion. Thus management of soils of the area likely depend on soil types, soil fertility, slope of the land, water holding capacity of the soils and workability of the soils. Application of animal manures, crop residues, and mulching

the farmland is very limited and tends to releasing of soil moisture. Farmers are not well aware about these applications and its benefits.



Source: Ethiopian Mapping Agency, 2013

Figure 4.1: Map of the study area

4.2. Climate and water resources

The district is a typical of woina dega agro-ecological zone (55% woina dega, 40% kolla and 5% dega zones). The mean annual total rain fall ranges from 600 mm to 1500 mm and has an average maximum temperature ranging from 25⁰c to 30⁰c. It has two rainy seasons, kiremt and belg. Belg is the shortest rainy season of the district and lasts between March and May. On the contrary, kiremt is the longest rainy season which lasts between June and August. More than 90% of the total rainfall amount has been recorded during kiremt months. The rain which is raining during the kiremt season is more intensive, erosive and caused severe soil erosion. (Based on oral interview from district finance office).

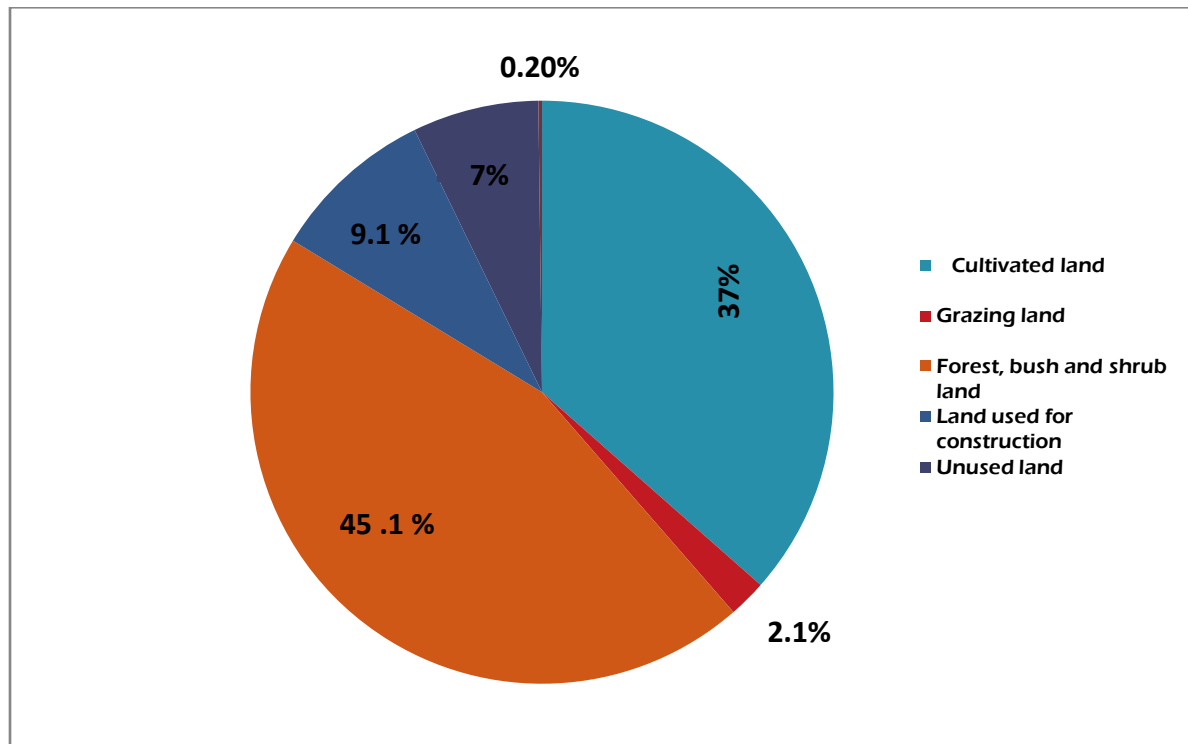
Most of the crops which are growing in the study area are produced during the kiremt season. On the reverse, the belg rain is used to produce chick-pea, lentils, and barely. In the kiremt season excessive rainfall causes huge amount of soil loss and crop damage. The amount and distribution of rainfall is declining from time to time due to climatic change.

Altitude, latitude and precipitation have played significant role on the climatic conditions of Ethiopia. According to the district agricultural office, the warmest months of the study area are April & May. On the other hand, the coldest months are October and November. In the district 85% of the populations have access to adequate water supply. About 80% of water supply comes from deep wells, streams and springs. Only 20% comes from modern tap water sources. The entire area is drained towards Abay River in the south west direction of the district. In the study area, there is only one stream (named, Legelencho river) which separates the two adjacent study kebelles (Tungni and Taye). There is also some permanent flowing springs which is used as sources of drinking water for the district town and rural community as well as for their animals. (Based on oral information obtained from district water and energy office).

4.3. Land use pattern and Vegetation cover

According to the WoA, the study area has long history of land use with high erosion damages, particularly with variation of land slopes. The area is currently covered with some remnants of plant species which is shown in the area with scattered tree species distributions. They are located here and there with limited coverage areas. However, the vegetation covered area has been removed and replaced by cultivable farmlands and plantation took place with exotic tree

species like eucalyptus and sespania. As the trend analysis of forest coverage, particularly in Tungni and Lencho kebelles; was 65% before 1970s. Between 1970 and 2000 the forest area coverage declined to 45.1 %. The main reason for this rapid decline of forest coverage area was excessive deforestation due to dramatic population growth and expansion of agricultural farmlands. Thus, like the remaining part of the country, the natural vegetation of the study area has been influenced by the interference of human being activities. Likewise, the forestland, grassland and shrub land grazing gradually changed in to farmlands due to human being interferences to attain additional farmlands. Based on data obtained from woreda agricultural office evidences, the total area of the district is estimated to be 11,121.87 km². In the study area six land use types were identified in the district (fig.4.2).



Source: Wereda agriculture office, 2012

Figure 4.2: Land use – Land cover patterns of Wegdi Woreda

Some common grazing lands existing in some pocket areas of the district and farmers graze their animals. Due to shortages of grazing lands, farmers own small number of domestic animals. In spite of that, accelerated soil erosion and soil fertility decline become the main problem of the area due to removal of forest coverage.

4.4. Crop production and economic activities

Agriculture is the main stay of the district economy. The rural farmers of the study area predominantly practiced subsistence farming activities. The practiced farming system in the study area characterized as high potential of cereal crop production. The dominant cereal crop which is growing in the study area includes teff, wheat, chick-peas, lentils, sorghum, bean, and maize. All of these crops could grow with and without commercial fertilizer application since the soil fertility is insufficient. Almost all types of crops that are produced within the district are used for home consumption and also for sale. Wheat, sorghum and teff are staple food crops in the study area. But wheat and teff are more common staple food crops in the study area. Except, lentils and chick-peas, all the remaining crops are grown once a year during the long rain season (kiremt). Agricultural productivity decline year to year. Economically, agriculture is the main stay of the livelihood of households. Majority of the people experienced and characterized by traditional mixed farming system or activities which includes both livestock rearing and crop production. More of these activities are rain-fed oriented and leads to occurrence of drought and food crop productivity failures / food insecurity.

Table 4.1. Area & production of various crops in Wegdi Woreda

Crop types	Area(in hac)	% of the area	Production in(Qt)	% of total production	Yield (Qt/ha)
Teff	13,819.5	52.8	483682.5	48.5	35
Cereal	342.9	1.3	6858	0.7	20
Barely	157	0.6	2355	0.2	15
Wheat	4849.5	18.5	203679	20.4	42
Maize	523	2	19874	2	38
Sorghum	5972	22.8	268740	26.9	45
Pulses	410	1.6	9020	0.9	22
Oil crops	126.3	0.4	2273.4	0.2	18

Source: Woreda agriculture office, 2013

Land is scarce resource in Wegdi woreda. Arable land size is declining from time to time as a result of rapid population pressure. In Ethiopia land is a state property & farmers have use rights on their possession. Due to frequent redistribution of farmlands, the farmland is getting too small and fragmented.

4.5. Settlement pattern of the study area

The study area has high population density. Majority of the farmers in Wegdi woreda built their house on the plateaus and plains. Their sons usually construct houses around their parents' home and form a village. Therefore, village is a collection of several individual houses. This situation leads to fragmentation and more closeness of homesteads and occurrences of overgrazing of range lands as well as declining of farmland productivity. When fragmentation of farmland occurred in the study area, the number of cut-off drains and gully development are commonly increasing. This reduces farmland holding size, and reduce amount of yields and biodiversity.

CHAPTER FIVE

RESULTS AND DISCUSSIONS

This chapter attempts to deal with the presentation, analysis and interpretation of data obtained from the selected sample respondents of the study area. This chapter has been made to discuss the state and level of farmers' practices and factors influencing the adoption and practices of induced structural SWC measures in Wegdi Woreda. The presentation, analysis, and interpretation of obtained data were present as follow.

5.1. Socio–economic Characteristics of Sample Respondents

Based on the National Population and Housing Census reports of 2007, the total population of the district was about 151,257. In the study area there is only one ethnic group. According to the district cultural and tourism office, the two dominant religious groups in Wegdi woreda are Muslim and Orthodox Christians. Their proportion in percentage is 64.23% and 35.77% respectively. The CSA (2007) reported the population of Wegdi district declined due to rural out migration of young (adult) people. Male population of the district accounted for about 49.4% of the total population and the remaining 50.6% were female population in the district. They dominantly participated in agricultural activities and reside in rural areas as well as experiencing food insecurity.

Table 5.1. Population size by sex and year in the sample kebelles

S.No	Kebelles	Population size by years						
		2010			2011/ 2012			Remark
		Male	Female	Tot al	Male	Female	Total	Increase/yea
1	Tungni	1,225	1,390	2,61 5	1,597	1,415	3,012	397
2	Lencho	2,068	2,188	4,256	2,437	2,642	5,079	823
3	Taye	3,058	3,099	6,157	3,359	3,423	6,782	625
Total		6,551	6,877	13,438	7,393	7640	15,033	1,595
Town		2,456	2,766	5,222	2,985	3,079	6,064	842
District		72,475	73,365	145,840	74,668	76,589	151,257	5,417

Source: Wegdi district finance and statistics office, 2012.

The population and characteristics of households are greatly related with the supply and demand of basic human necessities which in turn affects the use of induced modern agricultural technologies. Here, identifying socio-economic and institutional characteristics of sample household is very important. As a result, in the following portions of this chapter, the socio-economic situations of the selected sample households and its effect on induced structural SWC measures are discussed.

5.1.1. Demographic characteristics of sample households

5.1.2. Age, Sex and Size of households

Age of household members can affect overall practices of structural SWC efforts that exercised by farmers or households. Through long year experience, farmers perceived and understand the problem of soil erosion and decline of farmland soil fertility as well as the use of improved SWC technologies in controlling soil erosion. Sample farmers might understand the major factors influencing the adoption of structural SWC measures and use of traditional indigenous SWC measures by integrating with modern induced structural SWC technologies to preserve / improve farmland fertility.

Table 5.2. Age and Sex of Respondents' cross-tabulation

Variable	Category	Sample Kebeles						grand total	
		Tungni		Lencho		Taye			
		Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Sex	Male	30	24.3	36	29.3	40	32.6	106	86.2
	Femal	3	2.4	6	4.9	8	6.5	17	13.8
	Total	33	26.7	42	34.2	48	39.1	123	100
Age	20-29	2	1.6	5	4.1	8	6.5	15	12.4
	30-39	20	16.2	25	20.4	29	23.6	76	60.2
	40-49	6	4.9	7	5.7	7	5.7	24	16.2
	≥50	5	4	5	4	4	3.2	14	11.2
	Total	33	26.7	42	34.2	48	39	123	100

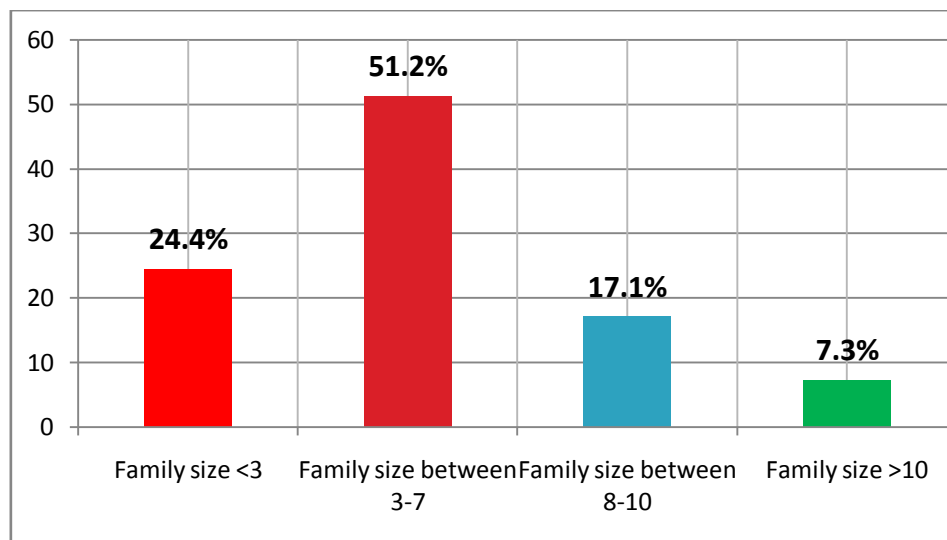
Source: field survey, 2013

As Table 5.2 shows that out of 123 respondents, the distribution of sample household heads by sex constitutes 86.2 % and 13.8 % males and females respectively. Here, female household heads of Wegdi woreda are adopters of biological SWC measures. This is happened due to biological difference between male and female households head. Biological structural SWC measures are less labor intensive than physical structural measures. Mostly, biological (agro-forestry) SWC measures practiced in garden and peripheral areas of homestead farmlands where as physical structural conservation measures SWC mainly adopted by male headed households on farmlands and it is more labor intensive measures. About 60.2 % of respondents have age between 30 and 39 years and about 16.2 % of respondents are between 40 and 49 years followed by 12.4 %, and 11.2 % for age group from 20-29 years, and above 50 years respectively.

Both mean and median age of sample household respondents is about 39 years. Concerning to age structure of respondents and adoption of structural SWC measures, age group from 30-39 years adopted physical structural SWC measures than age group less than twenty years old. This could be indicate greater activity is performed in the adoption of SWC measures and its conservation practices more displayed by the middle aged farmers who were both set up in their

farming activities and still expecting a number of years in farming. Thus, relatively more experienced farmers are better in managing their farmlands than less experienced farmers. In addition, possessing the capacity and inclination to make investment in the farm business depends on age of the farmers. Even though, age of the households and perception on land degradation were related positively, applying fertilizer and any conservation measures decrease (Fitsum and Holden, 2003).

Older farmers were likely to be relatively reluctant in their decisions to accept new conservation technologies because of their short planning horizon. However, it is also true that older farmers were likely to have more farming experience and would therefore be likely to be less receptive to new SWC technologies (Wegayehu and Lars, 2003). On the other hand, younger farmers would be more interested to accept new ideas and would invest in new and long term innovations.



Source: own field survey, 2014

Figure 5.1 Household Sizes of Respondents

Figure 5.1 shows distribution of households. The graph shows that about 51.2 % of the households had 3-7 members while 24.4 % of the households had < 3 members and 17.1 % and 7.3 % of households had from 8-10 and > 10 members respectively. Households with large family members practiced induced structural SWC technologies particularly physical structural conservation measures than households with small family size. Because there is labor available in the family. Because, physical structural conservation measures are more labor intensive and requires huge capital to invest on it.

5.2. Educational Level of Respondents

Households with better education are expected to be more aware of new conservation technologies and thus more likely to adopt it. However, more-educated households may be less prone to adopt labor intensive technologies if they have higher labor opportunity costs as a result of better opportunities of the farm activities. Low level of education and high illiteracy rate is a typical characteristics of developing countries like Ethiopia. In fact, educational level of farmers' is considered to increase the ability to get and use of agricultural related information and improved conservation technologies. To analyze the responses of sample farmers regarding the introduced structural soil and water conservation measures by education, household heads were divided into four groups (Table 5.3). Majority of farmers that removed structural induced soil and water conservation structures completely fell in the group is illiterate. Large proportion of farmers that removed conservation structures selectively who have lower status of education level. Conversely, farmers may maintain structural SWC measures when they had better education level and showed an increasing trend with increasing educational attainment (Table 5.3).

Table 5.3: Educational level of sample households / farmers

Educational level of farmers	Household respondents	
	Frequency	Percent
Illiterate	62	50.4
Read and write	41	33.3
Primary	11	8.9
Secondary	9	7.3
Total	123	100

Source: field survey, 2013

In Wegdi woreda, 50.4 % of respondents did not attain formal education and were unable to read and write; whereas about 33.3 % of the respondents were able to read and write. Level of education with literate categories was about 8.9 %, and 7.3 % attaining primary and secondary education respectively (Table 5.3). Education level improvements appear to have contribution to several activities of agricultural intensification and modern technology adoption including

fertilizers, composting, practicing induced structural SWC techniques, planting trees, wind break, increasing access to information, higher management expertise (Ervin and Ervin, 1982). In this study the educational level variable has carried a positive sign implying that educational level of respondents is familiar with adoption of induced structural SWC methods. In relation to educational level of respondents who have schooling are adopters of structural SWC methods than those did not attend formal schooling.

5.3 Livestock holding of sample households

Traditionally, livestock in Wegdi woreda has been reared for different purposes. They are breed for providing food, dairy production, agricultural activities and transport purpose and as a means of asset because farmers kept their livestock as a safeguard for reducing unexpected risk management as they hold considerable capital asset resources. Animals are sold in the time of need for food, tax payment, and to bought clothes for family members. Livestock holding of sample farmers was divided into groups to analyze the response of farmers towards soil and water conservation structures. The percentage of farmers that destroyed conservation structures completely increased with increasing livestock holding (Table 5.4). Majority of farmers retained conservation structures in their original local area had livestock in the range of 4-6. Farmers that had large animal numbers, give more emphasis towards induced structural soil and water conservation measures to control soil erosion in their farmlands. They had many alternatives to apply modern structural SWC technologies.

“--- as one farmer explained, livestock population is taken as an asset of farmers that serve for different purposes. Each farmer in the study area breeds animals to fulfill their basic necessity and to pay their annual tax as well as to conserve farmlands and to harvest water droplets. Households with large livestock numbers intended to practice induced soil and water conservation technologies. They also used cow dung on the farmlands to recover and increase its fertility.”

From the informant farmers, one can realize benefits of owning large number of livestock. As livestock population number increase in each farmers homestead, the farmers highly intended to practice conservation technologies on their farmlands. Beside this, they had many alternatives to construct and implement modern conservation technologies.

Table 5.4: Livestock population of sample households

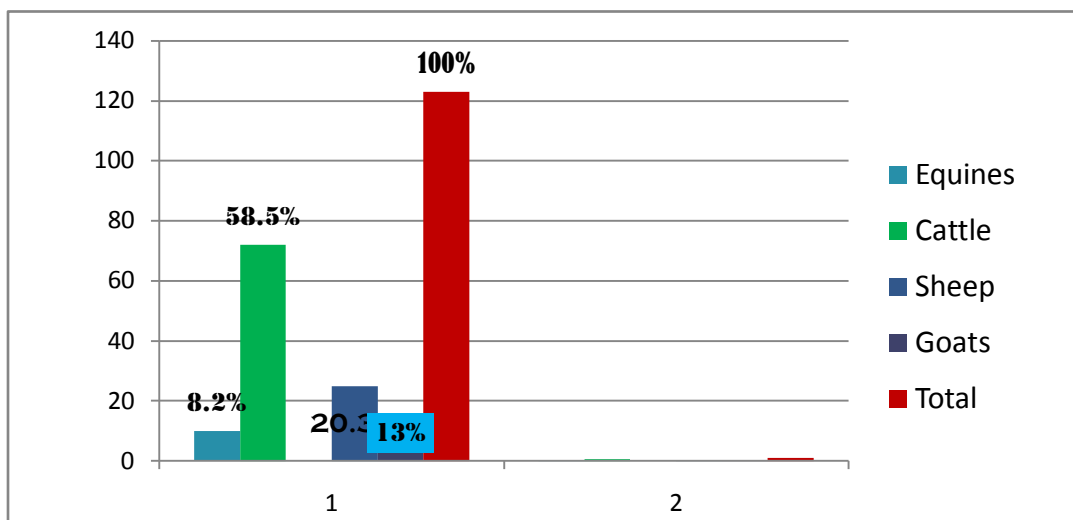
Livestock types	Alternatives	Sample respondents	
		Frequency	Percent
Animal rearing participant households	Yes	73	59.4
	No	50	40.6
	Total	123	100
Feed shortage for animals	Yes	85	69.1
	No	38	30.9
	Total	123	100
Causes of animal feed shortage	Marginalization of agricultural land	35	28.5
	Resettlement of farmers	19	15.4
	Land degradation	69	56.1
	Total	123	100

Source: field survey, 2014

According to Table 5.4 about 59.4% of the respondent's rare animal livestock in their local area and the remaining 40.6% of the respondents are not actively participated in livestock rearing.

In Wegdi woreda commonly reared animals are cattle (58.5%), sheep (20.3%), goats (13%), and equines (8.2%). The largest percentage share is taken by cattle and followed by sheep. At last, 13% and 8.2% is occupied by goats and equines respectively. As noted from the above (Table 5.4), 69.1 % of the respondents have faced feed shortage for their animals and 30.9 % of the respondents did not face feed shortage for their animals. From this we can understand that majority of the respondents' livestock breed is challenged by feed shortage.

On the other hand, as Table 5.4 shows that 56.1 % and 28.5 % of respondents pointed out land degradation and marginalization are the major causes that lead to animal feed shortage in their corresponding local areas respectively. 15.4 % of the respondents stated that resettlement of farmers is not extreme for the occurrence of animal feed shortage in the study area.



Source: Own field survey, 2013

Figure 5 .2 Livestock Holding of Respondents

Households that have enough animals were more interested to accept induced structural conservation technologies to control soil erosion and harvesting water to enhance soil moisture capacity in their farmlands. They used two pair of oxen to drawn plough and digging out cut-off drains as well as water ways.

5.4. Labor force of sample households

Labor is one of the most important factors of agricultural production activities. Without labor force any farming activities of agricultural practice may not be successful. Evidences from many parts of the world reveal that lack of control over resources is one of the major reasons for the degradation of natural resources; Such as, soil and water, range land, forest, etc. The size of labor force in the household is assumed to bring about differences in decision of farmers to use improved SWC measures. Farmers with large household members will be able to supply additional labor force that might be required for practicing structural soil and water conservation measures.

Table 5.5: Sample household labor force availability, types and shortage overcoming mechanisms

Characteristics	Alternative	Sample house hold respondents	
		Frequency	Percent
Labor force availability	Yes	45	36.6
	No	78	63.4
	Total	123	100
Ways of overcoming labor shortage	Using relatives	22	17.9
	By renting	2	1.6
	Daily labor	12	9.8
	Cooperation /debo/ wenfel	72	58.8
	Total	123	100
Types of hired labor force	Casual	72	58.8
	Permanent	28	22.8
	Both	23	18.4
	Total	123	100

Source: field survey, 2014

As Table 5.5 shows that the selected respondents of the study area did not have sufficient labor force to perform their farming activities. Out of interviewed respondents about 63.4 % of the respondents replied that there is labor force shortage to practice induced structural SWC measures in their farmlands. Only 36.6 % of the respondents replied that there is labor force access to perform farming activities. Here, we can understand that labor force is one of the decisive factors for agricultural production. So, farmers with labor force accessibility can able to acquire additional labor force for practicing induced structural SWC measures and technologies on farmlands.

Table 5.6 Sample households' agricultural activities and their participations

Characteristics	Alternatives	Sample household respondents	
		Frequency	Percent
Types of agricultural activities that need more labor forces	Tilling plowing	32	26.1
	Weeding	29	23.6
	Harvesting	26	21
	SWC activities	36	29.3
	Total	123	100
Female family involvement	Weeding	66	53.7
	Collecting crops and residues	23	18.7
	SWC activities	21	17.1
	Weeding &SWC	13	10.5
	Total	123	100
Participants of SWC activities	Children	14	11.4
	Women	9	7.3
	Men	97	78.9
	All	3	2.4
	Total	123	100

Source: field survey, 2014

As can be seen from Table 5.6, 29.3 % of the respondents reported that structural SWC activities need more labor forces and 26.1 %, 23.6 %, and 21 % of the respondents stated that tilling and plowing, weeding, and harvesting need more labor forces respectively. Here, it should be noted that induced structural SWC activities are labor intensive practices and need more intentions to be effective. Without knowledgeable and adequate labor force supply, structural soil and water conservation measures may not be effective. On the other hand, the table also shows that 53.7 % of female respondents are actively involved in weeding; the rest 18.7 %, 17.7 %, and 10.5 % of the female respondents participated in collecting crop residues, SWC activities, and weeding and SWC respectively. From this we can realize that females participate less in SWC activities. SWC measures are more labor intensive. As a result, female participants intended to apply biological

SWC measures than physical structural conservation measures because biological structural conservation measures are less labor intensive than physical conservation technologies.

In addition to this, as the table reveals that about 78.9 % men family members actively participate in SWC measures on their farmlands. The remaining 11.4 %, 7.3 % and 2.4 % of the household respondents were children, women and all the family members respectively. All in all, in the study area all family members are not equally participated in practicing structural SWC measures. The difference is resulted from low attitudinal perception regarding SWC structures on the sides of sex difference. Most farmers believe that female and children are not enough to practicing structural SWC measures and also stated that quality & strength may not long last where structural SWC measures made by these family members. As Lakew et al. (2005) reported that older and female farmers face difficulties in constructing structural soil and water conservation measures, but they could manage and maintain already constructed one.

Generally, agricultural activities in Wegdi woreda are predominantly practiced by male farmers. About 86.2 % of respondents were male headed farmers and the remaining share (13.8%) is occupied by female headed farmers. Even in group discussion held with 12 farmers, female farmers were only 5 and as per inclusion, hardly found so-called 'model' female farmers. As per the respondents, females become head of households upon the death of their husbands. Female farmers need help from male farmers near to them or elsewhere to build physical SWC structures on their farmlands. Constructing structural SWC measures demands equipments (hoe, shovel, and others), labor and time. For example, digging out water ways, ditches, and check dams takes long period. Hence, male farmers could construct structural SWC measures individually or in groups without any assistance but not female farmers.

Table 5.7 Sample households' participation in non- farming activities

Characteristics	Alternatives	Sample household respondents	
		Frequency	Percent
Types of off-farm activities	Tannery	23	18.7
	Weaving	10	8.1
	Collecting fire wood & selling	25	20.3
	Charcoal making	28	22.8
	Pottery trade	20	16.3
	Carpentry	17	13.8
	Total	123	100

Source: field survey, 2014

As Table 5.7 shows that farmers' who had an involvement in non-farm activities could generate additional income to hire extra labor forces and supplement practices of induced structural SWC measures on their farmlands. From this we can deduce that adoption of induced SWC practices require extra financial resources to do it effectively. Conversely, farmers did not involve in non-farm activities face financial shortage to practice structural SWC measures on farmlands. Because, practicing structural SWC measures needs additional income resources and intensive labor force to practice SWC measures on farmlands. Non-farm activity is an additional activity that a household performs annually. Furthermore, short term benefit obtained from non-farm works may give the benefits obtaining from investments in practicing structural SWC technologies.

The above table also shows that majority of the respondents participated in charcoal making (22.8%) to support their life. The second largest share goes to collecting fire wood and selling (20.3 %). From this one can understand that the majority of the respondents were intended to involve in charcoal making and collecting fire wood during winter or off- season where harvesting activity is finished. The remaining percentage share i.e. 18.7 %, 16.3 %, 13.8 % and 8.1 % of the respondents participated in tannery, pottery trade, carpentry and weaving

respectively. Moreover, structural SWC measures strongly related with income sources of respondents to adopt induced conservation technologies like mulching, stone bunds, soil bunds, contour ploughing, afforestation and reforestation, and strip-cropping. All of these require capital and labor investment. So, non-farming activity is essential to generate additional income for farmers' to invest and hire labor on induced modern SWC measures.

5.5. Farmland holding size and soil conservation

The average land holding of the respondents' was decreasing from time to time, due to population pressure and sharing of agricultural farmlands. Typically, a new family had one-third of hectare for their use. In Wegdi woreda SWC structure was performed mainly through crop rotation, strip-cropping and constructing soil and stone bunds on and around farmlands. This needs careful management and intention to increase proper yields of crop production. Farmers rotated different crops in order to maintain and improve soil fertility. The rotation period took place annually according to the seasons of different crops sowing. This is happened by shifting between the parts of the farmlands and replacing one crop with other crop types. In rainy seasons, flooding caused the most sever damages on farmlands and top soils were washed away from farmlands. Reasons and possible mitigation measures were understood and even discussed with district agricultural expert offices, but further action has not been taken enough until now.

It was clearly understood that erosion is sever and happening at the upper steep slope parts and had an impact on the lower farmlands. The respondents reported increasing needs of water way digging and ditches on the upper sides of farmlands to minimize rate of run-off occurrences. The lower plains of the water ways had high amounts of aggregates and rock silts coming down during the rainy seasons. This is happened due to intensive collection of firewood and free animal grazing at the upper hill side slopes. This has a negative impact on farmland productivity and sometimes causes damage and imposed extra work for the farmers. Range lands and forests around the community's farmlands belong to communal land. Deforestation, over grazing and fire wood collection was taken as the main reasons for increased run-off and erosion. This also increased frequency of maintenance of water ways, ditches, terracing and check dams. Reforestation was mainly practiced just along the primary hill sides of farmlands for the protection of soil erosion and harvesting water droplets. Landholding policy of Ethiopia

discourages people to engage in public action for environmental protection. Because of this, no one was responsible for reforestation activities in order to reduce erosion rate.



Photo source: own field survey, 2014

Figure 5.3. Stone bunds built before seven years ago

5.6. Farmers' Perception of Soil Erosion as a Problem

Majority of interviewed respondents (78 %) stated that there is soil erosion on their farmlands. The respondent attributed soil erosion is severe due to: vegetation covers removal (19 %), over cultivation (43 %), and slope of farmland (16 %). This confirms with the study of Mugendi, (1999) that intensive cultivation and farming on marginal farmlands leads to sever soil erosion occurrence.

Among farmers that retained conservation structures on their farmlands, 54% perceived that erosion problem is severe on their agricultural farmlands. However, large number of farmers that perceived erosion problem is severe due to removal of conservation structures completely. This study supports the finding of Woldeamlak (2003). According to him, perception of erosion as a problem with economic significance is not a sufficient condition for adoption of SWC measures though it is a necessary condition. As we noted from the focus group discussions, all sample

farmers' understood soil erosion as a problem of farming activities. Even though, farmers are familiar with soil erosion from observation of their local area, they acquainted with more understanding, developed experiences and pressures from soil and water conservation experts. Their farming experience allows them to practice traditional conserving mechanisms via the long run span of time and sharing experience with neighborhood farmers who practice SWC structures. Here, 28.5 %, 17.9 % and 17.1 % of farmers suggest that over cultivation, limited use of SWC measures, over grazing and cultivating steep slope farmlands respectively taken as a major factor of soil erosion in the study area.

Table 5.8 Farmers' Perception of the major causes of soil erosion

Causes of soil erosion	Sample household respondents	
	Frequency	Percent
Over cultivation	35	28.5
Over grazing	12	9.8
cultivating steep slope	21	17.1
Limited use of SWC	22	17.9
High rainfall intensity	12	9.8
Damaged conservation structures	11	8.9
Deforestation	10	8
Total	123	100

Source: field survey, 2014

As the study area is more exposed to soil erosion and relatively has high population density, absence of physical SWC structures and repeated preparation of farmlands for cropping makes the soil easy for soil erosion occurrence. This study clearly provides support for the conclusion of [Bekele and Holden \(1998\)](#) who stated that vast areas of the highlands of Ethiopia could be classified as suffering from severe to moderate soil degradation. Increasing intensification and continuous cultivation on sloping farmlands and marginalization of agricultural farmlands without supplementary use of soil fertility improvement techniques and conservation practices poses a serious threat to sustainable farmland use.

In addition, Brown and Wolf (1984) stated that the apparent increase of soil erosion over the past generation is not the result of a decline in the skills of farmers but rather the result of the pressure coming from high population growth on farmlands to produce more. Furthermore, 9.8%, 9.8%,

and 8.9 % of the respondents told their reasons as rainfall intensity (i.e. erosive power of rainfall), over grazing of animal herds and damage of conservation structures as causes of soil erosion on farmlands. Deforestation was mentioned as a cause of soil erosion by 8% of the sample farmers of the study area. Over grazing has received relatively less attention as a cause of soil loss / erosion in highlands. However, keeping livestock on flat sloped areas results in soil erosion by destruction of structural soil and water conservation measures.

5.7. Farmers’ perception on extent, causes, Indicators and Consequences of Soil Erosion

As we understood from the focus group discussions and interviews with respondents, they perceived soil erosion as a problem of agricultural productivity. Since, the selected farmers were familiar with soil erosion from observations of their surroundings and advanced experiences, there is pressures from DAs and district soil and water harvesting experts. Environmental situations lend them with indigenous knowledge and degree of awareness that could be obtained through prolonged farming experience and time passing while performing farming activities.

Farmers who choose the severity level of soil erosion as high understood and related the existence of soil erosion problem on their farmlands for development of gullies and rills on farmlands as well as the washing away of top soil. All respondents perceived the problems, severity level and final outcomes of farmland degradation in the study area.

Table 5.9. Farmers’ Perception on Consequences of soil erosion

Consequences of soil erosion	Households responses	
	Frequency	Percent
Low crop production	40	33
Loss of soil fertility	31	25
Farmland fragmentation	22	18
Demand of extra labor for agricultural activities	9	7
Wide spread of weeds	10	8
Gully formation	11	9
Total	123	100

Source: field survey, 2014

Most respondents understood effects of soil erosion on farmlands before adopting induced structural soil and water conservation technologies. This is happened due to low adoption of induced structural conservation techniques (poor farmland management, farmland fragmentation, and occurrence of deforestation). Table 5.9 shows that about 33 % of the respondents reported low crop production is the major consequences of soil erosion in the study area. It is followed by loss of soil fertility (25 %), farmland fragmentation (18 %), and gully formation (9 %). The rest 8 % and 7 % states gully formation and demanding extra labor for agricultural activities are another consequences of soil erosion respectively. All in all, as they expressed their thought occurrence of sever soil erosion increases migration of people from one area towards another area to fulfill their livelihoods. One of the informants stated that:

“---before forty five years ago, Lencho kebelle was densely covered with thick natural forest species and each farmers had vast farmlands with fertile soils as well as enough range lands for their cattle. However, currently we have owned barren lands as you are observing and small farmlands for cultivation and become infertile as a result of removal of vegetation cover and rapid population pressure.”

From the informant, someone can easily understand severity level of the problem in the study area. As population growth expands with time sequence, it has high influential impact on natural resources (e.g. farmlands, forests, range lands and others). This situation adversely affects the construction and implementation of induced structural soil and water conservation technologies.

5.8. Indigenous soil and water conservation measures in South Wollo

Soil erosion in Ethiopia has economic, physical, and social impacts. It is one of the causes to increase prices of food grains and other agricultural products both in rural and urban areas that ultimately brought low living standard of population. In order to solve such type of problems farmers practiced different traditional SWC measures starting from their life span. Farmers in Wagdi district have practiced traditional indigenous conservation measures to control soil erosion in their local area. The major traditional indigenous structural SWC measures identified in the study area include; mannuring, traditional water ways, fallowing, traditional stone lines, and leaving crop residues. They were practiced to maintain and recover soil fertility.

Mannuring: - it is a practice of spreading out of households' waste and animal dung on farmlands to maintain and increase soil fertility. The term literally expresses waste material which is composed of all kind of human and livestock residues in and around the residence of farmers. Such type of traditional farmland soil fertility management technique undertook commonly in households who have many livestock. Mostly, the practice and spread out of such measure is done on farmlands near to household residences.

Traditional water ways: - this conservation structures are mainly constructed by oxen drawn ploughing, but the drawn ploughing depends on the expected run-off and highly depends on the slope features and gradient, rainfall intensity and the type of crops cultivated on the farmlands and the construction is supplemented by hoe and shovel where it is necessary. The quality of SWC measures indicates that whether the farmers are active or passive to arrest soil erosion. Active farmers can monitor what consequences will happen at the upper sides of their farmlands. Farmers should identify what type of crops should be grown on the upper stream farmlands in order to implement the necessary conservation measures. They are relatively constructed with closer interval depending on the slope situation of farmlands.



Source: field survey, 2014

Figure 5.4 Traditional water ways development in the study area before three years ago

Fallowing: This involves suspending or cultivating a plot of farmlands to recharge / restore its fertility when the nutrient content is exhausted. Fallowing farmland is commonly used as range land grazing for livestock. This practice depends mainly on farmland holding of farmers and the nature of the farmlands to restore its fertility within the time which is allotted to recover. However, due to high population pressure, which resulted in reducing land holding size and share of farmers and hence lead to limiting range land grazing size. Leaving farmlands fallow have gradually become difficult from year to year. This is happened due to high population pressure. Currently, the practice is not clearly visible as a persistent means of conservation measures due to population pressures.

Traditional Stone lines: it is mostly practiced in areas that have loose stones. Mostly, the farmers built it following the slope contour of the farmlands. They transport stones using donkey and hand carts from other place towards elsewhere farmlands. Actually, farmers would never follow base line design to construct the stone lines. Since the construction is performed traditionally, it is very important to reduce soil erosion on farmlands. Due to percolation and penetration of water in to the soils, soil moisture content increases during the dry seasons in the area.

5.9. Introduced Soil and Water Conservation Practices and the Approach to their Promotion

The following descriptive analysis is primarily based on informal discussions with sample farmers and extension personnel of the survey area. As it has been indicated in the previous discussions, large amount of investment and effort has been made to introduce and implement structural SWC technologies in the study area. Induced conservation technologies include most of the time physical structures like soil / stone bunds, digging ditches, cut-off drains, water ways etc. These conservation structures are barriers of soil erosion that are constructed either with stones or soils or a combination of them along the contour level of farmlands to minimize fertile soil loss and to increase moisture content of the soil. They are expected to conserve soil sediments and slowing down occurrences of run-off on farmlands.

However, it is learnt that high focus was predominantly given to considering site characteristics of the environment in order to applying accurate conservation structures. Farmers disclosed that

soil bunds were constructed even on flat farmlands where no conservation structures were need and little emphasis was placed to incorporate indigenous knowledge of farmers. The induced conservation bunds which practiced on flat farmlands were closely spaced and reported to be so narrow that farmers faced difficulty in oxen ploughing. Moreover, since farmland holding size is small, they indicated the narrow spacing has a bearing on reducing the cultivable area and hence results in decline in yield benefits. This is in line with research findings by Soil Conservation Research Project in Ethiopia. Once practiced conservation structures on farmlands, the structures need to be recovered and maintained regularly. Nevertheless, we observed that the practice of maintaining conservation structures is insignificant and this eventually lead to the collapse of the conservation structures.

Table 5.10. Practices of induced soil and water conservation technologies

S.No	Types of induced soil and water Conservation technologies	Sample households' Responses	
		Frequency	Percent
1	Stone bunds	23	19
2	Soil bunds	14	11
3	Water ways	22	18
4	Modern check dams	5	4
5	Cut-off drains	32	26
6	Strip cropping	13	10
7	Mulching	6	5
8	Contour ploughing	8	7
Total		123	100

Source: field survey, 2014

Cut-off drains and Water ways: they are a type of channels which are constructed to collect run-off water from upper hill sides of farmlands and to divert its direction nearby a river. Thus, it leads to protecting farmlands which is located below the channels. It minimizes excessive soil erosion. As the above Table (5.10) indicates majority (44 %) of the farmers adopted cut-off drains and water ways conservation structures collectively to alleviate erosion problems on cultivated farmlands. They are done by oxen drawn ploughing and hoe digging. They are constructed along the slopes, often covered with grass to prevent destructions and primarily

installed in areas with high rainfall rates (Morgan, 1995). The farmers constructed such type of drains to prevent manures, seeds, fertilizers, and soil due to high run-off water flow on the surface of farmlands from upper hill sides of the cultivated farmlands. The excess water is disposed away from the fields. However, according to farmers' suggestion regarding such type of conservation structures, some of the constructed drain structures may aggravate soil erosion through prolonged time flow or passage. It happened due to an increment of catchment area coverage of the ditches from time to time.



Source: field survey, 2014

Figure5.5: Cut-off drains development on farmlands

As the figure shows that cut-off drains and water ways constructed on and around farmlands to control soil erosion and improving soil fertility management. Cut-off drains can divert the direction of run-off which occurs on farmlands. Since, the responses of many farmers indicated that the practices of such type of conservation measures, there were problems that challenge its construction on farmlands. As they stated major factors which challenges practicing conservation measures was slope variability of farmlands, soil texture, over cultivation, and information accessibility. Large proportion of surveyed farmers in Lencho kebele practiced cut-off drains and water ways due to agro-ecological and slope variability.

Stone bunds: is a type of stone lines which is constructed along the contour water harvesting channel or upper basin sides of farmlands. They are very common in areas that have loose stones on farmlands. It is constructed horizontally by collecting loose stones and forming base line along contour slope natures. The distance between stone lines depends on the slope and availability of stones on fields. It is used to arrest erosion and increasing soil moisture availability on cultivated farmlands. It may reduce the length of slope of farmlands and stops velocity of run-off. Mostly, it is constructed on farmlands that have slope greater than 15 %. As Table 5.9 shows that 19 % of the respondents adopted structural stone bunds to reduce and stop soil erosion on farmlands. Such type of conservation structure is mainly constructed by food for work campaign in the watershed area.



Source: Own field survey, 2014

Figure 5.6: Stone bunds constructed before three years ago

Soil bunds: it is an embankment of soils which is constructed from soil along the contour slope with water flowing channels at upper sides of farmlands. It is constructed by digging out soil fragments from basin down slope. It is used to control and reducing occurrences of run-off on farmlands. Such type of conservation structure is usually constructed on farmlands that have moderate slope features. Table 5.9 reveals that 11 % of the respondents were adopters of soil bund conservation structures. According to WFP (2005), it is effective in controlling soil loss, retaining soil moisture and ultimately enhancing productivity of farmlands.



Source: field survey, 2014

Figure 5.7: Ongoing soil bunds development on farmlands (2014)

Strip cropping and contour ploughing: strip cropping is the cultivation of crops with straight lines to avoid food share of inter closely grown crops and reducing erosion on farmlands. While farmers practicing this type of conservation structures, agricultural productivity of farmland increases from year to year. But, as we have seen from Table 5.9, only about 10.6 % of the sample farmers adopted strip cropping practices. This indicates that most of farmers were not interested to apply this technique of conservation structures. On the other hand, contour ploughing is the cultivation of farmlands horizontally by following the farm contours. As we seen from Table 5.9, about 7 % of the respondents were practicing contour ploughing to minimize erosion occurrence on farmlands and to enhance moisture level of the soil. Here, horizontal ploughing of farmlands by following slope natures reduces soil loss and increases

water penetration and infiltration in to the soils. This situation enhances soil moisture content and upgrade crop productivity.



Source: field survey, 2014

Figure 5.8: Strip cropping and contour ploughing of farmlands

Mulching and Modern check dams: they are also other structural techniques of soil and water conservation measures which is implemented in Wegdi district. These technologies improve soil moisture level and reduce soil erosion occurrences on farmlands. They can also minimize evaporation rate of water from the surface of farmlands. Frequently, mulching is practiced by leaving out crop and grass residues on farmlands. It can serve as farmland cloth to increase soil moisture content and soil fertility after decomposition of the residues due to fungi and termites. But, farmers in the study area did not practice commonly. Only 5 % of farmers were adopter of mulching. Due to intensive fund investment and skilled labor force requirement, modern check dams conservation structures were not practiced well in Wegdi woreda. As the discussion conducted with the respondents, only 4 % of farmers were practitioners of modern check dams on farmlands. From this one can understand that the two conservation structures were not practiced safely.



Source: Own Field survey, 2014

Figure 5.9: Modern check dams constructed before five years ago

As about 72 % of the respondents stated that the idea of applying conservation structures on farmland is put in to functional by the district department of agriculture office. The department informs the farmers through rural kebele administration and development agents (DAs) how to build the conservation structures on farmlands. Rural kebele administrators could be serve as a coordinator and mobilizing agent of the community for practicing structural SWC measures. Then, possible areas will be identified to apply the conservation structures and will be put up in to functions. To a greater extent the activity is characterized by top-down approach and participation of farmers at earlier stage of planning and design of conservation structures is very limited and there is no follow-up attention after building structural conservation technologies.

As most of the respondents reported, SWC measures were performed through campaign work and through Food-for-Work program incentives. There are well- established reasons for the provision of incentives. According to [Douglas \(1994\)](#) the motives behind incentives are: (a) small scale farmers are too poor to take any risk and usually have no resources to meet additional labor or capital costs; (b) many conservation measures involve a heavy labor investment and there is an opportunity cost associated with using family labor for conservation purposes; (c) soil conservation has off-site benefits, so if on-farm conservation is in the interest of the state (the wider society) then it is reasonable that the state should pay the whole or part of the cost; (d) a

farmer's income may be reduced in the initial stages of conservation because (i) production is lost or delayed, (ii) additional labor is needed for construction, (iii) inputs, time and effort are needed to restore soil quality following disturbance and subsoil exposure, and (iv) some actual loss in production area is likely; and (v) financial or material incentives can be looked upon as a cost-sharing between the project and the farmers.

From the above discussion, it is evident that the main objective of providing incentives is used to facilitate changes in the desired direction to conserve soil and water. Otherwise, as Sanders (2000) mentioned, incentive schemes such as Food-for-Work programs, turn into Work-for-Food without achieving their intended purpose of influencing farmers' behavior. In the study area, to some extent we observed such a behavioral pattern or dependency syndrome during the survey is carried out.

5.10. Factors Affecting adoption of Structural Soil and water Conservation Measures

This section tries to identify and explain the descriptive analysis of factors affecting farmers' adoption of introduced SWC structures. Factors for the study were identified from existing empirical and descriptive studies conducted elsewhere and found to influence farmers' adoption of conservation structures, which are discussed in chapter two.

Farmers practice structural SWC measures could possibly be influenced by different factors. The major factors include; age, gender, household size, income, soil type and depth, nature of topographic features, educational level of farmers, and farmland size were repeatedly mentioned by most of the surveyed households in Wagdi woreda. In addition to that, lack of appropriate information on benefits and costs of structural soil and water conservation measures, distance of farmlands from homesteads, frequency of contact with DA's and water conservation experts, extension and training services on soil erosion and soil conservation techniques have significant influences on practicing induced structural SWC measures. Among these factors some influences practice of structural conservation measures negatively whereas other factors affect the practice positively. A number of socio-economic and institutional factors are significant determinants of the probability to adopt induced modern SWC technologies in Wagdi woreda. Number of contacts with extension officers and training access in the previous year remains a significant determinant of adoption decision in accepting induced conservation technologies to control soil

erosion in which it appears. This is because extension officers remain as main source of information on improved production and conservation technologies.

5.10.1. Gender

In Wegdi woreda, agricultural activities are predominantly practiced by male farmers. From randomly selected sample farmers, 86.3 % were male farmers and the remaining 13.7 % of the sample households were female headed farmers. Even, in group discussion that is held in the study area, only 5 female farmers were there. As, 75 % of the respondents reported that there is visible difference between male and female headed farmers to practice induced modern structural soil and water conservation technologies. But 25 % of the respondent farmers argued that female and male headed farmers were equally practice induced conservation technologies and can get benefits from induced structural SWC measures. Even if, female farmers participated in SWC measures, constructing stone bunds and digging out cut-off drains in stony area is difficult for them. As [Lakew et al. \(2005\)](#) reported that older and female farmers face difficulties in constructing structural SWC technologies, but they could manage and maintain already constructed conservation measures. In the present study, maintenance of older soil and stone bunds by female headed farmers was found to be difficult. Encouraging women participation in tree planting and other induced structural SWC technologies may bring diversified benefits and increase agricultural productivity.

5.10.2. Distance of farmlands from homesteads

Far distance of farmlands from homestead was found to be one factor of inappropriate SWC practices. The basis of this was farmers with farmlands that are within residential area were expected to have higher probability of adopting induced structural SWC technologies. Moreover, farmers in the village live within a mean distance of 500 meters from their farmlands. This should have given them the opportunity to pay more attention to nearby farmlands but pay less care too far farmlands. Therefore, parcels of farmlands which are located near to farmers' residence must receive more attention and supervision than far farmlands. This finding is not in agreement with (Wogayehu and Lars, 2003) who found significant and negative correlation between no conservation decision and distance of a parcel from the residence but positive correlation between distance of the plot and adopting conservation decision in the district.

Caswel, Fuglie, and Ingram, (2001) also found out that farmers invest more in soil and water conservation technologies on farmland situated near to their residence.

5.10.3. Land tenure security and farmland sources

Land tenure is considered as land renting in or renting out in the form of share cropper etc. These happen under the circumstance of land scarcity and or unequal distribution of farmlands whatever the tenure ship is. In Wegdi woreda the distribution of farmland is not equal and farmers faced scarcity of cultivated farmlands. As a result, majority of the respondents (farmers) stated involvement in informal farmland exchange is very common in Wegdi woreda. **Share cropping** and **renting** of farmlands are the two important exchange mechanisms which is prevalent in Wegdi woreda. More than 78 % of the respondents participated in share cropping-in /out arrangements. In this form of tenancy, in the study area, yields are shared between land owner and the tenant usually with equal percentage share. Fifty six percent of the respondents involved in share cropping-out arrangement while twenty two percent involved in share cropping-in arrangement. The main reasons for share cropping-out include **old age, lack of oxen, food insecurity** and lack of labor force accessibility. Whereas, the main reason mentioned by respondents for share cropping-in was **shortage of farmlands**. However, our evidence does show that tenants (mainly share croppers) use fewer inputs and obtain lower yields at the plot level than owner operators. This may be because restrictions on the duration of farmlands lease contracts (no more than one year unless modern technologies are used by the tenant) prevent farmland owners from leasing land to tenants that they know well, so that the incentive problems involved in share cropping (i.e., tenants incentive to use less inputs because they receive only a fraction of the output resulting) can lead to reduced farming intensity and yields. Thus, the restrictions on land leasing in Wegdi woreda may be inhibiting productivity on share cropping farmlands. The tenants did not give more intention regarding adoption of induce SWC measures because they believed that the farmlands may not belong them in the future.

Majority of the people in the Wegdi Woreda intensively participated in cereal crop production activities. As a result, greater emphasis on adopting induced structural SWC measures should be given to increase agricultural productivity of farmlands. This analysis clearly indicated that, the adoption pattern and speed of adoption varied among individual farmers. As a result, farmers in the study area responded differently to the induced conservation technology packages. Some

adopted the induced structural conservation technology in the first period and continued to use it, others adopted it at different times and discontinued practicing it while others heard about it but were found reluctant to adopt and use it.

Furthermore, accesses to farmlands were observed to affect significantly the probability of SWC adoption. If the farmland holding size of the household increased, the probability of adoption of induced SWC measures increased tending to expand farmland under the improved technologies. This is especially true for Wagdi Woreda farmers who practiced induced structural SWC measures under various risk situations such as variation of topographic natures, family size, farming experience of farmers, education level, agricultural extension and training service access and farmers' perception regarding induced structural SWC measures.

5.10.4. Access to institutions

Farmers who were member of traditional work cooperation groups able to obtain and access information about agricultural technologies. They are nearest to new technology and have good awareness about soil and water conservation measures. Conversely, farmers who were not member of any institutions could not obtain information about induced structural soil and water conservation technologies. Farmers who are member of farmer based groups in Wegdi woreda such as 'mahber¹', 'ekub²', 'debo or wenfel³', and 'edir⁴' are better placed to adopt modern structural SWC measures than those who do not belong to any organizations. It is confirmed with adoption level of structural SWC technologies in the study area.

Membership of farmers in such type of organization enables farmers to acquire information about proper agro-ecological practices, credits, agricultural inputs as well as exchange of ideas and their benefits. As Dikito (2001) and Coleman (1998) indicated that self help group and formation of cooperatives is a more reliable and pragmatic means of achieving social capital and ensuring dissemination and adoption of innovative technology.

‘**Mahber**’¹ is a traditional institution which serves as self help group.

‘**Ekub**’² is a traditional financial institution which is set up for the purpose of money saving.

‘**Debo and wenfel**’³ is self help cooperation group of farmers to perform farming activities.

‘**Edir**’⁴ is a type of traditional institution which is established for the purpose of self help during death.

Generally speaking, it is a recognized fact that the diffusion of new technology on improved structural SWC measures is an important element of soil erosion arresting and water harvesting method to enhance agricultural productivity of farmlands. Farmers being member of work cooperatives and development agents have positive contribution to adopt and sustained use of new technologies. Unless, there is an adequate way of information sharing mechanisms among farmers in the study area, the adoption of induced structural conservation measures would not be successfully practiced and implemented on farmlands. Lack of reliable and latest information on new conservation structures can influence the wide spread adoption of induced conservation technologies. It is true in Wegdi woreda, like the rest of Ethiopia.

In Wegdi woreda sources of information for farmers were through communication with relatives, sharing experience with neighbor farmers, community leaders and government assigned mainstream agricultural extension experts and water conservation experts. Farmers pointed out that 'ekub', 'idir', 'debo' or 'wenfel' and 'mahiber' are an important sources of information and credit to apply and practice induced structural SWC technologies. An effort has been put in to practical to know and understand the new technology. Furthermore, proper land management, improving traditional conservation and structural conservation practices are among the major actions that is taken by farmers in Wegdi woreda. The result of the survey indicated that about 44 % of the sample households have good institutional accessibility and the rest (56 %) did not access such type of services. As a result, the later groups were not familiar with new information and unable to get financial credit to practice induced structural conservation structures / technologies.

5.10.5. Access to agricultural extension services

Access to agricultural extension service is very important element of institutional support needed by farmers to enhance use of agricultural technologies in practicing induced structural SWC technologies in particular physical environment. Natural resource development agents and water conservation experts were assigned in all sample kebelles. It was expected that sample farmers in the study area have had access to extension services through the DAs, attending field days and training services. Training and education on soil erosion and conservation measures expected to create further awareness and understanding on conservation practices. Farmers require extension services on induced structural SWC measures, crop production and yield productiveness, yield

storage mechanisms, enhancing soil fertility and farmland tenure and farmland use. The construction of structural SWC measures requires relatively frequent training and extension services. Although, the training on controlling soil erosion has very important contribution on application of structural soil and water conservation measures, level of extension and training service is very low in Wegdi woreda.

Farmers who did not access to training and extension services have got experience from their neighbors and traditionally from their elder parents. Farmers adjacent to each other can acquire experience in either strength or weakness of specific structural soil and water conservation measures from nearby farmers and neighbor kebeles. Most farmers got training and extension services on structural SWC measures. About 49.6 % of surveyed farmers usually get extension and training services on soil and water conservation measures and 31.5 % have got only a limited extension and training services and 18.9 % have received adequate extension and training services (Table 5.11).

Table 5.11 Extension and Training Services on Structural SWC Measures

How often got extension & training services?	Household respondents	
	Frequency	Percent (%)
Often	23	18.9
Sometimes	39	31.5
Usually	61	49.6
Total	123	100

Source: field survey, 2014

Farmers need training services on induced SWC techniques to enhance farmland soil fertility and agricultural productivity through time span. In addition to this, providing extension and training services increases farmers interrelationship among DAs and SWC experts and initiating them to accept induced structural SWC measures / technologies. As sample farmers stated extension services should be given to create awareness and know how in relation to induced conservation mechanisms and integrating with traditional indigenous conservation measures. Because indigenous conservation techniques may serve as a ground base of applying induced conservation measures through prolonged time space.

5.10.6. Nature of soil types and colors

In the study area, farmers realized the degree of soil erosion and its impacts on farmlands. Farmers used soil colors as an indicator of soil fertility and soil erosion on farmlands. In addition, soil erodibility natures also taken in to consideration as criteria to identify soil erosion on farmlands. In relation to this, soil moisture holding capacity also has an impact on soil and water conservation practices on farmlands. Interviews conducted with respondents showed that practicing structural SWC technology is influenced by soil colors and types. According to farmers' soil classification techniques in the study area, soils can be grouped in to “walka afer” (Vertisols) , “borebor afer” (cambisols) and “keyi afer” (Nitosols).

As indicated by 73 % of respondents, construction of structural SWC measures makes agricultural farmlands out of production. Because, they expect that constructing introduced structural SWC technologies on farmlands takes large portion of farmlands. When farmers see the color of soil black, they are not interested to apply induced structural modern SWC technologies on farmlands. But, they preferred to construct cut-off drains and water ways on the upper sides of farmlands to minimize erosion speed and its occurrence. Furthermore, sample farmers were more interested to construct induced structural SWC measures in dry farmlands rather than wet farmlands. All in all, from this one can understand that soil color and types has an impact on application of induced structural SWC measures on farmlands. The result of this paper is contradicting with Wegayehu and Drak (2003) conclusions which are stated as farmers that cultivate black soil and invest on soil conservation more whereas; farmers who cultivate low quality of farmland adopt conservation practices less frequently.

5.10.7. Topographic nature of farmlands

Topographic variation has an impact on the day- to-day activities of human beings. Farmers decide to construct different structural conservation technologies on farmlands by considering the slope situation of cultivated farmlands. On flat farmlands, farmers intended to construct cut-off drains and water ways because the area is less susceptible to erosion risk compared with steep slope areas. In steep slope farmlands, farmers have forced to implement different structural conservation measures. About 86 sample farmers whose farmlands found in steep slope and the rest stated under moderate and flat slopes.

Slope of farmlands (SFL) as expected, the variable SFL took the hypothesized positive sign and significant. This implies that slope of farmland influences adoption of structural SWC technologies negatively. This is happened because of slope is taken as an indicator of soil and water loss from farmlands. Thus, farmers cultivating steep slope farmlands recognized the severity level of soil loss is harsher than farmers who cultivated gentle or flat slope farmlands. This implies that farmers cultivating vulnerable farmlands more likely to adopt induced structural SWC technologies on their farmlands than those cultivating less vulnerable farmlands.

Table 5.12. Topographic Nature of farmlands and Practices of Soil and Water Conservation Measures

S.No	Household respondents and structural soil and water conservation practices							
	Sample kebells	Slope types(*)	Practices of structural SWC measures					
			Yes		No		Total frequ ency	grand percent
			Frequency	percent	Frequency	Percent		
1	Lencho	Steep slope	44	35.8	9	7.3	53	43.1
2	Tungni	Flat	19	15.4	12	9.8	31	25.2
3	Taye	Moderate	23	18.7	16	13	39	31.7
Total	3	3	86	69.9	37	30.1	123	100

Source: field survey, 2014 * Simple assumption of study area slope

The slope nature of farmlands affects soil development both directly and indirectly. Steep slopes are more susceptible to rapid run-off surface water that might force farmers to use induced structural soil and water conservation measures. As we realized from the above table (5.12), 35.8 % of the respondents reported that their farmland slope is located in steep slope area and need more intention to apply and implement induced structural conservation measures on farmland fields. About 67 sample farmers whose farmland is located in slope of moderate to steep slope farmlands, 51.2 % of the farmers practiced induced structural soil and water conservation measures on their farmlands, whereas 31.7 % of the farmers farmland slope is located on flat slope lands and about 13 % of the respondents have not practiced induced structural SWC measures to arrest soil erosion. The slope category of the farm plot has been found to be positively affecting the farmer's decision to invest in conservation technologies (Ervin and Ervin, 1982; Wagayehu, 2003). Moreover, the slope of farmland affects farmers' decision by

influencing the magnitude and velocity of run-off, which in turn affects the economic significance of soil fertility, thus reducing the productivity of the cultivated farmlands. From this one can generalize that as slope increases or become steeper, the requirement of SWC measures increase to control and arrest soil loss from farmlands. So, slope of farmlands and adoption of induced structural SWC technologies has direct proportion.

5.11. Benefits of soil and water conservation measures

Most of the respondents expressed practicing induced structural SWC measures / technologies provide numerous benefits to control soil erosion and improving soil fertility as time gone through practicing and increased agricultural productivity. The respondents also requested to compare and contrast traditional indigenous SWC measures with modern induced conservation technologies. About 59.3 % of the respondents practiced structural SWC techniques. Eventhough, they practiced both conservation mechanisms (traditional and modern conservation measures), the respondents could not identify the basic difference between the two. But 45.4 % of respondents stated that induced structural SWC measures appeared more productive and effective to control soil erosion as well as to manage soil fertility. However, they require more labor force, large capital, consume more time and more skilled expert support to install and maintain on farmlands.

Soil and stone bunds are structures commonly built to control run-off and thus increase soil moisture capacity and reduce soil erosion. However, constructing and implementing continuous bunds to protect farmlands is costly and often difficult. So, alternative structural conservation methods of soil erosion control are also employed. These include grass strips and contour leveling, sometimes incorporating trees to reduce run-off velocity and allow water to infiltrate and trap sediments within soils. In addition, waterways help direct precipitation flows along specified pathways in farmlands and water-harvesting structures, including dams, ponds, and diversions ensure water availability in the dry season. Overall, the most commonly used structural soil and water conservation technologies in Wegdi woreda are soil and stone bunds, cut-off drains, water ways, and grass stripping. The result shows clear spatial heterogeneity in the use of structural SWC measures and suggesting that such technologies were performed differently by considering environmental conditions and agro-ecological classes of the study area.

CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATION

6.1. Summary

This study analyzed farmers' practice and factors influencing the adoption of structural SWC measures. The researcher also tried to assess problems which are closely associated with SWC activities. The findings of the descriptive analysis of the use of conservation practices indicated the existence of problems in undertaking of conservation activities. It was identified that conservation structures not taking in to consideration farmers' knowledge and experiences and design programs. These problems call for the need to have a practical and interactive farmers' participation. If the aim is to overcome the problem of soil erosion and degradation, the planning, designing and implementation process of conservation activities should ensure farmers' active participation and integrating the existing local traditional conservation measures and knowledge with induced structural conservation technologies.

Run-off and soil losses are significantly reduced by using different controlling mechanisms like mulching, stone bunds, soil bunds, modern check dams, cut-off drains, water ways, contour ploughing, and strip cropping. A series of constructing such conservation mechanisms lead to arrest soil and water droplets losses and sediments on farmlands. It is possible to sustain soil moisture and water holding capacity of farmlands. In combating the effect of soil erosion, integrated conservation techniques were implemented on farmlands and local areas by considering position of slope features and farmers perception.

Adoption of induced structural SWC measures of farmers' is influenced by numerous factors. Such as economic, institutional access, physical factors, education level, and attitudinal factors. It was also found from the analysis that farm size, distance of farmlands from homesteads, farmers perceived risk of loss of farmlands in the future, availability of non-farm employment and perception of the benefits of conservation structures have a significant impact on farmers' retention behavior to practice structural conservation measures. Therefore, it is reasonable to

conclude that adequate consideration of these variables may greatly contribute to increase the sustainable use and widespread adoption of introduced conservation technologies.

6.2. Conclusions

Soil degradation is the most serious problem and threat of food production and hence food security, and natural resource conservation in the highlands of Northern Ethiopia. Farmers are remaining with no or very low harvest when cultivating vulnerable farmlands without proper management of the farmlands. The study clearly revealed that improving the productivity of farmlands, which are prone to soil erosion by applying proper conservation structures. Without structural soil conservation measures it is impossible to enhance its productivity. Therefore, integrating traditional and induced structural SWC measures in the degraded farmlands brought to stabilize farmlands for multipurpose use. Diversified application of conservation structures is very important to conserve the soil and increase crop productivities through prolong construction of conservation technologies. As the finding of this study reveals that practicing structural SWC technologies has a lot of advantages and improve agricultural farmlands productivity as well as water holding capacity of the farmland soils.

Proper construction of structural conservation action is also needed to increase farmers' level of awareness of the importance of conservation structures through agricultural extension and training services. This should be an integral part of soil and water conservation initiatives and helps to foster positive perception and shapes the attitude of farmers towards SWC efforts. Off-farm economic activities are an important means that supplement the low level of farmers' income generation. In this study, we found a positive relationship between access to off-farm activities and adoption of induced conservation technologies. This calls for the need to look for suitable continuous incentives that support farmers engaging in maintenance and sustainable use of the conservation structures.

Generally speaking, as agriculture is the backbone of Ethiopian economy, the problem of soil erosion has to be given great emphasis and taken serious action to improve farmlands fertility and moisture capacity of the soil. Integrating indigenous and induced SWC measures brought multipurpose advantages for farmers. To this end, it is important to give adequate consideration

of points which discussed above. The aspects emphasized and the recommendations forwarded could contribute substantially towards the sustainability of SWC measures.

6.3. Recommendations

The adoption of newly introduced structural SWC measures / technologies in the study area currently signify that addressing huge interrelated socio-economic and institutional factors that strongly influences farmers practices of structural SWC technologies. Adoption of SWC measures did not materialize continuously in Wegdi woreda. There are many reasons for individual farmers not to adopt SWC measures on farmlands. The reasons vary from farmer to farmer, as a result of their personal differences in terms of education level, attitudes (perception), varying farmland holding size, and agro-ecological variations. Understanding and knowing the major bottleneck factors and problems allows developing proper strategies to overcome the problem of practicing SWC measures. Thus, based on the findings of this paper, the following recommendations are considered to obtain benefits by addressing the constraints of farmers' practices in adoption of structural SWC technologies.

- ❖ Many farmers in Wegdi woreda have been practicing induced structural SWC measures as well as biological and agronomic measures. However, the integration of structural conservation measures with traditional one has better economic importance; because grasses on the top of the soil bunds and stone bunds used for livestock feeding and for sale as well as its remains decomposed and make humus which improves soil fertility. Farmers could identify structural SWC measures that brought them benefits within few years or to restructure regularly. For example cut-off drains are easier to maintain and reconstruct frequently than soil bunds and stone bunds. Hence, SWC experts sought to be able to consider the preference of local farmers while planning, designing and implementing structural conservation measures.
- ❖ Contact with DAs and WCEs in Wegdi woreda is limited. It is better to provide training and extension services on benefits of SWC technologies. Creating good level of awareness regarding problems, and costs of soil erosion and benefits of practicing structural SWC measures is necessary.

- ❖ As the finding of this study indicated soil erosion problem is very sever in continuously cultivated farmlands than less cultivated farmlands. More specifically, cultivating farmlands without rotating cereal crops leads to expose the farmlands for sever land degradation. So, reducing soil erosion gradually from more exposed farmlands requires proper conservation strategies like cut-off drains, water ways, soil and stone bunds, to alleviate sever effects of soil erosion problems.
- ❖ Farmers with large family size and large farmland size practiced structural conservation measures to arrest soil erosion and obtain labor accessibility to practice structural SWC measures and have alternatives to construct it. Whereas, farmers with small family size and less access to farmlands have challenge to construct and implement structural SWC technologies. Farmers who have access to farmlands have great intention to construct and implement structural conservation technologies but landless farmers participated in share cropping and did not have interest to involve in SWC measures because they expect that the farmland is not belong to them in the coming future. So, the government should redistribute farmlands for all farmers equally and approve its belongingness to farmers in the coming future and certifying farmland owner ship of farmers.
- ❖ Farmland distance from farmers' residence is also another factor that influences practices of SWC technologies. Farmlands which is located near to farmers' residence gets more attention and practice of SWC measures than farmlands located far away from farmers' residence. So, nearby farmlands get better construction of structural SWC measures and great focus is given by farmers. Because, practices of structural SWC measures are more labor intensive and take time to conserve soil and water on farmlands. So, the government must resettle and consult farmers to reside around their farmlands.
- ❖ Even if, farmers practiced structural SWC measures on cultivated farmlands, the slope natures, situations and soil types were taken into consideration and being account to practice structural conservation measures to control soil erosion and to harvest water droplets. And while practicing structural SWC technologies there must be great priority to consider soil type and slope features as a result of erosion severity in the study area.
- ❖ Practicing and constructing effective structural modern SWC measures require land tenure system which leads to secured land owner ship. Still in Wegdi worda, there is no full land tenure certification of farmlands. Hence, providing farmland certificate for

farmers may create good filling and belongingness of farmlands in the coming future then farmers may intend to practice SWC measures.

- ❖ Farmers' know-how on practices of SWC appears to be based on previous farming experiences. It is important to establish and appropriating the intended benefits of the recommended practices of SWC measures. This facilitates promoting SWC measures where it is appropriate. Therefore, there should be DAs and water conservation experts intervention to increase farmers awareness regarding adoption of SWC measures and farmers should be integrating traditional conservation measures with induced SWC measures.
- ❖ Lastly, based on this research finding results and other related findings, factors which are affecting farmers' practices of structural induce SWC technologies were many and diversified, and vary from farmer to farmer and area to area. This means that planning strategies and implementation should be considerably depends on the real situation of local rural kebelles and erodability of soils in connection to diversify structural conservation technologies.

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9. Household family size in age and sex (HHs)

Household Family size	Sex		Total
	Male	Female	
< 3			
4-6			
7-10			
>10			

PART II: Labor availability of household respondents

2.1. Do you have enough labor force to perform all the farm works? 1. Yes 2. No

2.2. Which type of your agricultural activities need more labor force?

1. Tilling plowing 2. Weeding 3. Harvesting 4. Soil and water conservation activities

2.3. If you have labor force shortage, how do you solve it?

1. Using relatives 2. By hiring 3. daily labors 4. By cooperation /debo/ wenfel/

2.4. If you use hired labor, what type of labor force hired?

1. Casual 2. Permanent 3. Both 4. If others, specify-----

2.5. Do you get labor force when you need? 1. Yes 2. No

2.6. On which type of farm activities female family members can participate actively?

1. Weeding 2. Soil and water conservation activities 3. Collecting crops & crop residues

2.7. Among your family members who can participate actively in soil and water conservation activities? 1. Children 2. Women 3. Men 4. All

2.8. Do your family members work none farming activities? 1. Yes 2. No

2.9. If your answer is “Yes” for Q (2.8), in which of the following none farm activities do you Participate? More than one answer is possible.

1. Tannery 2. Daily work 3. Weaving 4. Collecting fire wood and selling it
5. Charcoal making 6. Black smith 7. Pottery trade 8. Brewery 9. Carpentry
10 If others, specify it,-----

2.10. Do you participate in animal rearing? 1. Yes 2. No

2.11. If your answer is “yes” for Q (2.10), fill the following table properly.

S.No	Types of animals reared	Total number of animals
1	Equines(donkey, mule, horse)	
2	Cattles	
3	Camels	
4	Sheep	
5	Goats	
6	If others, specify	

2.12. How is the present size of your animals compared to 10years ago?

1. Remains constant 2. Decreased 3. Increased

2.13. What are the main sources of feed for your animals?

1. Straw 2. Lawn 3. Field grass grazing 4. If others, specify-----

2.14. Is there feed shortage for your animals? 1. Yes 2. No

2.15. If your answer is ‘yes’ for Q (2.14), what is /are the causes of shortages?

1. Marginalization of agricultural land 2. Resettlement of farmers 3. Land degradation

2.16. What are the major constraints for your livestock rearing in your local area? Fill the following table and put your answer in rank (1, 2, ---).

S.No	Constraints of livestock rearing	Ranks of the constraints
1	Frequent drought	
2	Occurrences of animal diseases	
3	Shortage of animal feeds	
4	Shortage of improved feeds	
5	If others, specify	

2.17. What should be done to solve animal feed shortage? More than one answer is possible.

1. Fallowing farm land 2.Cultivating fodder crops 3. Minimizing the size of animals
4. Conserving dib (weber)

APPENDIX: II

LAND HOLDING CHARACTERISTICS

PART III: Land and Land holding characteristics of household respondents

3.1. How many timads of land do you have before 20 years ago? 1. Two timads 2 .three timads

3. Four timads 4. Five timads

3.2. How many timads of plot land do you own currently (2006 E.C)? 1. One timads plots

2. Two timads plots 3. Three timads plots 4. Four timads plots 5. Five timads plots

3.3. State the size of your farm land plots and its distance from your house. Fill the following table properly.

Farm land No	Size of farm land	Distance of farm land (by walking in minute)
1		
2		
3		
4		
5		

3.4. If your farm land holding has changed since, 1984, how many times did it happen?

1. One times 2. Two times 3. Three times 4. Four times

3.5. In what way the 1997/98 land redistribution affected your land holding?

1. I gained farmland 2. I lost farmland 3. It is the first time to own farmland 4. No changed

3.6. In your opinion, is the farmland which you own currently will be your own property in the future?
1. Yes 2. No 3. I do not know

3.7. If your answer is 'No' for Q (3.8), what is your explanation in this situation? -----

3.8. How can you see the size of agricultural farmland from time to time?

1. Decreased over time 2. Increased over time 3. No change over the time

3.9. If your answer is ‘decreased over time’ for Q (3.10) what is the reason behind it?

1. High population growth
2. Farmland fragmentation
3. Farmland degradation
4. Selling
5. All
6. If others, specify it, _____

3.10. If your answer is ‘increased over time’ for Q (3.10), what is the reason behind it?

1. Marginalization of farmland
2. Gift from my parents
3. If others, specify it _____

3.11. How do you perceive your current farmland holding to support your households?

1. Enough to feed
2. Not enough to feed
3. Excess

3.12. What is your opinion if farmland shortage is a problem in your local villages?

1. Migrating to new area
2. Going for resettlement
3. Improving farm land productivity by using modern technologies
4. Using selective seeds

3.13. Is there land use policy in your village? 1. Yes 2. No I do not know

3.14. By which mechanism do you distinguish fertile soil from infertile soil?

1. by soil texture
2. By seeing the productivity of the soils
3. By depth of the soils
4. by the color of the soils

3.15. State your farmland fertility by saying high, moderate and low. Use the following table and tick under the conditions.

Farmland No	Conditions of soil fertility		
	High	Moderate	Low
1			
2			
3			
4			

3.16. How do you see your farmland fertility situation over time?

1. Decreased
2. Constant
3. Increased
4. I do not know

3.17. If your answer for Q (3.18) is ‘decreased’, what do you think the major factors for decreasing of Farmland fertility? More than one answer is possible.

1. Soil erosion by running water
2. Deforestation
3. Over grazing
4. Over cultivation
5. No use of compost/ manure
6. Poor land management
7. All

3.18. If your farmland productivity is declining, how do you improve /enhance the fertility status of it? More than one answer is possible.

1. By Application of commercial fertilizers
2. Crop rotation
3. Fallowing
4. Animal manuring
5. Intercropping
6. Tree planting
7. mulching
8. Construction of bunds / ditches
9. Using compost
10. Control cultivation

3.19. How can you describe the slope nature of your farmland?

1. Flat slope
2. Very steep slope
3. Gentle slope
4. Moderate slope

3.20. Which type of soils can exist in your farmland areas? More than one answer is possible.

1. Vertisols (black soils)
2. Lateritic soils (Nitosols)
3. Sandy soils
4. Rocky soils (lithosols)
5. Alluvial soils

APPEDEX: III

PART IV: Perception of soil erosion problems

4. Questionnaires on adoption and practices of soil and water conservation technologies

- 4.1. Is there any soil erosion problem in your farmlands? 1. Yes 2. No
- 4.2. If your answer is “yes” for Q (4.1) what is level of severity?
1. Very sever 2. Sever 3. Moderately sever 4. Very low
- 4.3. If your answer is ‘Yes’ for Q (4.1), how did you establish the presence of soil erosion in your farmland?
1. Soil color change 2. Declining in production 3. Loss of land cover
4. Appearance of rills 5. Appearance of gullies 6. Appearance of bare land
- 4.4. In your perspectives what are the main causes of soil erosion on your farmlands?
1. Steep slope 2. Erodibility of soils 3. Deforestation
4. Occurrences of run-off 5. Poor farmland management
- 4.5. currently, is your farmland productivity is low? 1. Yes 2. No
- 4.6. Do you think that soil erosion is the cause of yield reduction in your farmlands?
1. Yes 2. No 3. I do not know
- 4.7. What other factors are responsible for low agricultural productivity in your area? _____
- 4.8. Do you implement induced soil and water conservation measures in your farmland?
1. Yes 2. No
- 4.9. If your answer is ‘yes’ for Q (4.8), which type of soil and water conservation measures do you apply in your farmlands? More than one is possible.
1. Soil bunds 2. Stone bunds 3. Water ways 4. Modern check dams 4. Cut-off drains
5. Strip cropping 6. Mulching 7. Contour ploughing

4.10. When did you start to use modern conservation measures in your area?

1. 10 years ago
2. 15 years ago
3. 20 years ago
4. 30 years ago

4.11. Who introduced modern SWC to you?

1. DAs
2. Wereda Agricultural experts
3. Using my own experience

4.12. If your answer is 'Yes' for Q (4.8), in how many of your farmlands these are found?

1. One of my farmland
2. Two of my farmlands
3. Three of my farmland
4. Four of my farmland
5. All of my farmland

4.13. What opinion do you have concerning with soil and water conservation measures?

1. High level of awareness
2. Low level of awareness
3. Medium level of awareness
4. Not understood it

4.14. In which time soil erosion problem is observed in your farmland areas?

1. during tillage practice
2. During rain shower
3. Recent years
4. Where there is no vegetation cover

4.15. At what time soil erosion problem began in your farmlands?

1. Prior to my birth
2. Since my childhood
3. In recent years
4. I do not know

4.16. What type of opinion do you have concerning the wear out of soil from the farmlands?

1. Low depth of top soil
2. Low water holding capacity
3. Low agricultural productivity of soils

4.17. Do you believe that soil erosion will influence your plot of land in the coming future if the current situation allowed to continue?

1. Yes
2. No

4.18. In your opinion, what are the major causes of soil erosion? Use the following table and rank it.

S.No	Causes of soil erosion	Rank (1, 2, ---)
1	Over cultivation	
2	Over grazing	
3	Ploughing steep slope	
4	Limited use of soil and water conservation	
5	High rain fall intensity	
6	Damaged conservation structures	
7	If others, specify it	

4.19. What seems to be the trend of soil erosion in your farmland?

1. Decreased 2. Increased 3. Remain constant

4.20. Do you think that soil erosion can be controlled? 1. Yes 2. No

4.21. What are the controlling measures / mechanisms of soil erosion?

1. Terracing 2. Afforestation 3. Reforestation 4. Mulching 4. fallowing

4.22. Do you fill that you are responsible to conserve farmland from the threatening effect of soil erosion? 1. Yes 2. No

4.23. What type of consequences do you expect from soil erosion on your farmlands? Use the following table and rank it.

S. No	Consequences of soil erosion	Rank (1,2 ---)
1	Low crop production	
2	Washing away of soil fertility	
3	Farmland degradation	
4	Shortage of livestock feed	
5	Demand of extra labor force for agricultural activities	
6	Wide spread of weeds	
7	Gully formation	
8	Bad lands	

4.24. Do you use traditional soil and water conservation measures in your farmlands?

1. Yes 2. No

4.25. If your answer is “No” for Q (4.24), what is / are the reasons? _____

4.26. If your answer is “yes” for Q (4.24), which type of traditional soil and water conservation techniques do you construct? More than one answer is possible.

1. Ditches /boyi 2. Dib / Weber 3. Agidim mares /contour ploughing 4. If others,
Specify it,_____

4.27. What is the status of the current soil and water conservation technologies? Use the following table.

Types of soil & water conservation technologies	Current status		
	In good condition	Partially damage	Totally damaged

4.28. If the damage is totally / partially, what is the problem?

1. over grazing 2. Run-off 3. Over cultivation 4. Over grazing 5. If others_____

4.29. If the damage is purposefully for Q (4.28), what is the reason?

1. Harm oxen ploughing 2. Taking more productive farmland 3. Poor structures of designs
5. Poor construction of modern measures

4.30. If the damage is run-off /sheet for Q (4.28), what is the reason?

1. Improper construction of structures 2. Lack of maintenance of old age structures
3. Repeated occurrence of run-off 4. If others, specify_____

4.31. In how many years interval does maintenance of soil and water conservation structures practiced on your farmland?

1. With three years interval 2. Every year 3. When damage appears
4. If others, specify it,-----

4.32. Which type of erosion is sever in your farmland fields?

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

4.33. Which land do you perceive more productive?

1. Flat slope 2. Gentle slope 3. Moderately steep 4. Very steep slope

4.34. Do you perceive that the yield is being increasing with soil and water conservation practices?

1. Yes 2. No 3. I do not know

4.35. On which plot of land did you practice specific type of SWC measures?

1. on cultivation field 2. On range land 3. On forest field 4. On both

4.36. Do you get training and extension service on SWC technologies?

1. Often 2. Sometimes 3. Never

4.37. From whom do you get information on SWC practices?

1. From DAs experts 2. From NGos 3. From my neighbor 4. From previous experience

4.38. Do you have contact with DAs? 1. Yes 3. No 3. Some times

4.39. How do you explain the contact you have with SWC experts?

1. limited 2. Good 3. Very good

APPEDEX: IV

Part V: check list questions for focus group discussion

1. Is there soil erosion in your local area?
2. What is its effect if there is soil erosion?
3. Do you perceive any signs of soil erosion in your farm land area?
4. Does your farmland soil productivity decrease from time to time?
5. What is the fertility status of your farmland in general, before, and after?
6. Is there any change?
7. What are the reasons for this change?
8. What problems do you face due to this change?
9. How do you solve these problems?
10. Do you get any incentives to apply modern soil and water conservation measures in your farmland?
11. What type of incentive techniques do you get to apply induced soil and water conservation measures in your farmland?
12. For what purpose do you use induced soil and water conservation structures?
13. What factors are influencing the adoption of soil and water conservation practices in your farmland areas?
14. What type of solutions do you recommend for the future to control soil erosion?

APPEDEX: V

Part VI: checklist questions for interviewed respondents

1. Is there land cover change in your villages?
2. What is the cause of land cover change?
3. What possible solution do you suggest to overcome this change?
4. Do you encourage female household members in SWC practices?
5. Do you use integrated SWC measures to reduce soil erosion?
6. Do you get extension service in your village?
7. Do you use animal manure to increase your farmland productivity?
8. What opinion do you have regarding induced SWC measures?
9. What type of traditional indigenous SWC practices do you use?

APPEDEX: VI

Part VII: checklist questions for the district water and soil conservation experts

1. Are there traditional indigenous SWC practices in the district?
2. Are there induced SWC measures in the district?
3. Currently, which one is more practiced by farmers?
4. When farmers did begin to use induced SWC measures?
5. Do you give training service for farmers on SWC measures regularly?
6. Do you belief that farmers are volunteer to practiced induced SWC techniques?
7. What is the purpose of these measures?
8. Do you consult farmers to use animal manure on their farmlands?
9. What problems may affect adoption of induced SWC in the district?
10. What type of solutions do you suggest to overcome these problems?