# Factors Influencing Farmers' Decision in implementing Sustainable Land Management Practices in Erosion- prone Areas of East Gojjam Zone, Ethiopia

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**CENTER FOR ENVIRONMENT AND DEVELOPMENT**

This is to certify that the thesis prepared by Haymanot Eshetia entitled: as Factors Influencing Farmers' Decision in Implementing SLM Practices in Erosion prone Areas of East Gojjam Zone, Ethiopia submitted in partial fulfillment of the requirement for the Degree of Master of Arts in (Environment and Sustainable Development) compiles with the regulation of the university and meets the accepted standards with respect to originality and quality.

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**DECLARATION**

I declare that this thesis is submitted for the partial fulfillment of the degree of Master of Art in Environment and Sustainable Development. It is my original work and has not been presented for a degree in any other university and all sources of materials used for this thesis is dully acknowledged and references are listed at the end of the main body of the thesis and cited using APA system.

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**ACRONYMS**

| | |
|---|---|
| AA | Addis Ababa |
| ANRS | Amhara National Regional State |
| CIDA | Canadian International Development Agency |
| DM | Debre Markos |
| EFD | Environment for Development |
| ESIF-SLM | Ethiopian Strategic Investment Framework for Sustainable Land Management |
| EthiOCAT | The Ethiopian Overview of Conservation Approach and Technology |
| FAO | Food and Agricultural Organization of the United Nation |
| FGD | Focus Group Discussion |
| MoA | Ministry of Agriculture |
| NGO | Non-Governmental Organization |
| SLM | Sustainable Land Management |
| SLMP | Sustainable Land Management Practices |
| SWC | Soil and Water Conservation |
| UNCCD | United Nation Convention to Combat Desertification |

## Abstract

*A number of governmental and nongovernmental organizations have made efforts to reduce soil erosion and improve the productivity of land through sustainable land management practices. Despite all these efforts, East Gojjam Zone is still facing significant problem of soil erosion and agricultural land degradation. Systematic random sampling technique was employed to draw 188 sample household heads from two woredas of East Gojjam Zone. The study employed both qualitative and quantitative data collection approaches. The quantitative data was collected through structured questionnaires while the qualitative data was collected using direct observation, focus group discussion and a key informant interview. Binary logit model and descriptive statistic were utilized to analyze the factors influencing farmers' decision in implementing sustainable land management practices. Descriptive result revealed that the level of farmers' awareness about the advantage and disadvantage of sustainable land management practice were high. The major land management practices implemented by farmers' were terracing, strip cropping, counter farming, and stone bund practices were the dominant land management practices implemented in the study kebeles. In addition, Fanya juu and animal dung or Compost physical conservation practices also practiced on the study kebeles. The result from Binary logit indicates that the off farm activities of household heads, land holding size, lack of attention, and lack of farm equipment are negatively affecting the farmers decision in implementing sustainable land management practices. While resource availability are positively affecting the decision of farmers' to implement sustainable land management practices. The findings of this study recommend that dissemination of farm equipment or agricultural input to the farmers' and strengthen continuous work of land management practices and information about sustainable land management practice should need.*



**Key words: -*land, Land management, land degradation, soil erosion, Sustainable Land Management (SLM)***

# CHAPTERONE

## 1. INTRODUCTION

### 1.1.Background of the study

At the global scale, key problems threatening natural resource and the sustainability of life supporting systems are soil degradation, the availability of water and the loss of biodiversity. This occurs in virtually all socio-cultural and economic contexts worldwide. This indicates that the availability and decline of the natural resource make the life-supporting system at risk worldwide (Hurni, 1997).

On average, one out of every three people on earth is in some way or other affected by land degradation, latest estimates indicate that nearly 2 billion hectares of land worldwide are already seriously degraded, some irreversibly (Emmanuel, 2013).

In Ethiopia land degradation has been the major responsible factors for the declining and low agricultural productivity, persistent food insecurity and rural poverty, the major cause of land degradation in Ethiopia is heavy reliance of the countries rapidly growing population on wood and other biomass for the purpose of household energy together with rapid expansion of agriculture in to forested areas (MoA, 2014).

The Ethiopian economy has its foundation in the agriculture sector and this sector continues to be a fundamental instrument for poverty alleviation, food security and fueling economic growth. However, this sector continues to be affected by land degradation in the form of depletion of soil organic matter, soil erosion and lack of adequate plant nutrient supply (EFD, 2009).

Over the last three decades, the governments of Ethiopia and a consortium of donors have invested substantial resource to develop and promote sustainable land management practice as part of efforts to ensure sustainable and increased agricultural production and reduce poverty. However, due to the low rate of adoption; most of the proposed practices have been only partially successful. In some case, Dis-adoption and reduced use of technologies have been reported (EFD, 2009).

The ministry of agriculture and rural development in collaboration with the relevant stakeholders and partners initiated the establishment of the Ethiopian overview of conservation approaches

and technologies (EthiOCAT) network under the natural resource sector with responsibilities of documenting the various approaches and technologies applied for the land management in various localities of Ethiopia, in addition to this the MoA has recently developed the Ethiopian strategic investment framework for SLM (ESIF-SLM) which provides guidance on harmonization and alignment of efforts, resource and expertise needed for scaling up SLM practices in a systematic manner and the ESIF-SLM also offers strategies, directions and investment opportunities for SLM in Ethiopia for the coming 15 years (Daniel, 2010).

According to Emmanuel (2003), factors such as population growth, deforestation, and poor farming techniques have been pointed out as the major causes, which triggered overgrazing and use of inappropriate farming practice, while the number of population increases the need for using natural resource increases and it will lead to overuse of natural resources beyond the carrying capacity of nature and it causes the depletion and deterioration of natural resources.

Land management in Ethiopia has involved into various farming systems with a different level of intensification (Wegayehu, 2006). Gete *et al.,* (2006), classified the land management practices which have been applied in Ethiopia into two broad categories which is indigenous and introduced, with different degrees of acceptability, areal coverage and based on their benefits. The acceptance and implementation of these management practices are depends on farmer's willingness, which in turn request continuous and effective activities from agricultural experts and researchers. In fact, it is not easy to put common criteria to categorize land management practices in to indigenous and introduced. As a result, this categorization is done based on the direct purposes of the management techniques why farmers apply on their farmlands (Tadesse, 2011).

Land degradation and soil erosion is a global phenomenon throughout the world that endangers the agricultural land and leads to the decreasing in the agricultural production and it also endangers the livelihoods of rural farmers at a large scale as well as countries ability to produce. It is one of the major challenges for agricultural production in Ethiopia. Because of this reason, different land management technologies are introduced to combat the problem but the effectiveness of this practice is below expectation.

Promotion of soil and water conservation (SWC) technologies as a means to mitigate worsening soil conditions has been suggested as a key adaptation strategy for countries in the developing world, particularly in sub-Saharan Africa (Kurukulasuriya and Rosenthal, 2003). However, in order to prevent soil degradation constantly and fully, only promoting SWC measures is not enough. Reliable and up-to-date information on the following issues is highly required: (1) where soil erosion takes place? (2) What are the factors influencing farmers' decision of implementing soil and water conservation practices, and (3) how land users are addressing soil erosion through land conservation measures?

**1.2.Statement of the problem**

According to Melese (2014), land degradation has become a serious problem affecting all spheres of social, economic and political life of the population. It is one of the major challenges to agriculture development and food security of people in Ethiopia. In Ethiopia, the rate of the countries land degradation is very high. A large portion of agricultural land which is mainly located in the highland part of the country is affected by severing to moderate land degradation (Kruger *et al.,* 1997). To solve the problem of land degradation in the country many efforts have been made since the 1970s a large number of soil and water conservation activities were implemented in different parts of Ethiopian highlands in the 1970s and 1980s with a huge resource obtained from the international community, particularly world food program (WFP). Although different activities have been performed to bring about the desired change it didn't bring sustainable change. This is because of the limited capacity of farmer' to invest in SLM practices, farmers, incentive from their investment in SLM practice is limited and also because of other enabling conditions for motivating farmers' to invest on SLM practices or technologies (Melese, 2014).

A number of local and international NGOs have involved in implementing land management practices, and more importantly local communities have been practicing a range of traditional land management practices with the purpose of improving land productivity, increasing availability of soil moistures and reducing soil nutrient losses (Daniel, 2010). Despite all these efforts, the area coverage and sustainability of land management practice have been limited and localized in projects and program areas and only with the communities practicing those (MoA, 2010).

In Ethiopia land degradation in general and soil erosion in particular still remains the major challenges, it adversely affects the agricultural performance of the country, hence the call for improved land management practices is timely (Woldeamlak, 20003).

Ethiopia is a highland country with 65 percent of its total area having an elevation of more than 1400 meter above sea level (m.a.s.l) and a substantial area lying well over 3000 m.a.s.l. About 50 percent of Ethiopia can be defined as mountainous, because of its high altitude above about 1500m. The country's highland areas include about 90 percent of its arable lands and are occupied by 90 percent of the human population and 60 percent of all livestock (Hurni, *et al*., 2010). ThePopulation has expanded all over the highland parts of Ethiopia as they are very suitable places for living and agricultural activity. The Ethiopian Highlands, once endowed with rich natural resources, are agriculturally used since millennia and now heavily degraded (Gete, 2010).

Different studies were conducted related to SLM such as Motuma (2017); Micheal (2002) and Mamuye (2015). These researchers generally focus on assessing what land management practices look like, what are the causes of land degradation and assessing the traditional land management practices and its role on their study area. As to the researcher's knowledge, there is a research gap on the issue related with an assessment of the benefits of farmers' gating after practicing SLM practices. On the other hand, the methodology they used to conduct their research was simple descriptive statics like percentage and frequency and cross tabulation which different from this study. Hence this study assesses the benefits of farmers' after implementing SLM practices in erosion-prone areas of East Gojjam Zone, Ethiopia. The reason behind selecting the study area is because the area is found in the highlands and it is very prone to erosion and land degradation.

## 1.3.Objective of the study

### 1.3.1. General objective

- The general objective of the study is to investigate factors influencing farmers' decision in implementing sustainable land management practice in East Gojjam zone, Ethiopia.

### 1.3.2. Specific objectives

- To assess farmers' awareness level about the benefit of land management practice in East Gojjam zone, Ethiopia.
- To evaluate the implemented land management practices adopted by the farmers' in East Gojjam zone, Ethiopia.
- To investigate the determinants of farmers' decision to Implement sustainable land management practices in East Gojjam zone, Ethiopia.

### 1.3.3. Research questions

- What is the farmers' awareness level about the benefit of land management practice in East Gojjam Zone, Ethiopia?
- What are land management practices adopted by the farmers' in East Gojjam Zone Ethiopia?
- What are the determinants of farmers' decision to implement SLM practices in East Gojjam Zone Ethiopia?

## 1.4. Significance of the study

The study tried to fill the gaps by studying factors influencing farmers' decision in implementing sustainable land management practice in the study area. The study also tried to identify the factors affecting farmers' decision to implement SLM practices. The result of this study can serve as a secondary source of information for researchers who are interested to conduct research upon related topics.

## 1.5. Scope of the study

This study was conducted in East Gojjam Zone, Machakel Wereda, and Gozamen Wereda. It focused on the factors influencing farmers' decision in implementing SLM practices. In this study the researcher tried to identify the potential factors influencing farmers' decision to implement SLM practices, it also tried to assess the farmers' awareness about land management practices and its benefit and different land management practices those farmers used in the study area.

## 1.6. Limitation of the study

The problem the researcher faced during conducting this study includes shortage of time, unwillingness of the targeted wereda key informants and influential respondents to provide genuine knowledge, experience, lack of transportation to reach the selected kebele especially on Sostu Debreshelel was a big challenge to collect the data from households and focus group discussion timely. Expectation and personal information's due to political fear and shortage or lack of satisfactory perdim payments for this issue from the researcher were the limitations of this study

## 1.7. Operational definition of terms

**Land** - Land is a delineable area of the earth's terrestrial surface, encompassing all attributes of the biosphere immediately above or below the surface including those of the near-surface, climate, the soil and terrain forms, the surface hydrology, the near surface sedimentary layers and associated groundwater reserve, the plant and animal populations, the human settlement pattern and physical results of past and present human activity.

**Land degradation-** is any reduction or loss in the biological or economic productive capacity of the land resource base.

**Soil erosion-** is the process of wind and water moving soil particles from one location and transporting and depositing them elsewhere.

**Land management** - is the process by which the resources of land are put into good effect also encompasses all activities associated with the management of land that are required to achieve sustainable development.

**Sustainable land management (SLM)** - the combination of plans of activities or different activities used to improve the productivities of land in a sustainable manner.

## 1.8. Organization of the study

This thesis has five chapters. The first chapter is about background information of the study. The next chapter reviews the related literature about sustainable land management practices and it also contains the main concept of the study. The methods and tools used for the study are found in chapter three. Fourth chapter presents and discusses the major finding and results of the analysis. Conclusion and recommendation part is found in the last chapter which is in chapter five.

# CHAPTER TWO

## 2. LITERATURE REVIEW

### 2.1.Concept and Definition of sustainable land management

The concept of SLM refers to divers and long-running dispute over the direction of societal actions. For all the ambiguity and diversity involved in defining the term precisely, the definition contained in the Brundtland report is often mentioned as a general starting point, it contains the formulation, "sustainable development is the development that meets the needs of the present generation without compromising the ability of future to meet their own needs" (Weith*et al.,* 2013).

Sustainable land management is the combination of technologies, policies and activities aimed at integrating socio-economic principles with environmental concerns so as to simultaneously maintain or enhance production, reduce the level of production risk, protect the potential of natural resources and prevent soil and water degradation be economically viable and be socially acceptable(Dirk *et al.,* 2004).

SLM also defined as a system of technology and/ or planning that aims to integrate ecological with socio-economic and political principles in the management of land for agriculture and other purposes to achieve intra and intergenerational equity (Hurni*et al.,* 1996). SLM is thus so composed of the three development components 'technology', 'policy' and in particular 'land use planning' (Bouna, 1997).

According toFAO (2008), SLM is simply about people looking after the land for the present and for the future. The main objective of SLM is thus to integrate people's coexistence with nature over the long- term, so that the provisioning, regulating, cultural and supporting services of the ecosystem are ensured. SLM is the antidote, helping to increase average productivity, reducing seasonal fluctuations in yields, and under pinning diversified production and improved incomes.

SLM has been defined by Terrafrica partnership (2006), as the adoption of land use system that through appropriate management practices enables land users to maximize the economic and social benefits from the land while maintaining or enhancing the ecological support functions of the land resources. SLM includes management of soil, water, vegetation and animal resources. SLM focuses on increasing productivity of agro-ecosystems while adapting to the socio-

economic context, improving resilience to environmental variability, including climate change and at the same time preventing degradation of natural resources (FAO, 2011).

SLM is crucial to minimize land degradation, rehabilitating degraded areas, and ensuring the optimal use of land resources for the benefit of present and future generation. Thus it is based on four major common principles;1) land user-driven and participatory, approach 2) integrated use of natural resources at ecosystem and farming system levels, 3) multi-level and multi-stakeholder involvement, and 4) targeted policy and incentive mechanisms for SLM adoption and income generation at the local level( Liniger*et al.,* 2011).

According to the perspective of the World Bank, knowledge as a resource is equally important to be able to integrate different management areas. "Sustainable land management is a knowledge-based procedure that helps to integrate land, water, biodiversity and environmental management including input and output externalities to meet rising food and fiber demands while sustaining ecosystem service and livelihoods (Weith*et al.,* 2013).

World Bank (2008) cited by Weith*et al.,* (2013), states that SLM is necessary to meet the requirements of a growing population and improper land management which can lead to degradation of land in a significant reduction in the production and service functions.

**2.2.SLM practices**

SLM practices are agricultural practices that preserve and enhance production capacities of land for crops, livestock's, water shade and forest, and actions to minimize and reverse land degradation and also they are necessary to meet the food needs of the growing population, rehabilitate degraded lands, adapt to changing climate and mitigate climate change ( Rechaet *al.,* 2014).

The most frequently SLM practices and/or measures based on its importance are Bund (stone face soil bund, trench), fanyajuu, waterway, cut off drain, and terrace construction. However, these technologies are applied not only for the purpose of immediate reduction of soil erosion but also the increased percolation of water (MoA, 2014).

The practices including diversified cropping systems (strip cropping and mixed intercropping), integrated agronomic practice (multiple cropping, mulching, and strip cropping), structural soil

erosion practices (terraces both soil and stone bund ), soil management practices ( compost, green manure and fertilizer usage) and cultivation practices like minimum tillage and conventional tillage are the most sustainable land management practices and are a key mechanism for effective change in the sustainable use and management of land resources (Webb, 2004). Overall the SLM practices will be determined by the local context and particular situation of local stakeholders, it can be different from region to region and based on topographic condition.

Unsustainable land management practice can threaten biodiversity and increase the release of carbon especially through the destruction of the forest as well as impacting adversely on water resource management. On the other hand, they present the opportunities' for enhancing the livelihoods of the poor or fostering inclusive growth as well as for achieving environmental goals (UNCCD and FAO, 2009).

As modified from FAO (2011), adopting SLM practice contributes for the mitigation of climate change by sequestering atmospheric carbon in the soil and in the perennial vegetation through the help of technology include afforestation, agroforestry, reduce tillage, improved grazing land management, greenhouse emission can also be reduced by limiting deforestation, reducing the use of fire, better livestock management, and better agro-economic practices.

Practices to be truly sustainable must be environmentally friendly, reduce current land degradation, improve biodiversity and increase resilience to climate variation and change. SLM interventions are vital to prevent, mitigate and rehabilitate land degradation. The choice of SLM practice will be determined by the local context and particular situation for local stakeholders (FAO, 2011).

## 2.3. Agriculture and sustainable land management

Within the sphere of agriculture, land management includes maintenance of soil productivity. This contains the combination of soil treatment including the application of mineral and organic fertilizer like animal dung with soil and water conservation measures implementation of agronomic, soil management and physical measures such as contour ridging, terracing or providing ground cover through mulching, use of plants and living crop residue (Wood fine,

2009). Also like any limited resource, it is important to manage agricultural land because it is most suitable for farming and also essential.

SLM is a necessary building block for sustainable agriculture development and it is a key element in AGENDA 21's goals of sustainable development (chapter 10). Sustainable agriculture development, conservation of natural resource and promoting sustainable land management are key objectives of the new World Bank rural investment programs, from vision to action ( world bank,1997), and increasingly these objectives are being include in all agriculture development and natural resource management projects.

According to Pieri*et al*., (1995), more ecological balanced land management can achieve both economic and environmental benefits, and this must be the foundation for further rural intervention (investment). Without good land management, other investments in the rural sector are likely to be disappointing. At the same time, a requiring for the future maintenance of agriculture without reference to environmental sustainability is increasingly difficult.

### 2.4.Challenges of SLM practices

Three major factors for the limited investment in SLM by smallholder farmers in Ethiopia Includes: 1) farmers capacity to invest in SLM is very limited, 2) farmers incentive from their investment in SLM practice is limited, and 3) there are insufficient enabling conditions for motivating farmers to invest in SLM practice or technologies (Liniger*et al.,* 2011).

According to Weith*et al.,* (2013), economic globalization, climate change, global food security, biodiversity, water supply, migration, demographic change process and the world growing energy needs are the key to lead changes in land use in almost all major regions.

### 2.5.Factors affecting the implementation of SLM practice

Tadesse (2011) cited by Kefle (2016), argues that government policies and programs, socio-economic and institutional factors, farmer's local knowledge and practices, household's endowments of physical and human capital as well as topography, soil type and climate are the most important factors that could influence land management practices.

A study conducted by Kefle (2016), in Bale- ECO- regions of South Eastern Ethiopia Identified that education level of household head, age of household head, family size, agroecology, income, market access, extension service, access to credit, farming experience, livestock ownership, land holding size, sex of household, perception on soil fertility and training access to have an influence in the adoption of land management's. On the other hand, a study conducted in Werra Garso wereda, Oromiya, Ethiopia by Tola (2015), Identifies population growth, income level, urbanization, infrastructural development, policies at national and international level and land tenure and property rights are the major factors affecting sustainable land use management.

### 2.5.1. Physical factors

These are a factor which is related to characteristics of landforms, topographic conditions, farm size and land tenure or owner of lands.

#### 2.5.1.1.Topography

The topography of farmland may also determine the use of SLMP. The existence of farmland with the degradation and vulnerability to degradation has its own role to implement SLMP, which means that farmers who cultivate on sloppy and undulating lands are expected to be more conscious of information on SLMP (Babalola*et al.*, 2013).

Farmers having Step slop land have the probability of practicing sustainable land management practices when the farmland of the farmer is very stepper, they are very inclined to practice land management practices in order to protect the soil from erosion and to improve their production output (Motuma, 2017). This implies that the steepness of landform is good to implement SLM practices.

#### 2.5.1.2.Climatic characteristics

Climate plays a major role in the type of land management practices a farmer can adopt. Rainfall pattern is the major determinant for land management practice adoption according to (Chomba, 2004). Change on the rain fall pattern affects the farmers' decision to practice land management practices. In addition, change in rainfall patterns has shortened the time available for land preparation as the fields dry out very quickly. This limited time to prepare fields for growing crops has led to the use of inappropriate tillage practices this is because when the rain fall comes

very late this poses a limited time to prepare the land management practices and also poor rain fall at the beginning of the season tend to cause manure to scorch the crops because of the already high soil temperature (Paulus, 2015).

### 2.5.2. Socio-economic factors

This is factors which are related to household's socio-economic condition includes age and sex of the household heads, education level of the household heads, livestock holding size and farm size or land holding size of the household heads.

#### 2.5.2.1.Age and sex of farmers

The age of farm household are relatively and significantly influence the adoption of SLM, this implies that younger farmers have a potential of practicing SLM practices than old farmers. Young farmers might have longer planning horizon and more flexible in deciding to practice new ideas and technologies, while the old farmers have shorter planning horizon and they are physically weak, more resistance to change and hence less interested in practicing SLM practices and soil conservation practices ( Mihertu and Yimer, 2017).

According to Motuma(2007), Being male or female has its own implication to identify factors affecting implementation of SLM practices, which indicates that Meal headed households has the potential to practice land management practices than Female-headed households.

#### 2.5.2.2.Education level of farmers

The study conducted by Tola (2015), Argues that education levels of household's are the major factors affecting sustainable land management practices. Education level affects household's decision which determines the welfare of the society such as income, health, and their attitudes towards using of land management. It may also enable the households to have broad vision about land management practices or overall the surrounding environments.

#### 2.5.2.3.Livestock resources

Livestock is the major component of the agricultural system in Ethiopia. Wealthy farmers or farmers having livestock had accesses to more manure and implement more soil fertility management practices than other farmers that do not have livestock (Michael, 2007).

#### 2.5.2.4.Farm size

Farmer's having Large farm sizes are expected to practice better land management practice, this is due to farmers perception to large farm size is very high because farmers having large farm size are practiced better land management practice by planning different land management technologies (Motuma,2017). In this context farmers' having small land farm size is relatively small or not practice good land management practices.

### 2.6. Institutional factors

These factors are related to institutional facilities which tackling the implementation of land management practices.

#### 2.6.1. Access to credit

According to Samuel (2014), Access to credit is one of the major drivers of farmers' investment on SLM technologies and it improves the problem of liquidity and enhances the use of agricultural input in production as it is often claimed in development theory.

As described by Pender and Kerr(1998) and Holden *et al.,* (2004), credit helps to reduce the extent to which household strange about the future and this would enable them to make more investment in land conservation practices.

#### 2.6.2. Access to extension services

Informal education through extension workers will enhance SLM practices among peasant farmers. This is due to the role of that extension services play in providing informal education to farmers who might be illiterate on different aspects of farming activities (Samuel, 2014).

### 2.6.3. Access to persistence information

A study conducted by Zeneb and Aad(2003), shows that accesses to persistence information as major factors which positively influence farmers' investment in land management practices. This implies that lack of access to adequate and persistence information affects farmers' decision in implementing SLM practices.

## 2.7. Components of SLM

According to Peter *et al.*, (2013), The common components for SLM understand the ecology of land use management, maintain or enhance productivity, maintenance of soil quality, increased diversity for higher stability and resilience, provision of economic and ecosystem service benefits for communities and social acceptability. SLM requires a better understanding of the direct and indirect effect of land management and ecosystem functions.

The foundation for the success of SLM system often depends on the adaptability and the social acceptability of that system by the affected communities. Sustainability among different communities may have a different level of social perceptions, various factors like knowledge and education, geographic variability, time and social affiliation may affect social acceptability.

The components for sustainable land use management include: achieve biological balance in the country; needs for nature protection and rational utilization of natural resources; in particular, the protection of the land, water, forests, and gene pool, important for the protection of cultural and historical resources; needs for the regeneration of human resources and the protection of human health; demands on the humanization and aesthetic appeal of the landscape. These incorporate the fundamental principles of sustainable societal development. Sustainable development accentuates caring for the Earth by putting sustainable living principles into practice and integrating conservation and development: the conservation to maintain human actions within the Earth's capacity and the development to enable people everywhere to enjoy long, healthy, and fulfilling lives (Ruzicka and Miklos, 1990).

## 2.8. Land policy of Ethiopia

The present constitution of Ethiopia, which was put in to force January 1995, vests land ownership exclusively in the state and in the peoples of Ethiopia. The relevant section continues to, the land is a property of the nations, nationalities and peoples of Ethiopia and shall not be subject to sale or to other means of exchange (Art, 40 of the constitution). Despite these differences to land reform, Ethiopia still faces issues of sustainable food self – sufficiency.

The Ethiopian constitution asserts state ownership of land; these are no private property rights in land. Even if there are national debates on the existence of different ownership and tenure regimes for land in Ethiopia, the government of Ethiopia is not prepared at this time to realize private property right in the land. While the government of Ethiopia is the decentralized administration of land to the regional governments, the formulation of broad land policy still rests with the federal government (Adopted from Ethiopian land policy and administration assessment final report, 2004).

## 2.9. Empirical literature related to factors of SLMPs

A study titled as "assessment of land management practices in Grar Jarso woreda, central Ethiopia by Motuma (2017) uses survey questions, FGDs, and key informant interview in order to assess the land management practices in the study area. The study analyzes the qualitative data in a narrative way and the quantitative data was analyzed using frequency and percentage the result of quantitative data was analyzed in the form of a table. The finding of this study shows that in the study area traditional land management practices such as fallowing; manure application, counter farming and drainage ditch were more applicable and practiced than the modern land management practices. This study also found that the lack of arable land, topography, population pressure and vegetation cover affects farmers decision on adoption and use of introduced land management practices.

Melese(2014), conducted a study on land degradation and challenges of its management practices in case of Lemo Woreda, Hadiya zone, Ethiopia tries to identify the causes and types of land degradation and its management practices for land degradation and the challenges for management practices. The objective of this study was, identifying the main causes of land degradation, identifying the land management practices, identifying the main challenges for the

implementation of degraded land management and assessing the measures taken to sustainably manage degraded lands in the study area. To achieve this objective this study were uses both qualitative and quantitative data and this data was analyzed using simple descriptive statistics in a descriptive way. Decrease in productivity of farmland, off-farm activity, population growth, lack of full cooperation of family member in land management practices, low assistance gained from neighborhoods, less access to extension service and inadequate attention from woreda agricultural and rural development office was the finding of this study and they are the main challenges encountering the implementation of land management practices in an effective way.

## 2.10. Conceptual framework of the study

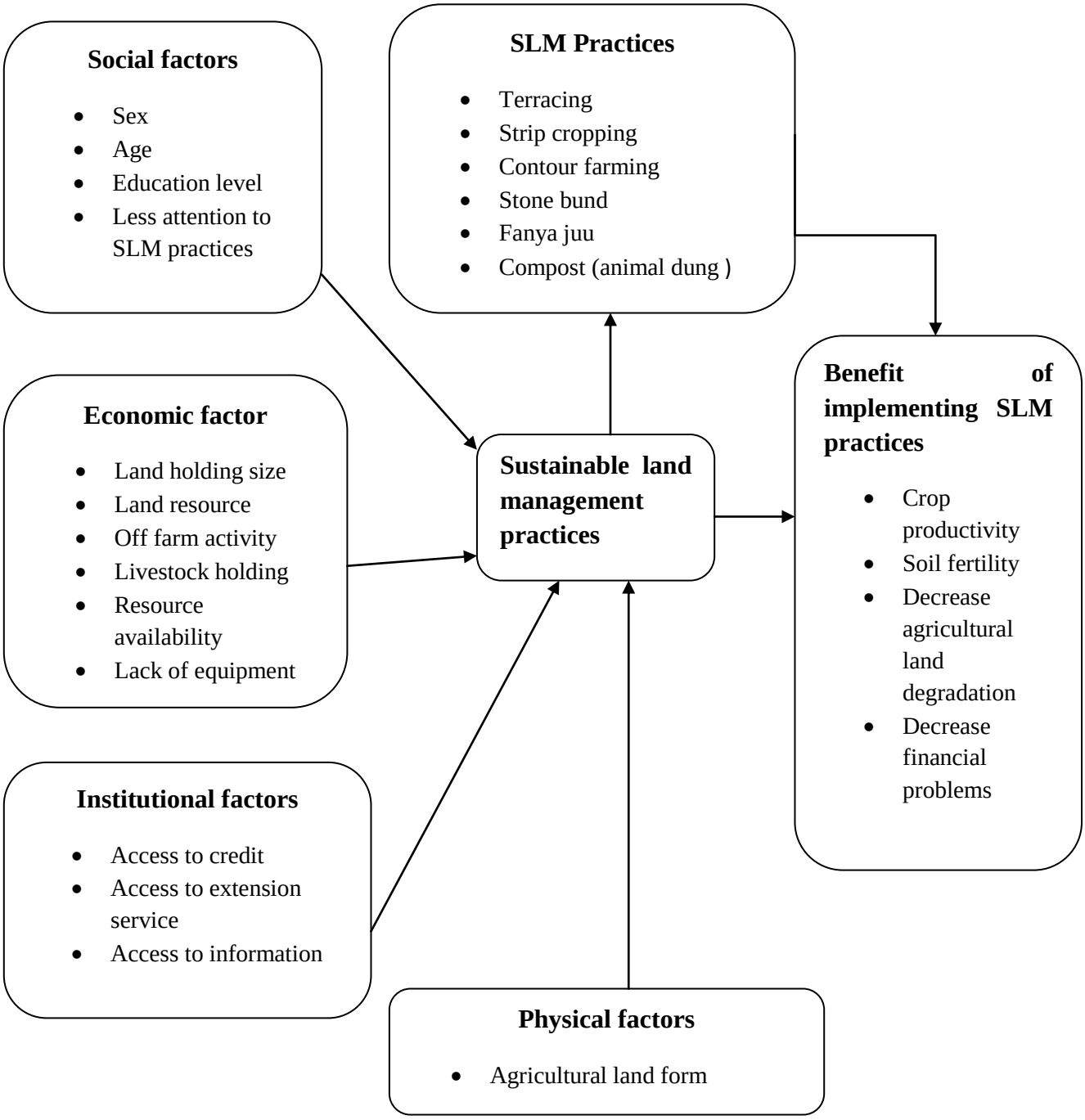



**Figure 1: Conceptual framework of the study**

**Source: Own construction (2008)**

# CHAPTER THREE

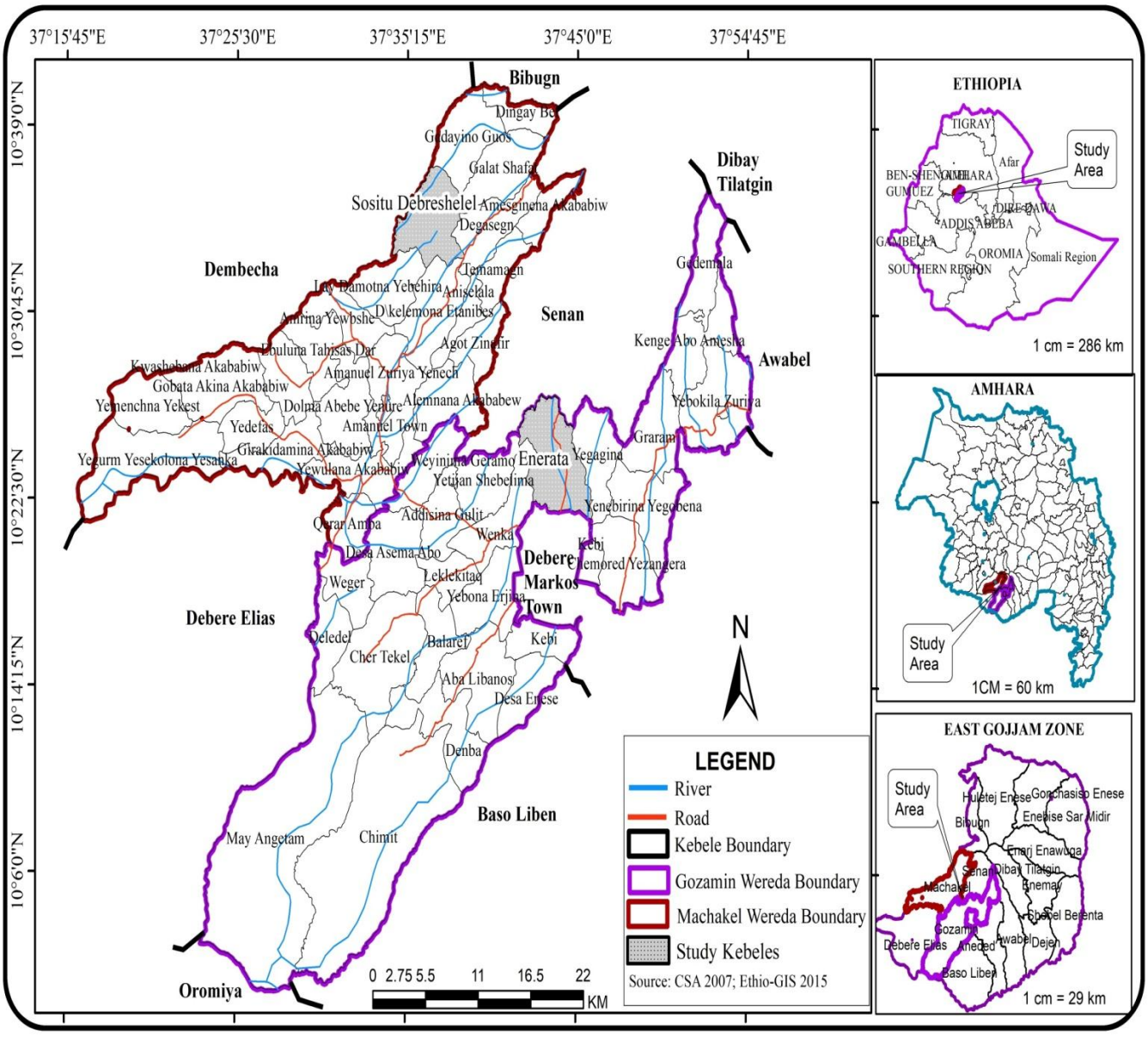
## 3. DESCRIPTION OF THE STUDY AREA AND RESEARCH METHODOLOGY

### 3.1.Description of the study area

#### 3.1.1. Location

This study was conducted in East Gojjam zone, Machakel, and Gozamen Woreda. East Gojjam Zone is a Zone found in Amhara regional state of Ethiopia, and it's named after the former province of Gojjam. East Gojjam zone is a border on the South by Oromia region, on the West by Mirab Gojjam, on the West by Debub Gonder and on the East by Debub Wello; the bend of the Abay River defines the zones Northern, Eastern and Southern boundaries. Its highest point is mount Choqa also known as Mount Birhan. However, the study area was on Gozamen and Machakel Woreda of East Gojjam Zone respectively. Machakel Woreda is found geographically located in $10^0$ 19' 75" to $10^0$ 41' 00" N latitude and $37^0$ 16' 46" to $37^0$ 45' 42" E longitude. The Woreda is surrounded by Dembecha Woreda in the West, Gozamen Woreda in the East, Debre Alias Woreda in the South and Sinan Woreda in the North direction. It is 330 km far from Northwestern part of A.A town, 237 km away from Southern part of Bahirdar the capital city of Amhara regional state and 30 km far from Western part of Debre Markos town, which is the administrative city of East Gojjam Zone. This Woreda is divided into 24 rural kebeles and 1 urban kebele centered Amanuael as an administrative town, from this Kebele this study was conducted on one of 24 rural kebeles which are on Sostu Debreshelel kebele which is found in Woyna Dega agroclimatic zone.

Gozamen woreda is one of the 17 weredas of East Gojjam zone ANRS lies between $10^0$ 1' 46" to $10^0$ 35' 12" N latitude and $37^0$ 23' 41" to $37^0$ 55' 52" E longitudes. It is found at a road distance of about 250.8 km BD (the capital city of ANRS) and is bordered by Aneded and Debay Tilatigni Woredas in the East, Machakel and Debre Alias Woredas in the West, Sinan woreda in the North and Baso liben Woredas and Oromia regional state (Abay River) in the North. From this Woreda, this study was conducted in one of the rural Kebeles which are on Enerata.




Source: CSA, 2007; Ethio-GIS 2015

**Figure 2: Map of the study area**

### 3.1.2. Population of the study area

Based on the 2007 census conducted by the central statistics agency (CSA), the total population of Machakel Woreda is about 118,097 from this 5,442 population is found in the study area in Sostu Debreshelel Kebele of this population 2,681 is Male and 2,761 is Female. Also, the total

population of Gozamen Woreda is around 132,883 from this 5,243 population is found in the study area in Enerata Kebele of this population 2,600 is Male and 2,643 is Female.

### 3.1.3. Area Coverage and Land Use Type

Machakel Woreda has a total area of 79558ha. From this around 41584ha is agricultural land, 13656ha is grazing land, 5382ha is covered by natural forest, 6177ha is covered by manmade forests, 9285ha is villages and around 3471ha is covered by others. The major landform of the Woreda includes 48% mountainous, 50% plain and 2% valleys. Sostu Debreshelel Kebele is one out of 24 Kebeles of Machakel Woreda and it covers a total land area of 7300 ha out of this 2500ha is agricultural land, 1310ha is grazing land, 152ha is occupied by natural forest, 67ha is covered by manmade forest, 23ha is valley and 62.5ha is occupied by mountains and the rest 5185.5ha is occupied by others (Machakel Woreda agricultural Office, 2018).

Gozamen woreda covers a total area of around 123157.24ha. Out of this 49152ha is agricultural land; around 13150.78ha is covered by forests, 9074.25ha covered by deciduous bushes and forest, 6278ha is covered by natural frankincense, around 14065ha is grazing land, 2092.04ha is covered by bare land and 29345.17ha is covered by others. The major relief feature of the wereda includes mountainous with area coverage of 26.53%, undulating plain with 67% coverage and valley with 6.47%.Eneratakebele is part of Gozamen district and it covers a total land area of 4800ha of which 2252ha is cultivable land, 935ha is grazing land, 146ha is occupied by residential houses, 170ha is covered with forests, and 7ha of land is occupied by buildings. Mountain, plain and valley are landforms covering 70%, 22%, and 8% respectively (Gozamen Woreda agricultural Office, 2018).

### 3.1.4. Climate and soil type

The altitude of Machakel Woreda ranges from 2000-3600 m above sea level; 5% of the Woreda is kola, 54% is Woyna Dega, 37% Dega and about 4% Wurch (frost) agro-climatic Zone. The mean annual rainfall amount of the Woreda ranges from 900-1800mm and the mean annual temperature of the Woreda is around 12.5-22.5°c. The altitude of Sostu Debreshelel kebele ranges from 1188-2220 m above sea level (m.a.s.l). The dominant agro-ecology of the Kebele is Woyna Dega. The mean annual rainfall amount of the Kebele is ranges from1800-2000mm and the dominant soil type is Nito soil (Machakel Woreda agricultural Office, 2018).

On the other hand, the elevation of Gozamen woreda ranges between 800 - 3748m above sea level. The Woreda is classified into 4 different traditional agro-climatic Zones which are Dega16%, Woyna Dega 74% Kolla 9% and Wurch (frost) 1%.the mean annual rainfall amount of the Woreda ranges From1148-1808mm and the average temperature of the Woreda ranges from11-25°c. From this Woreda, this study was conducted on the Northern tip of the Woreda which is found in Dega agro-climatic zone on Enerata kebele. The altitude of Enerata ranges from 2450-2500m above sea level (m.s.l). The dominant soil type of the kebele is Nito soil (Gozamen woreda agricultural Office, 2018).

### 3.2.Research design

The research design employed for this study was cross-sectional research design which incorporates both qualitative and quantitative survey method. The rationale behind the choice of this design was the short duration of the study which obliges the data was collected through one - time survey.

### 3.3.Data source

This study includes both primary and secondary data sources. The primary source for this study was collected through direct observation of the study area, questionnaires for sample households, focus group discussion with farmers who practice and do not practice SLM and key informant interview with the selected weredas agricultural office and extension service workers. The secondary source data used for this studywas written documents, published researches, books and other related sources.

### 3.4.Sampling procedure and sampling size determination

To conduct this study the researcher selected two Woredas from East Gojjam Zone using purposive sampling technique which are Machakel and Gozamen Woreda of this Woreda Sostu Debreshelel and Enerata kebele is selected randomly using lottery method from two Woredas respectively. Sostu Debreshelel Woreda has a total population of 5,442 of which 2,681 Male and 2,761 Female, with a total number of 1287households. EneratаKebele has a total population of 5,243 of which 2,600 is Male and 2,643 are Female with total number of1131 households. To select the respondent households in the selected Kebeles the researcher used simple random

sampling technique In order to remove bias and to get precise information. The sample size was calculated using the following formula developed by (Yamane, 1967) with 93% confidence level.

$$n = \frac{N}{1 + N(e)^2}$$

Whenn = the desired sample size

N = Population size of thehousehold head

e= level of precision

$$n = \frac{2418}{1 + 2418(0.07)^2}$$

$$= \frac{2418}{1+2418(0.0049)}$$

$$= \frac{2418}{12.8482}$$

n= 188.19≈ 188

The total sample size was 188

To calculate the sample size for each kebele

First, the researcher calculate percentage value for each Kebele

For Sostu Debreshelel Kebele %= the total household numbers in Sostu Debreshelel Kebele / total household of both Kebele × 100

$$= \frac{1287}{2418} \times 100$$

=53 for Sostu Debreshelel and

For Enerata Kebele % = the total household numbers in Enerata Kebele / total household of both Kebele × 100

$$= \frac{1137}{2418} \times 100$$

= 47 for Enerata kebele

To calculate the sample size for Sostu Debreshelel Kebele

$$n_o = \frac{1287}{2418} \times 188 = 100.06 \approx 100$$

To calculate the sample size for Enerata Kebele

$$n_o = \frac{1137}{2418} \times 188 = 88.40 \approx 88$$

**Table 1: Distribution of sample household head by Kebeles**

| Name of kebeles | Total population | Total household head | Sample size | Percentage |
|---|---|---|---|---|
| **Sostu Debreshelel** | 5,442 | 1287 | 100 | 53 |
| **Enerata** | 5,243 | 1131 | 88 | 47 |
| | 10,685 | 2,418 | 188 | 100 |

### 3.5.Data collection and instruments

The study used both qualitative and quantitative data collection methods to investigate in detail about the issue. The quantitative data were collected using questionnaires and qualitative data was collected through observation, key informant interview and focus group discussion.

**Questionnaires**

Questioners are the instruments it was employed to collect information from the sample households. A survey question was prepared to collect both qualitative and quantitative data. The questionnaire contains the demographic and socio-economic characteristics of the selected households, factors affecting the decision of farmers' to practice SLM, and also questions related with the advantage and disadvantage of practicing SLM on agricultural output and the questions were also contain different practices takes place for the purpose of SLM in the study area. To convey the questions effectively to the local interviewees, the questionnairewas translated into local language Amharic (*Amharegna*).

**Key informant interview**

Key informant interview was employed for the purpose of qualitative data. Key informant interview was conducted from different experts and individuals including Kebeles extension workers and Woredas agricultural office.

**Observation**

Observation, where employed to crosscheck the data found from different sources and the reality. This method is one way of collecting the qualitative data by gathering first- hand data from concerned bodies and farmers' who lives on the study area and it is also good for collecting data in the form of a photograph.

**Focus group discussion (FGDs)**

FGDs were another qualitative data collection methods, it was employed for those sample households who practice and do not practice SLM. One FGDs were conducted in each kebele and 12 members were involved in each kebele FGDs from the respondents who practices and don't practice SLM both male and females were involved, the religion of the discussants were orthodox and the age composition of the discussants were young and elder.

**Figure 3: Focus group discussion on Enerata Kebele**

**Figure 4: Focus group discussion on Sostu Debreshelel Kebele**

### 3.6.Selection of explanatory variable

**Table 2: Expected sign of explanatory variable**

| Variable | Nature of variables | Expected sign Binary Logit model |
|---|---|---|
| Age of the household head | Continuous | - |
| Sex of the household head | Categorical | - |
| Education level | Categorical | + |
| Landholding size | Continuous | - |
| Family size | Continuous | + |
| Distance of farm land to home | Continuous | - |
| Livestock holding | Categorical | + |
| Lack of credit | Categorical | - |
| Lack of extension services | Categorical | - |
| Lack of persistence information | Categorical | - |
| Slop of the plot | Categorical | + |
| Resource availability | Categorical | + |
| Lack of equipment | Categorical | - |
| Land resource | Categorical | + |
| Lack of attention | Categorical | - |
| Off farm activity | Categorical | - |

Source: Own depiction (2018)

### 3.7.Methods of data analysis

The collected data for the study were analyzed by using both descriptive and inferential statistics using binary logistic regression model.

#### 3.7.1. Descriptive statistics

Descriptive statistics means, standard deviations, frequency, and percentages were used using SPSS software version 21, and the data entered in SPSS were exported in to STATA for further analysis of the data. In addition to this, the statistical mean difference and the association of the dummy and continuous variables with the dependent variable were tested using chi-square and t-

test. Furthermore, data collected through key informant interviews and focus group discussions were analyzed using textual and tabular analysis.

### 3.7.2. Econometrics model

**Logistic regression model**

Logistic regression sometimes called logistic model or logit model, this model analyzes the relationship between multiple independent variables andcategoricaldependent variables and it also estimates the probability of occurrence of an event by fitting data to a logistic curve. There are two models of logistic regression, binary logistic regression, and logistic regression models. Binary logistic regression is typically used when the dependent variable is dichotomous (only two categories) and the independent variables are either continuous or categorical. When the dependent variable is not dichotomous and it is composed of more than two categories a multinomial logistic regression can be used (Park, 2013).

According to Gujarati(2004), when the dependent variable is dichotomous which means that it takes 0 or 1 value there is a need of using either logit or probit regression model. This study was analyzing the data using logit model. The reason behind why the study prefer the logit model than probit model is that because of its simplicity (the equations of logit model are very simple) and its interpretability (logit model is directly interpretable as log-odds), while the probit does not have a direct interpretation (Pindyck and Rubinfeld, 1981). By taking this into account this study uses the binary logistic regression model to predict the effects of independent variable on dummy (changeable) types of dependent variables.

According to Gujarati (2004),the model can be represented using the following formulas;

$$p_i = E(Y = {}^{1}/_{Xi} = \frac{1}{1+e^{-(B1+B2Xi)}} \quad \text{---------- (1)}$$

Where (Pi) is the probability of practicing SLM, (Xi) the probability of explanatory variable from farmers, who practice or do not practices SLM practices and( i) is an individual household observation.

Where equation one is logistic distribution equation

Let consider, $z_i$= β1+β2Xi or replaced by $z_i$in the first equation, then we obtained equation 2

$$p_i = \frac{1}{1+e^{-zi}} = \frac{e^z}{1+e^z} = \text{---------- (2)}$$

Ziis between -∞ and +∞ and Pi is between 0 and 1. Where Pi shows the probability of farmers' who practice SLM practices, Xi is the explanatory variables,( i) is an individual household observation (where pi equal to one the probability that farmers' who practice SLM and 1-Pi the probability of that farmers' who can be categorized under not practicing SLM.

1-$p_i$= then, the probability of farmers' who do not practice SLM can be explained in equation 3 as follows:

$$1\text{-pi} = \frac{1}{1+e^{Zi}} \text{---------- 3}$$

Equation 4 can be obtained by dividing the farmers' who practice do not practice SLM practices.

So, the equation is;

$$\frac{Pi}{1-Pi} = \frac{1+e^{Zi}}{1+e^{-Zi}} = e^{Zi} \text{---------- (4)}$$

Using the natural logarithm of both sides of the equation, equation (5) canbe obtained

$$\ln\left(\frac{pi}{1-pi}\right) = \ln = \left[e^{\beta 0} + \sum_{i=1}^{M} BiXi\right] = Zi \text{---------- (5)}$$

The disturbance term Ui is taken in to account the logit model becomes:

$$Z(i) = \beta 0 + \beta 1x1 + \beta 2x2 + \beta 3x3 + \cdots \beta mxm + ui \text{---------- 6}$$

Where Bo is the intercept

$\beta 1\beta 2\beta 3$ ....are the slope parameters in the model. The slope coefficient cantell the change log-odds in favor of being implementing SLM practices change as independent variable change.

Xi is the vector relevant characteristics of households

Ui is error term

$Zi = \beta 0 + \sum_{i=1}^{M} \beta i Xi + Ui$---------- 7

Therefor, the above econometric model was used in this study to analyze the factors affecting farmers' decision in implementing SLM practices.

### 3.8. Statistical analysis and model test

#### 3.8.1. Model diagnostic test results

According to Gujarati (2004), it is essential to test the problem of Multicollinearity among the selected explanatory variables before the start of any regression analysis. Model of specification test for the overall model fit (model goodness of fit or gof) and test for model specification error test (link test) also have been employed after running logistic regression.

**Table 3: Model diagnosis test**

| **Tests** | **Tests name** | **Prob>Chi2/F** |
|---|---|---|
| Gof | Pearson (chi2) | 0.0720 |
| Multicollinarity | Pwcorr | Min= -0.2881 |
| Linktest | Hatsq | Max= 0.6065 |
| | | 0.509 |

**Source: Computed from own field survey (2018)**

The pairwise correlation tests or Multicollinearity test employed in order to test the existence of a correlation between independent variables. According to (Stock and Watson, 2007), the correlation of above +0.80 and -0.80 are considered as a critical point to indicate a serious Multicollinearity problem. So, for this study, the coefficient of all variables found to be above -0.2881 and below 0.6065 (see appendix 5). This indicates that there is no sever Multicollinearity problem between independent variables.

Model goodness of fit test (Gof) was also employed to test is the model robust enough to explain the dependent variable. This is evidenced by the fact that the model of was tested using prob> chi2 which found to be 0.7784 which lies between 0 and 1 (appendix 7). The result confirms that the explanatory variables of the model could explain the dependent variable. So we can conclude that the models were correctly fitted.

Finally, link test was employed to test the model specification error. The null hypothesis is that there is no specification error. If the p value of hatsq is not significant so we fail to reject the null hypothesis and conclude that our model is correctly specified or this model has not specification problem. Here the p value of hatsq for this model is 0.509 (see appendix 7).

# CHAPTER FOUR

# 4. RESULT AND DISCUSSION

This part presents the discussion and interpretation of the findings. Both descriptive statistics and econometric analysis where employed to identify the relationship between explanatory variables and dependent variables. Binary logistic regression was used to investigate factors influencing farmers' decision in implementing SLM practices of sample household heads.

## 4.1. Demographic and Socio-Economic Characteristics of respondents

### 4.1.1. Demographic Characteristics of respondents

The demographic characteristic of household head includes age, sex, family size and marital status. As shown from Table 3, the minimum and themaximum age of respondent were 24 and 72 respectively. The mean age of the household heads who don't implement sustainable land management practices were 45.357 and the mean age of household heads implementing sustainable land management practice were 45.969. The p value indicates that, there is no significant mean difference on age between household heads who implement and who don't implement SLM practices.

In addition, the minimum and maximum family size of the household head respondents were 2 and 11 respectively, According to the CSA, (2008) the average family size of rural household head is 4.9 which is approximately 5, based on the data indicated in Table 4 Shows that, the study area family size exceeds the average national rural family size. The mean family size value of farmers' who don't implement SLM practices were 4.911 and the value for farmers' who practice SLM practices were 4.916. According to Table 3 the p value for family size indicates that there is no significant mean deference on family size of farmers' who implement and don't implement SLM practices.

**Table 4: Demographic characteristics of respondents on continuous/discrete variables**

| Explanatory variables | Min | Max | Land management practice | | p-value | t-value |
|---|---|---|---|---|---|---|
| | | | Not implementing SLM | Implementing SLM | | |
| | | | mean | mean | | |
| Age of HHs | 24 | 72 | 45.357 (9.787) | 45.969 (9.603) | 0.69 | 0.3977 |
| Family size of HHs | 2 | 11 | 4.911 (1.632) | 4.916 (1.630) | 0.98 | 0.0229 |

Source: Own survey data (2018)

Numbers in parenthesis indicates standard deviation

**Table 5: Demographic characteristics of respondents on dummy/categorical variables**

| Explanatory variables | | Land management practices | | | | |
|---|---|---|---|---|---|---|
| | Category | Not implementing SLM | Implementing SLM | Total Number | Percentage | P value $Chi^2$ test |
| Sex of HHs | Male | 38 | 119 | 157 | 83.51 | 0.000*** |
| | Female | 18 | 13 | 31 | 16.69 | |
| Marital status of HHs | Married | 37 | 112 | 149 | 79.26 | 0.012*** |
| | Unmarried | 0 | 2 | 2 | 1.06 | |
| | Divorced | 12 | 12 | 24 | 12.77 | |
| | Widowed | 7 | 6 | 13 | 6.91 | |

Source: Own survey data (2018)

*** indicates significant level at 1%

As it can be seen from Table 4, from a total of 157 male household heads 38 respondents were not implementing SLM practices and 119 respondents were implement SLM practices. Whereas, from a total of 31 female household heads 18 were not implementing SLM practices and 13 respondents were implement SLM practices. The chi square test showed that there is statistical association between sex of the household heads and decision to implement land management practices. Thus, from the above Table information, the majority of household heads are Male households.

On the other wing, from a total of 56 households who don't implement SLM practices 37 is married, 0 unmarried (single), 12 divorced and 7 respondents are widowed. Whereas, from 132 households who implement SLM practices 112 are married, 2 unmarried (single), 12 divorced and 6 widowed respondents. According to the above Table the chi square test showed that there is a statistical association between marital statuses of the household head and decision to implement SLM practices.

### 4.1.2. Socio-Economic characteristics of respondents

The socio-economic characteristic of the household head includes Education, off-farm activity, land resource, land holding size and livestock holding. The response of sample household heads has been categorized as continuous/discrete and dummy/categorical variable and summarized in Table 5 and 6 respectively.

**Table 6: Socio-Economic characteristics of the households on continuous/ discrete variables**

| Explanatory variables | | | Land management practice | | p-value | t-value |
|---|---|---|---|---|---|---|
| | Min | Max | Not implementing SLM mean | Implementing SLM mean | | |
| Land holding size | 0.25 | 4 | 1.94 (1.09) | 1.74 (0.93) | 0.21 | 1.27 |
| Distance of farm land to home | 1 | 5 | 1.15 (1.09) | 0.76 (0.8) | 0.07 | 2.69*** |

Source: Own survey data (2018)

Number in parenthesis indicates standard deviation.

NB: *** indicates the level of significance at 1%

As indicated from the above Table, the land holding size is one of the socio-economic characteristics of the household heads. The minimum land holding size of household head respondent was 0.25 hectare and the maximum land holding size of household head respondents were 4 hectare. The mean value for households who don't implement and who implement SLM practices were 1.94 and 1.74 respectively, also the above Table reveals that there is no significant mean difference on land holding size between households implementing and don't implementing SLM practices.

Based on Table 5 the maximum distance for farmland of household head respondents were 5km and the minimum distance is 1km.the mean value for households who don't implement SLM practices were 1.15 and 0.76 were the mean value of households implementing SLM practices. According to the above Table the p value for distance of farm land to home indicates that there is a significant mean difference between households who implement and don't implement SLM practices.

**Table 7: Socio-Economic characteristics of the Households on dummy/categorical variables**

| | | Land management practices | | | | |
|---|---|---|---|---|---|---|
| **Explanatory variables** | **Category** | **Not implementing SLM** | **Implementing SLM** | **Total number** | **Percentage** | **P value Chi$^2$ test** |
| **Education** | Illiterate | 33 | 78 | 111 | 59.04 | 0.611 |
| | From 1-5 | 5 | 15 | 20 | 10.64 | |
| | From 5-10 | 0 | 3 | 3 | 1.60 | |
| | Write and read | 18 | 36 | 54 | 28.72 | |
| **Off-farm activity of HHs** | Yes | 12 | 39 | 51 | 27.13 | 0.252 |
| | No | 44 | 93 | 137 | 72.87 | |
| **Land resource** | Yes | 50 | 132 | 182 | 96.81 | 0.000*** |
| | No | 6 | 0 | 6 | 3.91 | |
| **Livestock resource** | Yes | 48 | 121 | 175 | 93.1 | 0.009*** |
| | No | 8 | 5 | 13 | 6.9 | |

Source: Own survey data (2018)

*** indicates that significant level at 1%

As shown from above the Table, from a total of 56 households who don't implement SLM practices 33 is illiterate, 5 is from grade 1 up to 5, 0 from grade 5 up to 10 and 18 respondents can read and write. Whereas, from 132 households who implement SLM practices 78 is illiterate, 15 from grade 1 up to 5, 3 from grade 5 up to 10 and 36 respondents can read and write. The chi square test indicates that there is no statistical association between education level and decision to implement SLM practices. Thus from this, we can conclude that the majority of respondents were illiterates. According to Todaro and Smith (2009), education is the key factors that affect development and growth.

On the other hand, from a total of 56 households who don't implement SLM practice 12 were engaged in off farm activity and 44 were not engaged in off farm activity. Whereas, from a total of 132 households who implement SLM practices 39 respondents were engaged in off farm activity and 93 were not engaged in off farm activity. Chi square test indicated in Table

6indicates that there is no statistical association between off farm activity and decision to implement SLM practices.

In addition from a total of 56 households who don't implement SLM practices 50 respondents have land resource and 6 has not land resource. While, from a total of 132 households a total of 132 have their own land. Chi square test for land resource indicates that there is a statistical association between land resource and decision to implement SLM practices.

As it can be seen from Table 6 from a total of 56 households who don't implement SLM practices 48 have their own livestock and 8 respondents don't have livestock. Whereas, from a total of 126 households who implement SLM practices 121 respondents have livestock and 5 respondents were don't have livestock. The chi square for livestock indicates that there is a statistical association between livestock holding and decision to implement SLM practices. According to Motuma (2016), farmers' livestock holding size could be considered as one indicator for better availability of resources or resource endowment.

## 4.2. Major crop type

**Table 8: The major crop types cultivated in each kebeles**

| Type of crops | | | Sostu Debreshelel | Enerata | Total |
|---|---|---|---|---|---|
| Teff | No | Frequency | 2 | 9 | 11 |
| | | % | 1.1 | 4.8 | 5.9 |
| | Yes | Frequency | 98 | 79 | 177 |
| | | % | 52.1 | 42.0 | 94.1 |
| | Total | Frequency | 100 | 88 | 188 |
| | | % | 53.2 | 46.8 | 100 |
| Wheat | No | Frequency | 2 | 12 | 14 |
| | | % | 1.1 | 6.4 | 7.4 |
| | Yes | Frequency | 98 | 76 | 174 |
| | | % | 52.1 | 40.4 | 92.6 |
| | Total | Frequency | 100 | 88 | 188 |
| | | % | 53.2 | 46.8 | 100 |
| Maize | No | Frequency | 1 | 9 | 10 |
| | | % | 0.5 | 4.8 | 5.3 |
| | Yes | Frequency | 99 | 79 | 178 |
| | | % | 52.7 | 42.0 | 94.7 |
| | Total | Frequency | 100 | 88 | 188 |
| | | % | 53.2 | 46.8 | 100 |
| Barley | No | Frequency | 28 | 26 | 54 |
| | | % | 14.9 | 13.8 | 28.7 |
| | Yes | Frequency | 72 | 62 | 134 |
| | | % | 38.3 | 33.0 | 71.3 |
| | Total | Frequency | 100 | 88 | 188 |
| | | % | 53.2 | 46.8 | 100 |
| Been | No | Frequency | 85 | 54 | 139 |
| | | % | 45.2 | 28.7 | 73.9 |
| | Yes | Frequency | 15 | 34 | 49 |
| | | % | 8.0 | 18.1 | 26.1 |
| | Total | Frequency | 100 | 88 | 188 |
| | | % | 53.2 | 46.8 | 100 |
| Potato | No | Frequency | 37 | 17 | 54 |
| | | % | 19.7 | 9.0 | 28.7 |
| | Yes | Frequency | 63 | 71 | 134 |
| | | % | 33.5 | 37.8 | 71.3 |
| | Total | Frequency | 100 | 88 | 188 |
| | | % | 53.2 | 46.8 | 100 |
| Engedo | No | Frequency | 100 | 9 | 109 |
| | | % | 53.2 | 4.8 | 58.0 |
| | No | Frequency | 0 | 79 | 79 |
| | | % | 0.0 | 42.0 | 42.0 |
| | Total | Frequency | 100 | 88 | 188 |
| | | % | 53.2 | 46.8 | 100 |

**Source: Own survey data (2018)**

According to the survey result, 177(94.1%) household head respondents where cultivate Teff only 11(5.9%) was not cultivating Teff. From this, we can conclude that Teff cultivation is common on both Kebeles. 174(92.6%) household head respondents where cultivate Wheat crop and the rest 14(7.4%) was not cultivated Wheat. The other major crop type cultivate in both Kebeles are Maize, around 178(94.7%) household head respondents were cultivated Maize and only 10(5.3%) household head respondent were not cultivated Maize crop. 134(71.3%) household head respondents were cultivating Barely and the respondents who don't cultivate barely are around 54(28.7%). 134 out of 188 household heads which means 71.3% of household respondent was cultivating Potato and the only household head respondents who don't cultivate Potato are 54(28.7%). Bean crop is the other crop types in both Kebeles and 49(26.1%) respondents were cultivating Bean and 139(73.9%) household respondents were not cultivating Bean. As we observed from the survey data in the above table Bean cultivation is most likely common on Enerata Kebele than Sostu Debreshelel. No one was cultivating Engedo in Sostu Debreshelel Kebeles and 79(42.0%) household head respondents were cultivating Engedo crop on Enerata Kebele.

The information in Table 7 indicates that the crop types like *Teff, Wheat, Maize, Barely and Potato* crops were cultivating on both Kebeles and this crop were the major crop types in both Kebeles. *Bean* crop was most likely cultivating on Enerata Kebele than Sostu Debreshelel Kebele, on the other hand,*Engedo*wascultivating only on Enerata and this crop was the dominant crop in the Kebele.

### 4.3. Livestock type

**Table 9: Livestock type in both kebeles**

| Livestock types | | | Sostu Debreshelel | Enerata | Total |
|---|---|---|---|---|---|
| Ox | No | Frequency | 8 | 13 | 21 |
| | | % | 4.3 | 6.9 | 11.2 |
| | Yes | Frequency | 92 | 75 | 167 |
| | | % | 48.9 | 39.9 | 88.8 |
| | Total | Frequency | 100 | 88 | 188 |
| | | % | 33.2 | 46.8 | 100 |
| Cow | No | Frequency | 8 | 9 | 17 |
| | | % | 4.3 | 4.8 | 9.0 |
| | Yes | Frequency | 92 | 79 | 171 |
| | | % | 48.9 | 42.0 | 91.0 |
| | Total | Frequency | 100 | 88 | 188 |
| | | % | 53.2 | 46.8 | 100 |
| Bull | No | Frequency | 84 | 75 | 159 |
| | | % | 44.7 | 39.9 | 84.6 |
| | Yes | Frequency | 16 | 13 | 29 |
| | | % | 8.5 | 6.9 | 15.4 |
| | Total | Frequency | 100 | 88 | 188 |
| | | % | 53.2 | 46.8 | 100 |
| Sheep | No | Frequency | 16 | 28 | 44 |
| | | % | 8.5 | 14.9 | 23.4 |
| | Yes | Frequency | 84 | 60 | 144 |
| | | % | 44.7 | 31.9 | 76.6 |
| | Total | Frequency | 100 | 88 | 188 |
| | | % | 53.2 | 46.8 | 100 |
| Goat | No | Frequency | 94 | 87 | 187 |
| | | % | 50.0 | 46.3 | 96.3 |
| | Yes | Frequency | 6 | 1 | 7 |
| | | % | 3.2 | 0.5 | 3.7 |
| | Total | Frequency | 100 | 88 | 188 |
| | | % | 53.2 | 46.8 | 100 |
| Donkey | No | Frequency | 19 | 32 | 51 |
| | | % | 10.1 | 17.0 | 27.1 |
| | Yes | Frequency | 81 | 56 | 137 |
| | | % | 43.1 | 29.8 | 72.9 |
| | Total | Frequency | 100 | 88 | 188 |
| | | % | 53.2 | 46.8 | 100 |
| Horse | No | Frequency | 95 | 46 | 141 |
| | | % | 50.5 | 24.5 | 75.0 |
| | Yes | Frequency | 5 | 42 | 47 |
| | | % | 2.7 | 22.3 | 25.0 |
| | Total | Frequency | 100 | 88 | 188 |
| | | % | 53.2 | 46.8 | 100 |

Source: Own survey data (2018)

Table 8 illustrates that, 167(88.8%) of the household head respondents do have Ox and 21(11.2%) do not have Ox. The purpose of Oxen is for plowing and threshing. 171(91.0%) household head respondents have Cow and only 17(9.0%) respondents don't have Cow. Cow is used for milk, beef and production or breeding purpose. 29(15.4%) of the household head respondent do have a Bull and 159(84.6%) don't have Bull. From this we can conclude that this livestock were not dominant in the area. Bull is used for breeding and beef purpose. The household respondents having Donkey and don't have Donkey were 137(72.9%) and 51(27.1%) respectively. Donkeys are considered as a transport animal for petty trade. As indicated from the above Table, 47(25.0%) household respondents have a Horse and 141(75.0%) household respondents were not a Horse. Horse is widely used as riding animal. Sheep and Goat animals were the other type of livestock's found in the study area, but the availability of Goat were limited because since the study area has found in Woyna Dega agro-climatic zone and most of the time Goats are found in kola agro-climatic zone, so because of this the number of Goats found in the study area were limited or almost none. Both Sheep and Goat are used for consumption, sell and production or breeding purpose. Based on the above table the household heads having Sheep and Goat were144 (76.6%) and 7(3.7%) respectively and those household head respondents doesn't have Sheep and Goat were 44(23.4%) and 187(96.3%) respectively.

### 4.4. Nature of landform

**Table 10: Nature of landform in the study area**

| Landforms | Category | Frequency | Percentage |
|---|---|---|---|
| Plain land form | Yes | 134 | 71.3 |
| | No | 54 | 28.7 |
| Total | | 188 | 100 |
| Valley land form | Yes | 95 | 50.5 |
| | No | 93 | 49.5 |
| Total | | 188 | 100 |
| Mountainous land form | Yes | 145 | 77.1 |
| | No | 43 | 22.9 |
| Total | | 188 | 100 |

Source: own survey data (2018)

Table 9 shows that, the major landforms in the study area those household head respondents plowing in the study area. According to the survey data, 134(71.3%) household respondents have plain landform and they are plowing on plain (flat) land and 54(28.7%) have no plain landform.

In addition, 95 (50.5%) household respondents have valley landform and they are practicing their agricultural practices on valley landform and 93(49.5%) household respondents were not practicing agricultural practices on valley land. Household respondents having mountainous landform according to the above Table are 145(77.1%) they are plowing on mountainous landform and 43(22.9%) household respondents have no mountainous form of land. This survey data indicates that almost most of the household respondents have mountainous landforms and they are plowing on sloppy areas. This in turn, indicates that the study area was very prone to erosion. Similarly, the result obtained from focus group discussants and key informant interviewers the households having a mountainous and valley landform are very inclined to practice SLM practices than those households having plain landform.

### 4.5. Awareness of farmers' about SLMP

As the researcher observed from FGDs and the information getting from key informant interviews, those farmers' included in the sample size in study area has a good awareness about SLM practices and also the advantage of practicing those SLM practices and disadvantage of while not practicing SLM practices. Also in both Kebeles of FGDs discussant as compared as previous time awareness of farmers' about SLM practices now a day's awareness is better because farmer knows about SLM Practices and which practices is better for which landform and soil type and also which practice is good to produce more. Despite all of this awareness are there for a long period of time the important nutrients which are crucial for soil fertility was lost by erosion and the acidity of soil also increased, this is because of those farmers' were plowing the land without practicing or making any land management practices (GWPD,2009).

While farmers' are aware of SLM practices the area coverage and the sustainability of land management practices are limited because of different problems. According to the FGDs discussants the major problems affecting farmers' to implement SLM practices where small family size, lack of grazing lands or open access to grazing, the small size of land and farm experience of farmers'.

"A Farmer who is not practicing land management practices is not considered as a farmer and he is simply breathing but not alive" this is a saying of one focused group discussant to greatly elucidate about the use of practicing SLM practices.

**Table 11: The awareness level of farmers' about benefit of practicing SLM practices**

| Explanatory variable | Category | Total Number | Percentage |
|---|---|---|---|
| **Benefit of SLM practices** | Yes | **175** | **93.09** |
| | No | **13** | **6.91** |

Source: own survey data (2018)

Table 10 indicates the farmers' awareness level on the benefit of implementing SLM practices. The household respondents who were aware of about use of practicing SLM practices are around 175(93.09%) and 13(6.91%) do not have any know- how about the use of practicing SLM practices. This indicates that the majority of household respondent were a good awareness about sustainable land management practices.

**Table 12: Household response to the benefit of practicing SLMPs**

| Household response | Category | Frequency | Percentage |
|---|---|---|---|
| **Increase crop productivity** | Yes | 166 | 88.3 |
| | No | 22 | 11.7 |
| **Total** | | **188** | **100** |
| **Increase soil fertility** | Yes | 163 | 86.7 |
| | No | 25 | 13.3 |
| **Total** | | **188** | **100** |
| **Reduce agricultural land degradation** | Yes | 155 | 82.4 |
| | No | 33 | 17.6 |
| **Total** | | 188 | 100 |
| **Reduce financial problems** | Yes | 102 | 54.3 |
| | No | 86 | 45.7 |
| **Total** | | **188** | **100** |

Source: own survey data (2018)

As it shown in Table 11, 166 (88.3%) household respondent responded that practicing SLMPs increased crop productivity and 22(11.7%) household head respondent was not say anything about the use of practicing SLMPs on crop production. When we come to the other response of household respondents about the use of practicing SLMPs about 163 (86.7%) responded that it

increases soil fertility. Similarly, the information gating from both Kebeles FGDs and key informant interviewers also revealed that practicing SLMPs is good to improve soil fertility by preventing the soil from erosion because of wind and water (flood and runoff) and also increase the fertility of soil by mulching the crucial soil nutrients within the soil. On the other hand, 25(13.3%) household respondents don'trespond to increased soil fertility as the use of practicing SLMPs. Whereas, 155(82.4%) household respondents were responded that practicing SLMPs is good to protect the agricultural land from degradation and the rest household respondents which account 33(17.6%) don't respond decrease the degradation of agricultural land as the use of practicing SLMPs. Bothe Kebeles FGDs and key informant interviewer also states that it's a key element to increase farmlands potential to increase the production of crops. Household respondents responding reducing the financial problem as use of practicing SLMPs accounts 102 (54.3%) and those who didn't consider decrease financial related problem as use of practicing SLMPs are around 86 (45.7%). furthermore, both Kebeles FGDs explained that before practicing the land management practices our agricultural land was degraded severely, they can't cultivate on that land because it doesn't give the ample result but after practicing the land management practices they are beneficial because they can get the ample result for their effort and they can get enough crops for them and beyond that they can get income by taking their products in to market and selling them. Additionally, the information from both Kebeles key informant also shows that the life of farmers' before practicing SLMPs and after practicing SLMPs were different, farmers' life status before practicing SLMPs was not interested and they were poor, but after starting practicing of land management practices they can get enough agricultural products and they can also educate their children's. The study conducted by (Tegegn, 2014) stated that, improved land management practices that ensure better resource use and promotes long-term sustainability are basic to future food production and to the economic welfare of rural communities.

**Table 13: Awareness of farmers' on the disadvantage of not practicing SLMP**

| Explanatory variable | Category | Total Number | Frequency |
|---|---|---|---|
| **TheDisadvantage of not practicing SLMPs** | Yes | 163 | 86.70 |
| | No | 25 | 13.30 |

Source: Own survey data (2018**)**

The above Table shows that, 163(86.70%) knows about the losses caused by not practicing SLMPs while 25(13.30%) household respondents were not know the disadvantages facing because of not practicing the SLMPs. According to the FGDs and household survey data, the most important Disadvantages listed by household respondents are the followings; degradation of farmlands or agricultural lands, decreasing of crop productivity, loss of fertile soil by wind and erosion, the soil fertility becomes decreased and it also aggravates the financial related problems. On the other hand, the 25 (13.30%) said that there is no difference while they are practicing or not practicing the SLMPs, no need of practicing the SLMPs because it doesn't make any change on the life of them.

**Table 14: Household Responses on Disadvantage of Not Practicing SLMPs**

| Household response on the disadvantage of not practicing SLMPs | Category | Frequency | Percentage |
|---|---|---|---|
| **Decrease crop productivity** | Yes | 154 | 81.9 |
| | No | 34 | 18.1 |
| **Total** | | 188 | 100 |
| **Loss of soil fertility** | Yes | 149 | 79.3 |
| | No | 39 | 20.7 |
| **Total** | | 188 | 100 |
| **Degradation of farm land** | Yes | 147 | 78.2 |
| | No | 41 | 21.8 |
| **Total** | | 188 | 100 |
| **Face financial problems** | Yes | 103 | 54.8 |
| | No | 85 | 45.2 |
| **Total** | | 188 | 100 |

Source: Own survey data (2018)

The survey data found in Table 13 indicates, the response of household respondents on disadvantage of not practicing SLMPs, 154(81.9%) household respondents were responded that decrease of crop productivity is caused by not practicing land management practices and 34 (18.1%) household respondents' don't say anything about disadvantage of not practicing SLMPs on crop productivity. 149(79.3%) household respondent says that not practicing SLMPs causes losses of soil fertility and it affects the potential of land to grow crops, the household respondents they don't consider soil fertility lose as a disadvantage ofnot practicing SLMPs accounts

39(20.7%). Farmland degradation considered as a result of not practicing SLMPs and this was responded by 147(78.2%) and the household respondents they don't consider farmland degradation as a result of not practicing SLMPs are around 41(21.8%). The household respondents which account 103(54.8%) sated that not practicing SLMPs increases financial problems and the rest 85(45.2%) doesn't consider the financial problem as a result of not practicing SLMPs.

According to the survey result indicated in Table 12 and 13, shows that the number of household respondents who knows about the advantage of practicing SLMPs and the disadvantage of not practicing SLMPs were high as compared as the household respondents who do not know about them. So, we can conclude that the awareness levels of the farmers in both kebele are high and it's better to practices the SLMPs.

**Figure 5: Gully erosion caused by not practicing SLMPs in Enerata**

Source: own field observation (2018)

**Figure 6: Shows the land broken as bread in Sostu Debreshelel kebele**

Source: Own field observation (2018)

### 4.6. Land management practices

In the study area land management practices were practice implemented in both Kebeles. The land management practice was implemented in different ways. Farmers' practiced land management practices to protect their agricultural land without any support (individually) hence the help of agricultural extension service workers plays a great role. Similarly, the interview result also revealed that the farmers' were protecting their farmlands through the help of different land management practices without any government support. On the other hand, one to five groups were also protects the land from erosion and degradation by making group. FGDs conducted in Sostu Debreshelel Kebele illustrates that, there were association of farmers' named as "*Mengistu member"* in Amharic , the purpose of this group was to protect the lands which is severely degraded lands by constructing different land management practices. This association protects not only agricultural land but also gully and check dam construction was also undertaken by this groups. Correspondingly, the FGDs and key informant interview on Enerata illustrates that, there were the information support center by government and non government organizations (NGOs) such as SLM and CIDA, this organization gives relevant information for farmers' about SLM practices. Based on the information getting from different sources farmers' were practicing land management practices within a group and individually.

**Table 15: Type of land management practices**

| Type of land management practices | Category | Frequency | Percentage |
|---|---|---|---|
| **Terracing** | **Yes** | **163** | **86.7** |
| | **No** | **25** | **13.3** |
| **Total** | | **188** | **100** |
| **Strip cropping** | **Yes** | **106** | **56.4** |
| | **No** | **82** | **43.6** |
| **Total** | | **188** | **100** |
| **Contour farming** | **Yes** | **123** | **65.4** |
| | **No** | **65** | **34.6** |
| **Total** | | **188** | **100** |
| **Stone bund** | **Yes** | **79** | **42.0** |
| | **No** | **109** | **58.0** |
| **Total** | | **188** | **100** |

**Source: Own field survey (2018)**

According to Table 14, both Kebeles household respondent implements the land management practices. As shown from the Table, 163(86.7%) household respondent practices terracing, 106(56.4%) practices strip cropping, 123(65.4%) household respondent's practices Contour farming, 57(30.3%) practices shallow farming practice and 79(42.0%) household respondents were practicing stone bunds.

**Terracing:**

Terracing is one of the SLM practices used in the study Kebeles. According to the survey result, 163(86.7%) household respondents were used terracing for soil conservation and they were applying this practices on their farmland. Also (zuazo et al., 2005) states that terracing is an agricultural technique for collecting surface runoff water this increases infiltration and controlling water erosion in many hilly and mountainous regions of the world.

Key informant interview revealed that, most of the time this practice was applied on mountainous and valley landforms because these landforms are very susceptible to erosion.

**Strip cropping:**

Was one of the SLM practices in the study Kebeles. According to key informants, this practice is practiced to reduce the usage of fertilizers and in case of using this practice, the crops were planting from east to west this because of in order to get crops planting on the farmland sunlight

and air. The focus group discussants illustrate that the crops most of the time planting by strip cropping is maize and bean. Based on survey data this practice was practiced by 106(56.4%) household respondents.

**Contour farming:**

Survey data in Table 14 indicates that, about 123(65.4%) household respondents practiced this SLM practices. The focus group discussants also revealed that this practice is practiced in large farm size than small farm size this is because of the uncomfortable condition of small farmland to return back the Ox's during plowing. Similarly, key informants illustrated that this practice is important to reduce water flow and catch sediments before it's washed away. Motuma (2017), investigating that counter farming is a common traditional practice of tilling the land along the contours of the slope in order to reduce the runoff on steeply sloping lands.

**Stone bund:**

According to survey data indicated in Table15, 79(42.0%) household respondent were practicing stone bund practices.

**Figure 7: Stone bund**

Source: own field observation (2018)

On the other hand, based on key informant information and focus group discussants, another SLM practices practiced in the study Kebeles include Fanya juu, and Animal dung.

**Fanya juu:**

Fanya juu is another land management practices practiced in the study area. Key informants of both kebele revealed that Fanya juu terrace is built along the counters and trees planted in the ditches. According to the researchers observation trees planted in Fanya juu terrace was rape (*sasmaniya*) which is important for animals feed supply.

**Figure 8: Fanya juu practices on Enerata**

Source: Own field observation (2018)

**Compost (Animal dung):**

This is the extraction of animals and is one of the SLM practices in the study area. Based on the focus group discussant this practice can be applied during Maize production and it's good to increase fertility of soil on the study area especially on Enerata Kebele.

## 4.7. Factors affecting farmers' decision in implementing sustainable land management practices

The logit regression model was employed to estimate the effect of an explanatory variable on the practicing decision of household heads. Table 17 shows that, the odds ratio, p value and marginal effect of explanatory variables on the dependent variable. I.e. practice of sustainable land management practices.

**Table 16: Results on factors affecting farmers' decision in implementing sustainable land management practices**

| Factors | Odds Ratio | Robust Std. Err. | z | P>z | Marginal effect (dy/dx) |
|---|---|---|---|---|---|
| Sex of household head | 4.295104 | 4.236049 | 1.48 | 0.139 | 0.0925744 |
| Age of house hold head | 1.00911 | 0.056778 | 0.16 | 0.872 | 0.000576 |
| Family size | 1.09016 | 0.385060 | 0.24 | 0.807 | 0.0054831 |
| Off farm activity | 0.282123 | 0.18666 | -1.91 | 0.056* | -0.09001 |
| Slope of the plot | 2.691466 | 2.051368 | 1.30 | 0.194 | 0.0900113 |
| Crop production decision | 0.675468 | 0.661777 | -0.40 | 0.689 | -0.026107 |
| Land holding size | 0.584764 | 0.172205 | -1.82 | 0.068* | -0.034079 |
| Livestock holding | 1.761088 | 1.655902 | 0.62 | 0.547 | 0.0344292 |
| Lack of attention | 0.054514 | 0.049064 | -3.23 | 0.001*** | -0.263355 |
| Lack of grazing land | 0.562382 | 0.598131 | -0.54 | 0.588 | -0.034153 |
| Labour and time incentive | 8.441979 | 6.126146 | 2.94 | 0.003*** | 0.172421 |
| Sharing cropping | 0.261960 | 0.228089 | -1.54 | 0.124 | -0.093278 |
| Lack of equipment | 0.042248 | 0.043157 | -3.10 | 0.002*** | -0.329354 |
| Distance of farm land to home | 0.933206 | 0.280238 | -0.23 | 0.818 | -0.004390 |
| _cons | 7.932025 | 12.79366 | 1.28 | 0.199 | |

**Pseudo R2=0.4449**

**No of observation=188**

**Source: Computed from own field survey (2018)**

NB: ***p<0.01, *p<0.1

**Off farm activity:** the relationship between off farm activity of the household heads and implementation of sustainable land management practices become negative and statistically significant at 10% with an odd ratio value of 0.282. The odd ratio value indicates, the probability of implementing sustainable land management practices is decreased by 0.282 times for household heads engaged by off farm activity. The Marginal effect with value of -0.09001 implies that keeping other factors constant, as the household head is being engaged in off farm activity, the chance of implementing sustainable land management practices are decreased by -9.001%.Thiswould be due to those household respondents engaged in off farm activity are unable to practice land management practices because of shortage of time and in addition, they are committed on off farm activities than farm activities. The finding of this study is similar with

the previous work of Paulus (2015), which indicates that commitment in off farm activities can negatively influence farmers to carry out land management practices.

**Land holding size:** landholding size of the household head is one of the economic factors affecting farmers' decision in implementing sustainable land management practices. The relationship between land holding size and implementing sustainable land management practice become negative and significant at 10% level of significance with odd ratio value of 0.068. The odd ratio value indicates that the practice of sustainable land management decreased 0.068 times for large land holding size than small land holding size. The Marginal effect with value -0.034 indicates that keeping other factors constant, as the land holding size of the household head is increased by one hectare, the likelihood of practicing sustainable land management are decreased by -3.4%. this might be due to those household heads having large land holding size are unable to protect and control their farmland using land management practices because implementing land management practices on large land holding size takes time and resource like man power and finance. This finding is in harmony with the previous work Habtamu (2006), indicates that the land holding size of the household were identified as a significant negative influence on farmers decision to retain the introduced land management practices.

**Lack of attention**:the other factors affecting farmers' decision in implementing sustainable land management practices is lack of attention for sustainable land managemnt practices. This variable has odd ratio and P value of 0.0545 and 0.001 respectively and this is negatively related to farmers' decision to implement sustainable land management practices and significant at 1% level of significance. The odd ratio indicates that the likelihood of implementing sustainable land management practices decreased by 0.0545times as the household heads being low attention towards sustainable land management practices is increased. The marginal effect of lack of attention of the household head on implementing sustainable land management practice with a value of -0.2633 implies that keeping other factors constant, if the likelihood of implementing sustainable land management is decreased by -26.3% as the household heads became less attention. This might be due to those household heads having less attention towards sustainable land management have a little awareness about the practice but they are reluctant to implement the practices. This finding is in agreement with the previous work of Sterve (2010), indicates that lack of giving sufficient attention to land resources negatively restricting the farmers' decision to invest on land management practices.

**Resource availability:** the relationship between availability of resources to farmers' decision to implement sustainable land management practice are positive and significant at 1% level of significance with the odd ratio and P value of 8.442 and 0.003 respectively. The odd ratio value indicates that the probability of implementing sustainable land management increased by 8.442times for increment of resources used for practicing land management practices including time, man power and financial resources of the farmers'. The marginal effect resource availability on implementing sustainable land management practice with a value of 0.1724 implies that keeping other factors constant, as an increamnt of farmers' resource availablity, the likelihood of implementing sustainable land management is increased by 17.24%. this might be those farmers' having enough resources have very inclined to implement land management practices due to the availability of enough time and man power as compared as the farmers' who don't have availability of resources. This finding is similar with Yesuf and Pender (2006), indicating that availability of labour is positively linked with the adoption of long term and short term land management technologies.

**Lack of equipment:** lack of equpmient has indicating significant and negative relationship with the decision of farmers' in implemnting sustainable land managemnt with the odd ratio and P value of 0.0422 and 0.002 respectivily.The odds ratio indicates that the chance of implementing sustainable land management practices is decreased by 0.0422 times when the farmers' being faced lack of farm equipment. The marginal effect of lack of equipment in implementing sustainable land management practice with value of -0.329 implies that, keeping other factors constant, as the farmers' are being faced lack of farm equipment the probability of farmers' to implementing sustainable land management becomes decreased by -32.9%. This might be due to those farmers' having less farm equipment has unable to practicing sustainable land management this indicates that farm equipment are one of the tools used for implementing land management practices. This finding is in line with the previous work of Sterve (2010), founds that lack of equipment negatively restricting adoption of sustainable agricultural practices.

Besides the result of the regression model analysis there was also another variables affecting the decision of farmers' in implementing sustainable land management practice which was found during focus group discussion and key informant interview, this variable includes lack of grazing land (problem of grazing animals openly), inconsistency of land management practices and share cropping (giving the farmland to share). This variable was included on the model but this was dropped because of Multicollinearity problem.

**Lack of grazing land:** The problems of open access to grazing land for livestock were also the other problems raised by focus group discussants. When livestock were openly graze some where they have tendency of destructing the agricultural land which is treated by land management practices by their legs. Because of this the farmers became hopeless and careless to think about tomorrows practice, so that the farmers' don't practice by saying tomorrow also the animals become graze and destruct the land so why we are working and spent the time and the power.

**Land management practice needs maintenance:** the other and major factors influencing the farmers'decision to do not practice land management practices was the need of maintenance of the already treated land using SLM Practices for the coming or the inconsistency of sustainable land management practices. Once the farmer implementing land management practices, that practice provides treatment for only one year not only for two or more than years. Becauseofthese farmers' become boredom to practice. On the other hand farmers' are reluctant for the cost of used for maintaining the land.

**Share cropping:** The other problem was giving the land for share. Once the farmer gives their land to shear for the other the whole responsibility is giving to the person who takes the land for share this causes competition between the farmers' who takes and gives the land for share at this time the land leads to risk. This may also affect the land because the farmer who takes the land not protect timely by thinking "tomorrow I will leave this and talk the other land from another farmer" at this condition the land reduce its production and fertility.

# CHAPTER FIVE

# 5. CONCLUSION AND RECOMMENDATION

## 5.1.Conclusion

This study was conducted to investigate the factors influencing farmers' decision in implementing sustainable land management practices in erosion-prone areas of the upper Blue Nile basin Ethiopia, in the case of East Gojjam zone, Machakel and Gozamen woredas on Sostu Debreshelel and Enerata kebele respectively. About 188 sample households were surveyed to conduct this study, 100 households were from Sostu Debreshelel kebele and 88 were from Enerata kebele.

To assess the awareness level of households and the major land management practices practiced on the study area, simple descriptive statistics was employed and to investigate the factors influencing the farmers' decision in implementing sustainable land management practices different demographic, social, economic and physical factors were conceptualized based on statistical methods of analysis using logistic regression model.

The first objective of this study was assessing the awareness of farmers' on sustainable land management practice on the study area. The survey data and the focus discussion result indicates that there was a high level of awareness around farmers' because they know each and everything about the advantage of practicing sustainable land management and the disadvantage of not practicing sustainable land management practices. Household survey indicates that increase crop productivity, increment of the fertility of soil, decrease the land degradation and minimize the financial related problems were the major advantage of sustainable land management practices and decreasing of crop production, soil fertility loss, degradation of farmland and aggravation of financial problem was the outcome of not practicing sustainable land management practices.

The second objective of the study was assessing the major land management practices practiced on the study area and simple descriptive statistics was employed to assess the dominant land management practices practiced on the study area, according to the survey result the dominant land management practices practiced on the study area are terracing, strip cropping, contour farming, stone bund and based on the information of the key informants and focus group discussants other land management practices practiced on the study kebeles are physical

conservation practices such as, Fanya juu and animal dung(compost) to protect the agricultural land from degradation and to control soil erosion.

Finally, logistic regression model was employed to investigate the factors influencing the farmers' decision in implementing sustainable land management practices. Based on the finding the major factors affecting the decision of farmers' to implement land management practices are off farm activity of the household heads, land holding size, lack of attention , availability of resource and lack of farm equipment are the major factors. Similarly, according to the focus group discussants lack of grazing land and the need for maintenance of land management practices or inconsistency of land management practices and shared cropping were also the major challenges affecting the farmers' decision to do not practice sustainable land management practices.

## 5.2. Recommendation

Based on the findings of this study the researcher sets the following recommendations.

- As shown from the findings, the land management practices practiced on the study kebeles were indigenous one indicating , the need for collaboration or active participation of farmers' with agricultural office workers or agricultural experts to integrate the indigenous land management practices with the new (introduced) land management practices.
- To make the land management practices sustainable the concerned bodies or stockholders must be responsible by taking the common issues to create comfortable condition and invest their effort in land management practices.
- Land management practices that are not currently being practiced by farmers' in each kebele but, have potential to improve crop production and reduce soil erosion should be identified and promoted in each kebele.
- The government and the concerned body should facilitate active participation in agricultural programs and should provide a great attention and give training intended for land management practices in order to increase the awareness level of farmers' on the use of sustainable land management practices.
- Non-governmental organization that support farmers' should extend their activities to cover land management practice issues and also integrates their activities in land management with the help of the government.
- The woredas agricultural office should disseminate the important farm equipment to the farmers' in order to strength the continuous work on sustainable land management practices and also they should provide persistence information and training about sustainable land management practices.
- The concerned body needs to prepare grazing land and ratifying rule for grazing land is necessary to reduce the farmland destruction by animals treated by sustainable land management practices.
- The Land resource is not only for the current generation, the future generation also has the right to use the land resources. So that, when they use they must be responsible to protect the land using land management practices.

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## Appendixes

### Appendix1: Household questionnaires

**Dear respondent,**

My name is Haymanot Eshetia. As a master student at Addis Ababa University, college of development studies, Center for Environment and Sustainable Development I conduct research on factors influencing farmers, decision in implementing SLM practices in the selected study areas. The survey may take about ____ minutes of your time to complete, but your answer will play a crucial role to the study I am conducting. I would like to declare that the information collected through this questioner will be used only for academic research purpose; confidentiality of personal data is assured.

I highly appreciate your cooperation and I thank you in advance for taking your time to fill in this survey!

**General information**

1. Question no. _____
2. Date of interview_____
3. Enumerators name _____ sign._____
4. Checked by _____ sign._____

**Household information**

1. Age of respondent? (years)
2. Sex of respondent?
   1. M 2. F
3. Family size _____
4. Religion of households?
   1. Orthodox 2. Muslim 3.Catholic 4.Protestant 5. Other (specify) _____
5. Marital status of households?

   1. Married 2. Unmarried 3.Divorced 4.Widowed 5.Other (specify)

6. Education level of households?

1. Illiterate 2. From 1-12 3.Above 12 4. Other (specify)_____

7. Main occupation of the household head?

| 1. farming | 2. cattle rearing | 3. Agriculture( cattle rearing &farming | 4. trading | 5. military | 6. others specify |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |

7. Family size (total) male_____ female _____

8. What is your status in your locality 1.Model farmer 2. Ordinary farmer

**Socio-economic factors**

**Off-farm activities**

1. Do you get income from non-farming activities?
   1. Yes 2. no
2. If your answer is yes for question no. , from which activity do you get income?

   1. Trade 2. Military 3.Daily labour4.Handcraft5.Carpentry 6.Masonry 7.Others (specify)

3. Do you think that the availability of non-farm income affect your decision to practice SLM practices?
   1. Yes 2. no
4. If yes, how does it affect your decision?

**Land resource**

1. Do you have your own lands?

   1. Yes 2. no

2. If your answer for Q1 is yes, what is the landform of your plot?

1. Flat 2. Rugged 3.Steep slope 4.Other (specify)

3. Do you think that the landform has any implication whether to use or not land management Practices?

1. Yes 2. No

4. If your answer for question 3 is yes, explain the reasons?

_____

_____

5. What type of crop do you cultivate on your land?

1. Teff 2. Wheat 3.Maize 4.Barley 5.Potato 6.others (specify)

6. Do you think the type of crop one produces has anything to do with the decision to practice Land management?

1. Yes 2. No

7. If your answer to question number 6 is yes, how?

_____

_____

8. How many times do you cultivate your land in a year?

a. 1 b. 2 c. 3 d. other (specify)

9. Do you think that there are some reasons that the frequency of cultivation in a year has any relation to the decision of land management practice?

1. Yes 2. No

10. If your answer for question number 9 is yes, explain how?

_____

_____

10. If your answer for question no. 8 is a, is cultivation of crop one time within a year has any relation to the decision of land management practices?

    a. Yes  b. no

11. If your answer for question 11 is yes, explain how it can be related with your decision of land management practices?

    _____

    _____

12. What is the total size of your land (in ha)?

13. Do you think that there are some reasons related to the size of land owned with owners' Decision of land management practice?

    1. Yes  2. No

13. If your answer for question number 12 is yes, can elaborate how?

    _____

    _____

**Distance of farm land from home**

1. How far is your farm land from your home? ( either m or km)

_____

2. Do you think that the distance of your farm land from your home affect your decision to practice the SLM practices?

    a. Yes  b. no

3. If your answer is yes, how dose distances of farm land from your home affect your decision? Pleas elaborate briefly?

_____

_____

**Farming experience**

1. For how long have you been in farm experience (in number of years)?

a. From 1-5 b. 5-10 c. >10 years d. others (specify).

2. Do you think that farming experience of farmers affects thepractice of SLM in your kebele? a. Yes b. no

3. If your answer is yes, how? Which effect does it cause?

_____

**Livestock**

1. Do you have your own animals?

a. Yes b. no

2. If your answer for Q 1 is yes, what type of animal do you have?

| No | Type | quantity | Function |
|---|---|---|---|
| 1 | Ox | | |
| 2 | cow | | |
| 3 | donkey | | |
| 4 | horse | | |
| 5 | bull | | |
| 6 | sheep | | |
| 7 | goat | | |
| 8 | If others (specify) | | |

3. Do you think that the availability of livestock has effect on your decision to use or not land management practices?

   1. Yes 2. No

4. If your answer for question 3 is yes, which affect dose it causes? Please Explain briefly

_____

_____

**SLM Practices**

1. Did you practice land management practices?

a. Yes b. no

2. If your answer for Q1 is yes, which land management practice do you practice?
   a. Terracing b. strip cropping c. contour farming d. shallow farming e. other (specify)
3. What is your reason to select this practice (short and brief explanation)?

   _____

   _____
4. When did you start practicing land management?
   a. Before 5 years b. before 10 years c. > 15 years d. others ( specify)

5. How many times do you practice land management practices?
   a. 1 b. 2 c. 3 d. other (specify)
6. Do you believe that practicing land management practices have their own benefits?
   a. Yes b. no
7. If your answer forQ1 is yes what type of benefit do you know and/ or expect?

   _____

   _____

8. Do you think that you get thebenefit because of practicing SLM practices?
   a. Yes b. no
9. If your answer is yes, which benefit you get from that?
   a. Crop productivity increases
   b. Soil fertility
   c. Degradation of farmland decreases
   d. Decrease financial problems
   e. Others (specify)
10. If your answer for Q 1 is No, what is your reason for not practicing land management practices?
    a. Lack of information
    b. lack of access to credit
    c. lack of extension services
    d. characteristics of landforms

e. The Distance of farmland to home

f. Availability of nonfarm income

g. Farm experience

h. no need of practicing land management

i. other (specify)

11. What is your opinion about the major factors affecting the implementation of land management practices?

| No | Major factors affecting to implement land management practices | Ranks |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |

12. Are there any losses you faced because of not practicing SLM practices?

a. Yes b. no

13. If you say yes, which losses you face?

a. Decrease crop production

b. Loss of soil fertility

c. Increase of land degradation

d. Financial problems

e. Others ( specify)

14. If no, how?

_____

_____

*15.* Did you give your lands for others for share (*yekule*)?

a. Yes b. no

*16.* If your answer for Q15 is yes who is responsible to practice land management practices for shared lands?

*17.* What is your benefit from that land?

**Institutional factors**

**Lack of credit**

1. Have you got any chance for you to get credit?

   1. Yes  2. No

2. If no, why?

   _____

3. Have you received any type of credit in 2009 E.C?

   1. Yes  2. no

4. If yes, from where you get credit?
   a. From bank
   b. From credit and saving institution
   c. From rich farmers
   d. From pawnbroker
   e. Others (specify)
5. If yes, for what purpose did you receive credit?
   a. To purchase livestock's
   b. To purchase farm equipments
   c. To purchase fertilizers and pesticides
   d. To purchase grain for food
   e. Others (specify)
6. If no, for Q3 why? Multiple answer is possible
   a. No one to give credit
   b. Fear of inability to pay
   c. High interest rate
   d. No need of credit
   e. Others (specify)

**Lack of Extension services**

1. Have you got advice about SLM activities from extension services?

a. Yes b. no

2. If yes, who has given you the advice? Multiple choices is possible
    a. Government extension officers
    b. Association of Farmers
    c. NGOs (specify)
    d. Others (specify)
3. On what issue did the advice focus on?
    a. SLM practices
    b. Crop diversification
    c. Animal husbandry
    d. Others (specify)
4. How often do you get advice?
    a. Once a week
    b. Every 15 days
    c. Once a month
    d. Once in three month
    e. Once in season
    f. Others (specify)
5. From where did you get information about SLM practices?
    a. From extension services
    b. From neighbors
    c. From research center
    d. Others (specify)
6. Did you believe that the information that you get about SLM activities help you to practice SLM activities?
    a. Yes b. no
7. If yes, how? Pleas elaborate briefly

_____

_____

**Land tenure/ ownership**

1. Have you ever witnessed land redistribution (reform) in your area?

   1. Yes  2. No

2. If your answer for question 1 above is yes, do you think that this has any effect on decision of practicing land management practices?

   1. Yes  2. No  3. No idea

3. Your answer is yes how does it affect the decision of practicing land management practices?

_____

4. Do you think that the reason you give for question 3 has any relation with land tenure or ownership?

   1. Yes  2. No

5. If the answer for question 4 is yes can you briefly discuss the reasons for this?

_____

**Appendix 2: Key informant discussion questions given for both woreda**

**Dear key informants,**

My name is Haymanot Eshetia. As a master student at Addis Ababa University, college of development studies, Center for Environment and Sustainable Development I conduct research on factors influencing farmers, decision in implementing SLM practices in the selected study areas. The survey may take about ____ minutes of your time to complete, but your answer will play a crucial role to the study I am conducting. I would like to declare that the information collected through this questioner will be used only for academic research purpose; confidentiality of personal data is assured.

I highly appreciate your cooperation and I thank you in advance for taking your time to fill in this survey!

Date of discussion _____

Woreda _____

1. When was the land management practice introduced in this woreda?
2. Which type of practice is dominantly practice in this woreda?
3. What are the best practices practiced currently in this kebele?
4. How much is the current coverage of land management practice in this woreda as well as in this kebele?
5. What are the factors affecting farmer's decision to practice land management practice in this kebele?
6. What are the major (potential) factors affecting the farmers' decision to practice SLM practices?
7. What are the benefits of farmers getting from practicing land management practices?
8. What do you think about the benefits obtained from land management practices?
9. What are the losses those farmers facing because of don'tpracticing SLM practices?
10. Are there any efforts done to land management practices in collaboration with extension services and farmers in the woreda?

11. How much time the extension workers give the information about SLM practices to the farmers (in a week or in a month)?
12. What did you say about shard lands or *yekul*?
13. What is the advantage and disadvantage of giving land to share (*yekule)?*
14. What measure do you suggest for current and future practice of land management to be sustained?

**Appendix 3: focus group discussion questions**

**Dear discussion participants,**

My name is Haymanot Eshetia. As a master student at Addis Ababa University, college of development studies,Ccenter for Environment and Sustainable Development I conduct research on factors influencing farmers, decision in implementing SLM practices in the selected study areas. The survey may take about ____ minutes of your time to complete, but your answer will playa crucial role to the study I am conducting. I would like to declare that the information collected through this questioner will be used only for academic research purpose; confidentiality of personal data is assured.

I highly appreciate your cooperation and I thank you in advance for taking your time to fill in this survey!

Date of discussion _____

Kebele / village _____

1. When land management practice was started?
2. How many types of land management practice do you know?
3. Which land management practice do you practice?
4. What is your benefit after practicing land management practices?
5. Are there any loses you face because of don'tpracticing SLM practices? Which loses you face?
6. Did you get information about land management practices?
7. From where you get the information about the practices?
8. What wasthe information focused on?
9. Didyou get credit for land management practices?
10. What is your opinion about shard (*yekule*) lands?
11. Which person is responsible to practice land management practices for shared lands?
12. What is the determinant factors affecting your decision to practice land management practices?
13. What are the major challenges of practicing land management practices?

14. What facility and support you need from government and concerned bodies to manage your farmlands?
15. What would be your suggestion to improve, promote and sustain land management in an effective manner in your kebele?
16. What did you say about future to sustain best land management practices?

## Appendix 4: Pair- Wise Correlation Coefficient for Factor Affecting farmers Decision in practicing sustainable land management practices

```
. pwcorr sex_new hhhead_age hh_size nonfarm slop_of_the_plot cropproduced_decision_plmgt land_size_co availablity_livest_decition_slm PF
> _less_attention_for_soil_and_l PF_lack_of_grazing_land PF_takes_time_and_man_power land_share  PF_lack_of_equpiment distance_farm
```

| | sex_new | hhhead~e | hh_size | nonfarm | slop_o~t | croppr~t | land_s~o |
|---|---|---|---|---|---|---|---|
| sex_new | 1.0000 | | | | | | |
| hhhead_age | 0.2139 | 1.0000 | | | | | |
| hh_size | 0.0651 | 0.6065 | 1.0000 | | | | |
| nonfarm | 0.2066 | -0.1471 | -0.0934 | 1.0000 | | | |
| slop_of_th~t | 0.0190 | -0.0509 | -0.0246 | -0.0313 | 1.0000 | | |
| cropproduc~t | -0.0276 | 0.0336 | 0.0063 | -0.1808 | 0.2763 | 1.0000 | |
| land_size_co | 0.0524 | 0.0890 | -0.0210 | -0.0247 | 0.0643 | -0.0141 | 1.0000 |
| availablit~m | -0.1738 | -0.0652 | 0.0151 | -0.1865 | 0.2417 | 0.1634 | 0.0674 |
| PF_less_at~l | -0.2881 | -0.0838 | -0.1261 | -0.1758 | -0.0622 | 0.2130 | -0.1646 |
| PF_lack_of~d | 0.3092 | 0.1122 | 0.0344 | 0.0763 | 0.1659 | 0.2763 | -0.0425 |
| PF_takes_t~r | 0.2059 | 0.1251 | 0.0581 | -0.0140 | 0.1962 | 0.1140 | -0.0776 |
| land_share | 0.0079 | -0.0668 | -0.0723 | -0.0965 | -0.0118 | -0.1125 | -0.0146 |
| PF_lack_of~t | -0.0503 | 0.0580 | 0.0059 | -0.0359 | 0.1985 | 0.0450 | -0.0365 |
| distance_f~m | -0.1161 | 0.0218 | 0.0162 | -0.1494 | -0.1713 | 0.1080 | -0.0937 |

| | availa~m | PF_les~l | PF_lac~d | PF_tak~r | land_s~e | PF_lac~t | distan~m |
|---|---|---|---|---|---|---|---|
| availablit~m | 1.0000 | | | | | | |
| PF_less_at~l | 0.0950 | 1.0000 | | | | | |
| PF_lack_of~d | -0.0069 | 0.0700 | 1.0000 | | | | |
| PF_takes_t~r | 0.1403 | -0.1439 | 0.5606 | 1.0000 | | | |
| land_share | -0.1251 | -0.2225 | -0.0389 | 0.1089 | 1.0000 | | |
| PF_lack_of~t | -0.1044 | 0.0731 | 0.0359 | 0.0573 | -0.0322 | 1.0000 | |
| distance_f~m | 0.0751 | 0.1673 | 0.0274 | -0.1113 | 0.0764 | 0.0246 | 1.0000 |

## Appendix 5: Logistic regression result for factors affecting the farmers' decision to practice sustainable land management practices

```
. logistic landmngt  sex_new hhhead_age hh_size  i.nonfarm i.slop_of_the_plot i.cropproduced_decision_plmgt land_size_co  i.availa
> blity_livest_decition_slm i.PF_less_attention_for_soil_and_l i.PF_lack_of_grazing_land i.PF_takes_time_and_man_power i.land_shar
> e i. PF_lack_of_equpiment distance_farm ,r

Logistic regression                             Number of obs   =        188
                                                Wald chi2(14)   =      61.12
                                                Prob > chi2     =     0.0000
Log pseudolikelihood = -40.912921               Pseudo R2       =     0.4449
```

| landmngt | Odds Ratio | Robust Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| sex_new | 4.295104 | 4.236049 | 1.48 | 0.139 | .6215493 | 29.68054 |
| hhhead_age | 1.00911 | .056778 | 0.16 | 0.872 | .9037437 | 1.126761 |
| hh_size | 1.09016 | .3850601 | 0.24 | 0.807 | .5455487 | 2.178446 |
| 1.nonfarm | .2821237 | .1866612 | -1.91 | 0.056 | .0771365 | 1.031856 |
| 1.slop_of_the_plot | 2.691466 | 2.051368 | 1.30 | 0.194 | .6042609 | 11.98818 |
| 1.cropproduced_decision_plmgt | .6754683 | .6617777 | -0.40 | 0.689 | .0990047 | 4.608442 |
| land_size_co | .5847642 | .1722053 | -1.82 | 0.068 | .328332 | 1.041474 |
| 1.availablity_livest_decition_slm | 1.761088 | 1.655902 | 0.60 | 0.547 | .2788819 | 11.12095 |
| 1.PF_less_attention_for_soil_and_l | .0545139 | .049064 | -3.23 | 0.001 | .0093412 | .318135 |
| 1.PF_lack_of_grazing_land | .5623819 | .5981307 | -0.54 | 0.588 | .0699394 | 4.522109 |
| 1.PF_takes_time_and_man_power | 8.441979 | 6.126146 | 2.94 | 0.003 | 2.035857 | 35.0059 |
| 1.land_share | .2619605 | .2280893 | -1.54 | 0.124 | .0475438 | 1.443371 |
| 1.PF_lack_of_equpiment | .0422481 | .0431578 | -3.10 | 0.002 | .0057053 | .3128502 |
| distance_farm | .9332068 | .2802386 | -0.23 | 0.818 | .5180422 | 1.681089 |
| _cons | 7.932025 | 12.79366 | 1.28 | 0.199 | .336102 | 187.1962 |

```
. margins,dydx(*)

Average marginal effects                        Number of obs   =        188
Model VCE    : Robust

Expression   : Pr(LMPtrracing), predict()
dy/dx w.r.t. : sex_new hhhead_age hh_size 1.nonfarm 1.slop_of_the_plot 1.cropproduced_decision_plmgt land_size_co
               1.availablity_livest_decition_slm 1.PF_less_attention_for_soil_and_l 1.PF_lack_of_grazing_land
               1.PF_takes_time_and_man_power 1.land_share 1.PF_lack_of_equpiment distance_farm
```

| | Delta-method dy/dx | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| sex_new | .0925744 | .0603348 | 1.53 | 0.125 | -.0256797 | .2108285 |
| hhhead_age | .000576 | .0035538 | 0.16 | 0.871 | -.0063893 | .0075413 |
| hh_size | .0054831 | .0226793 | 0.24 | 0.809 | -.0389675 | .0499336 |
| 1.nonfarm | -.0900113 | .0515128 | -1.75 | 0.081 | -.1909746 | .010952 |
| 1.slop_of_the_plot | .0704763 | .0553474 | 1.27 | 0.203 | -.0380026 | .1789553 |
| 1.cropproduced_decision_plmgt | -.0261077 | .0685088 | -0.38 | 0.703 | -.1603824 | .1081669 |
| land_size_co | -.0340798 | .0187263 | -1.82 | 0.069 | -.0707827 | .0026231 |
| 1.availablity_livest_decition_slm | .0344292 | .0540619 | 0.64 | 0.524 | -.0715301 | .1403885 |
| 1.PF_less_attention_for_soil_and_l | -.2633355 | .0978254 | -2.69 | 0.007 | -.4550698 | -.0716012 |
| 1.PF_lack_of_grazing_land | -.0341526 | .057217 | -0.60 | 0.551 | -.1462958 | .0779906 |
| 1.PF_takes_time_and_man_power | .1724211 | .0669714 | 2.57 | 0.010 | .0411596 | .3036826 |
| 1.land_share | -.0927821 | .0660034 | -1.41 | 0.160 | -.2221464 | .0365822 |
| 1.PF_lack_of_equpiment | -.3293543 | .1193429 | -2.76 | 0.006 | -.563262 | -.0954465 |
| distance_farm | -.0043908 | .0191044 | -0.23 | 0.818 | -.0418348 | .0330531 |

Note: dy/dx for factor levels is the discrete change from the base level.

## Appendix 6: logistic model tests (model goodness fit) and link test

```
. estat gof

Logistic model for LMPtrracing, goodness-of-fit test

      number of observations =       188
 number of covariate patterns =       188
           Pearson chi2(173) =       158.49
                 Prob > chi2 =         0.7784

. linktest

Iteration 0:   log likelihood = -73.697911
Iteration 1:   log likelihood = -43.941778
Iteration 2:   log likelihood = -40.846854
Iteration 3:   log likelihood = -40.700019
Iteration 4:   log likelihood = -40.698473
Iteration 5:   log likelihood = -40.698473

Logistic regression                             Number of obs   =        188
                                                LR chi2(2)      =      66.00
                                                Prob > chi2     =     0.0000
Log likelihood = -40.698473                     Pseudo R2       =     0.4478

------------------------------------------------------------------------------
  LMPtrracing |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
--------------+---------------------------------------------------------------
        _hat |   1.146749   .3120872     3.67   0.000     .5350694    1.758429
      _hatsq |  -.0503281   .0762633    -0.66   0.509    -.1998014    .0991452
       _cons |   .0225663   .3909427     0.06   0.954    -.7436673    .7887999
------------------------------------------------------------------------------
```