FACTORS AFFECTING SMALHOLDER FARMERS' ADOPTION OF SOIL AND WATER CONSERVATION PRACTICES: THE CASE OF MIRAB BADAWACHO WOREDA, HADIYA ZONE, SNNPR, ETHIOPIA

MSc. THESIS

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A Thesis Submitted to the Department of Geography and Environmental Studies, In Partial Fulfillment of the Requirements for the Degree of Master of Science in Geography and Environmental Studies

(Specialized in Sustainable Natural Resource Management)

BY

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As thesis research advisor, I hereby certify that I have read and evaluated this thesis prepared under my guidance by Alemu Markos on the title "***Factors Affecting Smallholder Farmers' Adoption of Soil and Water Conservation Practices***:- The case of Mirab Badawacho Woreda, Hadiya Zone, SNNPR, Ethiopia". I recommend that it be accepted as fulfilling the thesis requirement.

Major Advisor

Abiyot Legesse (As. Professor) Signature-------------------------------- Date---------------------------

As members of the examiner board of the final MSc. open defense, we certify that we have read and evaluated the thesis prepared by Alemu Markos and examined the candidate. We recommend that it be accepted as fulfilling the thesis requirement for the Degree of Master of Science in Geography and Environmental Studies specialization of Sustainable Natural Resource Management.

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AUTHOR’S DECLARATION

I, the undersigned, declare that this thesis entitled Factors Affecting Smallholder Farmers’ Adoption of Soil and Water Conservation Practices: The case of Mirab Badawacho Woreda, Hadiya Zone, SNNPR, Ethiopia, is my original work, that it has not been submitted to any other institution anywhere for award of any academic degree, diploma or certificate, that I followed all ethical and technical principles of scholarship in the data collection, data analysis and preparation of this the report, and that all the sources that I have used and quoted have been indicated and acknowledged.

Name: **Alemu Markos** Signature_______________Date---------------------------

BIOGRAPHICAL SKETCH

Alemu Markos was born in 1972 E.C in the Southern Regional State, Hadiya Zone, Mirab Badawacho Woreda, Kachabira kebele from his father Markos Funke and his mother Abebech Mentamo. He completed the primary school in Mesafe-Ajacho elementary school and his secondary school in Shinshicho Secondary and Preparatory School. He was graduated from Wachemo Teacher Education in 1998 E.C in Certificate. In 2004, he was graduated Diploma in History at Summer Program from Hossana Teacher Education. He was graduated from Wachemo University in 2009 E.C in bachelor of degree in Geography and Environmental Studies at regular program in advanced standing. In 2010, he joined Dilla University following his Graduate Studies in Geography and Environmental Studies and specialized in Sustainable Natural Resource Management. He has been an employer in Hadiya Zone, Mirab Badawacho Woreda Education Office for the last half year.

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ACRONYMS AND ABBREVIATIONS

AARCMSD: Araka Agricultural Research Center Meteorological Station Data

AAU: Addis Ababa University

ADB: African Development Bank

ADLI: Agricultural Development Led Industrialization

DA: Development Agents

EPA: Environmental Protection Authority

EU: European Union

FAO: Food and Agricultural Organization

FDREEPA: Federal Democratic Republic of Ethiopia Environmental Protection Authority

FFW: Food for Work

FGD: Focused Group Discussion.

HHHs: Household Heads

GDP Gross Domestic Product

LCD: Link Community Development

MBAoF: Mirab Badawacho Woreda Agricultural Office

MBWARD: Mirab Badawacho Woreda Agriculture and Rural Development

NAP: National Action Plan

SLM: Sustainable Land Management

SNNPR: Southern Nation Nationalities and peoples Region

SCP: Soil Conservation Practices

SWC: Soil and Water Conservation

SWCP: Soil and Water Conservation Practices

PA: Peasant Association

PSNP: Productive Safety Net Program

UNEP: United Nations Environment Program

UN-EUE: United Nations Emergencies Unit for Ethiopia

UNESCO: United Nations Education, Scientific and Cultural Organization

USDA: United States Department of Agriculture

WFP: World Food program

WSSD: World Summit on Sustainable Development

WOCAT: World Overview of Conservation Approach and Technology

ABSTRACT

This research work was conducted on adoption of soil and water conservation practices, among smallholder farmers' in Mirab Badawacho Woreda, Hadiya Zone, SNNPR, Ethiopia. The objectives of this study were to assess factors that affect SWC practices, and to identify the soil and water conservation activities commanly practiced and to investigate farmers' adoption level of introduced SWC practices interms of non-adopters and adopters. The data for this study was collected from both primary and secondary sources. Both data was collected from four purposively selected kebeles. The primary data was generated from 346 sample household heads as well as 12 people for FGD and 8 people for interviews selected using non-probability sampling techniques. Similarly the secondary data was collected from published and unpublished documents.The collected data was analyzed using quantitative data analyses methods. To make analyses the investigator first edited the data which were collected by using questionnaires, intreviews, field observations, and FGD. Finally, the quantitative data generated from questionnaire, that filled by sample household heads were analyzed using descriptive statistics and binary logistic regression model. While, information gathered using field observations, intreviews, FGD were analysed and transcribed in the fom of description and used as supportive data to the main questionnaire. Demographic, economic, bio-physical, psychological and institutional factors influence the investment of household heads require to soil and water conservation measures. The result indicated that, age, sex, family size and farm size were significant factors whereas, marital status, educational status and involvement in off farm activities were insignificant factors on the adoption of soil and water conservation activities in the study area. In order to improve SWC practices; farmers', local people or communities, the woreda and kebele administrative and the office of agriculture at local level should give more attention for those significant variables that determine farmers' adoption of SWC measures.

Key words: *Adoption, soil and water conservation, soil measures*

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the Study

Soil erosion has accelerated in most parts the world, especially developing countries, due to different socio-economic and demographic factors and limited resources (Pacheco *et al.*, 2018). About 16% of the world's agricultural land is affected by soil degradation (Nellemann, 2009). Of all the processes leading to land degradation, erosion by water is the most threatening. It accounts for 56% of the total degraded land surface of the world. In Africa alone, it is estimated that 5-6 million hectares of productive land are affected by land degradation each year (Cronje, 2014).

Ethiopia is one of the least developed countries in the world (*Sun et.al*, 2014). Erosion is also the cause of the deterioration of the ecology and decreasing of the productivity of the soil in Ethiopia. As a result, food insecurity becomes a frequent phenomenon in the country. The average annual rate of soil loss is estimated to be 12 tons/hectares/year, and it can be even higher on steep slopes with soil loss rates greater than 300 tons/hectares/year or 250 mm/year, where vegetation is scant (Zhao *et.al*., 2013). It is also estimated that 25% of the highlands have been affected by serious soil erosion and nearly 50% of the soils have been significantly eroded (FAO, 2012).

Soil Conservation Research Project (SCRP) has estimated annual and soil loss of about 1.5 billion tons from the high lands. The Ethiopian High Land Reclamation carried out by FAO estimated that about half of the Ethiopian high lands (27 million hectares) were significantly degraded in 1984,out of which 2 million hectares of agricultural lands degraded to the extent that they will not able to sustain crop production in the future (Eyasu, 2006). Many studies in Ethiopia attributed the widespread poverty, structural food insecurity and recurring famine partly to the environmental degradation problem in general and soil erosion in particular (Mihrete, 2014).

Shiferaw and Holden (1998), analyzed resource degradation and conservation behavior of farm households in the degraded part of Ethiopian highlands. Farmer's reasons for adopting and intensification of the use of improved and indigenous soil and water conservation measures are affected by area of cultivated land, land ratio, age and education level of household head and distance of the plot from home provided (Anley *et al.*, 2007). The average land holding in study area is very low as result of population pressure and thus soil conservation technologies, which take some land out of production, like construction of soil conservation structures, have little acceptances by farmers in the area (Fikre, 2020).

Understanding why small-scale farmers' adopt soil and water conservation practices is complex. The literature indicates that such factors include age, education level, gender influence and practices, household income, farm size, land tenure, access to extension information, distance to farm land, access to labour, attitudes and perceptions, and population density (Bodnár *et al.*,2006). Different factors may contribute either positively or negatively for the adoption of soil and water conservation innovations. Farmers take several steps to learn about and accept innovations before they adopt them. First, they must have an awareness of particular problems affecting their land, and they must be willing to undertake measures to correct the root problems. Farmers need to believe in the potential benefits of soil and water conservation practices implementation before any are undertaken (Bodnár *et al.*, 2006).

On the other hand farmers may also be hindered by the complexity or social acceptability of an innovation (De Graaff *et al.*, 2008). Tenge *et al.* (2004) concluded the adoption of soil and water conservation technologies is likely increase with a higher level of education and a better security in land tenure. On other hand, involvement in off-farm activities, fragmentation of fields over different locations and lack of real short-term benefits from SWC to the farmer negatively influenced adoption of soil and water conservation practices (Tenge *et al.*, 2004). However, adoption of soil and water conservation innovations should start from acknowledging the erosion problem and developing a positive attitude towards soil conservation innovations (De Graaff *et al.*, 2008).

According to (De Graaff *et al*., 2008), there are three phases in the adoption process: the acceptance phase, the actual adoption phase and the final adoption phase. The acceptance phase generally includes the awareness, evaluation and the trial stages and eventually leads to starting investment in certain measures. The actual adoption phase is the stage whereby efforts or investments are made to implement soil and water conservation measures on more than a trial basis. The third phase, final adoption, is the stage in which the existing soil and water conservation measures are maintained over many years and new ones are introduced on other fields used by the same farmers. Ethiopia is exceptionally high in biodiversity but exceptionally low in capacity for protected area management (Jin, 2006).

The most important reason for limited use of SWC technologies is farmers' low adoption behavior. Kessler (2006) considers SWC measures fully adopted only when their implementation is sustained and fully integrated in the HHH's farming system. Adoption of SWC measures does not automatically guarantee long-term use. For example, when SWC measures have been established with considerable project assistance, not all farmers may continue using the measures. Therefore, introduction of SWC technologies may not lead to sustained land rehabilitation unless the farmers proceed to final adoption. From the 1990s onwards, implementation of SWC practices have been under taken as part of the agricultural extension packages of the government (Eleni, 2008).

The existence of soil erosion as a challenge for agricultural sector has been known for long period of time and protective measures, whether physical or biological has been taken for many years. Traditional conservation measures are also well known in some parts of Ethiopia. The people of Konso in Southern parts of Ethiopia applied terracing on their cultivated land long years ago. They have controlled land degradation even in hilly and mountain areas. Each terrace has been in place for more than 50% years (FDREEPA, 2004). Despite the fact that considerable works have been done on building SWC structures, soil degradation is a problem that continues to decline soil productivity. Hence, soil degradation in high lands of Ethiopia remains as a serious problem that threatens the sustainability of agriculture (Anley *et al.,* 2006). Therefore, these soil erosion adoption problem push for taking action on SWC in the study woreda.

1.2. Statement of the Problem

Previous studies on adoption of soil and water conservation practices in Ethiopia have simply highlighted the proportion of farmers participating in conservation practices while those that have looked at factors affecting farmers have largely addressed the adoption issues as a dual choice and have largely concentrated on farmers participating in individual project-supported areas rather than wide area of the country. The occurrence of traditional agricultural land use and the absence of appropriate resource management often result in the degradation of natural soil fertility. This has important implications for soil productivity, household, food security, and poverty in different parts of the country (Kohlin, 2011).

Serious soil erosion is estimated to have affected 25% of the area of the highlands and now seriously eroded that they will not be economically productive again in the predictable manner and the average annual rate of soil loss in the country estimated to be 42 tones/hectares/year which results to 1 to 2% of crop loss and it can be even higher on steep slopes and on places where the vegetation cover is low (Paulos *et al*., 2004). Soil erosion is one of the major causes of land degradation that causes low agricultural productivity in Ethiopia. Though, it is a natural process, its rate has significantly mainly by human activity (Tegegn, 2014).

Hadiya Zone is frequently affected by famine and associated with food security including the study woreda, (UN-EUE, 2003, Cochrane, 2011 and Bealu *et al.*, 2017). The area are densely populated and at the same time not well managed so that they are exposed to harsh soil erosion. There is also lack of concern for the constructed bunds and initiation to construct the physical structures which reduce the overflow of water and at the same time increase access of water into the soil to increase its productivity. Farmers do not take care of the constructed soil/stone bunds and not as such willing to construct the structure on their small plots of land. To minimize the harshness of problem, soil and water conservation intervention with some new technologies were implemented in many parts of the country including the study area. They were introduced in some degraded and food deficit area mainly through food for work programs (Woleamlak, 2007).

However, different reports indicated that many of these soil conservation structures have either not been adopted or not been sustainably used by the farmers (Fitsum *et al.,* 2002). Farmers that perceived to be adopting SWC practices due to incentive pressures often dismantled the structures partially from their cultivated land (Fitsum *et al.*, 2002). The failure to achieve the objective of adopting soil and water conservation technoliogies is attributed to both technical as well as socio-economic factors (Kessler, 2006).

The limited success of the efforts highlights the need to better understand the factors that encourage or discourage the adoption of soil and water conservation practices. Thus, it is difficult to generalize about the determinants of adoption of soil and water conservation technologies in different regions of the country because of the differences in agro-ecological and socio-economic settings under which farmers operate. In view of this study, it would be valuable to assess the practical knowledge gap on the factors affecting the adoption of soil and water conservation technologies. Therefore, this study attempts to investigate the factors affecting that determine smallholder farmers' to adopt soil and water conservation technologies.

1.3. Objectives of the Study

1.3.1. General objective of the study

The main objective of this study was to assess the factors affecting smallholder farmers' adoption of soil and water conservation practices in Mirab Badawacho Woreda, Hadiya Zone, SNNPR State.

1.3.2. Specific objectives of the study

The specific objective of the study is:-

- To identify the soils and water conservation activities commonly practiced in the study area;
- To investigate farmers adoption level of introduced SWC practices in terms of non-users and users of soil and water conservation practices; and
- To assess factors that determines the adoption of soil and water conservation practices in the study area.

1.4. Research Questions

1. What are the commonly practiced soils and water conservation measures in the study area?

2. What are farmers' adoption levels of introduced SWC practices in terms of users and non users?

3. What are the key factors influencing farmers' adoption of soil and water conservation practices at farm level in the study area?

1.5. Significance of the Study

Ethiopia has Agriculture Development Led Industrialization (ADLI) policy in which agriculture is expected to play a dominant role until industrialization takes the leading position. In contrast, agriculture is not in a position to do so and cannot support adequately the livelihood of the majority of people in Ethiopia. This is partly because of the long lived factors affecting smallholder farmers' adoption of practices which threatening soil and water conservation agricultural productivity. The presence of mismanagement that is reflected through over-grazing, over-cultivation and cutting trees contribute a lot for soil degradation process. The study would have contribute in understanding the factors affecting smallholder farmers' adoption of SWC practices, identifying factor that affect soil and water conservation (SWC) practices to the local land non-users and users. Finally, the study would hopefully call for other researchers to study further on similar issues.

1.6. Scope of the Study

The scope of the study was delimited in to four kebeles of the woreda. The study is focused on 346 household heads micro level analysis of responses of farmer to SWC practices in the study area. The result of the study can be prolonged to other area exhibiting similar agro-ecology. Yet, overview to a wider area requires preventive measures and further investigations as most of factors are related to adoption of soil and water conservation differently in different areas. Hence, it was mainly focused on factors affecting on adoption of smallholder farmers' on soil and water conservation practices (SWCP) in the study area.

1.7. Limitation of the Study

The limitations encountered the research while conducting the study includes shortage of time, lack of financial support, and the absence of related secondary data and the knowledge gap on collecting firsthand information as primary data. Additionally, now the world faced by the problem of pandemic diseases (Covid-19) that restrict any movement including Ethiopia and also the study area. And also the access of internet, poor infrastructure construction like roads and logistic support are factors. Therefore, the investigator minimize the above mentioned limitations by using appropriate time and budget wisely and effectively to complete the final thesis work.

1.8. Organization of the study

This thesis is organized into five chapters. The first chapter deals with introduction part in which background of the study, statement of the problem, objectives of the study which contains general objective and specific objectives, research questions, significance of the study, scope of the study and limitations of the study are included. The second chapter deals with the theoretical and conceptual bases of the study with shapes the research and gives the foundation for the studies as well as the review of related literatures to the topics of the current study are described.

The third chapter deals with the materials and methods in the description of the study area are given priority to the description of the materials used and the methods to employed. Then primary and secondary data sources were used as materials are described indetail. In the methodology part, the research design, research approach, sampling size and sampling techniques, target population, sources of data, instruments of data collection, methods of data analysis and presentation are described briefly. The fourth chapter deals with result and discussions in which the findings are presented, analyzed and discussed. Finally the fifth chapter includes conclusion of the major findings, and recommendations based on the findings of the study.

1.9. Definition of operational terms

Soil Erosion: The removal of top soil faster than the soil forming processes to replace it, due to natural, animal and human activities: overgrazing, over cultivation, forest clearing and mechanized farming. As a result, soil erosion is the most immediate environmental problem facing the nation at the present time (Tegegn, 2014).

Conservation: The term is applied in general to the positive work of maintenance, enhancement and wise management or reducing the rate of consumption to avoid irrevocable depletion, ignores to benefit posterity as in the conservation of nature such as: the forest, soil, wildlife, bio-diversity and environmental (Desta, 2009).

Soil and Water Conservation (SWC): The improved managements of the two resources “soil” and “water” to maintain in a medium to long-term perspective of the production capacity of the resources, often measured in terms of yield (WOCAT, 2004).

Adoption: The act of adopting new technologies; the state of being adopted and accepting/starting to use new technologies.

Diffusion: is the communication process through which an innovation travels or spreads through certain channels from a person, an organization, or any unit of adoption to another within a social system over time.

Level of adoption: Acceptance of an innovation, which consists of five stages like: - knowledge, persuasion, decision, implementation and confirmation.

Adopter: Farmers who use soil and water conservation (SWC) structures sustainably and soil and water conservation (SWC) practices are fully integrated in his/her farming systems.

Non-Adopter: Farmers who did not use soil and water conservation (SWC) structures sustainably and soil and water conservation SWC practice is fully integrated in his/her farming systems.

Land tenure: in countries having a land tenure which is characterized by government ownership of land it is believed that there is a fear of losing landholding in the redistribution (Shiferaw and Tadele, 2011)

CHAPTER TWO

2. Review of Related literature

2.1. Theoretical Frame of the Study

In the view of the fact that, our world obtains more than 99.7% of their food from the land and less than 0.3% from the oceans and aquatic ecosystems, conserving the cropland and maintaining soil fertility should be of the highest importance to human welfare. Soil erosion is one of the most serious problems facing the world food production. Each year about ten million hectare of cropland are lost due to soil erosion. The lost of cropland is a serious problem because the WHO and FAO report that two-thirds of the world population is malnourished. Overall, soil is being lost from agricultural areas 10 to 40 times faster than the rate of soil formation imperiling humanity's food security (Burgess et al., 2013).

Land degradation is a broad term including more than just soil (Yesuf and Pendre, 2006). Land degradation in the form of soil erosion, sedimentation, depletion of nutrients, deforestation, and overgrazing- is one of the basic problems facing farmers in the Ethiopian highland, and this limits their ability to increases agricultural production and reduce poverty and food security. The integrated process of land degradation and increased poverty has been referred to as the "downhill spiral of un-sustainability" leading to the "poverty trap" (Fikru, 2009).

Soil erosion is the main form of land degradation, caused by the interacting effects of factors, such as biophysical characteristics and socioeconomic aspects. Degradation resulting from soil erosion and nutrient depletion is one of the most challenging environmental problems in Ethiopia. Soil erosion by water is major problem in the country. It is estimated that more than one billion tons of top soil are lost every year. This is equivalent to a land area of the whole Ethiopian highlands (1/2 million km2) losing 3mm soil depth a year. Erosion is most severing in the highlands for obvious reasons: topography is rough, rainfall is intense, population pressure is high, and land management is poor. Research stations in these areas have measured a soil loss under arable use, on small runoff plots, of up to 280 tons/ha (Mohammed *et al.*, 2009).

Our world population obtains more than 99.7% of their food from the land and less than 0.3% from the oceans and aquatic ecosystems, preserving cropland and maintaining soil fertility should be of the highest importance to human welfare. Much of the world has been facing increasingly serious soil erosion of various degrees caused by both natural and human factors as well as its consequent environmental deterioration. Soil erosion is one of the most important threats to the sustainability of agricultural systems in the third world countries. The reduction in water availability due to land degradation and soil erosion is a major global threat to food security and the environment (Pimentel, 2006).

The population density of the developing countries is already higher than the agricultural production of the arable land, which leads to natural resource misuse. Therefore, population growth, resource management and degradation are central elements for sustainable ecosystem functioning. Conversely, resource deterioration cumulatively leads to environmental and land degradation (Antoci *et al.*, 2009). In African countries, while the population is increasing (UN, 2007), agricultural production has not kept pace (Bingxin *et al*., 2010).

Erosion by water is a primary agent of soil degradation at the global scale, affecting 1094 million hectares, or roughly 56% of the land experiencing human induced degradation. More than 80% of land degradation is due to soil erosion out of which 56% is due to the water induced soil erosion. A critical environment issue facing government of the developing societies is land degradation caused by soil erosion, which is crucial to among other things, the well-being of their people. Hence, soil is the basic natural resource for sustenance of life on the planet.

The use of this resource should not cause its degradation or destruction because of the existence of mankind depends on the continued productivity of the soil. What problem is that an over exploitation of resources without due attention to conservation measures is a challenge to our world. Therefore, as our well-being is highly dependent on the potential of soils throughout the world and the ways we take conserve it have great role in the continuity of the use of soil for human kind and other biodiversity.

2.2. Innovation Diffusion Theory

Innovation diffusion theory, developed by E.M. Rogers (1962), is one of the oldest social science theories. It originated in how, over time, communication to explain an idea and diffusion through a specific population. When promoting an innovation to a target population, it is important to understand the characteristics of the target population that will help or hinder adoption of the innovation. And an innovation, according to Rogers (1983) is *"an idea, practice, or object that* is *perceived as new by an individual or other unit of adoption.* "For the purpose of this study, soil and water conservation practices such as soil bunds, "fanyajuu" etc. are considered as innovation. The innovation-diffusion model assumes that the technology in question is appropriate for use unless hindered by the lack of effective communication (Obony, 2000).

A number of factors act together to influence the diffusion of certain innovation. The four major factors that influences the diffusion process are the innovation itself, how information about the innovation is communicated, time and the nature of the social system into which the technology is being introduced (Rogers, 1983). Diffusion/adoption research analyses how these factors and a number of other factors act together to ease or obstruct the progress of the adoption of a specific technology among its final user (Surry, 1997). Surry (1997) mentions the four most widely used and closely interrelated concepts of diffusion discussed by (Rogers, 1983).

Innovation Decision Process: this concept describes diffusion as a process through which an individual passes over time and can be seen as having well-defined stages. Rogers (1983) identifies five stages in the innovation-adoption process. The stages are knowledge, persuasion, decision, implementation and confirmation. According to this theory, potential adopters of an innovation must learn about the innovation, be influenced as to the advantages of the innovation, decide to adopt, implement and confirm the innovation (Surry, 1997).**Individual Innovativeness**: Rogers (1983) defines it as the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than the other members of a system. The central point of this concept is that individuals who are predisposed to being innovative will adopt an innovation earlier than those who are less predisposed (Surry, 1997)

Rate of Adoption: It signifies the relative speed with which an innovation is adopted by members of a social system (Rogers, 1983). **Perceived Attributes:** the concept of perceived attributes implies that potential adopters evaluate an innovation based on their perception with regard to five attributes of the innovation. This theory states that an innovation will experience an increased rate of diffusion if potential adopters perceived that the innovation: can be tried on a fragmentary basis before adoption, offers observable results, has an advantage relative to other innovation ,is not complex and compatible with the existing practices and values (Rogers, 1983).

There are five main adoption categories as given by Rogers. **Innovators:** These are farmers who are research minded and always want new ideas and changes. They are cosmopolites and have the ability to understand and apply complex technical knowledge and characterized by high educational levels, large farms, high income and high social status in the community. In general, innovators deviate from the norms of the community who don't have high regard for them as community leaders. **Early adopters:** These refers to the well-integrated members of the community who are often sought by neighbors for information and advice and are appropriate role models because they are not far ahead of the average individual in innovation. The farmer in this group knows that he has to continue to earn the esteem if his position in the social system is to be maintained.

Early majority: These are the individuals who adopt new ideas just before the average members of the community. The education levels of this group, flow of information, participation in social organizations and contact with change agents are slightly higher than the average farmers'. **Late majority:** In this group, adoption is an economic necessity and a response to increasing social pressure. They are doubter and only adopt when all or most members of the community have adopted. The majority of the people in the community have to favor the innovations before they can decide to adopt peer pressure is therefore necessary for this group to be motivated. **Laggards:** These are usually the last to adopt new technologies. Members have no opinion leadership and believe in the past and are suspicious of innovations, innovators and change agents.

2.3. Soil and Water Conservation Technologies

Land degradation, soil erosion and nutrient depletion contribute significantly to low agricultural productivity and the associated results of food insecurity and poverty in many hilly areas of the developing world (Ankeny *et al*., 2008). In response, considerable public and private resources have been mobilized to develop soil and water conservation technologies. Broadly SWC technologies can be categorized in to three categories structural methods, agronomic practices and water harvesting practices. Soil and water conservation technologies may offer private benefits, social benefits, and private and social benefits. The private benefits of SWC technologies is reducing soil loss from farmers plot, preserving critical nutrients and increasing crop yields. The social benefits of SWC technologies is reducing the movements of soils, water flow velocity, and the broader effect of erosion is the siltation of soil materials in rivers, lakes and dams that reduces their water volume (Tadele, 2011).

2.4. Soil Water Conservation Technologies in Africa

Some 80 percent of this degradation has taken place in developing countries and most countries lack sufficient resources to repair degraded land (Melville, 2006).A critical environment issue facing government of the developing societies is land degradation caused by soil erosion, which is crucial to among other things, well-being of their people. Soil erosion is environmental problem, which poses an ominous threat to the food security status of population and future development prospects of the country. Land degradation is the most serious problem which results inappropriate application of farmland management practices (Katewa, 2008).

Water and soil nutrient management form a critical component of agricultural production. The line between SWC technologies for crop production is very thin. SWC can be described as activities that reduce water losses by runoff and evaporation, while maximizing in-soil moisture storage for crop production. Ditches, construction of earth and some stone bunds, and vegetative barriers are normally defined as soil and water conservation structures, and are primarily promoted to reduce soil erosion.

2.5. The Adoption of SWC Technologies in Ethiopia

Soil and water conservation (SWC) technologies are very important in mountainous areas of developing countries like Ethiopia other than other parts of the world; because of the peoples rely almost wholly on agriculture for their income and livelihood. This is true for Ethiopia where 50 % of its highlands had significant erosion, 25% was seriously eroded and 4% beyond reclamation (FAO, 1986).Prior to the 1974 revolution, soil degradation did not get policy attention it deserved (Habtamu, 2006).

The famines of 1973 and 1985 provided a drive for conservation work through large increase in food aid. Following these, the then government launched an ambitious program of soil and water conservation supported by donor and NGOs. The use of food aid as a payment for labor replaced voluntary labor for conservation campaigns (Habtamu, 2006). By most performance measures, soil and water conservation effort of the country ended up in remarkable failure. A large sum of money has been spent in the name of encouraging environmental protection, encouraging farmers to adopt conservation measures. Nevertheless, the implementation was very poor and few structures persisted causing erosion rather than preventing it (Habtamu, 2006).

Soil and water conservation measures reduce soil erosion without any doubt. For instance, soil loss estimates from soil conservation research project in the north western and north eastern highlands of Ethiopia indicated that ”Fanyajuu” bunds, on average could reduce soil loss by 65 % or 25-72 tons per hectares per year (Tadele, 2011). According to De Graaf *et al*.(2008), there are three phases generally includes the awareness, evaluation and the trail stages and eventually leads to starting investment in certain measures. The actual adoption phase is the stage where by efforts or investments are to implement soil and water conservation (SWC) measures on more than a trial basis. The third phase, final adoption, is the stage in which the existing soil and water conservation (SWC) measures are maintained over many years and new ones are introduced on other fields used the same farmers.

Kessler (2006) considered SWC measures fully adopted only when their execution is sustained and fully integrated in the household's farming system. Therefore, introduction of SWC technologies may not lead to sustained land rehabilitation unless the farmers proceed to final adoption. Despite the ecological and economic benefits and substantial efforts to promote SWC technologies, the reality is that SWC technologies have not been widely adopted by small holder farmers in Ethiopia. The literature identified several factors that determine the adoption and performance of SWC technologies. The farmer attributes include: the demographic and socioeconomic variables and among the farm level attributes are the biophysical conditions of the farm plots. However, because of the presence of agro-ecological differences, the variables that affect one area may not be true for other areas.

2.6. Soil Erosion in Ethiopia

Soil erosion is one of the physical degradation processes and is the most widely spread form of soil degradation in Ethiopia. Soil erosion from unsustainable land use practices in Ethiopia is not new phenomena. According to (Gebreyesus, 2011) about 50% of the land area in the highlands was significantly eroded, 25% was seriously eroded, 5% had reached the point of no return and the remaining 20% was considered to be rather free from serious erosion risks.

2.6.1. Natural causes of soil erosion

Soil erosion is naturally occurring process involving the mobilization and deposition of soil particles, mainly by water and winds (Alex, 2006). The major components of climate that affect soil erosion are rainfall and wind. Although the effects of erosion are not easily observed on daily basis, water and winds are both capable of quickly damaging the soil. Flat land is very stable, loss increases rapidly with land sloping 2%-5%. Lands with 10% slopes have 8 times higher erosion which makes them impossible to farm by ploughing, but perennial crops may be sustainable. At 15% slopes, soil erosion doubles again but slopes over 20% appear to be less affected, and the reason for this could be that they are higher up hill, less prone to receive the water from a field higher up, and they run from hill crest to valley floor is shorter (Ephrem, 2008).

2.6.2. Human causes of soil erosion

According to (Verieling, 2006), soil erosion is one of the most serious environmental problems in the world today, as it threatens agricultural and natural environment. Human activities, such as damaged farming system, deforestation caused by over grazing, clearing of land for agricultural purposes and construction dam and diversion of natural courses of river, and mining activities are just a few among the various human activities which have either directly or indirectly weakened the top most layer of the planet. Thus, making it vulnerable to excessive wearing away by the various agents of erosion (Abhijit, 2011).

2.7. Farmers Perception to Soil Erosion

Farming in Ethiopia is practices under diverse farming system and cultural contexts, and farmer's verity play very vital role in agricultural productivities as whole. as a matter of fact, the highest portion of countries the genetic resources wealth essential for food and agriculture is still being conserved and improved on small- scale farmers' fields, and farmers practices in those regards are essential to meet their livelihood needs (Regassa,2006).

2.8. The Consequences of Soil Erosion

The impact of soil erosion is complex leading to reduction in soil depth and moisture storage capacity together with soil nutrients loss, and ultimately results in reduced agricultural production and productivity (Vancamperhout *et al.,* 2006). And threats not only to agricultural production but also to the economy, as the countries' economies depend on agricultures. Soil erosion creates sever limitations to sustainable agricultural land uses, as it reduces on farm soil productivity and cause food insecurity (Alonal, 2008). Erosion results in the degradation of soil productivity in a number of ways. It reduces the efficiency of plant nutrients use, damages seeding, decreases plants roots depth, reduces the soil water holding Capacity, decreases its permeability, increase run off, and reduces its infiltrations rates (Davis and Lawrence, 2006). In addition the loss of nutrients alone resulting from soil erosion has an estimated cost to the united stated up to$20 Billion years.

2.9. Practices and implications of SWC in Ethiopia

People were already aware of the negative consequences of soil erosion on agricultural production and the environment centuries ago. As a result, soil and water conservation practices exist as indigenous knowledge in some areas of Ethiopia (Nyssen *et al.*. 2007; and Currey, 2009). For instance, the Konso people in southern Ethiopia are known for traditionally well-developed terraces, where the terrace practices are registered by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as a world heritage.

The Konso terraces are estimated to be older than 400 years. Some simple and poorly established terraces on older aerial photographs and physical fragments can also be observed in different parts of the northern highlands. For example, (Nyssen *et al.*, 2007), reported old lynchets in the Tigray region. This is an indication of indigenous knowledge on SWC practices, and terracing is not only limited to the Konso area but is also found in other parts of the country. However, the SWC in Ethiopia covered very few areas and most of them, except those in Konso, have limitations in layout and construction quality (Nyssen *et al.*, 2007).

Land degradation in Ethiopia is largely associated with deforestation and destruction of biomass cover (Nyssen *et al*., 2009). Currently rapid deforestation is taking place in the tropics and damaging the thin layer of soil that is delicate and quickly washed away when exposed to the heavy rain. Globally, agricultural activities that makes the land surface more susceptible to soil erosion account for 28% (2 billion hectares), overgrazing for 34% and deforestation for 29% of soil degradation (Tekalegni, 2011).

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2.9.1. Community participation in sustainable SWC in Ethiopia

Ethiopia has the lowest safe water coverage in sub-Saharan Africa estimated at only 42% with an inadequate 31% rural coverage reported in (WSS, 2008). It aimed at contributing to sustainable management and utilization of natural resources and the development of models that could be replicated elsewhere in Ethiopia. The ultimate goal would be to achieve “sustainable poverty reduction and food security through the introduction of appropriate SLM techniques” and further “through the protection and conservation of natural resources, support to land certification and the development of SLM” (FAO, 2007).

The growing interest in the concept of sustainability was given added stimulus at the UNCED, held in Rio de Janeiro in June 1992.Agenda 21, a major action plan developed at UNCED, focused attention on the need to make development more economically and environmentally sustainable, and socially acceptable. Chapter 10 of Agenda 21 is concerned with the planning and management of land resources. For these reasons SLM is now receiving considerable attention from development experts, policy makers, researchers and educators.

2.9.2. Community participation and policies towards SWC in Ethiopia

Although it is difficult to compare the governmental structure of different regimes; that is the Imperial, the Derg, and the current Government, it can be said that the trend of Ethiopian Governments is towards pushing its own members to the lowest possible unit of the society. The Imperial State depended on the various forms of ruling that extended to power sharing at local political level and the lowest government structure was woreda. The two subsequent Regimes have in various ways increased and intensified state penetration down to kebeles level in the Derg Regime and to go and Government team level in the current Government (Helland, 2004).According to (Habtamu, 2006), the polices regarding to land, were the most important resource for the rural poor and of the national governments at different time played an important role in land management in Ethiopia. The final approach is also endorsed in the environmental policy document of the country and not also considers the individual farmer during planning and designing the policy.

2.10. Soil and Water Conservation Efforts in Ethiopia

Ethiopia is a country that its economy depends on agriculture. About 95% of agricultural crop land is found in the 44% of the high lands. The high lands are seriously eroded in the countries. The average annual soil loss is estimated to be 12tones/hectares / years and can be higher on steep slopes and in the area where there is low cover of vegetation (Alemayehu, 2007). To mitigate the problem, various soil and water conservation efforts have been made. During the regime of Derg, soil and water and a forestation programs were applied more widely even if they failed in combating land degradation. According to (Berhanu *et al.*, 2003) farmers removed the physical structure and their level of adoption is less. Mostly, the reason behind this is attributed to the lack of participation of farmers in planning, designing, and implementation process, in appropriateness of technology, limited availability of resources to farmers, institutional and organizational problem.

2.11. Empirical Studies on the Adoption of SWC Technologies

Determinants of the adoption of soil and water conservation technologies have been studied by many agricultural interventions by many projects. According to Ervin (1982), personal factors, Physical factors, economic factors and institutional factors influence farmers' decision on SWC. They found variables related to personal characteristics to be significant. Yohannes (1992) showed that factors such as technology characteristics, tenure, land fragmentation, age and education, steep land is prone to soil erosion and perception of the farmers' on soil and water conservation were identified as a barrier to physical soil conservation practices.

On the other hand, among household characteristics, age and education level of household heads affected adoption decision negatively and positively respectively. Goodwin (1993) reported that an older individual who is looking at a shorter time horizon might not be able to earn all of the benefits from conservation investment. Sureshwaran *e/ al.* (1996) hypothesized that factors such as orientation to farming, education, and cost-sharing or government assistance affected significantly the decision behavior of farmers on soil conservation practices.

Contrary to the expectation forwarded, income and education did not dictate adoption. Holden (1998), examined factors of affecting soil conservation decisions of peasants in the central highlands of Ethiopia. Households with large human capital may invest more in conservation (Pender and Kerr, 1998).This is precisely because soil conservation structures are labor intensive to build and maintain and hence households with large human capital may invest more in conservation. The larger the family, the higher the probability that future generation will form the land and secure the future benefits of conservation investments (Goodwin, 1993).

However, family size is found to have a significant negative correlation with the adoption of a modified type of structure. This might be due to the relation between larger family size and the corresponding higher demand for food in the household. In a family with a greater number of mouths to feed, competition arises for labor between food generating off-farm activities, like daily labor, and investment in soil and water conservation. Under such conditions the satisfaction of immediate food needs is given higher priority and labor is diverted away from conservation (Wegayehu, 2003).

Lapar and Pandy (1999) undertook a micro-economic analysis of adoption of contour borders by upland farmers in the Philippines to identify the factors that determine adoption. They found that adoption depends on several farm and farmer characteristics. Farm size is often correlated with the wealth that may help ease the needed wateriness constraint. Some empirical studies found that large farms are more likely to use conservation technology than small farms (Drake, 2003).

However, the land holding per economically active person in the family is found to have a very significant and significant negative correlation with modified and recommended type of conservation structure, respectively. It indicates the preference of farmers with large land holdings per economically active person in the family to invest less or not to invest at all in conservation. This result neither supports the argument that larger land holdings, as associated with greater wealth and increased availability of capital, make investment in conservation more feasible, nor that wealthier people are willing to bear more risk than poorer people (Wegayehu, 2003).

In the Ethiopian context, recent studies in different parts of the country found that tenure insecurity generated by fear of further redistribution of rural lands was the principal factors explaining farmers' unwillingness effort in measures to improve soil conservation and enhance fertility (Bekele and Drake, 2003). Empirical studies in different parts of Ethiopia reported a positive and significant effect of the slope of a plot on the decision to adopt soil conservation structures (Gebremedhin and Swinton, 2003).

In some studies, there was no substantial relationship between soil erosion perception and farmers' conservation behavior, whereas in others, there were direct links. For instance, the perception of erosion was found to be important to the adoption behavior of SWC in the Philippines and at Andit Tid, Ethiopia. Farmers' decisions to retain conservation structures are positively and significantly related to soil erosion perceptions, attitude towards new technology and exposure to new practices.

Positive environmental attitudes towards the protection of soil and water resources are a necessary but not sufficient condition to bring about the adoption of conservation programs at the farm level. Socio-economic and institutional factors influence the level of investment households committed to SWC. And size of cultivate land ,ratio of economically active labor to the size of own farm are, livestock ownership farmers perception level of soil erosion, type of crop usually grown on farm land, the farm land fragmentation are significantly related to the adoption of SWC practices by farmers (Kumela, 2007).

Generally, we can understand that different empirical studies have been carried out to see the direction and magnitude of the influence of different factors on farmers' decision behavior regarding adoption of new agricultural technologies like soil conservation practices. The summary of such literature indicates that farmers 'response to a technology is influenced by personal and household characteristics, farm endowments, social, institutional, and other related factors. Therefore, the above evidences and reviews of studies signify the importance of location specific studies to identify the major factors, which are barrier or facilitator to the adoption of a technology, and to recommend on the basis of the results for better achievement.

2.12. Determinants of SWC Adoption

Different factors may contribute either positively or negatively for the adoption of SWC innovations. For instance, age, farm size and the availability and profitability of the technology can have its own impact on adoption. However, adoption of SWC innovations should start from acknowledging the erosion problem and developing a positive attitude towards soil conservation innovations (De Graaff *et al.*, 2008). Processes of internal sense making and actor specific perceptions are important for the spread of SWC measures (Yinager, 2012). Integrating SWC technologies is the issue of sustainability of many countries, whose economy largely depends on agriculture (Fikru, 2009).

In response to high demand of improving the productivity of land many countries including Ethiopia are engaged in massive SWC works. However, the adoptions of SWC measures in different areas of the world are not satisfactory. According to (Antle *et al*., 2005) the adoption rates for conservation technologies were rarely 100 %, if ever and were often below 50 % and in some near to zero. In Ethiopia there are few, but growing number of researches done on the determinants of SWC technology adoption. Although determinants of SWC adoption varies from place to place based on the specific local conditions, all previous studies show that the adoption behavior of farmers is related with personal, socio-economic, and bio-physical conditions (Fikru, 2009).

2.12.1. Demographic Factors

Farmer's perception of soil erosion problem: perceiving the problem to adopt conservation practices Habtamu (2006) indicated that higher degrees of environmental damage reinforces and enhances farmers' adoption of best management practice. Norris and Batie (1987) indicated that farmer's perception of soil erosion problem is positively correlated with their decision to the adoption of SWC technologies. Kessler (2006) found that perception of the problems did not influence farmers' decisions on how much to invest in soil and water conservation. Woleamlak (2003) and Habtamu (2006) concluded that perception of erosion problem is not a sufficient condition for adoption of conservation practices.

Age of the household head: age is another issue found to be important factor in the adoption of soil conservation technology. Chombar (2004) found that age of the household head has a positive and significant relation with cut-off drain type of SWC adoption. On the contrary, Eleni (2008) indicated that the age of the household head has negative, but not significant influence on the continued use of SWC technologies in southern Ethiopia. Another study conducted by Sidba in (2005) he concluded that younger household head have used the new soil and water conservation measures.

Education of the household head: education influences farmers' decision to adopt technologies by enhancing farmers' ability to obtain, understand and utilize the practice, and by improving overall managerial ability of farmers (Habtamu, 2006). The findings of (Krishana *et al*., 2008) and (Fikru, 2009) indicated the fact that better education level of the household heads has strong positive relation with their adoption behavior because of their ability to find new information and understand the new technologies. In the contrary the findings of Eleni (2008) showed that there is no significance correlation between education level and adoption of SWC measures.

Sex of the household head: Fikru (2009) showed that households headed by women have no significant differences with that of households headed by men in their adoption behavior of SWC technologies. Male headed households have a higher chance to be involved in continued use of soil and water conservation than female headed households because of women spend most of their time in domestic responsibilities like preparing food, washing clothes, care of children, fetch water and collect fire wood for house consumption.

Family size: physical conservation measures are labor intensive technologies. Studies conducted in Ethiopia indicated that for installation of recommended physical conservation measures about 70 and 50 person days per ha for soil and stone bunds, respectively, were estimated to be required (Habtamu, 2006). Woleamlak (2003) identified that the lack of interest in SWC measures is due to shortage of labor. Up till now, studies conducted in Ethiopia indicated that larger family size has negative impact on the adoption of SWC technology (Amsalu, 2006: and Fikru, 2009).

2.12.2. Economic Factors

The increasing dependences on non-agricultural activities reduce the economic significances of soil erosion. This is because involvements in off–farm activities crowds out resources required for installing and maintaining the conservation measures. According to (Gould *et al.,* 1989) found the negative relation between proportion of off-farm income and adoption of minimum tillage. Recent estimates by *(*Hagg*et al.,* 2010) put the non-farm share of the total income of rural households in the developing countries in the range of 35% and 50%, with the contributions among rural households in sub-Saharan Africa expected to rise significantly in the coming years given the increasing population growth and limited agricultural productivity growth in the region.

Evidences in literature suggest that a key motivation leading to off-farm labor supply among farm households in both the developed and the developing country has been the desire to have diversified sources of income and manage risk, (Mishra, 2008),as well as (Chavas, *et al.,* 2005) among others, have also reported that given the very weak capital market in most developing countries, many farm households in the often resort to off-farm work to raise cash with a view to relaxing their cash flow and liquidity constraints. This view is supported by evidences in (Stampini *et al.,* 2009) that reported that households engaged in off-farm activities was able to spend significantly more on seeds, services, hired labor, and livestock inputs, which confirms that off-farm income relaxes credit constraints in agriculture.

Studies by (Eleni, 2008) showed that farmers who engaged in off farm activities were less involved in the continued use of soil and water conservation practices. Similarly, the findings by (Belay *et al.,* 2008) indicated that involvement in off farm activities negatively influenced the continued use of soil and water conservation measures. (Eleni, 2008) also showed that farmers who invest more in fertilizers are more involved in the continued use of soil and water conservation measures. (Fikru, 2009) pointed out that involvement in off farm activity might have negative effect on the adoption of soil and water conservation due to reduced labor availability. According to (Mulgeta, 2009) studies showed that there was positive relationship between off farm activity and adoption of new technologies.

Farm size-literatures suggest that the size of a farm has its own impact on farmer's decision towards the adoption of conservation measures. There is a tendency for farmers with large farms to invest on SWC technologies (Amsalu and Graff, 2006; Eleni, 2008; and Fikru, 2009). Farmers with small size farms tend to invest less on SWC technologies because of most conservation structures particularly the physical structures reduce the land that would be invested for crop production. Another explanation of previous studies was that farmers with a large farm land get a high annual income that helps them to invest more on resource conservation.

Availability of credit services- study on the eastern highlands of Ethiopia, Bekele and Drake (2003) suggested that credit services for farm inputs and consumption helps to increase the adoption of conservation measures by farmers. Accordingly the use of credit motivated farmers to produce more cash crops and get more income led to a better implementation of conservation measures. The result of Eleni (2008) was different from the above findings: she concluded that access to credit was not the factor affecting the adoption of SWC works. The explanation was that farmers may use the money obtained from credit for purposes other than conservation measures.

2.12.3. Institutional Factor

2.12.3.1. Land tenure security

In countries having a land tenure which is characterized by government ownership of land it is believed that there is a fear of losing landholding in the redistribution (Tadele, 2011). As a result of this farmers tend to invest less for any kind of investment on their plot. The degree of effective soil conservation is greatly influenced by land tenure. It is well known that uncertainty of land tenure leads to soil depletion. Furthermore, the frequent redistribution of land caused farmers to feel insecure since they may lose parts of their farm, and this will have an impact on soil conservation activities. Before Haile Selassie was removed from power in 1974, there were many forms of land tenure. Many of these land tenure systems can be classified into one of three categories: communal (rist), grant land (Gult), and a combination of both (rist-Gult) (Crewett *et al.* 2008).

Rist land rights were communal and meant that both male and female descendants would inherit land through their family membership. Inherited land was forbidden to be sold or distributed in any way that would mean the loss of land from the family or clan to whom it collectively belonged. However, through inheritance and time, land under the rist system was fragmented and subject to competitive bargaining for land use rights (Crewett *et al*., 2008). In Gult land right systems, farmers worked the land for a tenant much like a landlord, were those of organizations, such as the church, or they were acquired by nobles and aristocrats. Often gult rights would be given by the Imperil State to military personal as compensation for their service. When an individual was granted gult land rights on top of their pre-existing rist rights (rist-gult), security in continued land ownership was greater (Crewett et al., 2008).

During the imperial regime land was private property but not in equal basis. Over 70% of the land was owned by only 1% of the property owner of the entire population in Ethiopia (Shimelles, 2009).The exploitation of peasant farmers by their landowners in areas where gult land rights were instated created resentment for the acting government. In 1974, after the overthrow of Haile Selassie, the Derg introduced the agrarian reform the Public Ownership of Rural Lands which declared that all land belonged to the state. Once instated, land was then distributed to each peasant family (Crewett *et al.*, 2008).

Land reform was greeted with mixed responses. In the south, where the gult system meant exploitation to peasant farmers, it was welcomed. In the northern regions, where families generally felt they had a good land use system in place, the agrarian reform was received negatively. In some areas, land was fractured and redistributed continuously to make up for population growth. Though the maximum land size for farmers was set at 10 hectares, one study around Addis Ababa in 1979 showed that farmland ranged from 1 to 1.6 hectares (Crewett *et al.*, 2008).The fall of the Derg in 1991 brought with it expectations for land privatization reform (Crewett et al. 2008). The ratification of the constitution of the Federal Republic of on use of land for agricultural productivity could result with a redistribution of that land at the loss of the current tenant (Crewett *et al.*, 2008).

The current land tenure system is debated today. The main arguments in favor for the privatization of land claim that the current system is keeping Ethiopia from developing too quickly and that people with capital should be encouraged to invest in land so that they can make it more productive. On the other hand studies in some parts of Ethiopia proved that the present land tenure system of the country has no significant effect on the farmers' investment of any kind of technologies on their land (Eleni, 2008 and Fikru, 2009).

2.13. Biophysical factors

Biophysical factors are serious determinants that hinder the adoption decision of physical soil and water conservation by farmers. Farm size is often social and economic in nature (Abera, 2003).According to (Deannah, 2010) studies by other scholars have found that producers with larger farms had greater conservation practice adoption rate. Increasing or decreasing of farm size is a matter of adoption on soil and water conservation practices.

2.14. Psychological related factors

The adoption of soil and water conservation practices is significantly influenced by psychological factors such as knowledge about physical soil degradation and attitudes towards soil and water conservation practices. Various scholars in their findings indicated that awareness of farmers about soil erosion problem and attitudes towards soil and water conservation measures influence the adoption. Erwin (2005) found that attitude towards the soil conservation practice is the most explaining factor or determinant that affect the adoption decision by farmers. Teklu and Gezahegn (2003), in their study of indigenous knowledge and practice for soil and water management in East Wollega, Ethiopia indicated that awareness about the existence land extent of land degradation and its contributory factors are a precondition for farmers to take action on the problem. Farmers were aware of soil erosion process, which is defined as carrying away of soil or removal of top-soil by water or loss of soil triggered by human activities (Okoba *et al,* 2005).

2.15. The Adoption of Soil Conservation Measures

In Ethiopia, efforts towards soil and water conservation practices were started since 1970s and 1980s. The limited success of those efforts highlights the need to better understand the factor that encourages or discourage the adoption and sustainable uses of introduced conservation practices. People were already aware of the negative consequences of soil erosion on agricultural production and environments century ago. As result, soil and water conservation practices exist as indigenous knowledge's in some area of Ethiopia (Watson *et al.*, 2009). For instances, the Konso people in southern parts of Ethiopia are known for traditionally well-developed terraces, where the terraces practices are registered by the United Nation Educational, Scientific and Cultural Organization (UNESCO) as a world heritages. However, the soil and water conservation (SWC) in Ethiopia covered very few area and most of them, except those in Konso, have limitation in lay out and construction quality

2.16. Economics and Environmental Benefits of SWC

In response, many public resources have been mobilized to develop soil and water conservation technology and promote them to farmers (Kassie *et al.*, 2008). This is because using these technologies in mountain region has significant economic and environmental benefits. It reduces movements of soil, water velocity, and the broader effects of erosion. Soil and water conservation technique reduces soil loss from farmer's plots, preserving critical nutrients and increasing crop yields. The soil and water conservation technologies serve not only the social good but also increase yields; they are considered win- win approach (Kassie *et al.*, 2008).

2.17. Adoption of new technologies

Economists and Geographers have been attracted by the adoption of new technology in agriculture, because agriculture is the main sector in which the majority of population in developing countries derives its livelihood and technological change can offer an increased productivity and higher incomes (FDER *et al.*, 2008).In the study of adoption, there are users and non-users of a particular technology by farmers at a point in time, or over time.

Adoption presumes that the new technology exists; studies of the adoption process analyze the factors of whether and when adoption takes place (Colman and Young, 1989). Adoption is a decision making process in which the farmers pass through different stages (Enters, 1996).Agriculture is very dynamic- Farmers keep changing their management strategies based on their own experiences. New technologies introduced by various organizations also affect farmers' normal practices. Research organizations, extension institutions and rural development projects need to determine the level of acceptance of new technologies on farm and make changes accordingly. Adoption of improved technologies in agriculture has attracted the attention of many development economists and sociologists because of the vast majority of the population in many developing countries derive its livelihood from agricultural production (Feder *et al,* 1985). The decision to adopt improved technologies involves fixed costs.

The choice whether or not to adopt a new technology needs careful assessment of a large number of technical, economic and social factors. The effectiveness of the technology transfer is another important issue that is captured in adoption studies. In order to identify ambiguity that exist within the generation of a certain technology it becomes necessary to follow- up on the extent to which the farmers have accepted or rejected a technology. This would thus encourage communication between researchers and policy makers and even establish linkages between different government and non-governmental organization.

2.18. Conceptual Frame of the study

In this study the factors that may determine the adoption of soil and water conservation technologies were grouped into five categories such as: the demographic factors include:-age, sex, marital status, family size of the households and educational level of the household heads, socio-economic factors such as off-farm of household heads, availability of credit services of household heads etc.; institutional factors includes information, visit by development agents, training, land tenure security and bio-physical factors includes:- farm size of household heads, distance to market and Psychological-related factors such as: -awareness of farmers' and information source.

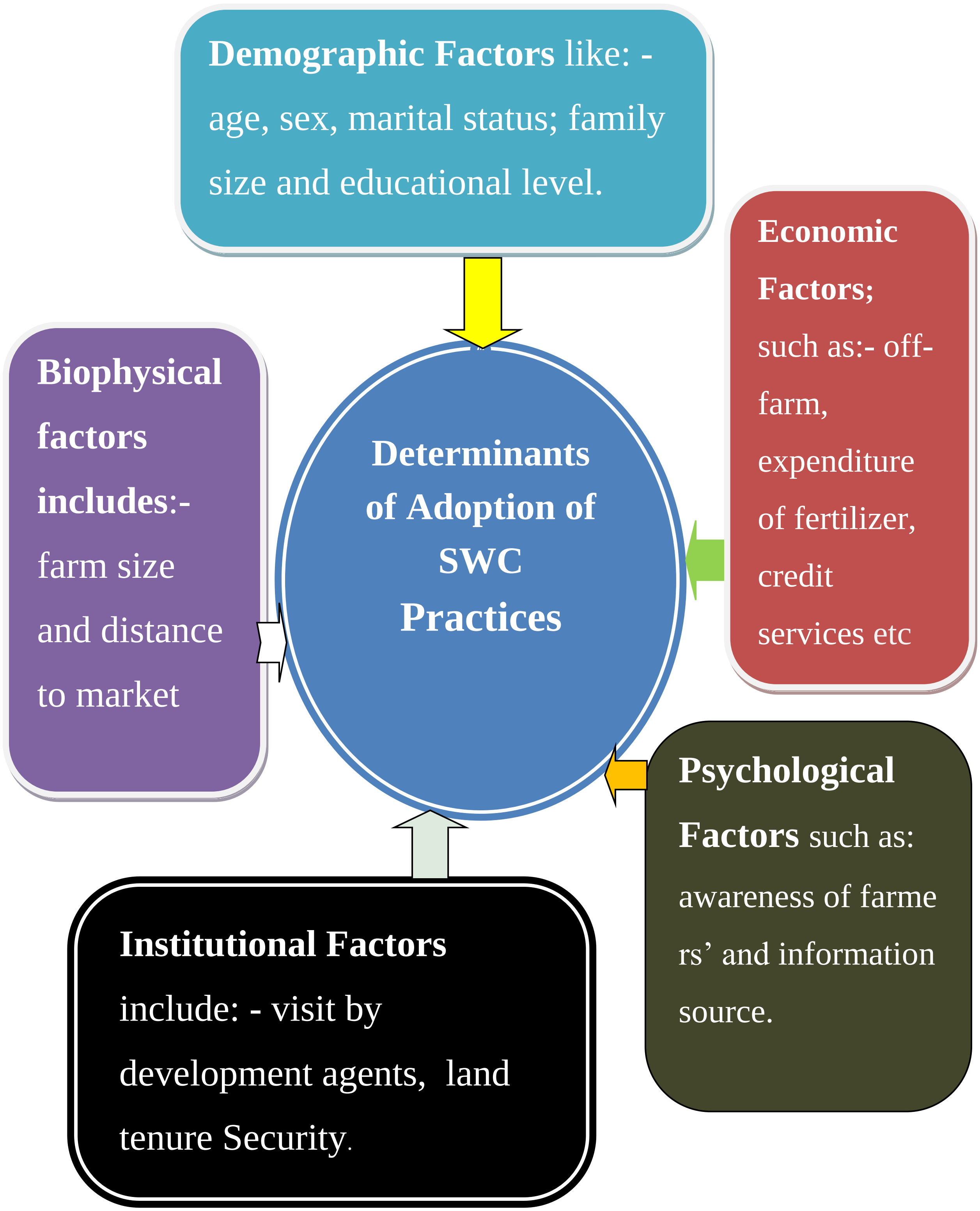

Figure 1. Diagram of Conceptual Frame on Adoption of SWC Practices of the Study Area.

CHAPTER THREE

3. Study area Description and Research Methodology

3.1. Description of the Study Area

Mirab Badawacho Woreda is located in Hadiya Zone, SNNPR state of Ethiopia. The study area is relatively bordered by Kadida-Gamela woreda in the north, Damot-Fullasa woreda in the south, Misrak Badawacho woreda in the east, and Kachabira woreda in the west. Astronomically, the woreda is located between at 7°09′00′ - 7°35′40′′N latitude and 37°52′00″ - 38°11′00″E longitudes and it is about 357km south of Addis Ababa and 127km from regional capital, Hawassa. The woreda with a total land area of 19,850 hectare is further divided in to 22 rural kebeles.

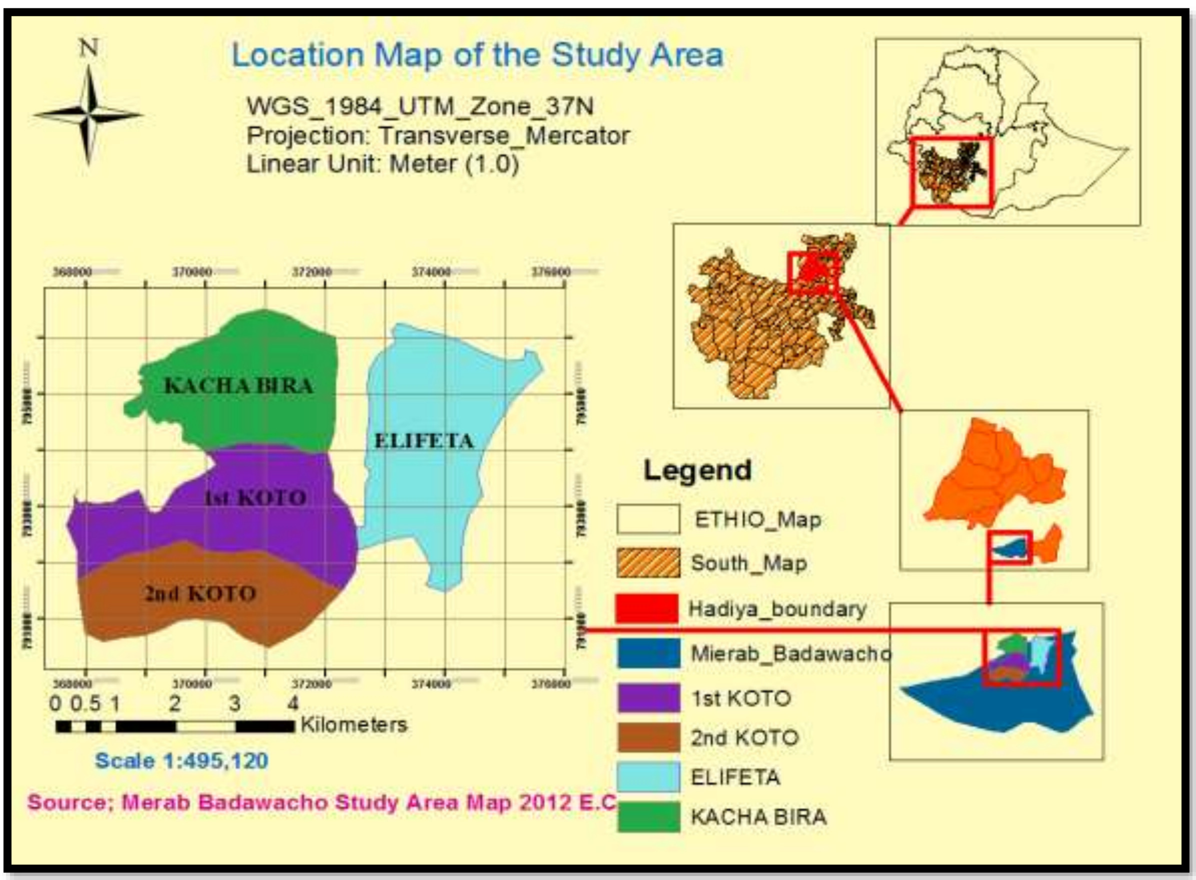

Figure .2 Location Map of the Study Area, 2020.

3.1.2. Climate

Agro-climatically, the study area lies within wet Weyna-Dega traditional agro-climatic zone, and that has the elevation 1961.00 m.a.s.l or 6433.73 feet (MBAoF, 2015). According to Araka Agricultural Research Center Meteorological Station Data (AARCMSD), the rainfall is bimodal with average annual rainfall of 1497mm with a growing period of 9 months and with mean annual temperature of 13.5° c to 25.76° c.

3.1.3. Water resources

In Mirab Badawacho Woreda, there are recurrent and permanent streams and rivers which drain in to Shapha river basin. Constant River which flow in rainy and dry season namely Angachicho drain in to Shapha River that originate from the highland areas of woreda. Recurrent streams which drain the area only during rainy season. In general, streams and rivers in the area drain the land and join the Shapha River creating big gullies in Boloso Sore woreda in Wolayita Zone.

3.1.4. Soil types

Soil erosion varies with soil types and erosive factors like slope of the land, rainfall characteristics, soil cover and land management (Prasannakumar *et al*, 2012). The type soils of the study area are volcanic origin, often over a sedimentary base. As to (MBAoF, 2016) report tick-soils and vertie-soil soils are the dominant soils covering increases rapidly with depth. The soils are well drained with a high moisture holding capacity.

3.1.5. Land use

Land in the study woreda is scarce, mainly due to population pressures. The farm size varies between less than 1 up to 5 hectares, and landscape categories for the study area are classified into relatively flatland, midland and highlands, which occupy about 90, 5 and 5% of the total landmass of all the study area, respectively. According to (MBWARD offices of 2014), fallow lands are not common, Because of the small farm size and there is also a shortage of grazing land. In the study Woreda, land is used for various purposes, such as for crop cultivation, grazing, forestry and cultivable land.

3.1.6 Natural vegetation

Vegetation cover degradation has also threatened the bio-diversity potential, and the plant seed reserve has also become eroded due to surface cover clearance and soil degradation (Wassie *et al.*, 2009). The woreda has various types of vegetation in responses to the variation of soil, climate and human activities. At present time, matured and naturally grown tree are observed in the homestead. In the remaining area, natural vegetation is very much degraded. Some of the major indigenous tree which still survive in the area includes 'Warka' (Ficus Vaita), 'Bisana' (Croton Macrostachyus), 'Grar'(Acacia Nilotica), 'Weira'(Olea Africana). In addition, important Oxotic tree 'Key bahirzaf' (Eucalyptus Camaldulesis), and in some parts of woreda, 'Yeferenge Tid' (Cupressus Lustanica) is commonly observed. But now a day these indigenous trees have been replaced by bush and grassland because of the population explosion. Eucalyptus is now the dominant in the study area eliminating indigenous species.

3.1.7 Natural resource management efforts

Natural resource degradation is the main environmental problem in Ethiopia (Million, 2004). However, the 1974 up to 1975 famine became a turning point in Ethiopian history in terms of establishing a linkage between degradation of natural resources and famine. From those times on ward, it drew the attention of the scholars to publish articles on degradation of natural resources. So, these helped create public awareness about the threat of soil erosion to agricultural production (FAO, 2003), Mirab Badawacho woreda is not different from other areas of Ethiopia.

Eyasu, 2002 indicated that the majority of the farmer perceived that their soil has been declining its fertility and described the soil fertility in their local language "harsha" (fertile soil) and "kereta" (infertile soil) in the study woreda. Mirab Badawacho woreda where the original forests are destructed, soils are eroded taking away the nutrients by soil erosion. Therefore, natural resource management efforts are less in the woreda even though there is beginning in some parts of the woreda. Thus, in the woreda, the government through collaboration of Mishigida-Sike Project taking part in the process of soil and water conservation practices through food for work program and awareness creation about the effect of soil degradation recently.

3.1.8. Socio-Demographic characteristics

The population density in the study woreda is relatively high, and small units of land are widely cultivated by subsistence farmers. Based on the 2007 Census conducted by the CSA, this woreda has a total population of 83,439, of whom 40,876 (48.99%) are men and 42,563 (51.01%) are women. Of these total populations, 81,325 (97.47%) of them are live in rural area, and only 2,114 (2.53%) lives in urban areas and their income are mainly based on mixed farming. The type besides total number of livestock owned across all sample household includes: oxen, caw, sheep, goat, poultry and donkey. The main source of feed for livestock in the study area includes straw and grazing land (MBWARD Offices, 2014).

3.2. Research Design and approach

The research design for this study was descriptive survey, which is analysis largely through quantitative methods. It gives direction from the underlying philosophical assumption to the justification research design, and data collection. This method helps to describe various forms of data as well as incorporating human experience. A mixed approach was employed in this research to investigate the implementation and adoption level of soil and water conservation concurrent triangulation design was used to simultaneously collect both quantitative and qualitative data sets. Using both qualitative and quantitative method is also important to analyze the data in different manner and to minimize the weaknesses of each of the approaches.

3.2.1 Sources of data

Quantitative and qualitative data were collected from different sources through various methods. These include both primary and secondary data sources. The importance of collecting and considering both primary and secondary sources through qualitative and quantitative methods of data collection was to complement and supplement the diverse data generated from different sources which in turn is used to make the data and the result of the research reliable. Research data can be collected from various sources depending on the objective of the study and type of data to be analyzed. Sample HHHs, key informants and FGD were the main source of primary data while the published and unpublished document, related thesis works and websites.

3.4. Target population

The study was focused on total population of 25,199 from four kebeles, of whom men are (12,500) or 49.61%, and women are (12,699) or 50.39%. The researcher selected sample respondents from each kebele by using proportional sampling method because it is relatively more efficient than uniform based on agro-ecology and severity of soil erosion. Among the total households of the four kebeles (2,586), which means from 1stKotto (598) or 23.1%, 2ndKotto (497) or 19.3%, Kachabira (913) or 35.3% and Elifata (578) or 22.3% kebeles, and 346 sample household heads were chosen.

3.5. Sample Size determination and Sampling Technique

The study employed purposive sampling technique. First, Mirab Badawacho woreda was selected by employing purposive sampling as a research site why because the researcher was familiar with this area. Identification of study kebeles and household heads for survey followed the series of steps. There are 22 kebeles in Mirab Badawacho woreda. From those, four kebeles were selected purposively for this study. Among those kebeles, 260 or (75.1%) farmers used for non-adopters and 86 or (24.9%) farmers for adopters were used.

The researcher selected these four kebeles purposively based on their involvement in different soil and water conservation activities, presence of severity of the problem of erosion and the existing soil and water conservation technologies and due to shortage of resource like time, budget, labour, etc. and shortage of transportation facility. Hence, the total household heads of the four kebeles are 2,586 and required sample is 346 which are 13.38% of the total household heads and determination of Yamane (1967) at confidences level of 95% and accuracy level of 5%. The level of precision is the range in which the true value of population is estimated. Once the sample size is determined, the sample household heads by using proportional sampling method from each kebeles were selected; the investigator was selected 8 respondents for interview from development agent and model farmers as well as 12 respondents for FGD that from local elders, kebele chairmen and land administrators using non-probability sampling technique from each sample kebeles, it relies on the subjective and not random selection of the researcher. Finally, the sample size is calculated as follows:

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

Where; n = sample size,

N = the total number of household heads

e = Level of accuracy.

Therefore, $n = \frac{N}{1 + N(e^2)}$, n= $\frac{2586}{1 + 2586\,(0.05)^2}$ =346

Based on the above formula, the investigator selected 346 HHHs from 2,586 total populations. Among those kebeles, 1,943 or 13.38% (260) farmers were non-adopters and 643 or 13.37% (86) were adopters of soil and water conservation.

Table 1. Sample Size of Household Head Respondents

No	Kebele	Total HHHs	Sample Size of Household heads	Sample Size of HHHs in (%)	Sampling Techniques
1	1stKotto	598	80	23.1%,	Proportional Sampling
2	2nd Kotto	497	67	19.3%	Proportional Sampling
3	Kachabira	913	122	35.3%	Proportional Sampling
4	Elifata	57	77	22.3%	Proportional Sampling
	Total	2,586	346	100	

Source: Field Survey, 2020

3.6. Instruments of Data Collection

Data collection instruments are very important tools for collection of different kinds of information through it**.** Quantitative and qualitative information were collected. Pre-test was conducted prior the household survey. This helped the researcher to know whether there is a need to modify the questionnaire based on the feedback from the pre-test. Therefore, to generate and understand about SWC relevant information and related problems were: Questionnaire (i.e. Close and open ended questions) interview, FGD and field observation were employed.

3.6.1. Questionnaire

The advantage of using questionnaires as data collection tools mainly come from the fact that with the help of questionnaires large amount of data can be collected quickly and economically from a large sample (Krathwoh, 1998). Household survey is a typical method to collect primary data from the sample households. Structured questionnaire that has involved both closed and open-ended questions was constructed and employed to generate data from the respondents. Initially the questionnaire was prepared in English but it was translated into "*Hadiyisa"*, language to make the question simple, clear and understandable to the respondents.

Household survey was conducted through face to face interview between the respondent and the interviewer. HHHs were the appropriate respondents for the questionnaire designed for the survey. The main types of data collected from HH survey were the HH demographic socio-economic, bio-physical, psychological and institutional characteristics. Household survey was facilitated by well- trained enumerators under the close supervision of the researcher. Before the actual HH data collection, the pre-test was applied in the study area to decide its reliability and validity and one and half day training was organized to enumerators on how to manage the whole household survey task, interview and close contact communication was done to minimize the gap at survey time with respondents and fill the questionnaire concerning the problem under study.

3.6.2. Key Informants Interview

The investigator was used semi- structured interview, because of its flexibility and makes clear when there is ambiguity. To get first hand and open information from farmers and DAs the researcher used a semi-structured interview. It is most common type of instrument used in qualitative social research for which researcher produces an interview schedule which may be a list of specific questions or a list of topics to be discussed (Dawson, 2007). The interview was conducted with DAs and model farmers that are found in the selected kebeles by selecting using purposive sampling technique for factors affecting smallholder farmers' adoption on SWC measures because those were expected to have better knowledge and information regarding SWC practices in the study area that help to achieve the stated objective of the study.

3.6.3. Focus group discussion

For FGD, the investigator was selected 12 respondents based on socially respected within the society and who were having better knowledge on the present and previous environmental, social and economic status of the study area. In each kebele one FGD was conducted with the community. The participant includes local elders, land administrators and kebele chairmen. The main purposes of FGD were to get understandings on and realize about adoption of SWC practices among smallholder farmers' and administrators to know the awareness of the community about land degradation and how the people of the study area manage the land, comments, opinions and suggestions were compiled from different knowledgeable elders.

Table 2: No of Respondents for focus group discussions.

Name of kebeles	Local Leaders	Land Administers	Kebeles chairmen	Total
1stKotto	6	5	1	12
2nd Kotto	6	5	1	12
Kachabira	6	5	1	12
Elifata	6	5	1	12
Total	24	20	4	48

Source: Field Survey, 2020

3.6.4. Field observation

Field observation was conducted in each selected four kebeles by the researcher, together with natural resource management experts, DAs and model farmers to observe severity of the land degradation. Observation gives the firsthand account of situations under study and when combined with other data collection tools, it allows to researcher for an inclusive interpretation of the situations which was studied. It contributed a lot for the investigator to understand the actual situation and socio-economic condition of the study area. This method was help to reduce complexity and even makes the research work more fruitfully. The investigator was collected the necessary information by using checklist.

3.7. Methods of Data Analysis

To analyze factors affecting adoption of soil and water conservation technologies is difficult because of differences in agro-ecological and socio-economic settings within which farmers operate (Bekele, 2003). To address this difficulty, it was assumed that every farmer has the objective to maximize utility, but each farmer has their own perception of utility and makes practice adoption decisions based on the unique attributes of their own situation and location.

Farmers in the study area cultivate or manage several farmlands located at different distances from home. Each farmland has different soil and environmental conditions. As a result, farm HHHs may make different SWC practices for different farmlands depending on specific circumstances and the importance of the farmland to the household heads. This requires that data be interpreted at an individual farmland level rather than aggregated across all farms of a HHHs. The dependent variable is a made-up variable, which takes a value of zero or one is depending on whether or not a household is to adopt and implement SWC measures (i.e. adopter or applied new innovation= l , non-adopter or not applied new innovation =0).

Farm households' in the study area differ in the proportion of cultivated land on which different types of soil and water conservation structures are used. There are non-users of these improved and traditional soil and water conservation (SWC) measures even in the places where they are promoted. Because some households are non-adopters of SWC practices, the reported proportion of land with SWC for such households is equal to zero.

Thus, a binary logistic regression model was used to describe data and to explain the relationship between one dependent binary variable and one or more nominal, ordinal, interval or ratio-level independent variables. To accomplish the analysis at the farmland level, the data acquired for each farmland were analyzed using descriptive statistical techniques and provided by the Statistical Package for Social Sciences (SPSS version 20). MS-Excel was used to generate tables. For the informal key informant interviews and field observation notes, a qualitative analysis was used.

CHAPTER FOUR

4. RESULTS AND DISCUSSIONS

4.1. Background Information of the Respondents

The age, sex, marital status, family size, educational levels and farm size are presented and discussed to get general over view of the respondents position and how these characteristics influences SWC practices in the study area. Hence, descriptive method was employed to investigate factors that affect the adoption of smallholder farmers' to improve soil conservation technologies and the extent of SWC practices in the study area.

4.1.1. Age of the Respondents and Family Members

In table 4.1 below, their age at the time of survey, about 51.7%, 45.4%, and 2.9% of the total respondents were in the age group of 15-35, 36-64, and >65 respectively. From those household head non-adopter respondents, about 38.4%, 34.1% and 2.6% were in the age group of 15-35, 36-64, and >65 respectively**.** Adopter of household head respondents about 13.3%, 11.3% and 0.3% were in the age group of 15-35, 36-64, and >65 respectively. This indicates that 51.7% and 45.4% of household heads non-adopter and adopter were in age group 15-35 and 36-64 active participants and implementers on adoption of SWC practices due to the fact that they have been getting more information but did not implemented to the required level and adopted SWC in the study area.

The age of family members less than 15, 15 up to 64 and >65, were 61.5%, 37.3% and 1.2% respectively. This shows in table 3 below that, the majority of the family members that means 61.5% were under age 15 and less implementation on SWC adoption practices. Further, according to the statistical offices of the federal level, the age structure of the family members of the household is characterized by high proportion of young population (0-14years), with low old age >64 years (CSA,2007), which indicates the prevailing high fertility rate and high death rate. The statistical analysis revealed that there is strong relationship in age of respondents of SWC measures households at 5% significance level.

Table 4.1.Distribution of Sample Household Heads by Age

Age of HHHs in group	Age Range in (Years)											
	Non-adopters						Adopters					
	15-35		36-64		>65			15-35	36-64		>65	
	No	%	No	%	No	%	No	%	No	%	No	%
	133	38.4	118	34.1	9	2.6	46	13.3	39	11.3	1	0.3

Source: Field survey, 2020

4.1.2. Sex distribution of household heads

Women also sometimes inhibited from making decisions about soil and water conservation practices while their husbands are away (Benin, 2006). The survey results in table 4.2 below, indicated the sex distribution, the total sample HHHs, 87% were male and 13% were female HHHs. From those, 75.1% were non-adopters and 24.9% were adopters. That is male HHHs participated more actively than female HHHs in SWC because female HHHs have more responsibilities at home. In addition, women are more involved in regular HH activities than men. Moreover, a woman takes most of the household responsibilities such as child care, food processing, collecting fire wood for house consumption and weeding and fetching water from long distance. Thus, there is strong significant relationship between HHHs sex and adoption of SWC measures in the study. Soil and water conservation demands high amount of labor for construction and maintenance and done by male headed households than female headed HHHs.

Table 4.2. Distribution of Sampled Household Heads by Sex.

Sex of HHHs	**Adoption of SWC Measures**					
	Non-adopters		**Adopters**		**Total**	
	No.	%	No.	%	No.	%
Male	222	64.1%	79	22.9%	301	87%
Female	38	11.%	7	2%	45	13%
Total	260	75.1%	86	24.9%	346	100%

Source: Field survey, 2020

4.1.3. Marital status of the respondents

The marital statuses of household heads are one aspect of demographic characteristics that determine households' access to information and resources and hence have an effect on adoption of soil and water conservation practices (SWCP). As indicated in table 4.3 below, the overall marital statuses of household heads were characterized: single 10.8%, married 82% widowed 6% and divorce 1.2%.

This show that large number of households 82% are married which has useful for cooperation as well as to share information among each other within the formation and resources and hence have an effect on adoption of soil and water conservation (SWC) practices. This helps to implement the adoption of soil and water conservation practices (SWCP). Therefore, there is no significant relationship between marital status and adoption of soil and water conservation (SWC) measures in the study area.

Table 4.3. Distribution of Sample HHHs by Marital status of the respondents

Marital Status of HHHs						
Single	**Non-adopters**		**Adopters**		**Total**	
	No.	%	No.	%	No.	%
	19	5.6%	18	5.2%	37	10.8%
Married	224	64.7%	60	17.3%	284	82%
Widowed	14	4%	7	2%	21	6%
Divorced	3	0.9%	1	0.3%	4	1.2%
Total	260	75.2%	86	24.8%	346	100%

Source: Field Survey, 2020

4.1.4 Family Size

Family size is one of the most important characteristics of HHHs that determine the participation of HHHs in different social and economic activities. The house hold size, which can determine the amount of labour forces in the HHHs, is expected to bring about variation of households as to which soil and water conservation practices to use. Yet, studies conducted in Ethiopia indicated reverse, larger family size has negative impact on the adoption of SWC technology (Amsalu, 2006: and Fikru, 2009). Another explanation is when population increases, landholding per household will decrease which in turn has a negative on SWC adoption.

The survey results in table 4.4 below indicated, the family size of the sample house hold heads are:- 1-4 ,4-8 and > 8. From those sampled household heads, family members categorized that 176 or (50.9%), 121 or (34.9%) and 49 or (14.2%) respctively. Family size of the sampled household heads 50.9% of family members between 1-4, 34.9% of the family members were between 4-8 and 14.2% of the family members were above or greater than eight. This indicated that, the majority of family members (50.9%) were between 1 up to 4 family members. The average family member is two in the study area.

With regard to number of family members, the largest family size is 9 and the smallest is 2. Therefore, the size of family is decreases, the implementation and adoption of SWC technologies is decreases due to the shortage of labour force. Therefore, there is strong significant relationship between family size of HHHs and adoption of SWC measures in the study area.

Table 4.4. Distribution of Sample HHHs by Family Size of the respondents.

Family size of HHHs	Member of Family by size						Total
	1-4		4-8		>8		346
	176	50.9%	121	34.9%	49	14.2%	100

Source: Field Survey, 2020

4.1.5. Educational Status of the respondents

Educational status of a society, particularly literacy level is among the key factors determining development and growth (Todaro and Smith, 2009). According to table 4.5 below, five educational levels for household heads were identified, which includes: unable to read and write, literate with no formal education, primary level, secondary level, and preparatory level. From those, about 63.8% of sample household heads were unable to read and write. Out of this, 46.2 % were non-adopters and 17.6% were adopters. The remaining 36.2% of them could read and write. In addition, 19.3% were literate with no formal education, 9.1% were educated to grade 1-8, 7.8%, reached grade 9 up to 10 and there is no preparatory level and above.

Most of the farmers' household heads in the area are not educated and thus, have little access to information about newly introduced SWC adoption practices. From those total household head respondents, 75.1% were non-adopters of soil and water conservation practices they adopt and implement less effectively than those of 24.9% of adopters in the study area. The result revealed there is significant relationship between educational status of households and adoption of soil and water conservation measures of the sampled household heads in the study area.

Table 4.5. Farmers Educational Status of the respondents

Education Level	**No. of Household Heads**								**Percent**
	Non-adopters=260				**Adopters=86**				
	M	F	T	%	M	F	T	%	
Unable to read and write	151	9	160	46.2	56	5	61	17.6	63.8%
Literate with no formal education	34	19	53	15.3	12	2	14	4	19.3%
(1 – 8)	19	8	27	7.9	4	-	4	1.2	9.1%
(9 –10)	18	2	20	5.8	7	-	7	2	7.8%
Preparatory level and above	-	-	-	-	-	-	-	-	-
Total	222	38	260	75.1	79	7	86	24.9	100%

Source: Field Survey, 2020

4.1.6. Farm size in hectare

According to Benjamin (2007), study that describes the average land holdings in Ethiopia falling from 0.5 hectare per person in 1960 to 0.11 hectare per person in 1999. The farm size of household heads grouped in <1 hectare, 1-2 hectare and >2 hectare respectively. Of those sampled non-adopter and adopter household heads, the majority of 58.4% and 18.5% or 76.9% possessed less than one hectare of land, 13.6% and 5.2% or 18.8%, had 1-2 hectares and only 3.2% and 1.1% or 4.3% have more than two hectares that indicated table 4.6 below. This shows that the study area has densely populated and the farmland size is small.

Hence, the young generation would have very small plots that got very small land from their family. The size of farmland owned per household has been shrinking since so long due to the ever increasing human population. The result shows that there is a significant relationship between farm land size of the households and adoption of soil and water conservation measures in the study area.

Table 4.6. Farm size in hectare

	Farm Size in per/hec						**No.**
	Non-adopters			**Adopters**			
	< 1 hectare	1-2 hectare	>2 hectar	< 1 hectar	1-2 hectare	>2 hectare	
Total	202	47	11	64	18	4	346
Percent	58,4%	13.6%	3.2%	18.5%	5.2%	1.1%	100%
Both				266	65	15	346
	Non-adopter and adopter			76.9%	18. 8%	4.3%	100%

Source: Field Survey, 2020.

4.1.7. Source of Farmland holding

As it can be observed, from table 4.7 below, that 88.7%, 6.4%, 1.7% and 3.2% of farmers responded that they have their own land obtained through inheritance, kebele, gift and other sources respectively. Almost all of the farmers responded that the land belongs to them and it was obtained through inheritance from their parents. Land is registered in the name of the household heads and shared among the sons after the death of their father. This shows that they have possibility to take care of their own land. However, if land is obtained through other means as 3.2% of the farmers responded like share cropping, they only focus on the temporary profit and benefit rather than long term management and sustainable use of the land by conserving it.

Table 4.7. Sources of Farmland of the respondents

Source of land	Inherited		Kebele		Gift		Others		Percent	
All plots used by Sampled HHHs	No	%	No	%	No	%	No	%	No	%
	307	88.7%	22	6.4%	6	1.7%	11	3.2%	346	100

Source: Field Survey 2020.

4.1.8. Soil and Water Conservation practices in the Study Area.

Defferent major tradional and improved soil and water conservation practices have been identified by the local DAs in the study area with in the previous years. Before the intrvention through Productive-Safety-Net-Program, farmers' in the study area were exclusively practicing traditional methods. Thus, the use of "improved" SWC measures is a recent development.

4.1.8.1. Traditional and Introduced SWC practices

Until now, tradional SWC practices have often been underestimated by different stackholders. However, surveying both traditional and improved SWC prctices provides an understanding of farmers' way of thinking about the interventions. To prevent land degradation, especially soil erosion, in the study area, farmers' use a number of both traditional and improved SWC technologies. This technologies includes contour-ploughing, soil-bunds, application of manure, traditional and introduced cut-off drains, both traditional and improved planting trees and leaving crop residues in the farmland.

4.1.8.1.1 Contour-ploughing

Contour-ploughing is a practice of cultivating the land along contours of equal elevation in order to reduce the run-off on lands. It is used alone or in combination with other conservation practices like cut-off draina and plantation of differen types of trees. Of the sampled plots, 91.14% had contour-farming and although the farmers' were aware of the soil and water conservation function of contour-farming (Table. 4.8) below. In addition to this, it was implemented during land preparation before planting season because their ploughs the for preparing an appropriate seed-bed for production.

4.1.8.1.2 Application of Manure

Application of manure was used on more farm lands than any other conservation practices or 22.25% of the total farm lands (Table. 4.8) below. Farmers' applied manure near the homestead, rather than to land at a distance. Based on focus group discussions with key-informant interveiws, farmers' have increased the amount of manure applied because of the high price of inorganic fertilizers which the farmers' cannot be have enough money.

4.1.8.1.3 Soil-bund terraces

About 82.62% of the surveyed plots soil-bunds (Table. 4.8) below. In the common land especially around mountainous areas, farmers' were constructing bunds because of the cash they would earn from a Safety-Net-Program. During focus-group-discussions with key-informants, it was learned that farmers' are well aware of soil erosion problem in the study area. Moreover, they agree that bund-terraces are effective in protection soil erosion in steep-slope areas. The introduced SWC measures, soil-bunds, were widely acknowledged as being effective measures in attractive soil erosion and as having the potential to improve land productivity. Nevertheless, due to the top-down approach, adoption of these introduced soil and water conservation by the farmers' appears less likely (Mitiku *et.al*, 2006). During focus-group-discussion with key-informants, in the study area, the farmers' mentioned that effective designs by DAs are responsible for ignoring gullies. Farmers' used mostly soil bunds that are water-resistant intended to maintain all rainfall but when overtopped at one location will cause gullies unless they have specially designed spillways and protected soil. Key-informants indicated that the farmers' were aware of this SWC practices.

4.1.8.1.4 Planting Trees

Trees and non-crop plants are planted on 34.78% of surveyed plots sometimes with other consevation practices (Table. 4.8) below. During field observation, trees were observed to be planted along the contour in order to reduce run-off and conserve the soil and water around the root of the plants. Ingeneral, these plants are drought tolerant, not suitable for eating and therefore not destroyed by animals in the study areas. Another advantage is that farmers' use these plants to mark the border between adjecent plots.

4.1.8.1.5 Leaving Crop Residue

The survey results showed that most of the users are implementing this soil and water conservation measure in order to protect the soil from erosion. During field observation, there were largel amounts of crop residues 79.29% (Table. 4.8) below in farm plots. Key-informants interview indicated that the farmers' had serious fuel wood and animal feed shortages and therefore gradually used the crop residue for off-plot purposes. Most of the farm households in the study area, women members, collect crop residues from the field for animal feed and fuel wood. Similarly, research conducted by Tilahun (2008) found that farmers' in Areka removed all crop residues from their fields. Some of the residues from creals and legumes are stored in the home compound and sold as fodder or used to feed livestock during the dry season.

4.1.8.1.6 Cut-off drains

The survey results showed that almost 20.33% of the sampled plots had traditional and improved cut-off drains (Table. 4.8) below. The farmers construct these drains to prevent loss of seeds, fertilizers, manure and soil due to water flowing onto the plot from uphill. The excess water is disposed away from the farmlands. However, according to farmer opinions, some of the taditional structures increase soil erosion through time. Field obsevation with key-informant interveiws confirmed this, revealing several gullies between farm boundaries that were started by the cut-off drains. Farmers' in the study areas are, therefore, relucant to install this types of soil and water conservation practices. Soil and water conservation technicians believe that by better surveying, the performance of the cut-off drains can be improved.

Table 4.8 Traditional and Introduced SWC Measures Implemented by HHHS.

No	Description of SWC in the study area	Traditional SWC practices	Introduced SWC practices	No of plots	Percent
1	Contour-ploughing	✓		946	91.14%
2	Application of Manure	✓	✓	231	22.25%
3	Soil-bund terraces	✓	✓	796	82.62%
4	Planting Trees	✓	✓	361	34.78%
5	Leaving Crop Residue	✓		823	79.29%
6	Cut-off drains	✓	✓	211	20.33%
7	Fanyajuu Terraces		✓	0	0

Source: Field Survey, 2020

4.2. Farmers' Response towards farmland

The survey results in table 4.9 below indicated, in the study area all respondents of household heads have farmland but, the respondents have their own limitation on adoption of soil and water conservation practices on their farmland due to less attention. Therefore, the only existence of farmland is not enough for implementation and adoption of soil and water conservation practices in the study area.

Table 4.9. Farmers' Response about farmland

Variable	Response	Frequency	Percent
Do you have farmland?	Yes	346	100
	No	-	-

Source: Field Survey 2020.

4.2.1. The Status of Constructed SWC Structures of the Study

The survey results in table 4.10 also indicated below, 45.1%, 44.5%, 4.6%, 3.2%, and 2.6% of the HHHs responded that the structures are damaged, partially damaged, maintained, fully damaged and in good shape respectively. 45.1% of the constructed bunds are damaged and 44.5% of the constructed bunds are partially damaged. This shows that farmers' were not taking care of the physical structures of SWC practices in the study area.

Table 4.10. The Status of SWC Structures of the Respondents.

	Response	**Frequency**	**Percent**
What is the status of individual farm land on soil and water conservation structures?	Fully damaged	11	3.2%
	Damaged	156	45.1%
	Partially damaged	154	44.5%
	Maintained	16	4.6%
	In good shape	9	2.6%
	Others	-	-
	Total	346	100%

Source: Field survey, 2020

The survey results indicated in table 4.11 below, 9.8% of the respondents do have information about improved soil and water conservation maintenance, and 90.2% of the farmers' do not have introduced soil and water conservation maintenance. But in most cases, the sample kebeles, not well implemented and adopted improved soil and water conservation maintenance.

Table 4.11.Improved soil and water conservation structures maintained or not?

Do improved soil and water conservation structures maintained?	**Response**	**Frequency**	**Percent**
	Yes	34	9.8%
	No	312	90.2%
	Total	346	100%

Source: Field survey, 2020

The survey results indicated in table 4.12 below, 47.1%, 38.2%, and 14.7%, of the farmers responded that it is attributed to exclusion from PSNP, less attention by farmers and less attention by extension workers respectively. 47.1% of the farmers responded, farmers' exclusion from Safety-Net-Program, 38.2% that is due to less concern and attention given by farmers and 14.7% only the reason for less attention by extension workers. Therefore, the exclusion from PSNP (productive safety-net program and less concern and attention given by farmers were the major reasons for damaging soil and 14.7% only the reason for construction measures.

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Table 4.12. The reason for the maintenance of construction measures.

[What is the reason behind?	**Response**	**Frequency**	**Percent**
	Less attention by farmers'	13	38.2%
	Less attention by extension workers	5	14.7%
	Farmers' reluctance on its benefits	-	-
	Farmers' exclusion from Safety-Net-Program	16	47.1%
	Total	34	100%

Source: Field survey, 2020

4.2.2. Attitude of farmers towards introduced Soil and Water Conservation practice

The survey result shows in table 4.13 below, 82.7% of household have low attitude towards introduced soil and water conservation practices and 17.3% have attitude towards introduced soil and water conservation practices. The implication is decrease in attitude towards soil and water conservation decreases in use of soil and water conservation practices. Farmers who have low attitude towards soil and water conservation measures are less likely to be engaged in applying soil and water conservation practices in the study area.

Table 4.13. Farmers' attitude towards SWC practices

Do you have positive attitude towards SWC practices?	**Item**	**Frequency**	**Percent**
	Yes	60	17.3%
	No	286	82.7%
	Total	346	100

Source: Field survey, 2020

The survey results indicated in table 4.14 below, factors determining farmers' influence positive attitude towards soil and water conservation practices, 52.9% education, 28.3%, government policies and strategies, 9.5% gender, 6.1% income and 3.2% farmer experience. The major determinant factor that influences farmers' adoption on soil and water conservation practices in the study area is education, or more than half of the respondents. Therefore, there is a significant relationship between educational status of households and adoption of soil and water conservation measures of the sampled household heads in the study area.

Table 4.14. The expected factors determining farmers' influence Soil Water Conservation practices.

	Response	**Frequency**	**Percent**
Which are the expected factors determining farmers' influence SWC in your area?	Education	183	52.9%
	Income	21	6.1%
	Gender	33	9.5%
	Farmer Experience	11	3.2%
	Government Policies and strategies	98	28.3%
	Other	-	-
	Total	346	100%

Source: Field survey 2020

4.2.3. Farmers' response on the level of adoption of improved Soil and Water Conservation Practices.

As in the table 4.15 below indicated, 88.4%, 6.1% and 5.5% of the household heads responded that their adoption level is low, high and medium respectively. Thus, 88.4% of the farmers responded that their adoption level is low, this mean that less application. As the survey result shows there is no enough amount of adoption of soil and water conservation rather it is positive relationship. Thus, low adoption is not because of no attitude of farmers toward introduced soil and water conservation practices but can be explained by other factors. Therefore, the result indicated attitude is necessary condition, but not influencing for the adoption of soil and water conservation practices.

Table 4.15. Farmers' response on the level of adoption of improved SWC practices.

How about level of adoption?	**Response**	**Frequency**	**Percent**
	Low	306	88.4%
	Medium	19	5.5%
	High	21	6.1%
	Total	346	100%

Source: Field survey 2020.

4.2.4. Determinants of Adoption of Soil Water Conservation Practices

4.2.4.1. Economic factors

Identifying whether there was relationship between the economic factor and adoption of soil and water conservation practices was one of the concerns of this study. Economic factors promote or discourage the adoption of soil and water conservation practices. This means there is a relationship between economic factors and adoption of soil and water conservation practices. The main economic factors considered in this study were engagement in off-farm activities, access to credit, and expenditure on fertilizers.

4.2 4.2. Off-farm activities

Engagement in off-farm activity withdraws labor from agricultural land and creates labor shortage and discourages investment in soil and water conservation practices. Thus, different research findings indicated that involvement in off-farm activities negatively related to the adoption of soil and water conservation practices. This means increase in involvement of off-farm activities discourages investment in soil and water conservation practices. In this study, it is not expected that off-farm activities to affect the adoption of soil and water conservation practices. As indicated in table 4.16 below, 4.9% of the respondents are engaged in off-farm activities and 95.1% of household heads are not engaged in off-farm activities. The household with a greater number of mouth to feed; competition arises for labor between food generating off-farm activities, like daily labor rather than investment in soil and water conservation (Bekele *et al*., 2009).

Studies by (Eleni, 2008) showed that involvement in off farm activities negatively influenced the use of soil and water conservation measures. Normally, income from off-farm activity supports the small yield obtained from small plot of land of farmers in rural area. However, when much time, energy, and resources used for off-farm activities, but, in the study area there is no influence on soil and water conservation practices. This shows there is no significant relationship between adoption of soil water conservation measures and involvement in off-farm activities in the study area.

Table 4.16. Engagement in off- farm activities on adoption of SWC practices

Did you engage in off-farm activity?	**Response**	**Frequency**	**Percent**
	Yes	17	4.9%
	No	329	95.1%
	Total	346	100%

Source: Field survey 2020.

The survey information was gathered from key informants there is less engagement in off-farm activities in the study area. But, for those farmers' depending on off-farm activities in study area influenced the adoption of soil and water conservation practices that means, in table below 4.17, indicated that 70.6% of the existing agricultural production cannot support their family and 29.4% income from off-farm activities greater than that of agriculture were the reason for engagement of off-farm activities in the study area. Thus, it leads to expose for soil erosion in the study area due to less attention for soil and water conservation practices.

Table 4.17. Farmers' reason for the engagement in off-farm activity

What is the reasonfor the engagement in off-farm activity?	**Response**	**Frequency**	**Percent**
	Existing agricultural production cannot support my family	12	70.6%
	Income from off-farm activities greater than that of agriculture	5	29.4%
	Other	-	-
	Total	17	100%

Source: Field survey 2020.

4.2.4.3. Expenditure on fertilizer and adoption of SWC practices

According to table 4.18 below shown 48.6% of HHHs use fertilizer and 51.4% do not use it. The survey result shows that 52.8% of farmers responded that the reason for not using fertilizer is its price is high, 34.3% of farmer' responded as reason not using fertilizer is limited access and 12.9% of the respondents answered it decreases productivity. Thus, more than half of the household heads responded that they did not use fertilizer. The household heads want in some instance to use fertilizer but unable to use it for the absence of adequate supply and provision to them. Similarly a study by Chomba (2004 cited in Eleni, 2008) indicated that if fertilizer application would be increased, the likelihood of a farmer to follow conservation practices would also increase. For this, he argues that conservation practices prevent fertilizers from being washed away by erosion and hence are needed more. Therefore, fertilizer application influences the investment in soil and water conservation measures.

This is because those farmers who use fertilizer give care for their land and protect it from erosion by constructing the physical structures so that more yields can be obtained. On the contrary, other findings by Shiferaw and Holden (2008) showed that an increase in fertilizer application is expected to have a negative influence on farmers' choice for conservation measures. This is due to the increment on fertilizers serve as a replacement for SWC measures and hence discourages farmer from continuously using SWC structures.

Table 4.18. Use and Reason of fertilizer on adoption of SWC practices

Did you use fertilizer?	**Response**	**Frequency**	**Percent**
	Yes	168	48.6%
	No	178	51.4%
	Total	346	100%
Why did not use fertilizer?	Its price is too high	94	52.8%
	It decreases productivity	23	12.9%
	Its access for service is limited	61	34.3%
	Total	178	100%

Source: Field survey 2020

The survey result indicated, in table 4.19 below, 89.9% of household heads did not get credit service and whereas, 10.1% of the household heads got access to credit services. The sources of credits are 82.9% from other sources and 17.1% local NGOs. From those respondents who got credit services, 48.6%, 34.3%, and 17.1% used it for fertilizer purchasing, seed production and for other purpose respectively. Therefore, access to credit influenced the adoption decision of farmers in the study area. This is because those farmers who get credit are expected to return the money obtained after they have made profit out it. In line with this, a study by Krishna *et al*. (2008) cited in Eleni (2008) indicated that farmers who received loans from various institution for sewing of new crops were significantly more involved in continued use of SWC technology. This implies that access to credit service motivates farmers to produce more cash crops and to get more income which lead to better investment in soil and water conservation technology.

Table 4.19. Farmers' access to credit services

Do you have credit service?	**Response**	**Frequency**	**Percent**
	Yes	35	10.1%
	No	311	89.9%
	Total	346	100%
Where is the source of credit?	Kebele	-	-
	NGOS	6	17.1%
	Other	29	82.9%
	Total	35	100%
For what purpose did you use the credit?	Fertilizer purchase	17	48.6%
	Seed production	12	34.3%
	Other	6	17.1%
	Total	35	100%

Source: Field Survey, 2020

4.3. Discussion on Significant Explanatory Variables

Soil erosion as a problem was significantly and positively associated with adoption of soil and water conservation structures on cultivated owned land. This implies that the better the farmers perceive the problem of soil erosion, the more likely the farmers to adopt soil conservation structures on their lands. Fifteen variables were hypothesized to have an effect on the adoption of soil and water conservation structures and were entered to the model using (version 20.0) SPSS computer software. Out of the variables analyzed the coefficients of variables, namely age, sex, family size, educational status and farm size were significantly different from zero and found to be significant to affect the adoption of soil and water conservation measures in the study area. Marital status and involvement in off-farm activities were no significant relationship with the adoption of soil and water conservation measures in the study area.

On the other hand, participation in off-farm activities has a negative and significant influence on the adoption of soil and water conservation measures. The model result confirmed that involvement in off-farm activities no significantly determine the adoption of soil and water conservation activities in the study area. An increase involvement in off-farm activities decreases the decision on practicing soil and water conservation structures. A study conducted by Abera (2003) in Farta Woreda of Northern Ethiopia revealed that increasing involvement in off-farm activities for income generations decreases the participation of farmers towards soil and water conservation activities. Consistent with this finding, the variable off-farm involvement had a negative and significant effect on the probability of adopting soil and water conservation structures.

Table.20. Significant Explanatory Variables

Variables in the Equation							
		B	S.E.	Wald	Df	Sig.	Exp(B)
Step 0	Constant	-1.106	.124	79.099	1	.000	.331

Table.21. Model Summary

Model Summary			
Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	13.460[a]	.661	.981

Wald or Chi-square is used to find out explanatory variables

Cox & Snell R Square is used to determine the convergence of logistic regression.

Nagelkerke R Square is values provide an indication of the amount of variation in the dependent variable explained by the model. (Min=0 & max=1)

Table.22. Variables in the Equation

Variables in the Equation									
		Coefficient (B)	S.E.	Wald	Df	Sig.	Odd ratio Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Age	.885	11862.486	.000	1	.001123	2.424	.000	.
	Sex	-6.783	25079.678	.000	1	.004523	.001	.000	.
	MTs	.138	15863.886	.000	1	.0999	1.148	.000	.
	FSOHH	7.802	15365.147	.000	1	.011	2446.505	.000	.
	ESOHH	-9.859	6537.531	.000	1	.999	.000	.000	.
	AFL	18.271	5928.243	.000	1	.000998	86115637.412	.000	.
	SSWC	-8.618	6726.414	.000	1	.0000	.000	.000	.
	WTOT	-.875	17225.627	.000	1	.000	.417	.000	.
	TOISWC	1.477	6877.460	.000	1	.000	4.379	.000	.
	WCPSWCM	19.639	4865.777	.000	1	.997	338106272.274	.000	.
	FHPA	-8.350	13209.652	.000	1	.999	.000	.000	.
	EFDEISWC	-.141	6425.032	.000	1	.000	.869	.000	.
	ENFA	-8.825	17984.272	.000	1	.000	.000	.000	.
	MFSE	8.044	12445.697	.000	1	.999	3116.042	.000	.
	PTMSE	1.232	19929.687	.000	1	.000	3.428	.000	.
	Constant	-44.433	47514.921	.000	1	.999	.000		

A. Variable(s) entered on step 1: Age, Sex, MTs, FSOHH, ESOHH, AFL, SSWC, WTOT, TOISWC, WCPSWCM, FHPA, EFDEISWC, ENFA, MFSE, PTMSE

CHAPTER FIVE

5. SUMMARY OF MAJOR FINDINGS, CONCLUSION AND RECOMMENDATIONS.

5.1. SUMMARY OF MAJOR FINDINGS AND CONCLUSIONS

At present, Ethiopia is facing greater natural resource depletion in general and soil erosion in particular. Especially the problem is extremely serious and widespread in the highlands of Ethiopia including the study area. The study was carried out in Mirab Badawacho Woreda, Hadiya Zone and Southern Nation Nationalities and Peoples Regional State.

The specific objectives of this study were to identify commonly introduced soils and water conservation measures implemented and adopted by the local people of the study area; investigate farmers adoption level of introduced SWC practices in terms of non-adopter and adopters of soil and water conservation practices; and identify the factors that affect smallholder farmers' adoption of SWC practice. Data collection took place in two phases. The first phase involved collection of general information about the study area including review of secondary information from various publications and reports, informal discussions with key informants, individual heads of households and groups of heads of household. The second phase concerned with household heads level data collection using a structured and semi-structured questionnaire. The total sample sizes of the survey were 346 households; out of which 75.1% were non-adopter and 24.9% are adopters of SWC structures.

Thus, a binary logistic regression model was used to identify the determinants of adoption of SWC measures and to assess their relative importance in determining the probability of being an adopter of soil and water conservation measures. To accomplish the analysis at the farmland level, the data acquired for each farmland were analyzed using descriptive statistical techniques and provided by the Statistical Package for Social Sciences (SPSS version 20). MS-Excel was used to generate tables. For key informant interviews and field observation notes, a qualitative analysis was used. The introduced SWC structures implemented on individual farmlands and while the hillside terraces are the most common structures practiced in the study area.

In addition to these, farmers of the study area also practiced indigenous and improved soil and water conservation practices which include contour-ploughing (agdem mares), soil-bund terraces, planting trees, cut-off drains, application of manure and leaving crop residues. The binary logistic model was used to estimate the effects of the independent variables on the probability of the heads of the households to adopt introduced soil and water conservation measures. Adopters and non-adopters of soil and water conservation structures differed in some demographic variables; such as age, sex, marital status, educational status, family size and farm size between the two groups, which imply the differences in their soil and water conservation practices adoption behaviors.

A total of 15 variables were fixed in binary logistic regression model. Among these, age, sex, family size, education and farm size were statistically significantly related to adoption of soil and water conservation practices by the farmers. On the other hand, the coefficients of the variables such as marital status and the involvement of off-farm activities were not statistically significantly related to adoption of soil and water conservation practices by the farmers in the study area.

5.2. RECOMMENDATIONS

Even though farmers are trying to conserve their lands, soil erosion is still widespread problem in the study area. Both indigenous and introduced soil and water conservation technologies are practiced by farmers on individual farmlands. The soils and water conservation structures practiced are physical in nature and some are agronomic measures. The most common physical structures undertaken are contour-ploughing (agdem mares), soil-bund terraces, planting trees, cut-off drains, application of manure and leaving crop residues in the study area.In this study, analysis was also made to identify the demographic, economic, biophysical, institutional and psychological characteristics of soil and water conservation technologies that influence farmers' implementation and adoption technologies which are necessary and essential for the adoption of soil and water conservation structures. More specifically, based on the results of this finding the following recommendations are forwarded:

- The indigenous and introduced soils and sater conservation measures implemented and adopted by the local people of the study area on SWC structures should not be bottom-up approach.It should be participatory and depend on the indigenous knowledge of the farmers interst-based by combining the new one.
- Sustainable and participatory soils and water conservation structures must be implement ed and adopted by the community to reduce soil erosion and maintainthe eroded land for future. Enhancement of farmers' understanding on soil degradation process play a significant role in the promotion of technologies related to SWC. This was indicated by significant differences between non-adopters and adopters compared in this study.
- Adopter farmers' encourage non-adopters on adoption of introduced SWC measures to increase the level on adoption of SWC practices in the study area for sustainable use.The results of this study indicated that most conservation works are made on farm lands which are already degraded. So besides the conservation of degraded lands the non-adopter farmers' and the communities involved in SWC works should focus on the conservation of lands before the land lose its fertility.
- Age, sex, family size, educational status and farm size of households affect construction and maintenance of SWC technologies. Therefore, older farmers would facilitate the adoption of improved SWC practices and reduce farm lands degradation.
- Engagement in off-farm activities is not significant factor that influences farmers' apply to adopt soils and water conservation structures in the study area. But, this is due to the fact that farmers who are not considering that off-farm activities are affecting the adoption of soil and water conservation structures. Therefore, the farmers' must realize that off-farm is an influential factor for adoption on SWC practices and apply off-farm in line with in need of more income for different purposes.
- Farmers did not invest on SWC works if they have large farm sizes. Therefore, the local administrative should promote need based conservation of land. SWC works are operation work with a top-down approach. As a result of this the level of adoption by most farmers is not beyond acceptance stage of SWC. Therefore, they follow the three stages of acceptance phases.
- Hence, SWC program planning must be the concern of every farmer and the initiation must come from the community.

- ❖ Soil and water conservation programs should be designed by taking variation exist among individual households into consideration because of the adoption of SWC technologies are determined by socioeconomic, institutional and physical factors. Hence, development policy and program intervention designed to enhance agricultural productivity through promoting soil and water conservation strategies of land management in the study area need to take into account these most important variables with respect to the type of innovation and farmers preference.
- ❖ The office of agriculture at local level can only present the technical blue print for consideration. It is not integrated with other development programs. Therefore, in near future based on the needs of the farmers it should integrate other development aspects.
- ❖ The concerned bodies, the woreda and kebele administrative intervene to encourage farmers' awareness of reversing the problem and adopt any other ways to conserve the degraded land for future generation.
- ❖ In this study the only productive Safety-Net-Program (PSNP)for economic incentives (aids) and conserving effects of SWC measures is not examined.
- ❖ Therefore, the researcher recommends other researchers and concerned bodies to conduct further studies on these issues.

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APPENDICES

DILLA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

COLLEGE OF SOCIAL SCIENCES AND HUMANITIES

DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES

***FACTORS AFFECTING* SMALLHOLDER FARMERS*'* ADOPTION OF SOIL AND WATER CONSERVATION PRACTICES: -**

THE CASE OF WEST BADAWACHO WOREDA, HADIYA ZONE*, SNNPR, ETHIOPIA*

A Thesis Submitted to the Department of Geography and Environmental Studies,

In partial Fulfillment of the Requirements for the Degree of

MASTER OF SCIENCE

IN GEOGRAPHY AND ENVIRONMENTAL STUDIES

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APPENDIX-I

Definition of different variables and unit of measurements

Variables	**Units or type**
Adoption	**A dependent variable measuring whether the physical soil and water conservation used or not.**
Age	Age of the household heads measured in year.
Sex	Sex of the household heads Male =1 Female =2
Marital Status	Marital status of the respondents 1=if single, 2= if married 3= if widowed 4= if divorced
Education	Educational level of the households head 1, if illiterate 2, if literate with no formal education 3, if (1-8) 4, if (9-10) 5, if above
Family size	Family size of the respondents 1= if 1-4 members 2= if 4-8 members 3= greater than 8 members
Farm size	Farm size in hec. 1=if less than 1 hec. 2= if 1-2 hec. 3= if greater than2 hec.
Status of SWC	Status of SWC structure of the respondents 1= if it is fully damaged 2= if it is damaged 3= if it is partially damaged 4= if it is maintained 5= if it is in a good shape.
Attitude	Whether farmers have positive attitude towards SWC Practices or not Yes =1, no =0.
Factors of SWC	The expected factors determining farmers' soil and water conservation 1=education, 2= income, 3=gender, 4= farmers' experiences. 5= government policies and strategies.
Technology of SWC	Farmers' do have implemented and adopted SWC practices 1= if it is grass-trip, 2= if it is planting trees, 3= if it is contour-ploughing, 4= if it is fallowing, 5= if it is others.
Training	Whether farmers get training or not. Yes =1, no=0.
Information	Farmers' get information about soil and water conservation practices 1= if it is from mass-media, 2=if it is from neigh-bouring farmers', 4= if it is from NGOs training, 5= if it is government training.
Off-farm	Farmers' engage in off-farm activities 1= yes, 0= no
Level of adoption	Farmers' level of adoption 1= if it is low, 2= if it is medium, 3= if it is high.

APPENDIX-II

This questionnaire to be prepared for interviewers, key informants and focus group discussion.

Dear respondents!

This questionnaire is designed by a post graduate student to conduct a research on "**Factors Affecting Smallholder Farmers' Adoption of Soil and Water Conservation Practices**." The case of Mirab Badawacho woreda, Hadiya Zone, SNNPR, Ethiopia. The quality of the research out-put will be depended on the information that you give. Therefore, the researcher politely requests you to give real information on the matter that you are requested. Hence, you are kindly requested to provide your response for all questions. Your responses will be kept confidential and will used only for academic purpose.

General direction

1. You do not need to write your name.

2. Read all the instructions before attempting to answer the questions.

3. There is no need to consult others to fill the questionnaires.

4. Provide appropriate response by using a tick (✓) in the boxes that fit your opinion for answering the objective questions. (More than one answer is possible when necessary).

5. Write your opinion briefly for answering the open-ended questions.

Thank you for your cooperation!!

- **Instruction**: Give appropriate answer by encircling or putting a tick mark (√) on space provided.

General Information

1. Name of the Enumerator--

2. Date of the Enumeration--

3. Enumeration Kebele--

Part I. Personal Information

A. Demographic household heads characteristics.

1. Age: ------------

2. Sex: 1. Male 2. Female

3. Marital status: 1. Single 2.Married 3.Widowed 4.Divorced

4. The size of household: Male----------------Female--------------------Total----------------------

5. Educational status: 1.Unable to read and write 2.Literate with no formal education

3. (1 – 8) 4. (9 –10) 5. Preparatory level and above.

PART- II

B. Common Physical and Indigenous Soil and water Conservation Practices.

1. Do you have farmland? 1. Yes 2. No.

2. If your response is “yes” for question no 1, where did you get the farm land?

1. Inheritance 2.Kebele 3. Gift 4. Others specify---------------------------------.

3. How many hectares do you have? 1. <1 2. 1-2 3.>2

4. What is the status of soil and water conservation structures? 1. Fully damaged 2.Damaged

3. Partially damaged 4.Maintained 5. In good shape 6.Others------------.

5. Do improved soil and water conservation structures maintained or not? 1. Yes 2. No

6. If maintained for question no 4, who did maintain?

1. Farmers 2.Family 3. Hired laborers 4.Others-------------------------------.

7. If not maintained for question no 4, what is the reason behind?

1. Less attention by farmers' 2.Less attention by extension workers

3. Farmers' reluctance on its benefits 4.Farmers'exclusion from Safety Net program.

8. Have farmers' positive attitude towards SWC practices? 1. Yes 2.No

9. Which are the expected factors determining farmers' influence SWC in your area?

1. Education 2. Income 3. Gender 4 .Farmer Experience 5. Government Policies and strategies. 6. Others specify---.

C. Economic Factors

1. Did you engage in non-farm activity? 1. Yes 2. No.

2. If 'yes' for question no 2, what is the reason? 1. Existing agricultural production cannot support my family. 2. Income from non-farm activities greater than that of agriculture 3.others specify--.

3. Do you have credit service? 1. Yes 2. No.

4. If 'yes' for question no 5, where is the source of credit? 1. Keble 2.NGOS 3.others--.

5. For what purpose did you use the credit? 1. Fertilizer purchase 2. Seed production 3.Others--.

6. Did you use fertilizer? 1. Yes 2. No.

7. If 'no' for question no 8, why did not use fertilizer?

1. Its price is too high 2. It decreases productivity 3. Its access for service is limited.

D. Psychological related Determinants

1. Is there soil erosion in your area? 1. Yes 2. No

2. Do you have positive attitude towards improved soil and water conservation practices?

1. Yes 2. No.

3. How about level of adoption? 1. Low 2.Medium 3.High.

4. Where do you get the information about soil and water conservation practices?

1. Mass media 2.Neighboring farmers' 3.NGOS training 4.Government training

Appendix III

❖ Check list for Key Informants

- **Background Information of the interviewees**.

- ➢ Name of Kebele ---
- ➢ Respondent Name of ---
- ➢ Sex 1.Male 2.Female
- ➢ Age-----------
- ➢ Marital status 1. Single 2. Divorced 3. Married 4. Widow
- ➢ Family size Male----------- Female--------------Total---------------.
- ➢ Educational Status-----------------------.

1. Do you have soil erosion problem? ---.

2. What do you think is the cause for soil degradation? ---.

3. Do you apply indigenous and introduced soils and water conservation measures to conserve soil and water? --------------How? ---.

4. What are the indigenous SWC measures implemented and adopted by the local people of the study area?---.

5. What types of newly introduced SWC measures are being accepted by farmers? ---

6. Do you belief farm size, age, sex, land tenure and labor shortage affect adoption of SWC practices in the study area?------------ If “yes”, how?---.

7. Do you have physical improvement of soil and water conservation structure? ------------------- If “yes”, who constructed the structure? --.

8. Is local people participating in SWC practices?------ If “yes”, what is the commitment of the local people to participate in SWC?--.

If no, what is the problem to participate SWC in the study area? --------------------------------------
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9. How do you express the level of adoption?--

---.

10. Do farmers engage in off- farm activities?--------------------------------Why?--------------------
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------------------.

12. Which types of SWC practices is common in your area? --

--.

APPENDIX- IV

❖ **Check list for Focus Group Discussion.**

1. Specify the indigenous SWC measures you are implementing. ----------------------------------- ---.

2. Explain the introduced SWC measures you are implementing. --------------------------- ---.

3. What mechanism uses the local people to solve the problem of SWC practices in the study area? --- ---.

4. Do you believe that the existing SWC practices is appropriate and maintained for sustainable? -- ---.

5. If "yes", for question no 4, how you can specify? --- ---.

6. How can local people be involved in soil and water conservation practices in the study area?

7. How do you express the level of adoption? -- --

8. Discuss on the factors that affect farmers' implementation and adoption on SWC practices? --- -- ---

9. What you expect from the government to participate on SWC practices? ------------------------- ---

10. Discuss on how the demographic characteristics influence the adoption decision of farmers to SWC practices?-- -----------------------.

11. Discuss the role of the experts on SWC practices? --- -- ------------- --

APPENDIX –V

- **Check list for field observation**

1. Do you have soil erosion problem? ---.

2. What are the causes of soil erosion in the study area?

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3. What types of soil and water conservation practices that constructed in the study area? ____.

4. How soils and water conservation measures implemented and adopted by the local people of the study area? --

5. How do you express about level of adoption on SWC practices? ----------------------------------- ---

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6. What are the factors that influence the adoption decision of farmers to soil and water conservation practices? ____.