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THE IMPACT OF SOIL AND WATER CONSERVATION APPROACHES ON CROP PRODUCTIVITY IN LIBAN JAWI DISTRICT, WEST SHOA ZONE, OROMIA REGIONAL STATE, ETHIOPIA.

Research thesis submitted to the school of graduate studies of Addis Ababa University for the partial fulfillment of the requirements for the master of degree in Biological science.

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This is to certify that the thesis prepared by Abera Benti entitled “The Impact of Soil and Water Conservation Approaches on Crop Productivity in Liban Jawi District, West Shoa Zone, Oromia Regional State, Ethiopia” and submitted in partial fulfillment of the requirements for the Degree of Master of Science (Msc) in Biology complies with the regulations of the university and meets the accepted standards with respect to originality and quality.

Thesis advisor ___________________ Date _____________ Signature __________

Internal Examiner _________________ Date _______________ Signature __________

External Examiner __________________ Date ________________ Signature __________

Chairperson ____________________ Date ________________ Signature __________

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List of Abbreviations

BDARO	Babich District Agricultural Report Office
CSA	Central Statistics Agency
FGD	Focus Group Discussion
SWC	Soil Water Conservation
GDP	Gross domestic product
SPSS	Statistical package for social science

Abstract

Ethiopia's agriculture is plagued by periodic drought, soil degradation caused by overgrazing, deforestation, high levels of taxation and poor infrastructure (making it difficult and expensive to get goods to market). Agriculture in Ethiopia is the foundation of the country's economy, accounting for half of gross domestic product (GDP), 83.9% of exports, and 80% of total employment.. The purpose of this study was to analyze impact of soil and water conservation practices and its impact on crop productivity in Liban Jawi Woreda in Western Shewa Ethiopia. A total of 145 sample households randomly selected from the sample kebele and they were involved in survey questionnaire. Out of total respondents 75 of them were practicers and 70 of them are not practicers/non adopters of soil and water conservation technologies. The study were used both primary and secondary data. Primary data was gathered using household survey questionnaire, focus group discussion and key informants interviews. Published and unpublished research papers were major sources of secondary data. The results obtained form respondents were analyzed by using logit model, percentages, frequencies, mean and chi-square by using spss software. The result obtained from this study indicated that education level, sex, labour availability, distance of farm land, farming experience, extension worker contact, land ownership and livestock holding house hold head influence adoption/practicing soil and water conservation technologies. The outcome of the finding indicated that crop productivity of adopters was high yield than non adopters of soil and water conservation approaches in Liban Jawi Woreda,Western Ethiopia.

Keywords*: Agriculture, conservation, Crop Productivity,soil, water.*

CHAPTER 1

1. INTRODUCTION

1.1 Background of the study

Land degradation is a severe problem across sub-Saharan Africa, and Ethiopia is among the most affected country (Holden *et al*., 2005, Abiy, 2008). In Africa alone, it is estimated that 5 to 6 million hectares of productive land affected by water erosion each year (Stocking and Niamh, 2000). According to Mulugeta and Karl (2010), water erosion is the most threatening land degradation processes in the world and accounts for 56% of the total degraded land surface of the world.To overcome the existing problem of soil and water erosion, massive reforestation and soil and water conservation schemes were launched in Ethiopia. Including many non-governmental organization and governmental organization various conservation strategies have been introduced to enhance agricultural development and rural livelihood.

Degradation of land is a serious issue throughout the world, particularly in African countries. Estimated that nine million hectares of the world lands are tremendously degraded and their original biotic functions are severely degraded. However, 1.2 billion hectares of the world land was moderately degraded. Worldwide inappropriate agricultural practices account for 28% of the degraded soils (Addisu, 2011).

Land degradation is in the form of soil erosion and declining fertility is a serious challenge to agricultural productivity and economic growth in Ethiopia (Mulugeta, 2004). The productive land in Ethiopia in general and Southern (SNNPR) in particular has been seriously threatened by land degradation, which menacing both the economic and survival of the people (Genene and Abiy, 2014).

High population pressure, continuous and steep slope cultivation, low vegetation cover, deforestation and inadequate soil conservation practices, about 1.5 billion metric tons of topsoil lost from Ethiopian highlands (Girma, 2001).

Land degradation in the form of soil erosion and fertility depletion is a major challenge in the Ethiopian highlands due to its adverse impacts on crop productivity, food security and natural resource conservation (Laekemariam *et al*., 2016, Adimassu *et al*., 2017, Teklu *et al*., 2018).

The principal causes are rapid population growth and improper land resources management and utilization which finally declining agricultural productivity (Laekemariam *et al*., 2016). The review paper by (Adimassu *et al*., 2017) indicated that soil loss due to erosion in the Ethiopian highlands is between 42 and 175.5 t ha^{-1} $year^{-1}$. Other studies on crop fields have also confirmed that declining soil fertility and limited water availability resulted to low crop yields on Ethiopian highlands (Laekemariam *et al*., 2016; Adimassu *et al*., 2017; Teklu *et al*., 2018).

Empirical studies on the adoption of soil and water conservation practices revealed that there are a number of factors that can be categorized as personal, physical, socioeconomic and institutional which influence farmers to adopt and not (Ervin and Ervin, 1982).

1.2. Statements of the problem

In Oromia region, land degradation is the major problem. Erosion of soil often translate into food shortages and famines in the region because of the heavy dependence of agricultural production on natural rainfall. Based on the above information, Oromia region in general and the study area in particular are affected by soil erosion which affect crop productivity.

Clear knowledge of the local factors that determine farmer decisions is an essential part of combating severe soil erosion.

Local farmers ultimately determine the use of SWC measures, some subsistence farmers in the district are hesitant to accept different measures such as stone bunds, soil bund, cut off drain, hill side terraces and farmland plantation (BDARO, 2008). These farmers may not believe that these measures are effective, or they may have socio-economic challenges that restrict use of the specific promoted SWC technologies.

Causes of land degradation include such factors as population pressure on resources; poverty; high costs or limited access of farmers to agricultural inputs, fuel and animal feed; insecure land tenure; limited farmer knowledge of improved integrated soil and water conservation practices; and limited or lack of access to credit. Due to the above problems crops productivity in the study area is very low. Therefore, restoration as well as maintaining soil fertility status is an important strategy towards achieving food security in the study area.

Soil erosion in the study area is very high and according to the 2008 woreda Agricultural and rural development office report more than 50% of the land in the woreda is steep. To overcome these problems, different soil and water conservation structures such as level soil bunds and stone bunds have been widely implemented in the woreda. However, the performance of structures against the target has not been studied. This study will assess farmers' opinion on the effect of soil and water conservation (SWC) structures in improving crop productivity also aimed to investigate farmers' adoption of SWC technology in Liban Jawi district.

1.3. General objectives

The general objective of the study is to indicate the adoption of soil and water conservation practices and its impact on crop productivity in Liban Jawi district.

1.4. Specific objectives

1. To identify farm household adoption of soil and water conservation practice.

2. To analyze the level of farm household soil and water conservation practice.

3. To analyze impact of soil and water conservation practices on crop productivity

1.5. Research questions

The research was answering the following three research questions:-

1. What are the factors that influence households to adopt soil and water conservation practices?

2. What is the attitudes of farmers to soil and water conservation?

3. Is there change by practicing soil and water conservation on crop productivity?

1.6. Scope of the Study

The scope of the study was geographically limited in Liban Jawi District found in Oromia region West Shoa Zone National Regional State of Ethiopia. It was enclosed to analyze determinants of soil and water conservation practices adoption, intensity of adoption and its impact on crop productivity in the study area.

1.7. Significance of the study

The study was to indicate adoption of soil and water conservation practice and its influence on crop productivity. This will add new ideas to the existing literature and to similar rural endeavor of the country at large. Added to these, it would recommend policy issues related to soil and water conservation measure improving crop productivity in the region.

1.8. Limitations of the Study

In this study the researcher was considered the major factors that affect adoption of soil and water conservation practices. In addition, the study was constrained by time and political condition which hindered in-depth analysis of all variables. However, the researcher was tried to reduce these constraints through increasing working hours.

1.9. Organization of the thesis

This thesis was organized into five chapters. The first chapter deals with the introductory part that contains background of the study, statement of the problem, research objectives, research questions, significance, scope and limitations of the study. Chapter two presents the literature review on the theoretical, analytical and methodological related to soil and water conservation practices and its impact on crop productivity. In chapter three the research methodology was

presented which includes research design, sampling techniques and method of data collection and method of analysis. The main findings and discussions of the study were presented in chapter four. Finally conclusion and recommendation was presented in the last chapter.

CHAPTER 2

2. Review Literature

2.1. Definition of Soil and Water Conservation

2.1.1 Water conservation

Water conservation includes all the policies, strategies and activities to sustainably manage the natural resource of fresh water, to protect the hydrosphere, and to meet the current and future human demand (thus avoiding water scarcity). Population, household size and growth and influence all affect how much water is used. The key activities to conserve water are as follows: any beneficial reduction in water loss, use and waste of resources (Duane *et al*; 1984) avoiding any damage to water quality and improving water management practices that reduce the use or enhance the beneficial use of water (Vickers *et al*; 2002)

2.1.3 Physical Water Conservation

Physical water conservation measures are structure built for water conservation. This protect against damage due to excess runoff (Hurni, 1987).

Contour plough: It is plough across the slopes rather than up which helps in order to reduce runoff and water loss. It is simplest way to prevent soil erosion. This water conservation practices is useful on gently slope soil (Mulinge *et al*; 2010).

Terracing: It involves building level of surface at right angle to the slope to retain water and reduce amount erosion. Since it require moving of soil and stone to construct the level areas. It is expensive method of water conservation (Geremaw, 2005).

2.1.4 Biological Water Conservation

Biological measures for water conservation work by their protective impact on vegetation cover. In a dense vegetation cover the roots and organic matter stabilize the soil aggregate and increases infiltration (Hurni, 1987).

Crop residues in the field: leaving crop residues in the field will reduce the wind speed from the farm yard also uses to reduce evaporation transpiration so that conserve moisture because it acts as a wind break and soil cover of the soil surface.

Choosing water conserving species: growing crops species which are known for low transpiration potential and with less water usage, so that the moisture of the soil retained.

Wind breaks: allows the movement of air to be limited with decreased velocity. The best wind break has 50% porosity means and is planted across the direction of the predominant wind (Booker, 2009). The reduction in wind speed improve crop growth and reduces soil moisture loss.

2.2 Soil erosion and its conservation in Ethiopia

The existence of soil erosion has been identified as one of the core resource depleting issue across the globe especially on the hillsides (World Bank, 2006). Densely populated and hilly countries in the Rift Valley area like Ethiopia has the most negative values because of a high ratio of cultivated land to total arable land, relatively high crop yields, and soil erosion (Biruk, 2012). This calls for intervening the problem of soil erosion and the consequences of soil erosion by proper soil and water management systems. From this perspective, various on-farm SWC measure in the farmlands and hillside enclosures are considered effective in rehabilitating degraded hillside.

Accordingly the Ethiopian government implemented them from the mid-1970s in different parts of the country (Betru *et al*., 2005, Eleni; 2008). Overgrazing destroys the most palatable and useful species in the plant mixture and reduces the density of the plant cover, thereby increasing the erosion hazard and reducing the nutritive value and the carrying capacity of the land (FAO, 2005). As overstocking decreases vegetation cover and leading to wind and water erosion, reduced soil depth, soil organic matter and soil fertility that hurt the land's future productivity.

The consequences of overgrazing have been land degradation (soil compaction, broken soil crust and erosion) as well as reduced species diversity and density of vegetation (Chamshama and Nduwayezu, 2002). Degradation of arable lands became the major constraint of production in East African highlands, due to mainly nutrient loss resulting from soil erosion, lack of soil fertility restoring resources, and unbalanced nutrient mining (Amede *et al*., 2001). In Ethiopia an estimated 17% of the potential annul agricultural GDP of the country is lost because of physical and biological soil degradation (Tilahun *et al*., 2007). Causes for land degradation are human population growth, poor soil management, deforestation, insecurity in land tenure, variation of climatic conditions, and intrinsic characteristics of fragile soils in diverse agro ecological zones (Bationo *et al*., 2006). 6 In Ethiopia, the impact of soil erosion was recognized after the 1973 since then; the Government of Ethiopia initiated a massive program of soil conservation and rehabilitation in the highly degraded areas, which involved the mobilization of over 30 million peasants' workdays per year (Hurni, 1986). SWC interventions in the highlands focused both on physical and biological measures (Tamene *et al*., 2006; Babulo *et al*., 2009). The biological measures comprise enclosure of degraded land from human and animal interference, agro-forestry tree, seedling planting on farmlands, afforestation, and tree planting at homesteads and in enclosures as tree enrichment (Nyssen *et al*., 2009; Mekuria *et al*., 2011).

2.2.1 Physical Soil Conservation

A physical soil conservation practice is applicable of soil management using knowledge or art with the goal protection of soil resource form exploitation. In addition, among those different applications, different structure applied in different farm lands. However, these conservation applications depend on climate, soil type, vegetation cover and level of economy (Shiferaw H 2005).

Check dams: are techniques that help trap runoff water and washed soil in the runoff water this also increase infiltration and decrease the velocity of runoff water (Pender, 1998).

Proper soil management: with increase in organic matter of the soil the soil structure will be kept and retained. This is highly encouraged for soils that are excessively tilled and with poor structure it's due to the soils tendency to easily erode by surface runoff water (Teshome, 2010).

2.2.2 Biological Soil Conservation

Biological soil conservation practices are vegetation strips, protective tree stands, natural drainage way and rotated by permanent grass cover and afforestation (Mitiku *et al*; 2006).

Soil vegetative cover: it can help to reduce soil erosion as it reduce the impact of rainwater droplets hitting the soil, increasing water infiltration and slow down the speed in which runoff flows through the field (MOA, 2015).

Crop residues cover: farm yard with minimum of 30% surface crop residue cover is considered beneficial for minimizing soil erosion mulching crop residue which helps to slow down surface runoff velocities, improve water infiltration, increase soil organic matter levels and improve water holding capacity (Shiferaw, 2005).

Reforestation and Afforestation: reforestation is the planting of trees where the trees have been removed by natural or human causes. Afforestation refers to the planting of land to covered with trees to make of forest for commercial and other purpose which protect soil from erosion (Booker, 2009).

2.2.3 Cause of Soil Erosion and Soil Productivity in Ethiopia

The cause of soil erosion is related with complex cultural intuition, socioeconomic and environmental factor classified the causes of soil erosion as natural and anthropogenic.

Anthropogenic Causes: Besides the natural agents there are some human activities, which cause soil erosion

Deforestation: The forests are cut down for timber, or for farming purpose, then the soil no longer protected from the effect of fell in grins consequently, the top soil washed away and enter into river and ocean.

Poor farming system: It is described as an improper tillage and improper ways of harvesting which exposes the land to erosion and decreases the water holding capacity of the soil. During the sunny season the soil exposed so become dry and can be blown away as dust easily (Mitiku *et al*; 2006).

Over grazing: Over grazing by flocks of cattle's, goats, and sheep's leave very little plant cover on the soil. Their hooves make the soil and can be blown away easily. This cause vulnerability to soil erosion on which force soil to low productivity (Shiferaw, 2005).

Natural Causes: Erosion of soil takes places due to the effect of natural agents like wind and water. High velocity winds over lands which have no vegetation carry away the loose top soil.

2.3 Adoption and Challenges of Soil and Water Conservation in Ethiopia

There are barriers or challenges for farmers to adopt Soil erosion control measures in Ethiopia. As Nigussie (2015) reviewed, some of these challenges include, labor unavailability, limited capital, lack of or limited incentives and benefits (e.g., food for work), insecure land tenure policy, inappropriate technology choices (not fit to local conditions), lack of technologies that provide quick returns for substituent farmers, weak technical support from development agents and officers, and poor community participation (due to command-and-control policies). Belay and Eyasu (2017) assessed the main challenges and extents of implementation of soil and water conservation (SWC) measures in Guba-Lafto Woreda of North Wollo. This study indicated that lack of awareness on SWC, land shortage, labor shortage, and wealth status of the farmers were challenging the households to implement SWC practices on their farmlands. Field survey conducted in Goromti watershed revealed that factors such as slope of the area, contact with extension workers, tenure status, age, size of household and training influenced farmers to adopt soil and water conservation measures Addisu Damtew (2011). Even some farmers failed to maintain adopted soil conservation measures mainly due to the reduced plot size by conservation measures, poor design, and lack of labor and incentives.

The result of another field survey conducted to examine factors affecting adoption of introduced soil and water conservation practices in WereIllu Woreda indicated that the age of household heads, off-farm activity, and distance of farmlands from homesteads influenced the adoption of introduced soil and water conservation practices negatively (Daniel *et al*; 2017).

Farmers perception on soil and water conservation practices in Ethiopia are the major constraints that determine the implementation of soil and water conservation such as absence of integrating indigenous practices, lack of considering socio-economic profile and low perception (Nigatu 2017). The factors influencing the adoption of soil and water conservation (SWC) technologies for sustainable watershed management and planning include that household size, farmland size, labor, perception of soil erosion problem, and training service in soil erosion control, land tenure; access to institutional services, and farmland distance from homesteads had an impact on adoption of introduced structural SWC technologies (Mubarek, 2014).

2.4 Farmers′ perception on soil and water conservation

Perception is process by which individuals interpret and organize sensation to produce a meaningful experience of the alternative chosen (Adesina and Baidu-Forson, 995). Understanding farmers′ perception of soil erosion and its impact is important in promoting soil and water conservation technologies (Chizana *et al*., 2006). Soil erosion is a menacing and slow process therefore farmers need to perceive its severity and the associated yield loss before they can consider implementing soil and water conservation practices. Soil conservation in Ethiopia has a long tradition in Sub-Saharan Africa, indigenous techniques, such as ridging, mulching, constructing soil bunds and terraces, multiple cropping, fallowing and the planting of trees, were performed starting from long decades and combined erosion control with water conservation (Fitsum *et al*., 2002). However, their effectiveness has been constrained by various means. For example, Azene (1997) stated that lack of farmers′ involvement in the planning and implementation of the programs, soil conservation measures were poorly executed and maintained. Different farmers may have different attitudes towards soil conservation. Sometimes, farmers who have good attitudes also may not practice soil conservation due to the socio economic failures (Bandara and Thiruchelvam, 2008). Perceiving the soil erosion problem and positive effect of soil conservation measures also provides stimulus to and shapes opinions about to adopt conservation practices that stop the problem (Habtamu, 2006). Sidibe (2005) reported that, in Burkina Faso, education level and area of cultivation had a positive role for the practicing of SWC. In the West Usambara highlands of Tanzania, farmers responded that involvement in off-farm activities, insecure land tenure, location of fields and a lack of short-term benefits negatively influenced practicing of SWC measures (i.e., vegetative strips, bench terraces, fanya juu), whereas memberships in farmer groups, level of education and contacts with extension agents positively influenced the perception of those measures (Tenge *et al*., 2004). Bewket (2007) reported that, soil conservation has been carried out with limited success, due to less-willingness of farmers to accept and maintain the extensively introduced practices of soil and water conservation. In the Baressa watershed, age, perception of profitability, farm size and steep slopes positively influenced practices and livestock number and high fertility negatively influenced practices (Amsalu and De Graaff, 2006)

2.5 Factors affecting adoption of Soil and water conservation

Adoption of agricultural technologies is influenced by a number of interrelated components within the decision environment in which farmers operate. For ease of grouping, the factors identified as having relationship with adoption are categorized as household's demographic, economic, social and institutional factors.

2.5.1 The household's demographic factors

Household's demographic factors (age, sex and education) are among the most common household characteristics which are mostly associated with farmers' adoption behavior. Age of the household head is an important factor affecting adoption of agricultural technology. Age is said to be primary latent characteristics in adoption decision. However there is contention on the direction of the effect of age on adoption. Age was found to positively influence on adoption decision and intensity of SWC measures in Dedo district, Western Ethiopia (Anley *et al*., 2007).

The effect is thought to stem from accumulated knowledge and experience of farming systems obtained from years of observation and experimenting with various technologies. However, age has also been found to be negatively correlated with adoption, or not significant in farmers' adoption decisions.

In this line, the result of the study undertaken by Million and Belay (2004) shows that age has significant but negative influence on the adoption of fertilizers. The study conducted in Anna water shade, Hadiya zone by Habtamu (2006) revealed that age of the household head was negatively influenced adoption of physical SWC structures. Sex of the household head is one of the important factors influencing adoption of improved agricultural technologies. Due to long lasted cultural and social grounds in many societies of developing countries, women have less access to household resources and also have less access to institutional services.

Regarding the relationship of household's sex with adoption of agricultural technologies, previous studies reported that male-headed households are more likely to adopt new technologies than their female-headed counterparts. In this regard, Techane (2002) indicated that male farmers are more likely to adopt agricultural technologies than female farmers. Studies carried out by Aziz (2007) further indicated that male headed households are more likely to adopt rain water harvesting technologies. Abrahaley (2006) indicated that the likelihood of adoption of agricultural innovation is higher among male-headed farm households than female headed ones.

With regard to education, there is a general agreement that education is associated with adoption because education is believed to increase farmers' ability to obtain and analyze information that helps them make appropriate decision. Education was found to positively affect adoption of improved maize varieties in West Shoa, Ethiopia (Alene *et al*., 2001).

According to Mishra and Rai (2013), education level of the household head was positively and significantly influenced the probability of use of indigenous soil and water conservation among farmers in Sikkim Himalaya.

2.5.2 Economic factors

Economic factors influence household's adoption decision of agricultural technologies. In this study, economic factors such as total land holding, livestock ownership, non-farm activity and availability of labor would be assumed to play a great role in determining the willingness and ability to invest in adoption of agricultural technologies. Farm size influences different farming communities differently in their adoption decision process.

Several empirical adoption literature focus on farm size as the first and probably the most important determinant. Studies conducted in different areas were showed mixed result. According to Aziz (2007) farm size had positively and significantly affected the probability of adoption and intensity of rain water harvesting technologies.

Contrary to these results, the empirical results from Abrahaley (2006) have found that farm size influenced the probability of adoption of agricultural technologies negatively. In rural context, livestock holding is an important indicator of household's wealth position. Livestock ownership of a household influences the adoption of improved agricultural technologies differently by different people across different areas. In most cases, livestock holding has positive contribution to household's adoption of agricultural technologies.

This is evident from many of the past adoption studies which have reported positive effect of livestock holding on adoption. To mention some of them, for instance, Dereje (2008) have found that livestock holding has positive and significant influence on adoption of improved agricultural technologies. Contrary to the above findings, Mesfin (2006) reported that livestock holding influenced negatively the farm level adoption of farmers' participation on soil erosion and decision on land management. His explanation for this reason is that livestock are generally considered a symbol of wealth and farmers with large livestock herd sizes tend to focus more on their livestock operations and pay less attention to their land conservation.

Increasing dependence on non-farm activities reduce the economic significance of soil erosion. This is because involvement in non-farm activities consume out resource (time, labor) required for installing and maintaining the conservation measures. Habtamu (2006) found negative relation between proportion of non-farm and adoption of soil and water conservation measures. Nevertheless, Seid (2009) found that non-farm activities do not have influence on household's decision to invest in conservation measures.

Availability of household labor is the other important variable which in most cases has an effect on household's decision to adopt new technologies. Several studies reported the positive effect of household labor availability on adoption of improved agricultural technologies. For instance, Million and Belay (2004) in their study on factors influencing adoption of soil conservation measures in southern Ethiopia found positive effect of household's labor availability on adoption of soil conservation measures. Contrary to this, the negative effect of larger family size household is draw labor away from investment in conservation for search of food for survival (Abera, 2003).

2.5.3. Institutional factors

Institutional factors in the context of this study include support provided by various institutions and organizations to enhance the use of improved technologies such as extension, land source and land tenure system. Extension workers provide information related to agricultural technologies. Participation of farmers in extension events like involvement in hosting on-farm trials or demonstration and related training improves their consciousness on improved agricultural technologies and enhances adoption. In this line, Minyahel (2007) reported that participation on farm demonstration and attendance of training conducted positively to farmers' adoption decision.

Aziz (2007) in his study of analysis of determinants of adoption of rain water technology in Lamfuro Woreda found that farmers' participation in demonstration had positive and significant relationship with adoption. Distance of farm plot from farmers' residence usually affected the adoption of improved technology negatively. Households near the farm plot tend to have easier to follow the activity closely. A study by Habtamu (2006) showed that distance of plot from resident was one of the significant variables explaining the adoption of soil conservation and water conservation technology negatively.

Similarly, Jabessa (2008) reported that resident distance was negatively and significantly influenced the adoption of and intensity of adoption of different agricultural innovations. Farmers that have accessed cultivated land through renting have short term plan. As they lack chance in long-term productivity of land they cultivate, they have strong preference for current income without giving emphasis for conservation structures on the farm land. Contrary to this, in owner operated farms, in which a farmer has a personal chance in lands' sustainability, he farms harmoniously with nature and be concerned for future generations. Almaz (2008) predicted negative association between land renting and soil conservation practices. Like rainfall and nature of soil that affect erodibility, slope of a field affects the rate and amount of soil loss from fields (Tesfaye and Debebe, 2013). This forces farmers to control or mitigate the impact of erosion on fields that are situated in steep slopes and hence slope influences the decision of farmers to undertake conservation measures. Kassu (2011) observed that farmers cultivating steep slope fields install more effective conservation measures than farmers that cultivate level fields. On the contrary, farmers in less erosion prone areas (level fields) do not employ conservation measures on their farmlands.

2.5.4. Social factors

Membership and frequency of participation in different social organization is the other important variable expected to have relation with adoption of agricultural technology. Adoption studies conducted by Jabessa (2008) indicated that social participation had positive and significant effect on the adoption decision of farmers. The above evidence and reviews of empirical studies indicated the importance of local and site specific studies to identify factors affecting adoption of PSWC technologies and to generate scientific information which might be useful to policymakers to develop policies and strategies which are compatible to the local conditions to contribute to the solution of soil erosion problems and might give a clue to researchers for further research in the field and similar socio-economic and topographic conditions and help to recommend solution to the specific local problems based on the level and scope of the study.

2.6 Conceptual framework

The conceptual framework presented below illustrates the linkage between adoption of SWCP with crop production and its impact on productivity. The decision to adopt SWC practices or not is assumed to be determined by Socioeconomic and institutional factors. It is assumed that these factors along with the farmer's perceptions towards SWC practices influences the decision to adopt as well as the level of adoption of SWC practices are expected to have well maintained sustainable fertility farms which enhance crop productivity and better quality produce among other benefits. At the same time , adopters are assumed to be benefit maximizing hence it is expected that high crop productivity would lead to increase farm incomes , assuming the prices are reasonable enough to cover production cost involved and this is in turn contributes positively to increased household income. In addition, the effect of adoption will positively contribute to climate change mitigation due to reduced emissions, high stabilization of soil organic matter and increased soil water retention capacity. Finally SWC practices such as stone bund, soil bund, cut off drains and farm land plantation will help to conserve water, soil fertility and soil erosion control, hence leading to environmental conservation.

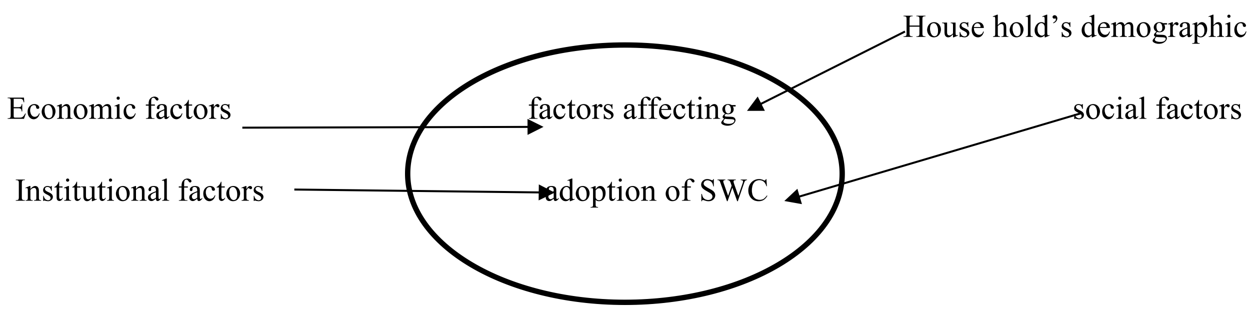

Figure 2.1:- Conceptual frame work of SWCP and its productivity impact.

CHAPTER 3

3. MATERIALS AND METHODS

3.1. Description of the study area

The research conducted in Liban Jawi District specifically Tulu Bajo kebele. The study area found in Oromia Regional State, West Shoa Zone and measure distance away from the capital city(town) of the Zone, Ambo 47 Km and from Addis Ababa 175 Km to western direction and just settled on the asphalted road which crosses to the western parts of the Ethiopia. The Woreda has 15 rural kebele administrations and one town municipal administration. The Woreda established recently i.e. in 2008 EC. The Woreda surrounded by neighbor hoods like Toke Kutaye Woreda in the East, Dire Hinchini woreda in South East, Jibat Woreda in Southern, Dano Woreda in SouthWest, Chalia Woreda in West and Mida Kegni in Northern border of Liban Jawi Woreda.

Weather condition classified as 25% Dega, 44%Woyina Dega, and 31% Kola (Source from Woreda's Administrative, 2012). According to the Administrative Woreda administration the population size of the woreda is 35,444 female, 35376 male, 70820 totals. From the woreda total population Babich Town shares males 5685 and female 6518, total 12203.

The socio-economic of the woreda is highly dependents on agriculture sector. The area is also suitable for agricultural productivity for both crop production and livestock husbandry. The general cereal crop production of an area are teff, barley, wheat, sorghum, corn, it is also comforted area for rearing livestock such as cattle, sheep, poultry, mule, horse, goat and etc. Teff is the special production of the area (Liban Jawi Woreda Administrative data, 2010).

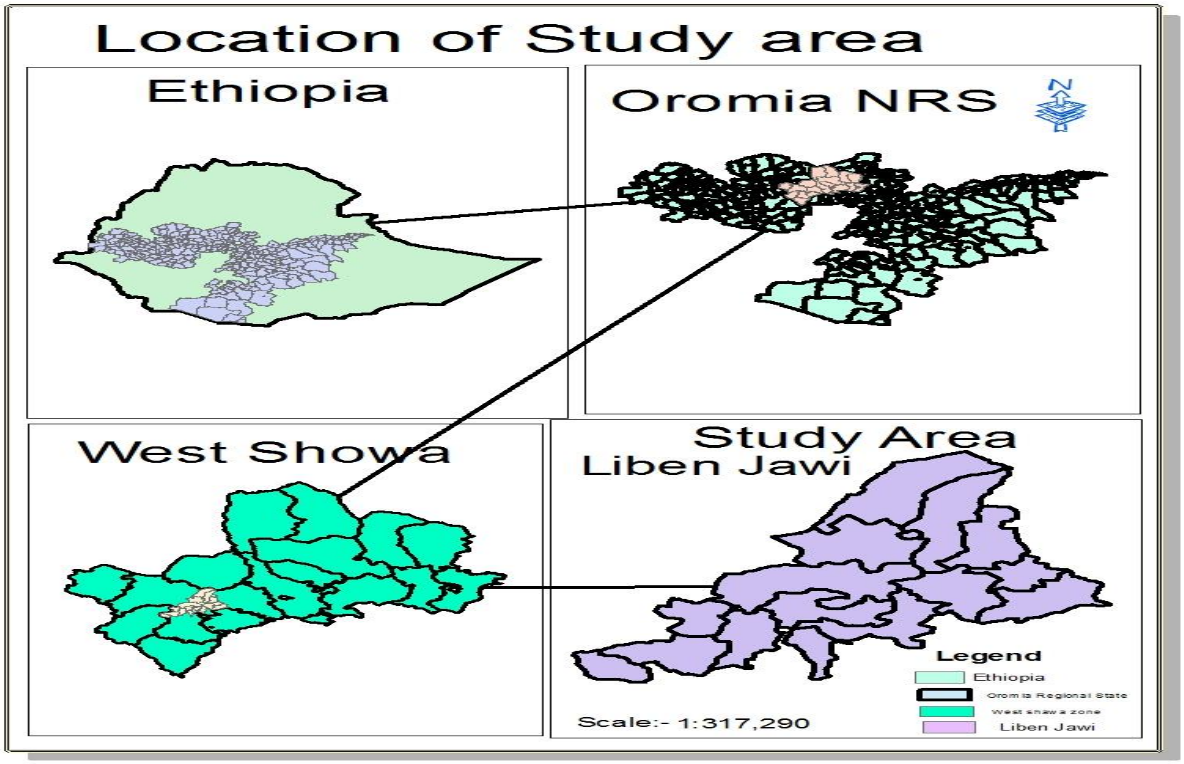

Figure 3.1, Map of the study area.

3.2. Research design

The study was used combining both quantitative and qualitative research approaches.

Quantitative method has the potential of covering many subjects to enable generalization and address various issues at a time. The qualitative method on the other hand, was used to supplement the data gathered using household survey and enable to get in-depth information about the opinion and perception of farmers in their own words.

As stated above, the use of mixed method designs provide the opportunity to avoid deficiencies and weakness that come from using a single method.

To answer the research question of study, the researcher was employing cross-sectional survey studies. Triangulation was employed for it helps to increase the reliability of the results by comparing the data obtain from one source with other source. The data was obtained from questionnaires and focus group discussion has triangulated with data from key informants.

3.3 Sampling techniques and procedures

In Liban Jawi district impact of SWC on crop productivity was studied in Tulu Bajo kebele. First, out of 15 kebeles Tulu Bajo was selected purposely because land degradation problem in the study area was very high and it was one of food insecure area. Simple random sampling technique was employed to select respondents in this study area. The study population was house hold farmers in the kebeles in the study area.

Yemane (1967) formula was used to compute the sample size for the population. This formula was employed to sample fairly large size as representation of the total respondents from the households such that the research finding obtain can consider valid.

Mathematically presented as: $n = \frac{N}{1+N(e)^2}$

: $n = \frac{N}{1+N(e)^2}$ =: $n = \frac{2624}{1+2624(0.08)^2}$=145.

Where, n = designates the sample size the research uses;

N = designates total number of household farmers in sample kebele;

e = designates maximum variability or margin of error 8% (0.08);

1= designates the probability of the event occurring.

Based on the above formula the sample household farmers were almost 145.

3.4. Data types and sources

This research was used both primary and secondary data sources. Primary data was collected from sample respondents, focus group discussion, field observation, and key informant interviews. Secondary data was gathered from all available published and unpublished documents, records and research reports of offices and other relevant stakeholders in relation to the objectives of the study.

3.5 . Methods of data collection

Data collection is the process of gathering and measuring information on variables of interest, in an established systematic fashion that enables one to answer state research questions, hypotheses and evaluate outcomes. For the purpose of this study, questionnaires, focus group and interview data collection tools were used. To gather information from the respondents of the selected sample, the researcher develop a questionnaires which containing open and closed ended questions. The questionnaires were distributed for the respondents.

The questionnaires were prepared in English language and translated into Oromiffa language to make the questionnaires simple for the respondents.

3.5.1. Methods of secondary data collection

Secondary data was collected from secondary sources such as review of books, journals, unpublished study documents and other official reports and internet sources.

3.5.2. Methods of primary data collection

Primary data was collected from institutions and respondents through questionnaires, interview, group discussion and observation.

Household survey: the household questionnaire survey was the main quantitative data source so as to determine the effect of SWCP on crop production. The survey questionnaire was designed comprising of both open and close ended questions. It was categorized as basic household information, perception on SWCP, impact of SWCP on crop productivity in the study area. In order to maintain the validity and reliability of the data, the questions were extensively reviewed by agricultural experts.

Field observation: direct field observation was the one qualitative data source which is conducted to validate data gathered through household survey. Field observations was focused on land degradation, flood affected areas, water resources and vegetation cover and land management practices, crop patterns through its residuals, distribution of settlements, individual activities in the farming plots, and bush and grazing lands of non-participant household.

Key informant Interview: Interview is also another qualitative data source. For the sake of in depth understanding about the trend of soil and water conservation especially, the impacts of soil and water conservation practices on the crop productivity. The key informant participants was elders who know the area and trend of soil and water conservation practices in the woreda, they can provide information related to the problem soil erosion and the remedy solutions that under take in the local communities. Local administrators and development agents at kebele level and agricultural experts at woreda level was also vital to assess the extent of soil erosion problems and conservation measures in order to supplement the data to be collected through other data collection methods.

Focus group discussions (FGD): also qualitative data source was carried out with participants who are out of sample. This was help to triangulate, supplement, and enrich the results of the methods.

3.6 Method of Data Analysis

After collection the data through different methods, analysis was made using both quantitative and qualitative methods to address the research objective. The study employ qualitative method to analyze the data gathered through FGDs, observation and key informant interviews. The descriptive statistics was carried out using descriptive statistics such as testing statistical level of T-value and chi-square, frequency, mean and percentages to analyze the socio-economic characteristics of the respondents, their practices on soil and water conservation and its impact on crop productivity.

3.7 Model specification

For this study, a model that reflects the observed status of introduced soil conserving structures on any particular farm was required. Such observations reflect a dichotomous nature i.e. adopting or not adopting conservation structures. Logistic regression model is widely applied statistical tool to study farmers' perception conservation technologies (Shiferaw, 1998; Neupane *et al*., 2002). Logistic regression allows predicting a discrete outcome from a set of variables that may be continuous, discrete, and dichotomous or a combination of them. The dependent variable, (i.e., perception of soil and water conservation practices) is dichotomous discrete variable that is generated from the questionnaire survey as a binary response, and the independent variables are a mixture of discrete and continuous.

Farmers' decision about SWC practices can be conceived of having two components: whether to use SWC practices or not. Both of these components are assumed to be influenced by a number of variables that are related to a farmer's objectives and constraints. The dependent and independent variables employed in this analysis are listed below.

Dependent variable

Dependent variable is a variable that is said to be affected or explained by another variable/ variables. In this study, the dependent variable was crop productivity as a result of SWC.

Crop productivity: refers to the measure of crop yield in one hectare of land.

Soil and water conservation: refers to the protection of fertile top soil from erosion by wind and water and the replacement nutrient in the soil. SWC can define as the combination of the appropriate land use and management practices that promotes the productive and sustainable use of erosion and other forms of land degradation. It is a continuous variable and measured in meter.

Independent variables

Factors that influence the outcome variable refer to independent variable. In this study, the hypothesized independent variables might affect adoption of farmers on SWC practices. These factors are supposed to affect the adoption of farmers on those SWC practices positively or negatively.

Sex: It is a dummy variable, 1 for male and 2 otherwise. It was hypothesized that females are expected not to participate in SWC practices. Evidently, women have been involved in productive as well reproductive roles within a household. Women's face work loads so they have no sufficient time to get extension service about SWC practices. Male-headed households have better access to information than female-headed households. This situation may help to adopt SWC practices.

Age: It is the age of household heads. It is a continuous variable measured in years. Daniel and Mulugeta (2017) found that younger farmers spent more efforts on SWC measures compared to older farmers. Despite younger farmers are more likely to adopt agricultural technologies, age of the household-head can have a negative or positive influence on adoption of SWC activities.

Household size: Household size is a continuous variable, which refers to the number of people who live in a household.

Members in a household have an important bearing on the adoption of labor intensive agricultural technologies. It is Households with larger household size imply more human capital in terms of labor to adopt more SWC measures. Damtew *et al*. (2015) and Belete (2017) found that household with large size had more SWC practices. Therefore, household size was expected to have a positive influence on the adoption of SWC practices.

Education: Education is a discrete variable that refers to the level of education attended by the household head. The category for education was made based on previous studies (Erkie, 2016). Educational level of the household head assigned 1 for non-literate; 2 for literate. This variable was expected to have a positive effect on adoption of SWC practices. Educated farmers can have better knowledge and awareness on how to conserve water and soil to prevent run-off. They tend to recognize risks associated with soil erosion and hence they could have tendency to spend more time and money on SWC practices. This is because literate farmers seek knowledge from development agents about SWC practices as well as agricultural technologies. Educated farmers are presumed to have exposure to new technologies and innovations, and are more receptive to new ideas and willing to adopt SWC practices (Erkie, 2016; Belete, 2017; Daniel & Mulugeta, 2017).

Extension service: Access to extension service refers to contact of development agents with farmers to deliver extension services. It is a dummy variable 1 for household-heads that access to extension service and 0, otherwise. Extension is the effort to disseminate information on SWC practices to farmers at Kebele and sub-Kebele levels. Extension service plays a great consciousness about SWC practices and the possibility of a farmer to decide to practice SWC activities.

If farmers contact with development agent and access to information and advice on innovations and types of SWC measures and their use, and management of technologies which will directly lead to enhance farmers' investments on their land. Therefore, extension contact was expected to have a positive and significant influence on the adoption of SWC practices.

Livestock: Livestock size is a continuous variable, that is, the total number of livestock holding of a farmer measured in tropical livestock unit (TLU). Therefore, livestock size is expected to enhance adoption of SWC positively.

Slope of farm land: Slope is a discrete variable, assigned 1 for steep farmlands, 2 for gentle farmland and 3 for flat farmlands topography. Slope has been found to have a positive effect on the adoption of soil conservation practices. The steeper the slope, the more likely the land will be exposed to erosion. Hence, it is believed that adoption of SWC practice tends to be likely on steeper slopes (Damtew *et al*., 2015; Belete, 2017). The slope of the land was expected to affect adoption of SWC practice positively.

Training: Participating in training is a dummy variable 1 for trained household heads and 2 no trained. Training was expected to have a positive and significant effect on the adoption of SWC practices. If farmers participate in training by development agents on SWC practices, they can be more aware of on SWC practices than not participated. Daniel and Mulugeta (2017) reported that training of farmers could increase the probability of adoption, utilization and implementation of SWC practices.

Farm distance: Farm distance is a continuous variable. It is the distance between household's homes and farmlands for production activities and expressed in hours. Distance was hypothesized to be negative on the adoption of SWC practices.

If the distance between household's home and the farmland is long, farmers could not have interest to manage their land. Daniel and Mulugeta (2017) and Belete (2017) found that limited numbers of farmers were frequently inspected and maintain their land whilst the distance has increased. Less time and energy are needed to manage closed farmland than far from their homes as a result they are discouraged from conserving their farm land. It implies that longer walking distance between farmland and residential area was reduced the adoption of SWC practices.

Farm size: Farm size stands for cultivated and fallow lands. It is a continuous variable measured in hectare. Farm size is often correlated with farm income and wealth. Therefore, those farmers with larger farm size could have more cash to pay for wage labor while undertaking land conservation. According to Berhanu *et al*. (2016) and Belete (2017) land size is found to have positive effect on the adoption of SWC practice. This implies that farmers with relatively larger holdings had higher probability to apply conservation technologies.

Table 3.1 Definition, measurement and expected values of variables

Variables	Description variables	Type	Unit of measurement	Expected sign
Dependent variables				
CRPDT	Crop productivity	Continues	Kg of produced crops	
ASWC	Adoption of swc	Dummy	1 – for adopter, 2 – non-adopter	
Independent variables				
SEXHH	Sex of house hold head	Dummy	1 – for male, 2 – for female	+/_
AGEHH	Age of house hold head	Continues	Age of house hold	+/_
EDUHHH	Education level of house hold head	Dummy	1 – if literate, 2 – if non-literate	+
FSHHH	Family size of household	Continues	Number of house hold	+
MARITAS	Marital status of household	Dummy	1 – if married, 2 – if not married	+
LSTHHH	Livestock holding of ouse hold head	Continues	Number of livestock(TLU)	+
EXTCHHH	Extension contact of house old head	Dummy	1 – if yes, 2 – if no	+
FARS	Farm size of HHH	Continues	House hold farm size in hectare	+
LABAV	Labor availability of house old head	Continues	Level in number	+
DISPLOT	Distance of the plot	Continues	Distance of the plot from residence	_
SLOPLA	Slope of the land	Dummy	1 – if steep slope, 2 _ gentle nd 3 – flat	+
LANS	Land security	Dummy	1 – if owned, 2 – otherwise	+

CHAPTER 4

4. RESULT AND DISCUSSIONS

This chapter deals with the analysis, discussion, presentation and interpretation of the collected data related to the impact of Soil and water conservation practices on crop productivity in the study area. The results and discussions of this research presented are categorized in two parts. The first part is about demography and socioeconomic characteristics of the respondents. The second part includes the results of major findings of Adoption of Soil and water conservation practices and its impact on crop productivity.

4.1 Descriptive statistics

4.1.1 Demographic characteristics of the respondents

As indicated in Table 4.1 the frequency of SWC practices adopters marital status and education level of households shows significant variation.The study revealed that, the total household heads 105 were male - headed and 40 were female - headed. This result implies that households are normally headed by males. From the total 145 house holds 75 house hold heads were adopters (male=69 which is 47.6% & females=6 which accounts 4.1%). Marital status of households were 130 married and 15 not married. It is clear from the table that from the total sampled respondents 75 were adopter, out of the adopters 69 were male and 6 female. This coincides with Tesfaye (2006) found that male headed household has better access to information than female headed household. Hence male headed households are expected to adopt introduced improved technologies better than female headed households.

Table 4.1 Descriptive Analysis of sampled HHs Demographic Variables

Obtained from survey analysis 2015/2016

Demographic variables		Adoption status of wsc of household head: Adopter Frequency	Adopter Percentage	Non-adopter Frequency	Non-adopter percentage	Chi-square
Sex of household Respondent	male	9	7.6%	6	4.8%	29.834
	female		.1%	4	3.4%	
	Total	5	1.7%	0	8.3%	
Marital status of household head	married	6	5.5%	8	0.0%	0.773
	not married		.2%	2	.3%	
	Total	5	1.7%	0	8.3%	
Education level household head	Litrate	2	5.9%	7	8.6%	13.816
	Non-letrate	3	5.9%	3	9.7%	
	Total	5	1.7%	0	8.3%	

Obtained from survey analysis 2015/2016

4.1.2. Socio-demographic characteristics

As presented in Table 4.2, Percentage of adopters' household head age and non-adopters varied from younger and elder. Household head with older age and large family size have influence adoption of SWC practices positively i.e 44.0% and 61.3% respectively. Percentage of livestock holding of adopters were not varied from non-adopters. The result indicated that age and family size influence adoption of soil and water conservation practices positively.

Table 4.2 Descriptive analysis of socio-demographic variables

Socio-demographic variables		Adoption status of wsc of household head			
		Adopter		Ion-adopter	
		frequency	percentage	Frequency	percentage
Age of household	20-40	4	2.0%	3	7.1%
	0-50	8	4.0%	1	5.7%
	0+	3	4.0%	6	7.1%
Family size of household	large 5-10	6	1.3%	8	0.0%
	medium 3-5	4	8.7%	6	2.9%
	small 1-2	5	0.0%	6	7.1%
Livestock holding of household	yes	5	00.0%	0	00.0%
	no		.0%		.0%

Obtained from survey analysis 2015/2016

4.1.3. Economic and institutional characteristics of the respondents

As presented in Table 4.3, Frequency of adopters' household head extension contact with agricultural experts varied from non-adopters statistically. Frequency of land ownership household head of adopters also varied from non-adopters statistically. As indicated in Table 4.3 that out of the total respondents 100% respondents believe that land belongs to them and say "yes " when ask the question do you believe land belongs to you? And from the sample household 56.9% of the respondents were adopters. This indicates that sense of land ownership affects use of SWC practices positively.

Table 4.3 Descriptive results of sampled household economic & institutional characteristics

		Adoption status of wsc of household head			
		Adopter		Non-adopter	
Eco-institutional variables		frequency	percent	frequency	percent
Extension contact of household	yes	4	1.2%	0	8.8%
	no		.4%	0	7.6%
Land owner ship of household	yes	6	6.9%	0	3.1%
	no		1.0%	0	9.0%
Distance of farmland	30’	9	9.0%	1	1.0%
	1hr	6	5.6%	9	4.4%

Obtained from survey analysis 2015/2106

4.2 Logistic regression analysis

Logistic regression was performed to determine how independent variables affect farmer's adoption status of soil and water conservation practices. Table 4.4 indicated that extension contact, farming experience, slope of farm land, marital status and education level were found significant to affect soil and water conservation practices.

Educational level: Education is a discrete variable that refers to the level of education attended by the household head. The category for education was made based on previous studies (Erkie, 2016). Educational level of the household head assigned 1 for non-literate; 2 for literate. This variable was expected to have a positive effect on adoption of SWC practices. Educated farmers can have better knowledge and awareness on how to conserve water and soil to prevent run-off. They tend to recognize risks associated with soil erosion and hence they could have tendency to spend more time and money on SWC practices. This is because literate farmers seek knowledge from development agents about SWC practices as well as agricultural technologies. Educated farmers are presumed to have exposure to new technologies and innovations, and are more receptive to new ideas and willing to adopt SWC practices (Erkie, 2016; Belete, 2017; Daniel & Mulugeta, 2017).

Extension service: Access to extension service refers to contact of development agents with farmers to deliver extension services. It is a dummy variable 1 for household-heads that access to extension service and 2, otherwise. Extension is the effort to disseminate information on SWC practices to farmers at Kebele and sub-Kebele levels. Extension service plays a great conscientiousness in awareness about SWC practices and the possibility of a farmer to decide to practice SWC activities. If farmers contact with development agent and access to information and advice on innovations and types of SWC measures and their use, and management of technologies which will directly lead to enhance farmers' investments on their land. Therefore, extension contact was expected to have a positive and significant influence on the adoption of SWC practices.

Slope of farmland: Slope is a discrete variable, assigned 1 for steep farmlands, 2 for gentle farmland and 3 for flat farmlands topography. Slope has been found to have a positive effect on the adoption of soil conservation practices. The steeper the slope, the more likely the land will be exposed to erosion. Hence, it is believed that adoption of SWC practice tends to be likely on steeper slopes (Damtew *et al*., 2015; Belete, 2017). The slope of the land was expected to affect adoption of SWC practice positively.

Table 4.4 Logistic regression analysis for perception of SWC practices

Variables in the Equation

	Explanatory variables	B	S.E.	Wald	df	Sig.	Exp(B)
Step 1a	Farm size of household	-1.815	.070	.769		.381	.163
	Extension contact of HH	-.617	.087	.088		.767	.539
	Land owner ship of HH	-3.976	.975	4.051		.044	.019
	Farming experience of HH	.228	.174	.011		.916	1.256
	Degree erosion of farmland			2.384		.304	
	Degree of erosion of farmland(1)	1.658	.723	.371		.543	5.249
	Degree of erosion of Farmland (2)	-.394	.588	.023		.879	.674
	Slope of farmland			.975		.614	
	Slope of farmland(1)	-1.175	.428	.234		.628	.309
	Slope of farmland(2)	.021	.100	.000		.992	1.022
	Distance of farmland	6.137	.604	14.645		.000	2.886
	Age of household	2.163	.241	.932		.334	.115
	Sex of household	8.409	.019	4.379		.036	.000
	Marital status of household	.509	.474	.119		30	1.664
	Education level of household	. 911	.488	.374		.541	2.486
	Constant	.436	0.523	.643		.423	11.305

Obtained from survey analysis 2015/2016

4.3 Analyzing the Intensity of SWC by using survey data

4.3.1. Demographic and biophysical factors affecting adoption intensity of use of SWC

As presented in Table4.5, degree of erosion of farmland (severe) and slope of farmland (steep) greatly enhance the chance of household head to adopt SWC practices. About 50.7% and 62.7% of adopters contain severe degree of erosion of farmland and steep slope of farmland respectively.

Table 4.5 Descriptive results of sampled household Socio-demographic characteristics

Socio-demographic variables		Adoption status of wsc of household head: Adopter		Non-adopter	
		frequency	percentage	frequency	percentage
Degree of Erosion of farmland	severe	8	0.7%	3	7.1%
	not severe	2	9.3%	0	4.3%
	low	5	0.0%	7	8.6%
Slope of farmland	steep	7	2.7%	4	8.6%
	gentle	4	8.7%	0	8.6%
	flat	4	8.7%	6	2.9%

Obtained from survey analysis 2015/2016

4.3.2 Descriptive Analysis of Crop productivity

Crop productivity is the amount of crop production in each household farmer in one hectare of land in the study area. As presented in Table 4.6, crop productivity among adopters varied from non-adopter. About 85.1% of adopters of SWC obtain high crop productivity per hectare but, only 14.9% non-adopters get high crop productivity per hectare. Adoption of soil and water conservation practices in the study area had significant impact on crop productivity.

Table 4.6 Descriptive result of crop productivity

		Adoption status of wsc of household head			
		Adopter		Non-adopter	
Crop productivity		frequenc	percent	frequenc	percent
Crop productivity of household head	high productivity yield	7	5.1%	0	4.9%
	Medium productivity yield	8	3.1%	0	6.9%
	Low productivity yield		.0%		.0%

Obtained from survey analysis result 2015/2016

CHAPTER 5

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusion

This research investigated the impact of SWC practices on crop productivity in Liban Jawi Woreda, Oromia Regional State, Ethiopia. The soil and water conservation practice was influenced by sex, age, education, family size, land size, extension access, labour availability and distance from home.

More specifically, the SWC was influenced by sex. Male households adopt the soil and water conservation technologies than female households because of females are influenced by cultural background and time constraints to participate in technologies.

Soil and Water Conservation was negatively related with small family size. Small family size encountered with limited focus on protection and maintenance of SWC. Therefore, availability of family size need to construct of conservation structures in the study area.

Soil and Water Conservation was positively related with farming experience. The survey result indicated that a better farming experience had positive effect on practicing SWC. Also Soil and Water Conservation has positive relation with age. This implies that elder households were more willing to participate in SWC than another age because of their farming experience.

SWC was related with extension contact. Extension services need to create awareness of soil and water conservation measures among farmers. This result identified that households those who had contacted with developmental agents or other agricultural experts on soil and water conservation they have access to information about SWC technology and participating training on SWC. This suggests the role of developmental agents or other agricultural experts to provide information and creates awareness on Soil and Water Conservation was very important.

The most widely applied Soil and Water Conservation measures were the traditional water-ways, cut-off drains, contour plough, crop rotation, stone bund, planting trees, traditional ditches, reduced tillage, terraces and soil bund.

The rate of crop productivity on farm land after started using soil and water conservation practices was increased. The study indicated that crop productivity yield among adopters and non-adopters was vary. Due to adopters practiced SWC technologies, their out put from farmland was greater than that of non-adopters out put farmland.

5.2. Recommendation

The following recommendations were forwarded based on the study result;

❖ In the study area there was different technologies of soil and water conservation systems practiced by farmers like stone bunds, soil bund, cut off drain, hill side terraces and farmland plantation to manage their soil and water. That would had to encouraged the farmer's.

❖ In the study area there was improved crop productivity achieved via soil and water conservation practices. But the awareness of farmers on the technology of SWC were not uniformly accepted. Thus, there should be a continuous awareness creation mechanism among farmers and agricultural experts follow up process on the proper soil and water conservation technologies.

❖ Additionally there is a need of land ownership of farmland of household in the study area since farmers whose land belongs to them practices more than another.

❖ As this study family size have great role to influence adoption of SWC practices, because it is linked with labour availability. So it is important to collaborate household to solve labour availability.

❖ Also this study explain that females were late to adopt soil and water conservation practices than male house hold. This may result low crop productivity in family of female household. To solve this problem it is important to encourage female in training and practices of conservation technologies.

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Appendixes

Appendix I: Questionnaire for household survey

The objective of this questionnaire is to collect information from woreda farmers related to

adoption of SWC practices and its impact on crop productivity in Liban Jawi Woreda, Oromia Regional State, Ethiopia. The study is conducted for academic purpose only. Hence, I request honest and fair responses to fill this questionnaire. Don't need to write your name.

Date of interview ________________________________.

Part I .General information

1. Code No. (Farmer no.) __________________

2. Home origin: Rural Kebele Administration Unit ________Village (*Gott*) ____________

Part II. Household Identification

1. Sex of the respondent/household head i) Male ii) Female

2. Age of respondent/household head __________________

3. Marital status i) Married ii) Not married iii) Divorced iv)Widowed

4. Educational level of household head ________________________

5. Family size: Male ______ Female ________Total _______

6. Social status i). Religion leader ii).Political leader iii). Free iv). Other _______

7. Farming experience in years _______________

Part III. Farm characteristics

1. Do you own cropped land? i) Yes ii) No

2. If Yes, Total Cropped land size in "gemed" ______________

3. distance of each farm plots and average distance (in minutes) from your residence.

Distance of farm plots from residence in minutes

Plot	Average distance meter	Distance from residence in minute
Plot 1		
Plot 2		
Plot 3		
Plot 4		

4. How do you see the size of agricultural land over time?

i) No change ii) Becoming scarce iii) Increase over time.

8. If the agricultural land is becoming scarce over time. What is the reason behind?

i) Increasing in population. ii) Land degradation. ii) Other specify _________________

9. If the agricultural land is increasing, what is the reason?

i) Expansion of agricultural land to newly opened up land.

ii.) Gift from other people (parent or relatives)

iii.) Other specify it ____

10. How do you understand your current land holding to support the house hold?

i) Sufficient. ii Insufficient. iii. Excess

11. Do you have parcel of land in villages where soil conservation intervention is going on?

i) yes ii) No

13. How do you see the productivity of your farm land overtime?

i) Increasing ii) The same iii) Decreasing iv) I don't know

14. If the productivity of your land is decreasing, what is the reason?

i) Frequent cultivation of land without fallowing ii) Not using compost& other SWCP.

iii) unreliable rainfall iv) High price of fertilizer

15. How do you describe the slope of your cultivation land?

i) Flat ii) Gently sloping iii) Moderately sloping iv) Steeply sloping.

16. Do you have land exposed to erosion on your farmland? 1.Yes 2. No

17. If you say yes, what is their impact? (more than one answer is possible)

i) Land degradation iii) Drought

ii) Loose of soil fertility iv) Food insecurity

Part IV. Crop production trend

No	Type of crop cultivated	Product gained per ectare(quintal)
1	Teff	
2	Barley	
3	Maize	
4	Wheat	
5	Pea	
6	Bea	
7	Chick pea	
8	Lentils	
9	Sorghum	

1. How do you describe the current trend of crop productivity compared to the crop productivity that was before? i) Increasing ii) Decreasing iii).constant

2. If you say" Decreasing "what are the major factors affecting crop production in this area? (more than one answer is possible)

i) Low soil fertility v) extension service

ii) Inadequate farm land vi) distance from land

iii) Shortage of labor vii) extension service

iv) Unpredictable rainfall viii) lack of agricultural inputs

Part V: livestock production

1. Did you own Livestock? A) Yes B) No

1.1 If yes, provide the following information.

Livestock holding of house hold and income

No	Type of livestock	Number of livestock	Income obtained from old in 2015 (birr)
1	Bull		
2	Cow		
3	Heifer		
4	Calf		
5	Hen		
6	Goat		
7	Sheep		
8	Donkey		
9	Horse		

2. What is the source of animal feed? (more than one answer is possible)

i) Communal land ii) private grazing land iii) crop residue iv) Hay v) other specify _____

3. How do you describe the trend of animal feed?

i) Declining ii) increasing iii) the same iv) I do not know

4. If it is declining, what is the reason?

i) Population growth iii) Degradation of grazing land ii) Drought iv) other specify _______

5. What is the trend of livestock population in the area?

i) Decreasing ii) increasing iii) the same iv) I don't know

Part VI: land tenure arrangement

1. Do you think that land belongs to you? i)yes ii) No

2. If yes do you think you have right to inherit the land to your children? i)Yes ii) No

3. Do you expect that you will use the farm land throughout your life time? i)Yes ii) No

4. If you do not think that land belongs to you, why?

i) I expect land will be redistributed

ii) Land belongs to government

iii)I expect my farm land can be taken any time by the government

iv) Other specify ______________________

5. What do you expect in your land holding after five years from now?

i) Increase ii) Decrease iii) Remain the same

6. If decrease, why? ____

7.If increase, why ____

8. Did you get land certificate from the woreda land administration office? i)Yes ii) No

9. If yes what is the benefit (possible to choose more than one)

i) Increase owner sense iii) no change due to certificate

ii) Motivate to invest on land iv) Government forced to conserve land based on agreement

Part VII. Soil and water conservation

1. How do you describe the degree of erosion in your farm land?

i) Sever risk of soil erosion ii) minor risk of soil erosion

ii) Moderate risk of soil erosion iii) no risk of soil erosion

2. What do you think major causes of soil erosion?

i) The slope of the land being steep iii) run off from up slope area

ii) Rainfall being too much/ too heavy iv) soil being to erodible

3. Which soil and water conservation structures do you have?(more than one answer is possible)

i) Stone bund iv) hill side terrace

ii) soil bund v) farm land planting

iii) cut off drain vi) others _______________

4. If you are not construct conservation structures, what is the reason behind?

i) Shortage of labor iii) do not believe in the use of SWC structures

ii) Shortage of land vi) My land do not requires these structures

5. If you are not maintaining conservation structures constructed in your farm land, what are factors that discourage you from maintaining? (more than one choice are possible)

i) Work is very tedious ii) Cause loss of land to structures iii) High maintenance cost

iv) lack of household labor to maintain V) others specify _____________________

6. If you have made any form of destruction of conservation structures, what is/are the reasons for the destruction? (More than one answer is possible)

i) Search for fertile soil ii) Joining plots iii) destroy hiding place of rodent pest

ii) Need to avail more land iv) Destroying bad weeds

7. How do you recognize the productivity of soil conservation measures introduced to the area compared to the traditional one? i) Less productive than the traditional one ii) The same as the traditional conservation measures iii) More productive than traditional one.

Part VIII. Extension service delivery

1. Do you get advisory service from extension agent about soil and water conservation technology? i) Yes ii) No

2. If yes, on average, how often the extension agents advised you in a month? _____

2.1 How do you describe the access you have with SWC experts (DAs)

i) Non ii) Limited iii) Good iv) Very good

3. Did you get advice related to SWC Technologies from Zonal & Wereda Agri expert?

I. yes II. no

3.1 if yes, i) How frequently you were advised in a year? ________________________

ii) For how long (years) you have accessed advice? ____________________________

3.2 Does the DA available in your village? i) Yes ii) No

4. Did you participate in formal training in SWC Technologies? i) Yes ii) No

Appendix II: Focus group discussion (FGD)

1. Do you have information on Soil erosion?

2. Do you think there is Soil erosion in your area? If yes, what do you think the local indicators of Soil erosion?

3. What are the major impacts associated with soil erosion on crop productivity in your locality?

4. What activities were done by the local community, government and non government organizations to reduce local impacts of soil erosion in your kebele?

Appendix III: Interview checklists for key informants

1. Do you feel that Soil erosion in Babich woreda? What do you think the local indicators of Soil erosion?

2. What are the impacts of Soil erosion on crop production and which crop?

3. How do you explain the relationship between crop production and Soil erosion in your locality?