ADOPTION OF SOIL AND WATER CONSERVATION PRACTICES ON FARMLANDS: THE CASE OF KARITA WUHA WATERSHED, WEST BELESSA DISTRICT, NORTH GONDAR, ETHIOPIA

BY

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A THESIS

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DECLARATION

I hereby declare that the Dissertation entitled **ADOPTION OF SOIL AND WATER CONSERVATION PRACTICES ON FARMLANDS: THE CASE OF KARITA WUHA WATERSHED, WEST BELESSA DISTRICT, NORTH GONDAR, ETHIOPIA** submitted by me for the partial fulfilment of the M.A. in Rural Development to Indira Gandhi National Open University, (IGNOU) NEW DEHLI is my own original work and has not been submitted earlier either IGNOU or to any other institution for the fulfilment of the requirement for any course of study. I also declare that no chapter of this manuscript in whole or in parts is lifted and incorporated in this report from any earlier work done by me or others.

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Acronyms

EHRS:	Ethiopian Highland Reclamation Study
NGO’s:	Non-Governmental organizations
GDP:	Gross Domestic Product
FAO:	Food and Agricultural Organization of the UN
MoA:	Ministry of Agriculture
MoFED:	Ministry of Finance and Economic Development
OoA:	Office of Agriculture
PSNP:	Productive safety-net Program
SCRP:	Soil Conservation Research Project
SWC:	Soil and Water Conservation
SWHISA:	Sustainable Water Harvesting and Institutional Strengthening in Amhara
TLU:	Tropical Livestock Unit
UNEP:	United Nation Environmental Protection

ABSTRACT

Land degradation is one of the major challenges in agricultural production in many parts of the world, especially in developing nations like Ethiopia. Even though a number of soil and water conservation methods were introduced to combat land degradation, adoption of these practices remains below expectations. This research was conducted in the Karita-wuha watershed, West Belessa district Ethiopia to asses farmers' response, identify SWC measures, examine correlation between improved SWC practices and major factors of SWC practice.

Structured questionnaire and focus group discussion methods were used to collect the necessary information from farm households. The watershed was blocked in slope classes and then from each slope categories 50 percent of household heads who have farmland were selected using systematic random sampling technique. A total of 134 households were interviewed and several fields were visited during transect walks. Pearson correlation and Logit regression model were used for analyzing correlations among household characteristics, area, tropical livestock unit (TLU), extension support, plot characteristics and the adoption of improved SWC practices. In addition, data were analyzed using descriptive statistics and cross-correlation methods.

The results showed that more than 98.5 % of the households know the cause of erosion and traditional stone bund and improved stone terrace practice were practiced more than any of conservation measures in the area. Age of household head, education of household head, total number of livestock, access to extension support and degree of erosion were the major factors that positively and significantly influence adoption of soil and water conservation measures. However, degree of erosion of cultivated land has also influenced significantly negatively the adoption of improved SWC measure. In addition the result showed that, sex of the household head did not seem to make a difference in adoption of improved SWC practices

Key words:- Adoption, farmland, Karita-wuha watershed, SWC measures

1. INTRODUCTION

1.1. Background of the Study

Soil is one of main natural resources in agriculture. Maintain and if possible, increasing the productivity of existing soil is necessary to accomplish production and welfare goals in the short and long term (Alferdo et al., 1993), demanding and degrading these recourse, we do ourselves and our descendants grate land perhaps irreparable hams (Hillel, 1992; Tamiru, 1998).

The indiscriminate human interference and mismanagement of the soil, however, result in the loss of soil through accelerated erosion. Erosion reduces soil depth, its organic matter, and moisture holding capacity, which is turn lower crop yields, shorten fallow periods in appropriately, or induces agricultural encroachment to lands not suitable for farming (Berhe, 1996; Mclintire, 1990; 1998, 1998).

Soil erosion particularly erosion by water is a problem in most parts of the world affecting a number of economic activates including the national economy. According to Food Agricultural Organization (FAO) and United Nation Environmental Protection (UNEP), cited in Sheng (1980) worldwide between 5 and 7 million hectors (ha) of land are lost annually through soil degradation. If the current rates of degradation continue, close to one third of the world arable land will be destroyed by the year 2000(UN, 1978; in Sheng, 1989).

Ethiopia is one of the poorest countries in Sub-Saharan Africa (Bekele, 1998) as citied Habtamu 2006. Its economy is mainly dependent on rain -fed agriculture. The agriculture sector is the main source of employment for about 80% of the population (FAO, 1993). It also contributed to a very large property of the country's gross domestic product (GDP) (MoFED, 2002a).

Small holders dominate the agricultural sector of the country and cultivate about 1 hectare of land, the average being 0.8 ha. They produce over 90% of the agricultural output of the country. Nevertheless, most of their produce goes for their own consumption (Stefan.1990).

Despite the fact that the agricultural sector of the country disproportionally employs the largest segment of the population, its contribution to the GDP of the country is only 45% (MoFED, 2002a). Though this can be explained by a multitude of factor, soil degradation is one of the most important factors (Woldeamalk, 2003). In Ethiopia, soil erosion by water constitutes the most widespread & damaging process of soil degradation (Wadeamalak, 2003). It has caused several negative impacts on land (EPA, 2003; CFSCDD/MoA, 1986).

The impact of erosion is particularly severe in the highlands of the country (areas that lie above 1500m), which constitute less than half of the country (~ 43 percent of the country). Due to its favorable climate for production and presence of relatively fertile soil as well as less disease incidence, the Ethiopian highland host about 88% of the national population (FAO, 1986). Thus, the pressure on the resource base sevier in highland of the country. Though Ethiopian highlands are among countries with highest agricultural potential in Africa, they contain one of the largest areas of ecological degradation (Hurni, 1983, Blaikie, 1985; Blaikie and Brookfild, 1987; Habetamu, 2006). Studies made in the middle of the 1980s revealed that 50% of the highlands are significantly eroded, 25% seriously eroded, while 4% had reached a point of no economic return (FAO, 1986a; Habtamu, 2006).

At present, the country is faced with complex problems of severe poverty, low productivity, and poor natural resource (Peneder et al., 2006) in which the problem of land degradation, mainly of soil erosion is most pervasive.

In response to the problem of soil erosion the government of Ethiopia began large scale massive conservation programs in the 1970s and 1980s. , The 1970 and 1980 were remarkable periods in the history of soil conservation in the country (Amsalu, 2006). However, the measure did not mitigate the problem, where they are accepted by the farmer soil erosion reduction or improvement was too low like many parts of the country.

1.2. Statement of the Problem

Agriculture in Ethiopia is not only an economic activity but also the way of life and is under continuous threat from varies forms of natural resource degradation. Soil erosion is one of the major problems that affected this sector (FAO, 1986). According Greenland et al (1994) marginal and sloppy lands are generally susceptible to soil erosion. Areas which have semiarid climate are also vulnerable to soil erosion because of high and erratic rainfall. Study indicated that soil erosion in the Ethiopian highland is caused by the combination of many factor such as increase of cultivation on sloppy land; high population pressure, clearance of forest, poor management of agricultural land, etc (Fikru, 2009).

The soil conservation research project (SCRP) in Ethiopia has estimated an annual soil loss of about 1.5 billion tones from the highlands and soil erosion is greatest on cultivated land where soil loss is 42 ton/ha/yr (Hurni, 1988). On the other hand the Ethiopian highland reclamation study (EHRS) indicated that soil erosion is estimated to cost the country 1.9

billion US dollar between 1985 and 2010 (FAO, 1986). Wood (1990) indicated that erosion reduce the country food production by1-2% per annum.

Although the history of soil erosion problems goes back to the beginning of agriculture itself, it attracted the attention of policy maker's; researchers and public at large after the devastating famine problem of 1973/74, (Shifraw and Holden, 1998). Knowing the severity of these problems, soil and water conservation technologies were implemented in many parts of the highlands during the 1970s and 1980s. However, they were introduced on some degraded and in food deficit areas mainly through food-for-work incentives (Habtamu, 2006). Reports indicated that these conservation structures have not been adopted and sustainably used by the farmers (Admassie, 2000; Bekle and Drake, 2003, Amsalu, 2006; Eeleni, 2008; Fikru, 2009).

Today extensive conservation projects are being carried out by the government with the help of some NGO's and various conservation measures have been introduced to farmers. The government package of community based participatory watershed management program and productive safety net program which provides farmers with grain or cash payment are examples of programs being carried out.

There are three phases in the adoption process of SWC technologies: the acceptance phase, the actual adoption phase, and the final adoption phase (De Graff et al., 2001). The acceptance phase includes the awareness, evaluation and the trial stages where farmers start investments in certain measures. The actual adoption phase is the stage where by investments are made on more than the trail basis and the third phase, final adoption is the stage in which farmers tend to maintain the previously constructed structures and replicate into other fields.

The introduction of SWC technologies may not lead to sustainability and rehabilitation unless the farmers proceed to final adoption, where farmers begun to integrate the measures with their farming system. However, the results of researches in many parts of the country indicated that the adoption rates of conservation technologies are far below the expectation (Antle et al., 2005). Farmers, in the area where the productive safety net program is being implements, are criticized for they preferred to remove the structure from their farm land instead of maintaining and replicating them (Eleni, 2008; Fikru, 2009).

The limited adoption of soil and water conservation practices is not only due to technical problems; rather it is due to socio-economic and biophysical problems (Kessler, 2006; Tadele, 2011). Studies, made on SWC adoption showed that demographic, socioeconomic, institutional and biophysical attributes have influential roles on farmers' decision of towards the adoption of SWC measures (Noris and Batie, 1987; Amsalu and De Graff, 2006;Eleni, 2008; Fikru, 2009). Therefore, clear understanding about the level of adoption and the local factors, work against farmers decision is an important parts of the government policy of combating sever soil erosion as one factors of increasing productivity.

From the North western highlands of Ethiopia, Karita Wuha sub-watershed is one of the areas, which is exposed for series erosion problems. Therefore; developing SWC measures that are suitable to the local environments and executing them in an efficient way is an issue of sustainability that needs an integrated effort of the government, researchers, NGOs, the general public, and other concerned bodies. In the study area where, this research was soil conservation practices were being conducted by the government as a package of integrated watershed management program through the project Sustainable Water Harvesting and Institutional Strength in Amhara (SWHISA). However; reports of West Belessa district

Agricultural Office (2011) and the informal field observation indicated that the rate of adoption the newly introduced/improved SWC technologies is too low like many parts of the country.

1.3. Hypothesis and Research Questions

Hypothesis

Farmer's decision about SWC practices can be conceived of having two components: whether to use SWC practices and, if so, how many practices on how much land to use or not use SWC practices. Both of these components are assumed to be influenced by a number of factors that are related to farmer's objectives and constraints.

The dependent factors represent the SWC practices in each plot and independent variables represent factors both household level and plot level.

Research questions

- What are the indigenous and newly introduced SWC technologies currently implemented by farmers in the study area?
- How farmers in the study area responded towards the introduction of conservation technologies?
- What is the correlation that existed between demographic, socioeconomic, institutional and physical conditions of the study area and the adoption of SWC technologies?
- What are the major constraints affecting the ADOPTION rate of improved SWC technology in the study area?

1.4. Scope and Limitation of the Study

Scope of the study

This study limited to the study of adoption of SWC technologies in KARITA WUHA WATERSHED within the last three years of intervention by SWHISA project. Study covered only 345.33ha and 268 households of the watershed. Different types of conservation measures were introduced to the study area. But, assessment of farmers' adoption of SWC is limited to structures introduced on farm lands.

Limitation of the study

Most of the respondents of rural households were illiterate and this made data collection difficulty. Most of the data were collected by direct observation of farm plot. The other most important limitation of the study was lack of willingness by some of farmers to give genuine information on some issues, for example information on land holdings and income. Absence of well compiled data in the study area was another shortcoming.

1.5. Objectives of the Study

General Objective

The general objective of this research was to assess farmers' perception towards the ADOPTION of traditional and newly introduced SWC technologies and evaluate the correlation between households and farm characteristics in respect to the adoption of newly introduced/improved SWC technologies in KARITA-WUHA WATERSHED.

Specific Objectives

- To assess farmers response towards the introduction of SWC technologies.
- To identify the type of traditional and improved SWC structures implemented on FARM LAND
- To investigate the correlation of demographic, socioeconomic, institutional and physical factors and the improved SWC structures by farmers.
- To find out the major factors that affect the ADOPTION of improved SWC technologies currently implemented in the study area

2. LITERATURE REVIEW

2.1. Theoretical Framework

2.1.1. Definitional Problems

Land degradation, soil degradation and soil erosion are related concepts used interchangeably. 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” (Green land et al., 1994; Fikru, 2009).

Soil degradation is narrow term for declining soil quality, encompassing the deterioration in physical, chemical and biological attributes of the soil. The physical degradation such as compaction, surface sealing and crusting, water logging and acidification; chemical degradation includes depletion of soil nutrients, acidification, Salinization and pollution; and biological degradation including loss of soil organic matter, flora and fauna populations or species in the soil.

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. The Ethiopian highlands have been experiencing declining soil fertility and sever soil erosion due to intensive farming on steep and fragile land (Amsalu and De Graff, 2006; Fikru, 2009). 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 (Tantigen and Mohammed et al., 2009). Those parts of the highlands, which are not yet threaten by famine, are being gradually degraded, and it is a question of time before the problem threatens the livelihood in these areas too.

2.1.2. 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 (Pagiola, 1999; Ankeny et al., 2008; Tadele, 20011). In response, considerable public and private resources have been mobilized to develop soil and water conservation (SWC) technologies. Broadly SWC technologies can be categorized in to three categories structural methods, agronomic practices and water harvesting practices.

SWC 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 (Minale et al.,2008; Tadele, 2011) that reduces their water volume

2.1.3. Soil and Water Conservation in Ethiopia

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 (hurni, 1986; Wogayehu and Lars, 2003; Habtamu, 2006). The famines of 1973 and 1985 provided an impetus for conservation work through large increase in food aid (imported grain and oil). Following these sever famines, the then government launched an ambitious program of soil and water conservation supported by donor and non-governmental organizations (Hoben, 1996). The use of food aid as a payment for labor replaced voluntary labor for conservation campaigns (Campbell, 1991; 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 and coercing farmers to adopt conservation measures. Nevertheless, the implementation was very poor and few structures persisted causing erosion rather than preventing it (Pretty and Saha, 1996; Habtamu, 2006). As a rule of tamp pluoghing of lands recommended up to 45% slope of land and conservation structure most suitable up to 8% slope of land.

2.1.4. The Adoption of SWC Technologies

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 Fanajuu bunds, on average could reduce soil loss by 65 % or 25-72 tons per hectares per year (Grunder and Herweg, 1991a, 1991b; Tadele, 2011).

The adoption of improved SWC technologies in developing countries has attracted much attention from scientists and policy makers mainly because land degradation is a key problem for agricultural production (De Graaf et al., 2008). 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 SWC measures on more than a trial basis. The third phase, final adoption, is the stage in which the existing 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 economical 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. These are farm level and farmer (house hold) attributes (Bekele and Drake, 2003). The farmer or household 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. Therefore, it is necessarily important to test whether or not the variables have similar results.

2.2. Determinants of SWC Adoption

Integrating SWC technologies is the issue of sustainability of many countries, whose economy largely depends on agriculture (Antle et al., 2005; Hengesidjisk et al., 2004; Minale et al., 2008 and Fikru, 2009). In response to high demand of improving the productivity of land many countries including Ethiopia are engaged in massive soil and water conservation 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.

As a result of this many studies on determinants of SWC adoption have been conducted in different parts of the world including Ethiopia.

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 , socioeconomic, and biophysical conditions (Bekele and Drake, 2003; Eleni, 2008 and Fikru, 2009).

2.2.1. Demographic Factors

Farmer's perception of soil erosion problem: perceiving the problem to adopt conservation practices (Long, 2003; Traore et al., 1998; Habtamu, 2006).Traore et al (1998), as cited by 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. On the contrary, Belay and Woldeamlak (2003) found that in spite of high level of soil erosion problem adoption of conservation structures was very limited. Kessler (2006) found that perception of the problems did not influence farmers' decisions on how much to invest in soil and water conservation. Woldeamlak, 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 cutoff drain type of SWC adoption. Fikru (2009) found similar results in koga watershed. 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 (Etana, 1985; 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. According to Eleni the reason for this negative, but not statistically significant result was the positive and significant correlation between education and off-farm activities.

Sex of the household head: Fikru (2009) showed that households headed by women have no significant differences with that of households headed by man in their adoption behavior of SWC technologies. Eleni (2008) and Krishhana, et al. (2008) indicaed that the opposite was true. Male headed households have a higher chance to be involved in continued use of SWC than female headed households because of women spend most of their time in domestic responsibilities.

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 (Wagayehu and Lars, 2003; Habtamu, 2006). Woldeamlake (2003) identified that the lack of interest in SWC measures is due to shortage of labor. Geoffer (2004) found that household size was associated negatively with adoption of no conservation practice and positively with adoption of conservation practice. Yet, studies conducted in Ethiopia indicated that larger family size has negative impact on the adoption of SWC technology (Bekele and Drake, 2003; Amsalu, 2006: and Fikru, 2009). The proponents of this view support their findings with the explanation that in a family with higher number of mouths to feed, immediate food need is given priority and, thus, labor is diverted to off-farm activities that generate food. Another explanation is when population increases, landholding per household will decrease which in turn has a negative on SWC adoption.

2.2.2. Socioeconomic Factors

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.

Land ownership-studies found the tendency that operators to use more conservation practices on land they owned compared to land they rented (Esseks and Kraft, 1989; Atakilte, 2003, Habtamu, (2006). Ervin and Alexader (1981), as cited by Habtamu (2006) observed erosion to be more sever on rented land than on owned. On the contrary, Bultena and Hiberge ,1983; Habtamu, 2006; Traore , 1998 and Hbtamu, 2006 did not find a relationship between the way farmers accessed land (whether rented, leased or owned) and adoption of conservation measures.

Wealth status- the wealth status of farmers was found to be positively correlated with the farmer's adoption of SWC measures (Norris and Eleni, 1987; Bekele and Drake, 2003; Kessler, 2006 and Eleni, 2006). According Bekele and Drake, (2003) the opportunity cost of labor for wealthier farmers is lower than poorer farmers, so that they can invest their available labor in SWC activities during slack labor season.

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. Krishna et al. (2008) also found similar results. 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 in 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.

2.2.3. Institutional Factor

Information – farmers who know nothing about a practice cannot be expected to adopt it unless they understand its expected costs and benefits. Accurate and timely information has a positively impact on farmers ‘conservation adoption decision. More informed farmers better assess the impact of soil erosion on long-term productivity of their farm land and adopt practices that help resolve the problem (Traore et al., 1998; Habtamu, 2006).

Visits by development agents- the existing literature holds two opposite views concerned with visits by development agent on SWC adoption. One view holds that contact with extension personnel increases the amount of variance explained in conservation tillage (Nowak, 1987; Habtamu, 2006). The study conducted in Ethiopia indicated that if a farmer receives better information/advice from extension agents, the farmer will be willing to construct new conservation measures and to maintain the existing ones (Wagayehu and Lars, 2003).

On the other hand, Fikru (2009) in his study on Koga watershed indicated that visits by development agents have no significant effect on the adoption of SWC technologies by farmers. Eleni (2008) has reached similar conclusion. She explained that the reason for this insignificant due to the fact that development agents is usually focused on matters other than conservation measures.

Training- training in a wide sense, including education and awareness rising, has been the main activity crucial for successful participation. The more educated and trained a person is, the greater opportunity he/she has to participate in planning and decision making as well as project implementation (Lill, 1993; Tamiru, 1998).

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 Holden, 1998; and Admassie, 2000, 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, because farmers are not certain to their entitlements with regards to use the land, they try to maximize short term production grains and tend to disregard long term investments (Afredo et al.,1993; Yerasworq, 1992; Tamiru, 1998). Furthermore, the frequent redistribution of land caused farmers to feel insecure since they may lose parts of their farm (Keddeman, 1989; Tamiru, 1998), and this will have an impact on soil conservation activities (Singh et al., 1993, Tamiru, 1998). On the other hand studies in some parts of Ethiopia proved that the present land tenure system of the country have no significant effect on the farmers investment of any kind of technologies on their land (Bekele and Darke, 2003; Eleni, 2008; Fikru, 2009).

2.2.4. Physical Factors

Slope of the farm land- like rainfall and nature of soil that affects the rate and amount of soil eroded , slope of a field affects also the rate and amount of soil loss from fields (Tripathi and Singh, 2001; Habtamu, 2006). This influences farmers to control or mitigate the impact of erosion on fields that are situated at steep slopes and hence slope influences the decision of farmers to undertake conservation measures. The degree of slope positively affected the investment of conservation measures (Bekele and Drake, 2003; Amsalu, 2006; Eleni, 2008, and Fikru, 2009). Farmers cultivating steep slope fields install more effective conservation measures than farmers that cultivate level fields (Saliba and Bomley, 1986; Habtamu, 2006).

Soil *fertility*- farmers perceive the effect of soil erosion when it reaches some critical level, which is very difficult to reverse the degradation at the subsistence farmer level (Osgood, 1992 in Woldeamlake, 2003; Habtamu, 2006). On deep and/or fertile soil, erosion process does not affect farmers at least in the short term. The symptoms of erosion can be easily plowed away and on such sites there may not be a big effect on productivity of land although the problem is recognized. Farmers cultivating such lands are reluctant to apply soil conservation measures (Valk and Graaff, 1995; Habtamu, 2006). According to Eleni (2008) the level of soil fertility has a negative and significant correlation with the degree of SWC adoption. The explanation here is farmers may have interest to improve the level of soil fertility that are already exhausted and increase the productivity of their plot.

Proximity- farmers residing close to their cultivation land invest more on soil conservation measures than their counter partners living at a distance. Cultivation land closer to the residences receives more attention and supervision than that is situated at the farthest distance. Farmers also want to invest more in the field that requires least effort (Kessler, 2006; as cited Habtamu, 2006). According to Gebrmedhin and Swinton (2003) plot closer to homestead discouraged investment in soil conservation, Fikru (2009) also found similar results. Wogayehu and Lars (2003) found significant and negative correlation between no conservation decision and distance of a parcel from the residence but positive correlation between distance of the pot and adopting conservation decision.

2.3. Conceptual Framework

In this study the factors/variables/ that may determine the adoption of SWC technologies were grouped into four categories such as: 1) the demographic factors include farmer’s perception of soil erosion problem, age of the household, education of the household head, sex of the household head and family size of the household, 2) socioeconomic factors such as farm size, land ownership ,wealth status , availability of credit services etc; 3) institutional factors includes information , visit by development agents, training, land tenure; and 4) the physical factors that include slope of farm land , soil fertility and proximity.

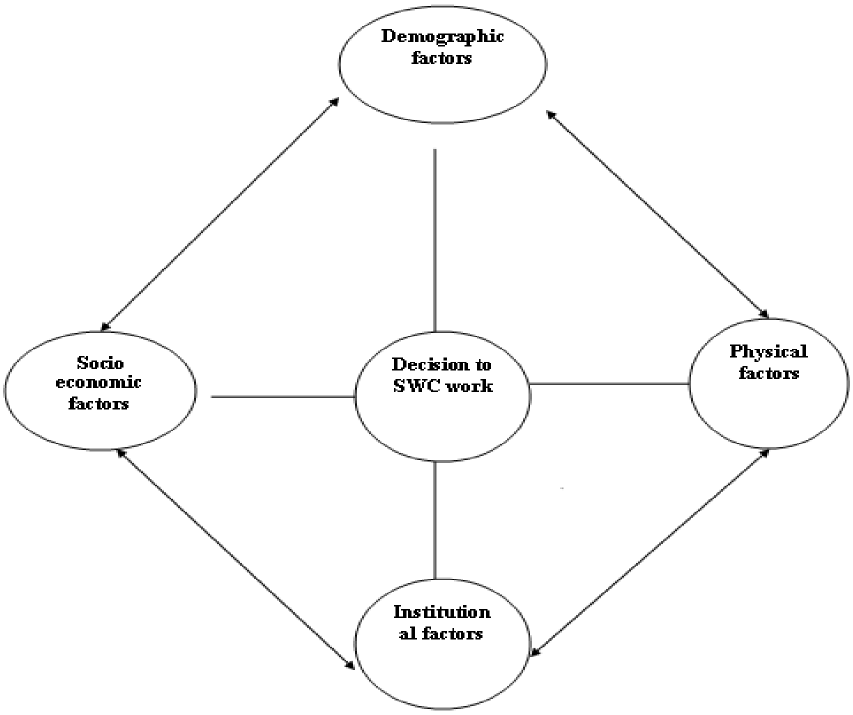

Figure 1: Factors that influences the adoption of SWC technology on farm lands (Tadele, 2011)

3. MATERIALS AND METHODS

3.1. Description of the Study Area

3.1.1. Location

Karita-Wuha watershed is one of the smallest watersheds in West Bellessa district, in North Gondar Administration zone of the Amhara National Regional State. Arbya is the district capital which is 726 km far north of Addis Ababa. Geographically, it is located at 12^{o}27' latitude and 37o 46' longitude. The watershed covers a total area of 345.33ha (Figure 2).

3.1.2. Topography

Karita-wuha watershed is found in the north western highlands of Ethiopia. There are four types of land form based on their slope. These are mountain (> 50 % slope), pleatu (30-50 % slope), undulated (9- 30 % slope) and gentle slope or almost plain (0-8 % slope). The study area found at 1900 meter above sea level, so it is assigned in sub-tropical zone (Managing land, 2005: Abebe et al., 2009).

3.1.3. Climate

Rainfall pattern of the areas is unimodal, with much of the rainfall occurring between June and September. Annual rainfall is below 900 mm. The mean annual temperature in the watershed is on average 27 degree centigrade.

3.1.4. Soils

The land forms have different soil depth and texture, the steep slope mountains have very shallow depth (less than 25cm) and sandy texture, semi mountains /hills/ have better depth

(25 to 50 cm) and fine particles of the soils easy for erosion, moderate slopes have moderate depth soils (50 to 100 cm) with clay and loam texture and the remain flat land has a good or best soil depth (100 to 150 cm) and black clay soil (Managing land, 2005: Abebe et al., 2009).

3.1.5. Vegetation types

The area in the past decades was forest with species such as Cordia africana (wanza), Acacia seyal (keygirar), Dodonaea viscose (kitkita) and the like. But currently it is covered with the bushes of Otostegia integrifolia (tinjut), Dodonaea viscose (kitkita) Calotropis procera (tobiaw) Euclea racemose (dedeho) and Euphorbia triucalli (kinchib).

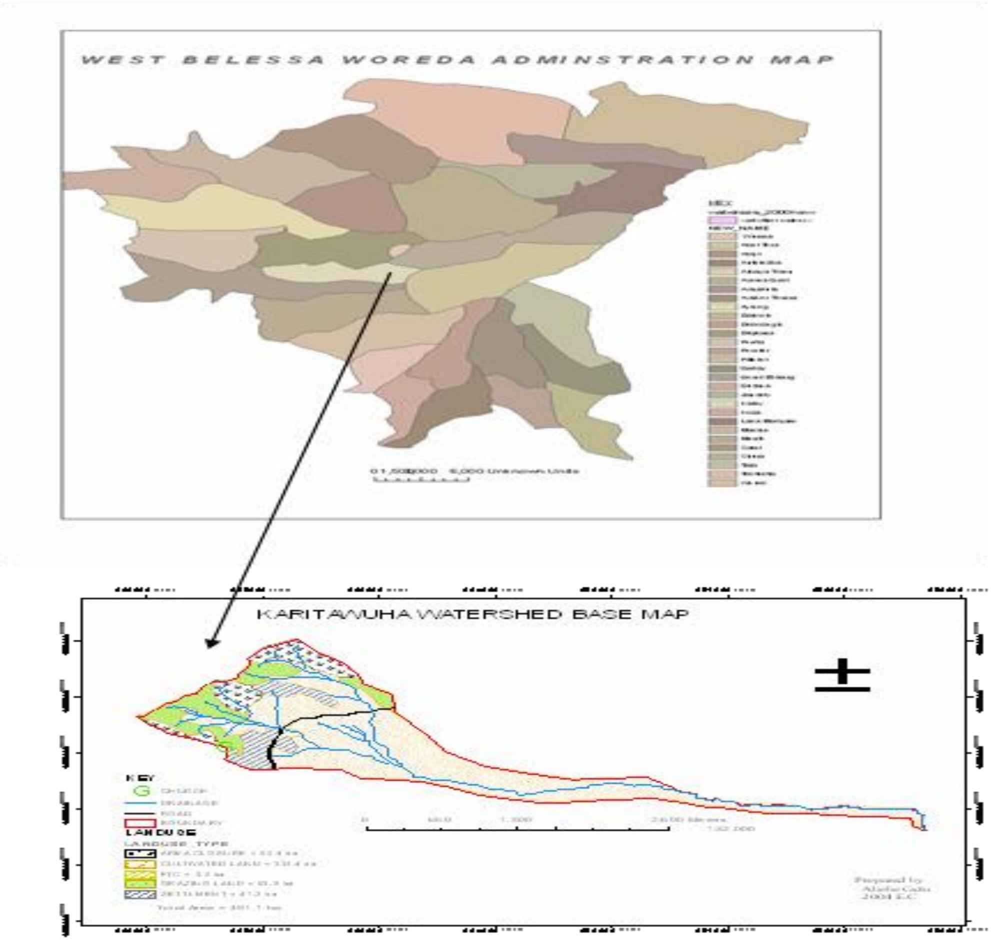

Figure 2: Location of the study area within West Belessa Administration and karita-wuha watershed (OoA, 2011)

3.1.6. Population

1340 people (690male and 650 female) are living within karita wuha watershed. From this male headed households are 193 while female headed households are 75 totaling to 268 households.

3.1.7. Socioeconomic Bases

The base of the economy is rain fed agriculture. Cultivation of land is carried out using a pair of oxen and traditional farm implement known as “Marsha”. The main crops grown in the area include: Zia Mays (maize), Sorghum bicolor (sorghum), Eragrostis tef (teff), Cicer arietinum (check peas) etc. Cattle, sheep, goat, donkey, poultry, etc are among the animals domesticated in the study area.

3.2. Research Design

To study the adoption of soil and water conservation technologies in the watershed the land was blocked using slope as criteria. Accordingly, slope category of 8-15% (block one), 16-30% (block two) and 31-50% (block three) were used.

3.3. Sampling Techniques

In west Belessa woerda there are 252 small watersheds; out of these watersheds Kaita Wuha watershed was selected using purposive sampling method because it was representative and model watershed of the woreda and SWHISA project site. From each slope categories 50 percent of household heads who have plot of farmland were selected using systematic random sampling technique. Finally, for this study a total of 134 household heads were selected.

3.4. Data Collection Methods

Quantitative and qualitative approach was employed to collect the data. The data source of this study was both primary and secondary data. The primary data was collect through formal survey using structured questionnaire. In addition, discussion with key informants was carried out. During discussion, watershed teams, kebele chairperson and district natural resources expert/ head have participated.

The secondary data for the study was collect from SWHISA project document, zonal and district agricultural office reports, journal articles and proceeding.

3.5. Methods of Data Analysis

The qualitative data analysis techniques were used for data collected from the reviewed documents, key informants, and open ended question of sampled households. For quantitative data analysis, descriptive statistical method was used for data collected from household survey. Percentages and level of significance tests were used to examine the relevant variables. Moreover, Pearson correlation was used to analyze degree of relation between demographic, socioeconomic, institutional and physical factor with the improved SWC structure adoption. Finally, quantitative data were computed using Microsoft Office Excel and statistical tools like SPSS version 16 and Stata SE 10 version.

4. RESULET AND DESCUSSION

4.1. Farmers' Response towards the Introduction of Soil and Water Conservation Technologies

Farmers in the study area seem to have some understanding of the problem of soil erosion and soil stabilizing effects of conservation measures. They gave unanimously a positive response to question concerning knowledge about yield reducing effect of soil erosion and the benefit of soil and water conservation. The degree of importance of soil and water conservation and the understanding about urgency of intervention needed vary from farmer to farmer depending on differences in farm circumstances. This illustrates clearly the effectiveness of more than eight years old soil and water conservation activities promoted by government through food aid throughout the district.

The result showed that 85 % of the respondents indicated the uneven distribution of rain fall, unable to use inputs, absence of SWC activities on farm lands and deforestation are the main causes of low productivity of their farm lands where as the remaining 15 % of the respondents reported that drought, overgrazing, weeds, pest and disease were the problems. From the total interviewed household, 87% of them pointed out that absence of SWC measures, deforestation, erratic rainfall and free grazing were the causes of soil erosion in farm land and the rest 10 % indicated that flooding, improper use of farmland; wind and road were the causes of soil erosion. The remaining 3% do not know the cause soil erosion and they are not practice SWC measures in their farm land. This showed that majority of the farmers have perceived problems of productivity and cause of erosion. Thus, there is a high and good opportunity to introduce effective SWC measures on farm lands that have the potential to increase productivity and food security without resistance.

The sampled household perceived 15, 54.5 and 30 % low, medium and high degree of soil erosion, respectively. About 98.5 % respondents acknowledged the causes of soil erosion. Furthermore, about 94 % of sampled household heads known the cause of soil erosion and the existence of improved soil and water conservation structure (Table 1). Hence, their lack of interest to adopt the introduced SWC measures cannot be explained by a lack of awareness about the problem and the potential of the technologies. Thus, more than 84 %farmers know the problem of productivity of their farmlands and causes of soil erosion, but 26.1 %, 14.2 % and 44.8 % practice indigenous, improved and both indigenous and improved SWC measures, respectively, to minimize soil erosion and increase productivity. Therefore, the government and other concerned bodies must focus on the mechanisms for implementation of SWC measures in farmlands rather than searching additional knowledge on the problems of productivity and cause of soil erosion. A similar result was reported by Bewket, (2001) and Fikru (2006) and both of them indicated soil erosion as an important agricultural problem and yet the majority of the farmers were not willingly participating in the construction of different bunds. Tegene (1992) also reported that in southern Ethiopia the majority of farmers were well aware of the problem of soil erosion, but they were less willing to utilize the introduced technologies. The findings of Bewket, (2001), Fikru (2006) and Tegene (1992) implicate that there is a change on farmers' perception on the erosion problem, but not sufficient enough for farm-level adoption of SWC technologies. Recent study in Digil indicated that about 98% of farmers have perceived the problem of farm land soil erosion (Weldeamlak, 2003)

Table 1: Farmers' Response toward the Introduction of SWC Technologies

Variable	Response	Frequency	Percent
Degree of soil erosion	Low	21	15.7
	Medium	73	54.5
	High	40	29.9
Do you know cause of soil erosion	Yes	132	98.5
	No	2	1.5
Know the existence of improved SWC structure to protect problem of soil erosion	Yes	126	94
	No	8	6
Type of SWC structure made on the cultivated land	No SWC	20	14.9
	Indigenous SWC measures	35	26.1
	Improved SWC measures	19	14.2
	Both indigenous and improved SWCs	60	44.8

Note: Sample size=134

4.2. Ttraditional and Improved SWC Structures in Karita-wuha Watershed

From the total sampled households 45.5% constructed stone terrace, 20.9% cut off drain, 36.6% stone check dam and 19.4% planted tree species and 4.5% used grass species as improved SWC practise on their farm land (Table 2). Improved stone terrace practice implemented more than any one of improved SWC practices in the farmlands. Improved stone check dam was next preferred conservation practices compared with the remaining.. The preference of stone based conservation could be due to the availability of stone in their farm lands and good understanding of training provided by office of agriculture (OoA) and Sustainable Water Harvesting and Institutional Strengthening in Amhara (SWHISA) project and development agents (Das) and orientation by district leaders. The use of improved grass species was very limited due to the inaccessibility of seed source and seedlings.

56.5% and 35.8% farmers have used the traditional stone bund and trash (garbage), respectively, on their farmland. Similarly traditional ditch, grass species, plantation of local tree and cut off drain were used by, 9%, 11.2%, 20.1% and 23.1% of sampled households, respectively (Table 2). The result showed again that traditional stone bund and trash were referred more than others due to the availability of both stone and crop residue in their farm lands. Traditional ditch and plantation of local tree species practiced more than traditional cut off drain and local grass species, because it is easily constructed and provides better result. Moreover, plantation of local grass species favoured more than cut off drain due to easily availability of seed and its impact on the improvement of soil fertility. Moreover it provides construction material for house and fencing of farmlands and homes.

Table 2: Traditional and Improved SWC Implemented in Karita-wuha Watershed

Types SWC practices	frequency	percent	Types SWC Practices	Frequency	Percent
I. Improved SWC			**II. Traditional SWC**		
Improved stone terrace	61	45.5	Traditional stone bund	76	56.5
Improved Cut off drain	28	20.9	Traditional ditch	31	23.1
Improved Stone check dam	49	36.6	Traditional trash	48	35.8
Improved soil bund	0	0	Traditional cut off drain	12	9
plantation of improved tree species	26	19.4	Plantation of local tree species	27	20.1
Plantation of improved grass species	6	4.5	Plantation of local grass species	15	11.2

Note, N=134

4.3. The Correlation of Demographic, Socioeconomic, Institutional and Physical Factors and the Improved SWC Structures by Farmers.

4.3.1. Demographic Factors with the Improved SWC Structures

Even if it has a positive values sex, age, marital status and family size of households did not show significant relation with adoption of SWC practices in Karita-wuha watershed. But education level of household has correlated negatively and significant at 0.01 level. However, from the trend it was possible to understand that age and family size of household have impacts on the adoption of improved SWC practices. Male farmers and married once adopted SWC practices better than the remaining groups. On the other hand, education level did not influence the adoption of improved SWC practices. This may be due to the availability of different job opportunities for income generation for educated household heads than counter parts (Table 3).

Table 3: Correlation of Demographic Factors and Improved SWC Structures

Variables	Variables					
	1	**2**	**3**	**4**	**5**	**6**
Sex of household	1					
Age of household	-0.06	1				

Marital status of HH	0.634***	0.017	1			
Education level of household	-0.095	-0.128	-0.086	1		
Family size of HH	0.006	0.457***	0.096	-0.036	1	
Adoption of improved SWC	0.023	0.020	0.119	-0.222***	0.54	1

Note:- 1= sex of household, 2= age of household, 3= marital status of household, 4= education level of household, 5= family size of household and 6= adoption of improved SWC. *** is significant at 0.01 level N=134

The total male and female headed households were 83% and 17%, respectively. In the watershed there are few households headed by females and all of them were not able to participate in the study due to their routine works in their home. The youngest household head was 17 years old and the oldest was 91 years. The productive age (17-68 years old) accounted 94.8 % of the interviewed households and average age of the sampled household was 40.1 years and farmers in this age category were assumed to have a good understanding of problems of soil erosion due to their potential access to information, and as a result, usually they were more interested in soil and water conservation practices than the remaining age groups. More than 46 % of households in the area were illiterate, but 48.5 % and 5% educated up to 1-4 and 5-8 grade level, respectively. The smallest family size of the household was two and the largest eleven. 68.7% of the households had a family size of 2-6 and less than 30 % of households had family size of greater than seven. But the average family size was 5.58 (Table 4 and 5).

Table 4: Values of Some Demographic Variables

	Demographic variables			
	Age of HH	Education level of HH	Family size of HH	Sex of HH
Minimum	17	0	2	-
Maximum	91	7	11	-
	40.81	1.34	5.58	-

Note, N= 134

Table 5: Some Demographic Variables Frequency and Percentiles

Sex of HH				Age of HH				Education level of HH						Family size of HH			
Male		Female		17-64 yrs		>65 yrs		0		1-4		5-8		2-6		7-11	
No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
111	83	23	17	127	94.8	7	5.2	62	46.5	65	48.5	7	5	92	68.7	42	31.3

Note: No. = number counted N= 134

4.3.2. Economic Factors and Improved SWC Practices

Table 6 showed a significant relation at P value less than ten percent (at p<10%) between the economic factors and adoption of improved SWC practices on land obtained by inheritance and land obtained by renting and where as livestock holding was negatively correlated at P value less than ten percent (at p<10 %). The result showed that farmer who obtained land from his ancestor adopt improved SWC practice in the farm land faster than any other means of land ownership with the assumption that no one could deprive his ownership right. Moreover, these groups of farmers conserve also their farm lands to increase the productivity, so that they can have accumulation of assets for the next generation. On the other hands a farmer who obtained land by renting from individual adopt the improved SWC practices to utilize the rented land in good manner in order to get high yield and maintain his long period access to rented land.

Due to waste of time in rearing of livestock and searching of livestock feed farmers with high number livestock adopted improved SWC practices less than those with small number of livestock. Moreover, their resource base was degraded due to over crowding and competition for resource.

Size of cultivated land and land given by government had a positive relation in the adoption of improved SWC measures, even though it was not at significant level. From this result it was possible to see the effect of farm size on the adoption of improved SWC measures. And chance technology adoption is possible as long as the farmers have access to land possessed by the government.

Table 6: Correlation of Economic Factors and SWC Practices

Variable	Variable						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Adoption of improved SWC	1						
Area of cultivated land	0.97	1					
Land obtained by inheritance	0.16*	0.48	1				
Land given by GOs	0.09	0.04	-0.5***	1			
Land obtained renting from individual	0.15*	0.021	0.09	-0.029	1		
Current market average price of crop	-0.104	0.402***	-0.026	-0.078	0.047	1	
Tropical livestock unit	-0.143*	0.314	-0.15*	-0.108**	-0.115	0.468***	1

Note: 1=adoption of improved SWC, 2=area of cultivated land, 3=land obtained by inheritance, 4=land given by GO, 5=land obtained from renting from individual, 6=current market average price of crop, 7=tropical livestock unit. ***.correlation is significant at the 0.01level, **.correlation is significant at the 0.05 level and *.correlation significant at the 0.1 level

The average cultivated land in the area is less than one hectare. 73.1% of the total interviewed farmers ranged from 0.25 ha to 1 ha and the rest 26.9 % have farm size of 1.125 to 3 ha. This shows that majority of the farmers have shortage of farmland. 14.9%, 41.1% and 44% of the farmers obtained a total yield of 1-5 Qt, 5.25-10 Qt and 10.5- 41 Qt, respectively, from their farms in 2010/2011 cropping season. And majority of the farmers have also smallest tropical livestock unit (Table 7),

Table 7: Values of Some Economic Variables

Area of cultivated land(Ha)				Total crop yield in quintal						Total livestock in TLU					
0.25-1 ha		1.125-3		1-5(qt)		5.25-10(qt)		10.5-41(qt)		0-3		3.1-5		5.2-9.6	
No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
98	73.1	36	26.9	20	14.9	55	41.1	59	44	98	73.1	31	23.2	5	3.7

Note: No. = number counted, %= percentile and N= 134

4.3.3. Institutional Factors and Improved SWC Practices

Even if they did not show significance at p<10% level institutional variables 2, 3, 4,5, 6, 7, 8, 10, and 13 showed correlation with the adoption of improved SWC practices,. But extension support to SWC technologies and experience sharing tour had a significant relation at p <5% as shown in table 8. Farmers that had accesses to extension support to SWC technologies like provision of seeds and seedlings and organizing farmers by teams adopted the improved SWC practices than those did not had the access to the above supports. Farmers that had opportunity to see good exercise in and outside the district adopted improved SWC practices than those who did not participate in the experience sharing tour.

Table 8: Correlation between Institutional Factors and Improved SWC Practices

Variable	Variable												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1	1												
2	.11	1											
3	-.106	-.127	1										
4	.046	-.203**	-.051	1									
5	.128	-.064	.054	.137	1								
6	-026	.066	-.22**	.016	-.109	1							
7	.005	.062	.263***	-.034	.147	-.127	1						
8	.035	.067	.091	.000	.101	.055	.086	1					
9	.273**	-.089	-.049	.273**	.126	.068	.022	.058	1				
10	.061	-.025	.094	.124	-.193	.059	-.058	-.047	-.400	1			
11	.164**	-.144	.201**	.161**	.19**	-.117	.235***	-.012	.26***	.005	1		
12	.193**	.064	.14	.125	.31**	-.097	.258***	.152*	.106	-.082	-.082	1	
13	.084	-.106	.027	.279***	.216**	-.132	.177**	.147*	-.005	.298***	.298	.169*	1

Note 1=Adoption of improved SWC , 2=Information source from neighboring farmer, 3= Information source from agricultural office training ,4=Information source from extension agent,5= Information source from NGOs training,6= Other form of information source, 7= whom land belongs, 8= Registration of plots, 9= Support of SWC technologies, 10=Extension service of DAs, 11=Training on SWC technologies in the last three yrs, 12= Experience sharing tour and 13=Credit service in the area.

***.correlation is significant at the 0.01 level, **.correlation is significant at the 0.05 level, *.correlation significant at the 0.1 level

Training on SWC technologies in the last three years had a significant relation in the adoption of improved SWC practices on their farm lands of karita-wuha watershed (at p<10%). This is an indication of how much training was important for the adoption of new technologies.

More than 94 % the sampled households plot was registered and have the right to inherit to their child, but the right to inherit did not had statistically significant in the adoption of improved SWC measures in the watershed (Table 9 and 10). More than 85 %and 75 % have access to extension support on SWC technologies and credit services in the area, respectively. This showed that adoption of improved SWC practices has a greater opportunity in the area. Even though the land ownership goes to the government, some households still believe that the land belongs to them throughout their life time.

Table 9: Same Statistical Values of Institutional Variables

Institutional variables	Yes		No	
	Frequency	Percentile	Frequency	Percentile
Do have right inherit the land to your child?	129	96	5	4
Are your plot registered?	127	94.8	7	5.2
Extension support on SWC	120	89.5	14	10.5
Experience tour	41	30.6	93	69.4
Training on SWC	86	64.1	58	35.9

Table 10: Same Statistical Values of Institutional Variables

Did you get credit service	Yes	Frequency	105
		Percent	78.4
	No	Frequency	26
		Percent	19.4
	Unknown	Frequency	3
		Percent	2.1
Land belongs	My own	Frequency	70
		Percent	52.2
	Government	Frequency	64
		Percent	47.8

Note: - N=134

4.3.4. Physical Factors with Improved SWC Practices

Average slope of land and soil fertility of the land had a non-significant positive correlation. But the location of sampled HH and average distance from home to farm land had negative relation to the adoption of improved SWC (Table 11). The result showed that as average distance from home to farmlands increase the adoption of improved SWC practices decreased.

Table 11: Correlation of Physical Factors with Improved SWC Practices

Variable	Variable				
	1	2	3	4	5
Improved SWC	1				
Sampled HH location	-0.02	1			
Average distance from home to farm land	-0.009	-0.036	1		
Average slope of land	0.05	0.501***	-0.130	1	
Soil fertility of the land	0.105	-0.073	-0.119	-0.214**	1

Note: - 1=improved SWC, 2= Sampled HH location, 3= Average distance from home to farm land, 4= Average slope of land and 5= Soil fertility of the land. ** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed). N= 134

4.4. Factors Affecting Improved SWC Practices

In this section the general relationships that exist between different demographic, socio economic, institutional and physical situation of the study area and farmers decision to adopt improved SWC technologies, at least at the acceptance phase was analyzed. There were different factors that played a major role in the adoption of SWC measures. According to Mcdonald and Brown (2000), farmers seldom sustain the technical solutions offered by external interventions in the long term unless proper consideration was given to those factors. Previous studies, concerning with adoption of SWC technologies have identified, household, farming and other external variables as the major determinants of adoption (Amsalu and De Graaff, 2004). In the case of Ethiopia, several households' and farm characteristics that influence the decision to accept SWC measures have been identified.

For this study the determinant variables selected included age, sex, education level of household and perception towards soil erosion problem from. Farm size (landholding), livestock holdings, on-farm income are among the socioeconomic variables. Access to training, access to extension support in SWC technologies, visits by development agents, access to credit, distance between home and farm lands, degree of slope and the level of soil fertility were also considered.

Age the household head had a positive significant relation at p< 10%) and a unit increase in age of household head has increased the adoption of improved SWC technologies by 0.009 times (Table 12). This proved that as the household heads get older they become more aware of the problems of erosion and the importance of soil and water conservation practices. This result was contrary to Habtamu (2006) and Wagayhu and Lars (2003). Habtamu (2006) and Wagayhu and Lars (2003) have indicated that as age of household increase due to lack labor to construct improved SWC practices adoption of improved soil and water conservation decreased.

Education of level of household head had a positive significant relation at p< 10% and a unit increase in education level of household head has increased the adoption of improved SWC practices by 0.299 times (Table 12). This result is in line with Fikru (2009), who showed the association of education levels with better information gathering on conservation measures that has resulted in a greater adoption of soil and water conservation practices. And Krishana *et.al.* (2008) has also found a positive relationship between the adoption of improved SWC technology and education of the HH head. Therefore, from the above findings it is possible to conclude that education can play a significant role in sustainable development of a country.

Family size of the household and adoption of improved SWC measures showed non-significant negative correlation. Previous study of Amsalu (2006) in the Beressa watershed indicated that farmers with a large family size were less likely to continue using stone terraces. Other studies by Bekele and Drake (2003) and Fikru (2009) have also confirmed the result of Amsalu and indicated that in a large family there is competition for labor between food generating off-farm and SWC activities. On the other hand the results of Eleni (2008) and Habtamu (2006) showed a positive and significant correlation between family size and the continued use of SWC structures.

Size of cultivated land of the household and adoption of improved SWC practices showed negative significant correlation at $p < 5\%$. As size of cultivated land increase by one hectare adoption of improved SWC practices has decreased by 0.334. This implies that farmers cultivating large land are less likely to adopt improved SWC structures. Similar result was also reported by Habtamu (2006). Habtamu (2006) indicated that most of farmers cultivating large holding are older farmers and often these farmers lack labour required for maintaining conservation structures. But, Wagayehu and Lars (2003) found a positive association between the two parameters.

Livestock holding of the household and adoption of improved SWC practice had a positive significant relation at $p<10\%$. Keeping the other factors constant, if TLU increase by one unit adoption of improved SWC practice increased by 1.36 (Table 12). This result contradicts with correlation of economic factor on adoption of SWC practices, because the model did not integrate the demographic and other factors. Fikru (2009) has found similar results and explained that money earned from the livestock has increased the purchase of materials for construction of SWC structures. But on the contrary, previous studies by Salibia andBromely (1986); Gould et al (1980) and Wagayehu and Lars (2003) showed negative association between the two parameters and they indicated that households with larger livestock holding spend most of their slack time looking after livestock. `

The use of land trough out life time and extension support for improved SWC practices had positive non-significant relation at p< 5% (Table 12) and as extension support for improved SWC practices such as provision of seeds and seedlings, awareness creation and organizing farmers by teams increase by one unit adoption of improved SWC practices increased by 0.746 than those who did not had access to extension support.

Slope and adoption of improved SWC practices had negative significant correlation and as slope increase the adoption of improved SWC decreased by 0.849 (Table 12). Thus, farmers at gentle slope fields adopt improved SWC structures less than farmers at lower slope. As slope categories increase adoption of improved SWC structure becomes tiresome due to the concentration of the structure and scarcity of working material. This result opposite the findings of Bekele (1998); Wagayehu and Lars (2003); Wu and Babcock (1998); Ervin and Ervin (1982); Norris and Batie (1987) and Gould et al (1989).

Degree of erosion problem (low, medium and high) on farmlands and adoption of improved SWC structure had positive and significant relationship at p value <5 %. The odds ratio 2.214 implies that as the degree of soil erosion problem increases from low to medium or medium to high the adoption of improved SWC structure increased by 2.14. This result proves the better adoption of improved SWC practices at areas affected by high soil erosion problem than the medium or low affected once.

Table 12: Factors Affecting Adoption of Improved SWC Practices

Variable	**Coefficient**	**Z**	**Odds ratio**
Catchment type	-0.163	-0.52	0.849
Sex of household head	0.937	1.3	2.554
Age of household	0.009	0.52*	1.009
Social position of household head	0.092	0.38	1.096
Education level of household head	0.299	1.77*	1.349
Family size of household head	-0.053	-0.41	0.948
Total cultivated land	-1.097	-2.0**	0.334

Distance from home to his farmland	-0.004	-0.20	0.996
Slope of land	-0.872	-2.14**	0.418
Degree of soil erosion problem	0.795	2.16**	2.214
Soil fertility of the land	-0.264	-0.62	0.767
Perception on soil erosion	-0.209	-0.79	0.811
Total crop cost	0.000	0.7	1.000
Tropical livestock unit	0.312	1.67*	1.366
Expectation to use the land though out life time	0.578	0.46	0.140
Extension support	1.965	-2.24**	0.746
Training of SWC measures in the last three years	-0.191	-0.56	0.825
Credit access	-0.192	-0.35	0.82
Constant	2.19	0.76	

Note: - The regression is logistic regression. LRchi2 (18) =29.83, Pro>chi=0.0392, Log likelihood=68.314075, Pseudo R2=0.1792

Degree of soil fertility and distance from home and the adoption of improved SWC practices had negative and non-significant relation.

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

This study aimed to assess farmers response towards the introduced SWC technologies, identify the type of traditional and improved SWC in use, examine the relationships between socioeconomic, institutional and physical factors and adoption of SWC practices, and find out the major factor that affect the adoption of improved SWC technologies by farmers in Karita-wuha watershed, West Bellesa District, North western part of Ethiopia. The result of this study is expected to give insights to the local government and other stakeholders who are dealing with the introduction and implementation of SWC practices in the study area.

In the study area, the main source of income of the population is agriculture, which is characterized as subsistence and rain fed. The farming system of the area is a mixed type (crop and livestock) like many parts of Ethiopia. The average family size for the study area is 5.58. The average land holding per household is 0.926ha. The average land holding has been declining because of the increasing population. Like many parts of the country, land degradation mainly in the form of soil erosion is the major problem that threatening the productivity of agriculture.

From the total household interviewed 54.5 and 29.8% of them have medium and high degree of soil erosion in their farmland, respectively. More than 98.5 % of the total knows the cause of erosion. 85 and 15 % of the interviewed households indicated that soil erosion, uneven distribution of rain fall, unable to use inputs, absence of SWC structure in the farm lands, deforestation and deforestation, overgrazing, weeds, and pest and disease, are the problems of productivity, respectively. To overcome the problem of soil erosion and the associated productivity reduction factors, farmers have been using various types of indigenous and improved soil and water conservation measures. Currently farmers understood the causes and effects of soil erosion in their farm land, but hesitate to use SWC measures due to dependency syndrome of aids in the area. Therefore, the government and NGO's or other concerning institutions must find other mechanism to implement SWC measures in their area.

The indigenous SWC measures that were adopted by the society for longer period include; stone bund, traditional ditch, trash or garbage cut off drain, plantation of local tree and grass species. They used either single measure or a combination of two and more measures together. Traditional stone bund implemented more than any other structures. Improved (newly introduced) SWC measures were introduced to the society before three years through sustainable water harvesting and institutional strengthening project in Amhara (SWHISA) and the government program of community based integrated watershed management program. The dominant improved SWC measures used by farmers include stone terraces, cut off drain, stone check dam, plantation of improved tree and grass species. However, the degree of adoption of such improved SWC measures are not beyond the acceptance stage of adoption (the first stage in the adoption of SWC technologies) and, therefore, the government and other concerned body have to work hard to put SWC practices beyond acceptance phase in order to rehabilitate the degraded land and safeguard land from further degradation. During target group discussion and informal meeting with farmers, it was possible to understand that traditional stone bund and improved stone terrace are the most preferred once (particularly those who integrate the structures with their farming system) because of their efficiency in conserving soil and increasing the moisture holding capacity of the farm land.

To see the relationships between improved SWC technology adoption and household and farm characteristics of the study area, correlation analysis was employed. Accordingly, SWC technology adoption was negative and significantly correlated with education level of household head. This indicates that as household head education level improves, they start to be involved in nonfarm activities. Among the socioeconomic variables, farm obtained through inheritance and renting had a positive and significant correlation with adoption of improved SWC practices and similarly livestock holding of the household showed positive significant correlation with improved SWC technology adoption when it integrate with demographic, institutional and physical factors. This indicates that as livestock holding increases farmers have accesses to resources for SWC works. Institutional variables such as experience sharing tour; training on SWC technologies in the last three years and extension support on SWC technologies have significant correlation with adoption of improved SWC technologies. Therefore, SWHISA project have to practice these extension inputs more than the previous intervention. Physical factor such as distance from home and slope of farm land had correlated negatively and positively with adoption of improved SWC, respectively.

Age and education level of household correlated positively to the adoption of improved SWC practices. Size of cultivated land and livestock number correlated negatively and positively, respectively, to the adoption of improved SWC practices. From the institutional factor extension support correlated positively to the adoption of improved SWC practices. In the case of farmland characteristics degree of soil erosion problem and slope of the farmland significantly correlated positive and negative with the adoption of conservation technologies, respectively.

Another most important finding of this study was the number of farmers, who integrated SWC technologies with their farming system. 88.8 % of them have maintained the previously constructed structures.

In general economic and institutional factors had played major roles in the adoption of SWC technologies than physical and demographic factors. Thus, one can conclude that the extension service provided by the Sustainable water Harvesting and Institutional Strengthening in Amhara(SWHISA project) through the Districts office of agriculture was an important input in the adoption process of SWC technologies.

5.2. Recommendation

Based on the results of the study the following points were recommended.

- Soil and water conservation programs should be designed by taking variation exist among individual households and plots position into consideration because of the adoption of SWC technologies are determined by socioeconomic, institutional and physical factors.

- Age and education level of household affect construction and maintenance of SWC technologies. Therefore, provision of education (formal education and informal education through farmers training centre and discussion with older farmers would facilitate the adoption of improved SWC practices and reduce farm lands degradation

- 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 government and other bodies involved in SWC works should focus on the conservation of lands before the land lose its fertility

- It is found that SWC works are more adopted by households who obtained land through inheritance. Therefore, those farmers who obtained their land from the government must be informed to use the land properly and that their use right will not be deprived or/and reduced unless the landholding is greater than the optimum. The government and NGOs should focus on provision of land information on land tenure system.

- Conservation works are done more by farmers who took training and experience sharing tour on improved SWC measures. Therefore, the SWHISA project should provide training and experience sharing tour (extension support) and financial incentives at different levels. Moreover, technical support by extension workers on the layout of such structures must be strengthened.

- Farmers did not invest on SWC works if they have large farm sizes. Therefore, the local government should promote need based land tenure system.

- SWC works are campaign 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. Hence, SWC program planning must be the concern of every farmer and the initiation must come from the community. The office of agriculture at local level can only present the technical blue print for consideration.

- Discussion with DAs and extension workers of West Belessa district agriculture office indicated that soil and water conservation works are implemented using the approach of farmers' mobilization. It is not integrated with other development programmes. Therefore, in near future based on the needs of the farmers it should integrate other development aspects.

- In this study the 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.
- The relation of tropical livestock unit obtained contradicted results in both analyses. Therefore, further studies should be carried out in the study area to verify further the impact of TLU.

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APPENDIX

APPENDIX

APPENDIX-A

Conversion factors used to estimate tropical livestock unit (TLU)

Animals	TLU equivalent
Calfe	0.25
Heifer	0.75
Cows and oxen	1.00
Horse	1.10
Donkey	0.70
Sheep and goat	0.13
Chicken	0.013

Source: strock et al. (1991) cited in Fikru (2009)

APPENDIX-B

Conversion factor used to estimate household income using the average market price of the local area in this year

Crops produced in the area	Average market price/k.g in Ethiopian birr
Sorghum	6
Teff	10
Chickpea	10
Maize	6
Finger millet	6
Seasem	19
Others (onion, garlic,etc)	8
Total average price	9.28 birr

APPENDIX-C

PROFORMA FOR SUBMISSION OF M.A. (RD) PROPOSAL FOR APPROVAL

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Name of Study Centre : Addis Ababa

Name of Guide : Eylachew Zewdie (Ph.D)

Title of the Project **ADOPTION OF SOIL AND WATECONSERVATION PRACTICES ON FARMLANDS: THE CASE OF KARITA WUHA WATERSHED, WEST BELESSA DISTRICT, NORTH GONDAR, ETHIOPIA**

Signature of the Student : --

Approved/Not Approved

Date:

ADOPTION OF SOIL AND WATER CONSERVATION PRACTICES ON FARMLANDS: THE CASE OF KARITA WUHA WATERSHED, WEST BELESSA DISTRICT, NORTH GONDAR, ETHIOPIA

BY

MULIE ALEMU BIZUNHE

PROJECT PROPOSAL SUBMITTED TO INDRIA GANDHI NATIONAL OPEN UNIVERSITY (IGNU) FOR THE PARTIAL FULFILLMENT OF MA RURAL DEVELOPMENT

Advisor: Dr. Eylachew Zewdie (PhD)

March, 2012
Addis Ababa

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Acronyms

NGO's: Non-Governmental organizations

OoA: Office of Agriculture

PSNP: Productive safety-net Program

SWC: Soil and Water Conservation

SWHISA: Sustainable Water Harvesting and Institutional Strengthening in Amhara

CHAPTER ONE

1. INTRODUCTION

1.1 Back Ground of the Study

Soil is one of main natural resources in agriculture. Maintain and if possible, increasing the productivity of existing soil is necessary to accomplish production and welfare goals in the short and long term (Alferdo et al., 1993), demanding and degrading these recourse, we do ourselves and our descendants grate land perhaps irreparable hams (Hillel, 1992; Tamiru, 1998).

The indiscriminate humane interference and mismanagement of the soil, however, result in the loss of soil through accelerated erosion. Erosion reduce soil depth , its organic matter, and moisture holding capacity ,which is turn lower crop yields ,shorten fallow periods in appropriately, or induce agricultural encroachment on to lands not suitable for farming(Berhe, 1996; Mclintire, 1990; 1998,1998).

Soil erosion particularly erosion by water is a problem in most parts of the world affecting a number of economic activates including the national economy. According to FAO and UNEP, cited in Sheng (1980) between 5 and 7 million hectors (ha) of land worldwide, are lost annually through soil degradation. If the current rates of degradation continue, close to one third of the world arable land will be destroyed by the year 2000(UN, 1978; in Sheng, 1989).

Ethiopia is one of the poorest countries in Sub-Saharan Africa (Bekele, 1998) as citied Habtamu 2006. Its economy is mainly dependent on rain -fed agriculture. The agriculture sector is the main source of employment for about 80% of the population (FAO, 1993). It also contributed to a very large property of the country's GDP (MoFED, 2002a).

Small holders dominate the agricultural sector of the country. These holders cultivate about 1 hectare of land, the average being 0.8 ha. They produce over 90% of the agricultural output of the country. Nevertheless, most of their produce goes for their own consumption (Stefan.1990).

Despite the fact that the agricultural sector of the country disproportionally employs the largest segment of the population, its contribution to the GDP of the country is only 45% (MoFED, 2002a). Though this can be explained by a multitude of factor, soil degradation is one of the most important factors (Woldeamalk, 2003). In Ethiopia, soil erosion by water constitutes the most widespread & damaging process of soil degradation (Wadeamalak, 2003). It has caused several negative impacts on land (EPA, 2003; CFSCDD/MoA, 1986).

The impact of erosion is particularly severe in the highlands of the country (areas that lie above 1500m), which constitute less than half of the country (~ 43 percent of the country). Due to its favorable climate for production and presence of relatively fertile soil as well as less disease incidence, the Ethiopian highland host about 88% of the national population (FAO, 1986). Thus, the pressure on the resource base Sevier in highland of the country. Though Ethiopian highlands are among those with highest agricultural potential in Africa, they contain one of the largest areas of ecological degradation, and in the world (Hurni, 1983, Blaikie, 1985; Blaikie and Brookfild, 1987; Habetamu, 2006). Studies made in the middle of the 1980s revealed that some 50% of the highlands are significantly eroded, 25% seriously eroded, while 4% had reached a point of no economic return (FAO, 1986a; Habtamu, 2006).

At present, the country is faced with complex problems of severe poverty, low productivity, and poor natural recourse (Peneder et al., 2006) in which the problem of land degradation, mainly of soil erosion is most pervasive.

In response to the problem of soil erosion the government of Ethiopia began in large scale massive conservation programs the 1970s and 1980s. , The 1970 and 1980 were remarkable periods in the history of soil conservation in the country (Amsalu, 2006). However the measure did not mitigated the problem, not where they accepted by the farmer reduced or improved is too low like many parts of the country.

1.2 Statement of the Problem

Agriculture in Ethiopia which is not only an economic activity but also the way of life. The majority of the population is under continuous threat from varies forms of natural resource degradation. Soil erosion is one of the major problems that affected this sector (FAO, 1986). According Greenland et al (1994) cultivated marginal and slopping lands are generally susceptible to soil erosion. Areas which have semiarid climate are also vulnerable to soil erosion because of high and erratic rainfall in the areas. Study indicated that soil erosion in the Ethiopian highland is caused by the combination of many factor such as increase in the slop of most cultivation on sloppy land; high population pressure, clearance of forest, poor management of agricultural land, etc (Fikru, 2009)

The soil conservation research project (SCRP) in Ethiopia has estimated an annual soil loss of about 1.5 billion tones from the highlands and soil erosion is greatest on cultivated land where soil loss is 42 ton/ha/yr (Hurni, 1988). On the other hand the Ethiopian highland reclamation study (EHRS) indicated that soil erosion is estimated to cost the country 1.9 billion US dollar between 1985 and 2010 (FAO, 1986). Wood (1990) indicated that erosion reduce the country food production by1-2% per annum.

Although the history of soil erosion problems goes back to the beginning of agriculture itself, it attracted the attention of policy maker's; researchers and public at large after the devastating famine problem of 1973/74, (Shifraw and Holden, 1998). Knowing the severity of these problems, soil and water conservation technologies were implemented in many parts of the highlands during the 1970s and 1980s. However, they were introduced on some degraded and in food deficit areas mainly through food-for-work incentives (Habtamu, 2006). Reports indicated that these conservation structures have not been adopted and sustainably used by the farmers (Admassie, 2000; Bekle and Drake, 2003, Amsalu, 2006; Eeleni, 2008; Fikru, 2009).

Today extensive conservation projects are being carried out by the government with the help of some NGO's and various conservation measures have been introduced to farmers. The government package of community based participatory watershed management program and productive safety net program which provides farmers with grain or cash payment are examples of programs being carried out.

There are three phases in the adoption process of SWC technologies: the acceptance phase, the actual adoption phase, and the final adoption phase (De Graff et al., 2001). The acceptance phase includes the awareness, evaluation and the trial stages where farmers start investments in certain measures. The actual adoption phase is the stage where by investments are made on more than the trail basis and the third phase, final adoption is the stage in which farmers tend to maintain the previously constructed structures and replicate in to other fields. The introduction of SWC technologies may not lead to sustained and rehabilitation unless the farmers proceed to final adoption, where farmers begun to integrate the measures with their farming system. However, the results of researches in many parts of the country indicate that the adoption rates of conservation technologies are far below the expectation (Antle et al., 2005). Farmers, in the area where the productive safety net program is being implements are criticized for they preferred to remove the structure from their farm land instead of maintaining and replicating them after they are constructed (Eleni, 2008; Fikru, 2009).

The limited adoption and spreading of soil and water conservation practices is not only due to technical problems, rather it is due to a socio-economic and biophysical problems with many constraints playing a role (Kessler, 2006; Tadele, 2011). The growing number of studies, made on SWC adoption showed that various demographic, socioeconomic, institutional and biophysical attributes have influential roles on the decision of farmers' towards the adoption of SWC measures (Noris and Batie, 1987; Amsalu and De Graff, 2006;Eleni, 2008; Fikru, 2009). Therefore clear understanding about the level of adoption and the local factors, work against farmers decision is an important parts of the government policy of combating sever soil erosion as one factors of increasing productivity.

From the North western highlands of Ethiopia, Karita Wuha sub watershed is one of the areas, which is exposed for series erosion problems. Therefore; developing SWC measures are suitable with the local environments and executing them in an efficient way is a burning issue of sustainability that needs an integrated effort from the government, researchers, NGOs, the general public, and other concerned bodies. In the study area where, this research will be conducted conservation practices are going on by the government as one package by PSNP in the name of integrated watershed management program with the help of the project Sustainable Water Harvesting and Institutional Strength in Amhara (SWHISA). However; reports of West Belessa district Agricultural Office (2011) and the informal field observation indicates the rate of adoption of SWC technologies mainly of the newly introduced/improved is too low like many parts of the country.

1.3 Hypothesis and Research Questions

Hypothesis

Farmer’s decision about SWC practices can be conceived of having two components: whether to use SWC practices and, if so, how many practices to use on how much land or not use SWC practices. Both of these components are assumed to be influenced by a number of factors that are related to farmer’s objectives and constraints. The dependent factors represent the SWC practices in each plot and independent variables represent factors both household level and plot level.

Research questions

- What are the indigenous and newly introduced SWC technologies currently implemented by farmers in the study area?
- How farmers in the study area responded towards the introduction of conservation technologies?

- What is the correlation that existed between demographic, socioeconomic, institutional and physical conditions of the study area and the adoption of SWC technologies?
- What are the major constraints affecting the rate of improved SWC technology adoption being implemented in the study area?

1.4. Scope and limitation of the study

Scope of the study

This study limited to the study of adoption of SWC technologies in karita Wuha watershed with the last three years of intervention by SWHISA project. In this study the area coverage of the watershed 345.33ha and 268 households.. Different types of conservation measures are introduced to the study area. But, assessment of farmers' adoption of SWC structures is limited to structures introduced on farm lands.

Limitation of the study

In this study the researcher encountered with many constraints. The major constraints face the researcher shortage of money because till now the researcher cannot get any sponsor, this may make difficulty of data collection from rural households, where more of the respondents are illiterate. Most of the data collected by directly by observing the farm plot this may make the situation complex.

Another constraint is shortage of time by the researcher, because the nature of the data collects, and the presence of office works and social responsibilities. The other most important limitation of the study will be lack of willingness by some of farmers to give genuine information on some issues, for example information on land holdings and income. And absence of well compiled data in the study area will be another shortcoming.

1.5. Objectives of the study

General Objective

The general objective of this research will be to assess farmers' perception towards the adoption of traditional and newly introduced SWC technologies and evaluate how households and farm characteristics are correlated with the adoption of newly introduced/improved SWC technologies in Karita-Wuha watershed.

Specific Objectives

- To assess farmers response towards the introduction of SWC technologies.
- To identify the type of traditional and improved SWC structures implemented on farm land.
- To investigate the correlation of demographic, socioeconomic, institutional and physical factors and the improved SWC structures by farmers.
- To find out the major factors that affect the adoption of improved SWC technologies currently implemented in the study area

CHAPTER TWO

2. LITERATURE REVIEW

2.1 Theoretical Framework

2.1.1 Definitional problems

Land degradation, soil degradation and soil erosion are related concepts used interchangeably. Land degradation is a broad term, reflecting the fact that land itself is abroad term, including more than just soil (Yesuf and Pendre, 2006). Land degradation in the form of soil of soil erosion, sedimentation, depletion of nutrients, deforestation, and overgrazing- is one of the basic problems facing farmers in the Ethiopian high land, 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 “down hill spiral of un-sustainability” leading to the “poverty trap” (Green land et al., 1994; Fikru, 2009).

Soil degradation is narrow term for declining soil quality, encompassing the deterioration in physical, chemical and biological attributes of the soil. The physical degradation such as compaction, surface sealing and crusting, water logging and acidification; chemical degradation includes depletion of soil nutrients, acidification, Salinization and pollution; and biological degradation including loss of soil organic matter, flora and fauna populations or species in the soil.

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. The Ethiopian highlands have been experiencing declining soil fertility and sever soil erosion due to intensive farming on steep and fragile land (Amsalu and De Graff, 2006; Fikru, 2009). 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 high lands (1/2 million km2) losing 3mm 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 (Tantigen and Mohammed et al., 2009). Those parts of the highlands, which are not yet threaten by famine, are being gradually degraded, and it is a question of time before the problem threatens the livelihood in these areas too.

2.1.2 Soil and water conservation technologies: Types and Importance

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 (Pagiola, 1999; Ankeny et al., 2008; Tadele, 20011). In response, considerable public and private resources have been mobilized to develop soil and water conservation (SWC) technologies. Broadly SWC technologies can be categorized in to three categories these are structural methods, agronomic practices and water harvesting practices.

SWC 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 effects of erosion such as siltation, rivers, lakes and dams (Minale et al.,2008; Tadele, 2011).

2.1.3 Soil and Water Conservation in Ethiopia

SWC technologies are very important in mountainous areas of developing countries like Ethiopia and other countries other than other parts of the world; because of the peoples in such areas rely almost wholly on agriculture for their income and livelihood. This 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 (hurni, 1986; Wogayehu and Lars, (2003); Habtamu, 2006). The famines of 1973 and 1985provided an impetus for conservation work through large increase in food aid (imported grain and oil). Following these sever famines, the then government launched an ambitious program of soil and water conservation supported by donor and non-governmental organizations (Hoben, 1996). The use of food aid as a payment for labor replaced voluntary labor for conservation campaigns (Campbell, 1991; 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 and coercing farmers to adopt conservation measures. Nevertheless, the implementation was very poor few structures persisted causing erosion rather than preventing it (Pretty and Saha, 1996; Habtamu, 2006). As a rule of tamp pluoghing of lands recommended up to 45% slope of land and conservation structure most suitable up to 8% slope of land.

2.1.4. **The adoption of SWC Technologies**

Soil and water conservation measures reduce soil erosion without any doubt. For instance, soil loss estimates from soil conservation research project experiments in the north western and north eastern high lands of Ethiopia indicate that Fanajuu bunds, on average could reduces soil loss by 65 %or 25-72 tons per hectares per year (Grunder and Herweg, 1991a, 1991b; Tadele, 2011).

The adoption of improved SWC technologies in developing countries has attracted much attention from scientists and policy makers mainly because land degradation is a key problem for agricultural production (De Graaf et al., 2008). 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 SWC measures on more than a trial basis. The third phase, final adoption, is the stage in which the existing SWC measures are maintained over many years and new ones are introduced on other fields used b the same farmers.

Kessler (2006) considers 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 economical 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. These are farm level and farmer (house hold) attributes (Bekele and Drake, 2003). The farmer or household attributes include: the demographic and socioeconomic variables and among the farm level attributes are the biophysical conditions of the farm plot. However because of the presence of agro-ecological differences, the variables that affect one area may not be true for other areas. Therefore it is necessarily important to test whether or not the variables in the existing literature have similar results in the study area.

2.2. Determinants of SWC Adoption

Integrating SWC technologies with the system of agriculture is the issue of sustainability for many countries, whose economy largely depends on agriculture (Antle et al., 2005; Hengesidjisk et al., 2004; Minale et al., 2008 and Fikru, 2009). In response to high demand of improving the productivity of land many countries including Ethiopia are engaged in massive soil and water conservation 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 are rarely 100 % , if ever and are often below 50 % and in some near to zero. As a result of this many studies have been conducted on different parts of the world including Ethiopia and there is a high need of further studies about determinants of SWC adoption.

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 various personal , socioeconomic, and biophysical conditions (Bekele and Drake, 2003; Eleni,2008 and Fikru, 2009).

2.2.1. Demographic Factors

Farmer's perception of soil erosion problem: perceiving the problem to adopt conservation practices that stop the problem (Long, 2003; Traore et al., 1998; Habtamu, 2006).Traore et al (1998), as cited by Habtamu (2006) indicated that higher degrees of perception of environmental damage further reinforces and enhances farmers' adoption of best management practice. Norris and Batie (1987) indicate that farmer's perception of soil erosion problem is positively correlated with their decision to the adoption of SWC technologies. On the contrary, Belay and Woldeamlak (2003) in their study found that in spite of high level of adoption of conservation structures was very limited. Kessler (2006) found that perception of the problems did not influence farmers' decisions on how much to invest in soil and water conservation. (Woldeamlak, 2003; Habtamu, 2006) conclude that perception of erosion problem is not a sufficient condition for adoption of conservation practices though it is a necessary one.

Age of the household head: age is another issue, found to be important factor in the existing literature. Chombar (2004) found that age of the household head has a positive and significant relation with cutoff drain type of SWC adoption. Fikru (2009) found similar results in his research on koga watershed. On the contrary, Eleni (2008) in her research on southern Ethiopia indicate the age of the household head has negative, but not significant influence on the continued use of SWC technologies. Another research conducted by Sidba (2005) concludes that younger household head have more probability of using 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 (Etana, 1985; Habtamu , 2006). The findings of Krishana et al.(2008) and Fikru(2009) indicates 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 their understanding of new technologies. In the contrary the findings of Eleni(2008) show that there is no significance correlation between education level and adoption of SWC measures. According to her explanation the reason for this negative, but not statistically significant result because of positive and significant correlation between education and off-farm activities.

Sex of the household head: in his study of Fikru (2009) showed that households headed by women have no significant differences with that of households headed by man in their adoption behavior of SWC technologies. In the researches of Eleni (2008) and Krishhana, et al. (2008) the opposite is true. Male headed households have a higher chance to be involved in continued use of SWC than female headed households because of women spend most of their time in domestic responsibilities.

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 (Wagayehu and Lars, 2003; Habtamu, 2006). Wol deamlake (2003) identified lack of interest in SWC measures to be shortage of labor. Geoffer (2004), who found that household size, was associated negatively with adoption of no conservation practice and positively with adoption of conservation practice. Yet, studies conducted in Ethiopia indicated reverse, larger family size has negative impact on the adoption of SWC technology (Bekele and Drake, 2003; Amsalu, 2006: and Fikru, 2009). The proponents of this view supports their findings with the explanation that in a family with large number of mouths to feed, immediate food need is given priority labor is diverted to off-farm activities that generate food. Another explanation is when population increases, landholding per household will decrease which in turn has a negative on SWC adoption.

2.2.2. Socioeconomic Factors

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 is, farmers with a large farm land get a high annual income that helps them to invest more on resource conservation.

Land ownership-studies found tendency of operators to use more conservation practices on land they owned compared to land they rented (Esseks and Kraft, 1989; Atakilte, 2003, Habtamu, (2006)). Ervin and Alexader (1981), as cited by Habtamu (2006) observed erosion to be more sever on rented land than on owned. On the contrary, (Bultena and Hiberge ,1983; Habtamu, 2006)and (Traore , 1998; Hbtamu, 2006) did not find a relationship between the way farmers accessed land (whether rented, leased or owned) adopting conservation measures.

Wealth status- the wealth status of farmers is found to be positively correlated with the farmer's adoption of SWC measures (Norris and Eleni, 1987; Bekele and Drake, 2003; Kessler, 2006 and Eleni, 2006). According Bekele and Drake, (2003) the opportunity cost of labor for wealthier farmers is lower than poorer farmers, so that they can invest their available labor in SWC activities during slack labor season.

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

2.2.3. **Institutional Factor**

Information – farmers who know nothing about a practice cannot be expected to adopt it unless they understand its expected costs and benefits. Accurate and timely information has a positively impact on farmers 'conservation adoption decision. More informed farmers better assess the impact of soil erosion on long-term productivity of their farm land and adopt practices that help resolve the problem of soil degradation (Traore et al., 1998; Habtamu, 2006).

Visits by development agents- the existing literature holds two opposite views concerned with visits by development agent on SWC adoption. One view holds that, contact with extension personnel increases the amount of variance explained in conservation tillage (Nowak, 1987; Habtamu, 2006). The study conducted in Ethiopia indicated that if a farmer receives better information/advice from extension agents, the farmer will be willing to construct new conservation measures and to maintain the existing ones (Wagayehu and Lars, 2003).

On the other hand, Fikru (2009) in his study on Koga watershed indicate that visits by development agents have no significant effect on the adoption of SWC technologies by farmers. Eleni (2008) reached similar conclusion. She explains that the reason for this insignificant may be the fact that visits by development agents is usually focused on matters other than conservation measures.

Training- training in a wide sense, including education and awareness rising, has been the main activity, crucial for successful participation. The more educated and trained a person is, the greater opportunity he/she has to participate in planning and decision making as well as project implementation (Lill, 1993; Tamiru, 1998).

Land tenure- in countries having a land tenure which is characterized by government ownership of land it is belived that there is a fear of losing land holding in the coming redistribution

(Shiferaw and Holden, 1998; and Admassie, 2000, Tadele, 2011). As a result of this farmers tend to invest less for any kind of investment on their plot. The degree to which incentives to conserve soil are effective is greatly influenced by land tenure. It is well known that uncertainty of land tenure leads to soil depletion, because farmers are not certain to their entitlements with regards to use the land, they try to maximize short term production grains and tend to disregard long term investments (Afredo et al.,1993; Yerasworq, 1992; Tamiru, 1998). Furthermore, the frequent redistribution of land caused farmers to feel insecure, since they may lose parts of their farm in the near future (Keddeman, 1989; Tamiru, 1998), and this will have an impact on soil conservation activities (Singh et al., 1993, Tamiru, 1998). On the other hand studies in some parts of Ethiopia proved that the present land tenure systems of the country have no significant effect on the farmers investment of any kind of technologies on their land (Bekele and Darke, 2003; Eleni, 2008; Fikru, 2009).

2.2.4. Physical Factors

Slope of the farm land- like rain fall and nature of soil that affects the rate and amount of soil that affect erodibility, slope of a field affects the rate and amount of soil loss from fields (Tripathi and Singh, 2001; Habtamu, 2006). This influences 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. The degree of slope positively affects the investment of conservation measures (Bekele and Drake, 2003; Amsalu, 2006; Eleni, 2008, and Fikru, 2009). Farmers cultivating steep slope fields install more effective conservation measures than farmers that cultivate level fields (Saliba and Bomley, 1986; Habtamu, 2006).

Soil fertility- farmers perceive the effect of soil erosion when it reaches some critical level, which is very difficult to reverse the degradation at the subsistence farmer level (Osgood, 1992 in Woldeamlake, 2003; Habtamu, 2006). On deep and/or fertile soil, erosion process does not affect farmers at least in the short term. The symptoms of erosion can be easily plowed away and on such sites there may not be a big effect on productivity of land although the problem is recognized. Farmers cultivating such lands are reluctant to apply soil conservation measures (Valk and Graaff, 1995; Habtamu, 2006). According to Eleni (2008) the level of soil fertility has a negative and significant correlation with the degree of SWC adoption. The explanation here is farmers may have interest to improve the level of soil fertility that are already exhausted and increase the productivity of their plot.

Proximity- farmers residing close to their cultivation land invest more on soil conservation measures than their counter parts living at a distance. This is because cultivation land closer to the residences receives more attention and supervision than that is situated at the farthest distance. Farmers also want to invest more in the field that requires least effort (Kessler, 2006; as cited Habtamu, 2006). According to Gebrmedhin and Swinton (2003) plot from homestead discouraged investment in soil conservation, Fikru (2009) also found similar results. Wogayehu and Lars (2003) found significant and negative correlation between no conservation decision and distance of a parcel from the residence but positive correlation between distance of the pot and adopting conservation decision.

2.3. Conceptual Framework

In this study the factors/variables/ that may determine the adoption of SWC technologies are grouped in to four categories such as: 1) the demographic factors include farmer's perception of soil erosion problem, age of the household, education of the household head, sex of the household head and family size of the household, 2) socioeconomic factors such as farm size, land ownership ,wealth status , availability of credit services etc; 3) institutional factors includes information , visit by development agents, training, land tenure; and 4) the physical factors that include slope of farm land , soil fertility and proximity.

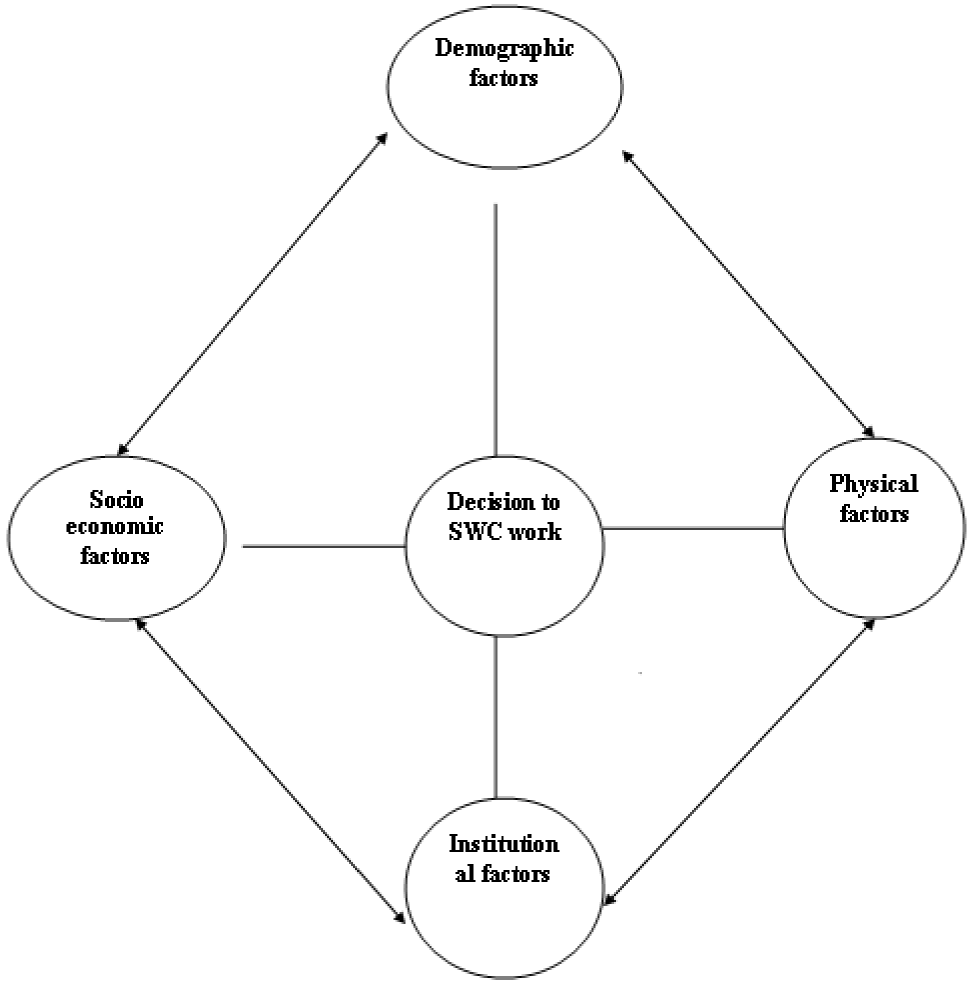

Figure 1: Factors that influences the adoption of SWC technology on farm lands (Tadele, 2011)

CHAPTER THREE

MATERIAALS AND METHODES

3.1 Description of the Study Area

3.1.1. Location

Karita-Wuha watershed is one of the smallest watersheds in West Bellessa district, in North Gondar Administration zone of the Amhara Regional State. Arbya is the district capital which is 726 km far from north of Addis Ababa. Geographically, it is located at 12^{o}27' latitude and 37^{o} 46' longitude. The watershed covers a total area of 345.33ha.

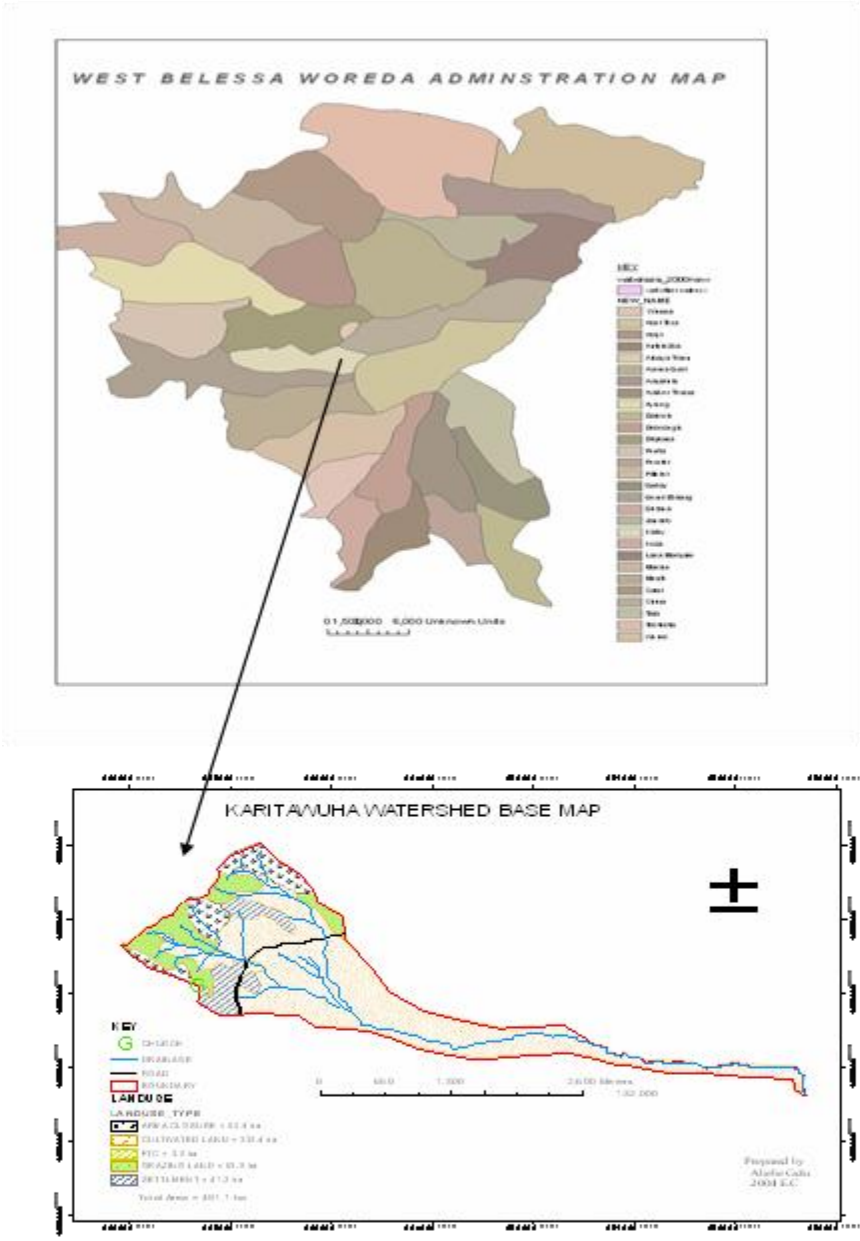

Figure 2: Map of the study area with in West Belessa Administration with all kebels and karita-wuha watershed (OoA, 2011)

3.1.2 Topography

Karita-wuha watershed is found in the north western highlands of Ethiopia. There are four types of land form based on their slope. These are mountain (> 50 % slope), pleatu (30-50 % slope), undulated (9- 30 % slope) and gentle slope or almost plain (0-8 % slope). The study area found at 1900 meter above sea level, so it is assigned in winadegh zone (Managing land, 2005: Abebe et al., 2009).

3.1.3 Climate

Rainfall pattern of the areas is unimodal, with much of the rainfall occurring between June and September. Annual rainfall is below 900 mm. The mean annual temperature in the watershed is on average 27 degree centigrade.

3.*1.4* Soils

Four types of soils found in each land form, the steep slope mountains have very shallow depth and sandy texture, semi mountains /hills/ have better depth and fine particles of the soils easy for erosion moderate slopes have moderate depth soils with clay and loam texture., and the remain flat land has a good or best soil depth and black clay soil.

3.1.5 Vegetation types

The area in the past decades was forest with species such as Cordia africana (wanza), Acacia seyal (keygirar), Dodonaea viscose (kitkita) and the like. But currently it is covered with the bushes of Otostegia integrifolia (tinjut), Dodonaea viscose (kitkita) Calotropis procera (tobiaw) Euclea racemose (dedeho) and Euphorbia triucalli (kinchib).

3.1.6 Population

In the watershed 1340 people (690male and 650 female) are living within karita wuha watershed. From this male headed households are 193 while female headed households are 75 totaling to 268 households.

3.1.7 Socioeconomic Conditions

The base of economy is the rain fed agriculture. Cultivation of land is carried out using a pair of oxen and traditional implements like “Marsha”. The main crops grown in the area include: Zia Mays (maize) Sorghum bicolor (sorghum), Eragrostis tef (teff), Cicer arietinum (check peas) etc. cattle, sheep, goat, donkey, poultry, etc are among the animals domesticated in the study area.

3.2 Design and Methodology

3.2.1 Type of Research Design

To study the adoption of soil and water conservation technologies in the watershed blocking the lands based on slope. Block one from 8- 15%, block two 16-30% and block three 31-50%.

3.2.2. Sampling Techniques

In West Belessa woerda 252 small watersheds the researcher selects Kaita Wuha watershed purposively because it is representative, model watershed of the wereda and SWHISA project and accessibility of the researcher. From each block 50 percent of the population used as a sample.

3.2.3 Data Collection Methods

Quantitative and qualitative approach will employ to collect the data. The data source of this study will be both primary and secondary. The primary data will collect through formal survey using structured questionnaire. And target group discussion with key informants will be conducted by using watershed teams, kebele chairman and woreda natural resources process head. The secondary data for the study will collect from SWHISA project, Zonal and wereda agricultural office, training manuals, literatures including previously made researches on similar topics.

3.2.4 Methods of Data Analysis

The data collected from different methods of primary and secondary techniques will be analyzed both qualitatively and quantitatively. The quantitative techniques include some descriptive statics, cross tabulation, figure and correlation analysis by using SPSS soft ware. Filed observation and informal and formal discussion will be analyzed using a qualitative analysis technique.

4. Time table

Table1: work plan

No.	Research activity	Time estimated
1	Submission of report	February 20-29/2012
2	Selection of sample	March 1-7/2012
3	Selection of data collector	March 8- 12/2012
4	Data collection	Marc13-April 13/2012
5	Editing of data	April 14-21/2012
6	Processing of data	April 22-30/2012
7	Statistical analysis of data	May 1-7/2012
8	Writing report	May 8-21/2012
9	Submission of report	May 22-30/2012

5. Estimated cost of the study

Table 2: Estimated Budget for the Study

No.	**Issues**	**Quantity**	**Unit price**	**Total**
1	Literature search			
	Photocopy service	1500 pages	1	1500
	Printing paper	3 reams	100	300
	Pencils	1 dozen	50	50
	Pens	1 dozen	300	300
	Duplicating paper	4 reams	100	400
	Flash disk	1 (4GB)	300	300
	Rewritable CD	6	25	150
	CD-R	10	8	80
2	Interview			
	Video cassette	2	100	200
	Tape recorder	2	600	1200
	Tape recorder cassette	6	35	210
	Battery	6 pairs	15	90
3	Assistant to data collection			
	Data collectors	6	1000	6000
	Data translators	3	1000	3000
4	Transportation cost	-	-	2000
5	Statistician	1	1000	1000
6	Contingencies			1708
Total				**18788**

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STRUCTURAL SURVEY QUESTIONNAIRE FOR FORMAL INTERVIEWER

Survey on adoption of soil and water conservation practices in Karita Wuha Watershed

West Belesa District, Ethiopia

Mulie Alemu

Indria Gandhi National Open University

1. General information

Farmer's survey identification: ---

Interviewer: ---

Date of interviewer: --

Respondent name ---

1.1) Sex: 1) Male 2) female

1.2) Age ------------ years

1.3) Marital status: 1) Single 2) Married 3) Divorced (separated)

4) Widow 9) No applicable

1.5) Kebele ---------------------

1.6. Distance to woreda market-------------------------------- (in minute)

1.7. Social position in the kebele

1. Members of kebele council 2. Religious leader

3. Other, specify --------------- 4. None

1.9 Educational level --------------------grade

2. Household characteristics

2.1 household family members' information

Sex

Male --------------- (No)

Female ------------- (No)

Age

0-15yr -------------- (No)

16-64yr ------------- (No)

Greater than 64 -------------- (No)

Education

0 grade ------------ (No)

1-4 ------------- (No)

5-8 ------------ (No)

9-12 ---------- (No)

3) Landholding and farm characteristics

No	Types of land use	Area in hectare(ha)
1	Cultivate land (farm land)	
2	Fallow land	
3	Grazing land	
4	Forest land	
5	Others	
6	Total	

4) Description of farm plots

Code: 1.Cultivated 2.Follow land 3. Grazing land 4.Forest land 5.Others 6. Total

No	Description	Plot 1	Plot 2	Plot 3	Plot 4	Plot5	Plot 6
1	Area of the plot()ha						
2	Source of the plot ownership 1.inherited from family 2. given by gov,t 3. rented from individuals 4. others (specify)						
3	Distance from home (in minute)						
4	Slope of land 1. Flat (0-5 %) 2. Gentle slope (6-15 %) 3. steep slope (16 % and above)						
5	Degree of soil erosion problem on the plot 1. low 2. medium 3. high						
6	Soil fertility of the slope 1. low 2. medium 3. high						

7	The type of SWC structure made on the plot 1. no SWC structure is made 2. indigenous SWC measures 3. improved SWC measures						
8	The time SWC measures is made (year)						
9	The name of indigenous SWC						
10	The amount of improved SWC measures made on the plot (in meter or number						
11	The name of improved SWC measures on the plot						
12	The amount of improved SWC measures made on the plot (in meter or number)						
13	Do SWC measure on the farm plot maintained 1. yes 2. no						
14	The present status of SWC measures 1. totally removed 2. partially 3. no removed 4. modified(adapted) 5. NA						

15	Source of labor for the construction and maintenance of SWC structures 1. family labor 2.hired labor 3. community participation 4. labor exchange (Debo)						
16	Perception of the farmer about soil erosion problem after the SWC measure is done 1.aggravated 2.remain constant 3. improved						
17	Physical Improved soil and water conservation structures built in meter or No						
	Soil terrace						
	Cut off drain						
	Stone check dam						
	Planting of d/t trees in No						
	Others, specify						
18	Who constructed the structures? 1) community participation 2) family (hired) labor						

	3) financial incentives by government 4) labor exchange 5) NA						
19	Who did the maintenance work? 1) community participation 2) Family 3) hired labor 4)Labor exchange 5) NA						
20	Traditional soil and water conservation structures built (in meter) 1. Traditional stone bund 2. Traditional ditches 3. Trash (garbage) lines 4. Cut off-drain 5. Plantation6. Others, specify						

5. Households income

5.1 Subsistence crops produced in the harvesting period of 2003/2004 EC

no	Types of subsistence crop	The amount of production	Cost /Qt if sold in market
1	Sorghum		
2	Teff		
3	Chickpeas		
4	Maize		
5	Sesame		
6			
7			
8	Others		

5.2 Off-farm activity produced in period of 2003/2004 EC

no	Off-farm (Non-farm) income	Family relationship	Annual income in Ethiopian birr
1	Petty trade		
2	Pottery		
3	Weaving		
4	Leather making		
5	Selling fire wood		
6	Labor wire out		

7	Selling water		
8	Selling charcoal		
9	Others		

5. Livestock holding of the household

no	Type of livestock	Number
1	Ox	
2	Cow	
3	Calve	
4	Heifer	
5	Horse/mule	
6	Donkey	
7	Goat/sheep	
8	Chicken	

7. Perception of farmers towards soil erosion and SWC technologies

7.1 What are the major problems of productivity in your farm land?

7.2 Do you know the cause of soil erosion?

a) Yes b) no

7.3 If your answer for question number 7.2 is yes what are the causes?

7.4 do you know the existence of improved soil and water conservation structured to protect the problem of soil erosion?

a) Yes b) No

7.5.1 If yes for 7.4 which type do you know?

1. Stone bund 2. Soil bund 3. Cut off drain 4. farm terrace 5. Planting of trees 6. Eye brow basin

7.6 What is your source of information for improved SWC technologies?

1. Neighboring farmer 2. Training by the wereda agricultural office

3. Extension agents 4. Training by NGO's 5. Other, specify--------------

7.7. Which of the following types of soil and water conservation measures are efficient and suitable to your farm plot?

1. Stone bund 2. Soil bund 3. Cut off drain 4. farm terrace 5. Planting of trees 6. Eye brow basin

8. The attitude of farmer about the existing land system

8.1 Whom do you think land belongs to?

a) My own b) the gov't c) unknown

8.2 do you think that you have the right to inherit the land to your children?

a) yes b) no

8.3 do you expect that you will use the land throughout your life time?

1. yes b) no

8.4 do you agree if the gov't allows private landholding and give farmers to sell, and change their land

1) agree 2) disagree 3) difficult to decide

8.5 are your plots registered?

1) yes 2) no

8.6 If yes for 8.5; did you get certificate for all plots?

1) yes 2)no

9. Farmers response about the extension support of the area

9.1 do you get extension support on SWC technologies

1) Yes 2) no

9.2 If yes for 9.1, who provide you the extension service?

1) DA's 2) extension workers of local agricultural office 3) NGO's

4) Others, specify------------------

9.3 How do you evaluate the degree of extension support on SWC works?

1) too little 2) less than enough 3) enough 4) more than enough

9.4 How often you have been visited by DA's

1) every one week 2) in every two weeks 3) in every weeks

4) in every one month 5) others, specify----------------------------

9.5 have you ever taken training on SWC technologies in the last three years?

1) yes b) no

9.6 If yes for 9.5, How often?

1) once 2) twice 3) three times 4) other , specify-------------------

9.7 If you ever took training, who provide the training?

1) DA's 2) the wereda agricultural office 3) NGO's 4) others

9.8 was the training helpful to your understanding of SWC technologies?

1) yes 2) no 3) difficult to decide

9.9 have you ever get experience sharingand tour ?

1) yes 2) no

9.10 If yesfor 9.9, how often?

1) once 2) twice 3) three times 4) other, specify---------------

9.11 if you get experience sharing tour , who provide the tour?

1) DA's 2) the wereda agricultural office 3) NGO's 4) others

9.12 was the tour helpful to your understanding of SWC technologies? 1) yes 2) no 3) difficult to decide

9.13 is there credit service in your locality?

1) Yes 2) no 3) unknown

9.14if yesfor 9.13, what was the source of the credit service?

1) ACSI 2) food security 3) gov't 4) friends 5) others, specify------------

9.15 How many times you get the credit service?

1) in the last four years 2) in the last three years 3) in the last two years 4) in the last one years 5) other , specify----------

9.16 Where do you spend the money, you borrowed?

1) To buy food 2) for trade 3) to buy farm inputs 4) to buy domestic animals

5) others, specify------------

Thank you very much for your cooperation!!!