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CHALLENGES OF SOIL AND WATER CONSERVATION PRACTICES AND
MEASURE TO BE UNDERTAKEN: THE CASE OF WUCHALE DISTRICT,
NORTH SHEWA ZONE, OROMIA REGIONAL STATE, ETHIOPIA.

BY: HABTAMU OLANA

ADVISOR: ASMAMAW LEGASS (PhD)

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A THESIS SUBMITTED TO ADDIS ABABA UNIVERSITY, THE SCHOOL OF GRADUATE STUDIES, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN GEOGRAPHY AND ENVIRONMENTAL STUDIES (SPECIALIZING; LAND RESOURCES MANAGEMENT).

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ETHIOPIA

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Declaration

I undersigned declare that this thesis which entitled “Challenges of soil and water conservation practices and measures to be undertaken in the case of wuchale District, North shewa Zone, Oromia Regional state, Ethiopia” is my original work and that all relevant sources used in the thesis have been due acknowledged.

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LIST OF ACRONYMS

ADLI	Agriculture Development-Led Industrialization
ANRS-BFED	Amhara National Regional State Bureau of Finance and Economic
CSA	Central Statistics Authority
CBO	Community Based Organization
CFW	Cash for Work
EFAP	Ethiopian Forestry Action Program
FAO	Food and Agricultural Organization
FFW	Food for Work
Ha	Hectares
IIED	International Institutes for Environmental and Development
IK	Indigenous Knowledge
IJEMA	International Journal of Environmental Monitoring and Analysis
Km	Kilometer
MoA	Ministry of Agriculture
NGOs	Non-Governmental Organizations
PAs	Peasant associations
SIDA	Swedish International Development Agency
SWC	Soil and Water Conservation
UN	United Nations
UNESCO	United Nations Educational Scientific and Cultural Organization
USAID	United States Agency for International Development
WFP	World Food Program
WDNRMD	Wuchale District Natural Resource Management Department

Abstract

Soil and water conservation in Ethiopia was not only closely related to the improvement and conservation of ecological environment, but also to the sustainable development of its agricultural sectors and its economy at large. In the study field survey, questionnaire and interviews were conducted to collect the necessary data from 122 sample households; which were selected via simple random sampling and purposively from four kebeles of Bole Becho, Bosoke Jate, Iluna-egu-Kura, and Ielu-Iteya. The household survey questionnaire data have tabulated, and summarized by utilizing the basic statistical package for social science (SPSS). The result shows that farmers of the study area were not participating on SWC activities by their interest (voluntary) but by the force of community leader, DAs, and district administrative order they are participate on the practices. The study revealed that factors such as; slope of the area, tenure status, age, gender, education status of households, land size, lack of information, level of contact with DA, lack of awareness, length of food secured months etc; are influence the practices of soil and water conservation structure. The farmer destruct the SWC method because of searching fertile soil, to join their plot of land, for need to avail more land, to destroy hiding places of rodent pests, removing a bund about to collapse etc. They said that when the risers become big, it cover large area that makes the cropland narrower, fertile soil were used for construction, and it allows weeds to cover the farmland. Soil bund, micro basin, improved pit, terraces, water way, cut off drain, drip irrigation and compost are the soil and water conservation structure practiced by farmers and DAs on small farm land to improve the fertility of soil. As the result of the study indicates to decrease the challenges of SWC in the study area of wuchale district, the DAs, and experts of the natural resource of the area advice farmers as it is not important to destroy the terrace bench, soil bunds etc;. They advise, as it would be better to redevelop the existing terraces and supporting them with other soil fertility and SWC methods and train the farmers to change the low awareness they have on SWC practices.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

At the contemporary time, the depletion of natural resources is among major problems facing humans throughout the world. The International soil Reference and Information Center (1995) estimated that nine million hectares of the world lands are tremendously degraded and their original biotic functions are severely degraded. However, 1.2 billion hectares of the world land was moderately degraded. Worldwide inappropriate agricultural practices account for 28% of the degraded soils (Addisu, 2011).

Similarly, in Ethiopia the depletion of the soil and water resource is enormous. Dominated by small-scale agricultural practices, Ethiopia is one of the most severely eroded countries in the world. Natural resources degradation is the main environmental problem in the country. Degradation mainly manifested through soil removal, nutrient exhaustion, deforestation, and run of surface water. The majority of the farmers in rural areas of Ethiopia are subsistence-oriented, commonly cultivating impoverished soils of sloppy and marginal lands where soil removal were highly susceptible (Million and Belay, 2004).

Soil erosion is a global environmental problem causing the loss of fertile top soil and reducing the productive capacity of the land and thereby raises the risk of global food security. It also negatively affect the natural water storage capacity of catchments areas, man-made reservoirs and dams, quality of surface water, the aesthetic value of the landscape and ecological balance in general (Woldeamlak, 2007). As Bliake cited in Bekele and Drake (2003) described Ethiopia are the most seriously affected soil erosion area in the world. Both wind and water erosion selectively have removed the fine organic particles in the soil and left behind large particles and stone. In Ethiopia soil erosion by water significantly contributes to food insecurity among rural households and poses a real threat to the sustainability of existing subsistence agriculture (Amde *et al.*, 2001, Haile *et al.*, 2006, Yirga, 2007).

People were already aware of the negative consequences of soil erosion on agricultural production and the environment centuries ago (Hurni, 1993 in Shimelis, 2011). As a result,

indigenous soil and water conservation practices have existed for many years in some areas of Ethiopia (Nyssen *et al.*, 2007, Watson and Currey, 2009). For instance, the United Nations Educational, Scientific, and Cultural organization (UNESCO) has registered the terraces of the Konso people of Southern Ethiopia as one of the world heritage (Shimelis, 2011). The Konso terraces are estimated to be older than 400 years (Tesfaye, 2003, Shimeles, 2011). Terracing is not only limited to the people of Konso area in Ethiopia but it is also found in other parts of the country. Such terracing activities in different areas of Ethiopia were the indicators of indigenous knowledge on soil and water conservation practices in the country (Nyssen *et al.*, 2007, Watson and Currey, 2009).

Soil and water conservation in Ethiopia was not only closely related to the improvement and conservation of ecological environment, but also to the sustainable development of its agricultural sectors and its economy at large. In Ethiopia, efforts towards this conservation goal were started since the mid 1970's and 80's (Shifera and Holden, 1998; USAID, 2000; Wogayehu and Darke, 2002) while different soil-water, conserving technologies with a varied approach has been underway.

To overcome the problem of land degradation, soil erosion, and deforestation; the Ethiopian governments have attempted to implement different soil and water conservation activities. Those activities are physical structure (terraces, soil bund, water ways, check dams, etc) to reduce over land flow thereby preventing removal of soil, soil fertility improvement practices (compost application), agro-forestry and reforestation of deforested hilly areas , maintaining soil pH, no-till farming practice and the positive results yielded. So far how communities can reduce land degradation, soil erosion and deforestation and improve their lively-hoods and food security (Kassu; 2011).

The basis for the implementation of the soil and water conservation interventions on a large scale was since the 1975 land reform and the establishment of peasant associations (PAs). The reform gives farmland to farmers that motivated them and the PAs to facilitate the implementation of soil and water conservation and played an instrumental role for labor mobilization (Shiferaw and Holden 1999; Woldemlak, 2007).

The soil-water conservation intervention has shown an inconsistent adoption trend over time. Initially, farmers viewed the structures as a limitation as they were not getting immediate return

from it (Amsalu et al., 2007). Among the limitation of soil and water conservation structures, farmers consider the mechanical structures terraced on the farmlands in reducing the area of cultivable land, harboring rodents, and the labor-intensive nature of the constructions (Amsalu and de Graaff, 2007). By disputing this wrong idea (practicing soil-water conservation decrease cultivable land, labor intensive, harboring rodents, etc) of some farmer on soil-water conservation practice; large farmer practice soil and water conservation seriously over their farmlands; because farmers have small and fragmented farmlands (Shiferaw and Holden, 1999; Amsalu and de Graaff 2007). Also Amsalu and de Graaff (2007) reported that larger farmers with less livestock, on steep slopes and with poor fertility adopted the practice better than those with contrasting conditions. In order to fill this information gap and support the country's effort in combating land degradation, soil erosion, overgrazing, over cultivation etc, the study that assesses the challenge of soil and water conservation practice and measure under taken for land management has paramount importance.

To overcome the problem of soil and water conservation practice, the current Government of Ethiopia has taken different measures such as policy interventions, conducted studies, and implemented massive soil and water conservation (SWC) and capacity building programs, especially after the 1987/88 of rainy seasons (Shiferaw and Holden 1999; Tilahun 2006). Since 1990s, resource conservation activities mainly SWC works in cultivated land have been undertaken as part of agricultural extension package of present government. However, the practice has remained delivery oriented in which the farmers are forced to implement conservation measures designed for them by technical experts. Soil and water conservation measures were implemented largely in the drought-affected areas, including in Wello and other areas of the country (Badege, 2001).

1.2 Statements of the problem

Ethiopia is the country that has abundant water resources, diversified flora, fauna, and substantial underground resources. Yet the standards of living of the people remain at a dismal level. As Alemayehu (2007) shows in his studies this was because of substantial mismanagement of natural resources in the form of over utilization of soil and water resources. Also as Kibemo (2011) explained in his research because of over exploitation of land resources, Socioeconomic and institutional factors influence, inadequate farming practices, house hold pressure (family

size) ,farmland size etc are important factors that contributed most for soil fertility decline and mismanagement of resource in Ethiopia.

In Ethiopia, soil erosion has been a problem ever since man made started to cultivate the soil and grazed domesticated animals (WRI *et al.*, 1996). High intensity rainstorms and steep slope areas suffer from high rates of soil erosion and nutrient loss. Although data on the extent of the problem are, patchy and inconsistent, available estimates indicate that the average rate of soil erosion is nearly 10 times the rates of soil-water regeneration in the highlands, and the rate of soil nutrient depletion was the highest in sub-Saharan Africa (FAO, 1993). The combination of the rapid growing world's population, slow economic growth and limited extent of natural resources, especially in many developing nations like Ethiopia has resulted in the un sustainability use of natural resources (FAO,2008).

Natural resource depletion has been a major problem for environmental, socio-economic, policy, and soil-water conservation in Ethiopia. The situation of natural resources has negatively affected the agricultural sector to a larger extent and the over- all economy as well as the livelihood of its people (Aklilu, 2001). As a result, the country is facing serious problems of environmental degradation. This problem involves decrements of production and agricultural stagnation because of soil erosion and nutrient depletion (Alemneh, 1990; FAO, 1993; Aklilu, 2001).

There was enormous threat posed by human activity to the natural resource base (primarily land, water, and soil) and to ecological balance in the Ethiopian highlands. Much of the pressure was found in the highlands above 1500m above sea level. This pressure coupled with many other physical, socio-economic, demographic factors has led to a serious degradation of land. The highlands were the center of the economic activity of the country where more than 85 percent of the population lives (Alemneh, 1990). This is because of land, soil, and water is very basic in securing food, livelihood, and providing ecosystem services. There was severe problem of natural resource degradation in the Oromia region, related to intensive cultivation, overgrazing, deforestation, soil erosion, poor water management, shortage of livestock feed and fuel wood crisis (FAO, 1993). The capacity of highland farming communities to sustain production was therefore, under serious pressure (Hans-Joachim *et al.*, 1996). Boja and Cassells (1995), thoroughly assessed land degradation in Ethiopia highlands and indicated that the immediate

gross financial losses due to land degradation was estimated to be 102 million USD per annum which constituted about three percent of the country's GDP at the time.

Evidently, the extent of soil erosion, demographic factors, overgrazing, and soil nutrient depletion justify the severity of the problem of land degradation in the study area. The destruction of natural vegetation cover contributed to the intensification of soil erosion and the declining trend of soil fertility. Forests have been cleared in the study area mainly for firewood, securing agricultural land and house construction (WDNRMD, 2013). Specifically, in the study area, agricultural lands are under heavy stress due to land degradation, overgrazing, over cultivation and soil fertility decline have become serious problems.

Over the years, farmers devised indigenous practices and systems of land use to protect and rehabilitate their lands. In the rural community of the Oromia region involving the study area, there is a tremendous pool of indigenous land management practices. These practices already seek to harmonize with ecological benefits (minimizing soil loss and runoff, improving the fertility of the soil), economic benefits (sustaining and increasing production), and social benefits (preventing out-migration of land users to urban centers).

Since only little attention was given to soil and water conservation in both secondary and higher education curriculum (Kebede and Hurni 1992), the extension agents and development workers who guide the effort lack the basic idea of conservation designees and implementations. As a result, in most cases, no appropriate design and layout procedures were followed. Consequently, only little was reported on the success of such a huge effort. Those have the influence on the awareness of community because of this some farmer criticize the practice of soil-water conservation over farmland.

1.3 Objectives of the study

Based on the above statement of the problem, the overall aim of this study is to investigate the practices and challenges of soil and water conservation and measure under taken in wuchale district of North shewa zone, Oromia regional state.

The specific objectives of the research are:

1. To identify the modern and indigenous methods of SWC practices of wuchale district.
2. To assess the challenges farmer faces in the implementation of soil and water conservation

Practice on their farmland in the study district.

3. To examine cause and consequences of the challenge farmers face when they practice soil and water conservation, and examine the measure under taken in the study district.

1.4 Research Questions

In relation to the research objectives, the study tries to answer the following research questions.

1. What were the modern and indigenous methods of soil and water conservation practice used by farmers to conserve resources of their farmland?
2. How do you evaluate (see) the challenges farmer face in practicing soil and water conservation strategies on their farmlands?
3. How farmers perceive the cause and consequences of the challenge farmer face when they practice soil and water conservation method?

1.5 Significance of the study

Conservation of natural resource such as soils and waters has been the major concern of the Ethiopians to enhance rural development strategy starting from the 20th century. Due to poor management of soil and water conservation practice, growth in the number of fed and proportionally low production and productivity led to alarming rates of land degradation, soil erosion, and environmental imbalance. Therefore, to eradicate this imbalance of environmental resource with number of fed and other problem understanding the practice and challenges of soil and water conservation techniques was helpful for farmers. Thus, the proposed research has a contribution to identify the practice and challenges farmers experience in the process of soil-water conservation in the study area.

Generally, the results of this study have significance, in identifying the major practices and challenges of soil and water conservation in the study area. Provides information to decrease the challenge that face the farmers in soil and water conservation practices, and it provide the information for the measure of this problem in the study district. Serve to provide information for other researchers who are interested to make future study on challenges of soil and water conservation practices and measures to be undertaken.

1.6 Scope of the study

Since it is not possible to cover the whole aspects of the study area with the available time and resources, it is advisable to limit the study size and scope of the problem to a manageable size. Hence, the study focused on the representative sites of four kebeles from Wuchale district. The findings of the study can be extended to other areas exhibiting similar agro-ecological, problem and socio-economic situation with certain level of adjustment. It also tried to see the difference between farmers of practicing soil-water conservation and not practice soil and water conservation in the area, also considering the impact of destructing terraces over soil conservation practices. Different types of natural resource conservation measures introduced in the study area were discussed. Yet assessment of farmers practice and challenges of soil conservation practices was limit to structure introduced on farmlands of study area.

1.7 Limitation of the study

Of course, it is clear that any research would not be free from certain limitations. One of the most limitations the researcher faced during the study conduct was financial constraints. Some other problems were also related to time and material constraints, no access to internet available, transport difficulty to collect the data, and lack of sufficient literature on the challenge of soil and water conservation practice and measure undertaken in the study district. In addition, since the question related to SWC was serious, the quality of the information gathered through structured survey questionnaire, interview and group discussion depends on the willingness, recalling capacity and knowledge of the respondents. Even though these were some of the limitations of the study, the results can be used to develop appropriate sustainable soil-water conservation strategies in the study area and for other regions, which have similar biophysical and socio-economical features.

1.8 Organization of the thesis

This thesis structured in six chapters. The paper tries to address what expectation to achieve by the end of the study. The first chapter gives overview of the problem related to soil and water conservation, objectives, research question, significance, scope, and limitation of the study. Chapter two include the literature review which related to practices and challenges of soil and water conservations and factors affect farmers to conserve soils and waters were dealt in depth.

The chapter that follows present the study area and issues related to climate, geology, population, soil, socio-economic etc; situation of the particular area. Chapter four presents methodologies used in the analysis of data for the study. Chapter five shows the analysis and discussion of the result; which collected through questionnaires, interviews, group discussion, field observation etc. The last chapter comprises conclusion and recommendations of the study.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Definition and Concepts of Soil and water Conservation

In the first part of the review of the related literature, attempt has been made to give concise definitions to commonly used terms in the research. As a result, land degradation is defined as the loss of utility or potential utility through the reduction of or damage of physical, socio-

cultural, or economic feature, and/or reduction of ecosystem diversity. There may be a single cause or a complex mix of causes (Headworth and Steines, 2003). According to UN (1992), cited in FAO 1993) land degradation is the temporary or permanent lowering of productive capacity of the land.

However, indigenous soil and water conservation refers to local practices or techniques, which have been adopted by the farmers since long time ago as distinct from the newly introduced or modern techniques imposed from outside. Indigenous knowledge is the result of social learning. It is generated through a social interaction as a person tries to make his/her environment suitable for living. A piece of knowledge on a given social phenomenon is developed, tested, improved upon and stored through utilization in the community of origin; thus, the knowledge is socially constructed (Scoones and Toulmin, 1999). This makes knowledge indigenous to the locality and to its descendants. Soil and water conservation is about solving the problem of land degradation, particular accelerated soil erosion. Accelerated soil erosion is a result of the operation of the physical forces of wind and water on soil, which has become vulnerable, usually because of human interference with the natural environmental. For this reason, soil erosion can be viewed as a symptom of bad land use and management.

Soil conservation refers to the protection of fertile top soil from erosion by wind and water and the replacement of nutrient in the soil by means of cover crops, terracing, contour farming crop rotation etc. SWC can be defined as the combination of the appropriate land use and management practices that promotes the productive and sustainable use of erosion and other forms of land degradation (Senders 2004). SWC is not restricted to the protection of the threatened hillside or their rehabilitation by planting of trees. Its scope is much larger and it involves the whole agricultural and natural resource conservation. Generally, soil-water conservation includes all forms of human action to prevent and treat soil degradation (IIED, 1998). As Tibabe and Mitiku, (2002) cited in Addisu, (2011), the aim of soil-water conservation is to facilitate optimum level of production from a given area of land while keeping soil loss below a critical value and protections of the life supporting capacity of soils such as soil quality, soil depth, soil structure, water holding capacity and soil productivity.

2.2 Soil and Water Conservation practices in Ethiopia

Prior to the 1974 revolution, soil degradation did not get policy attention it deserves (Wogayehu and Lars, 2003). The famines of 1973 and 1985 provided an impetus for conservation work through large increase in food aid mainly using imported grains and oil. Following these severe famines, the 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). The extent of conservation activities using food aid escalated tremendously and the conservation continued to grow arithmetically though the implementation could not keep pace with the plan. Up to 1986, food aid used for payment of conservation and related works as food-for-work payment accounted for approximately 29% of total food aid (71% of the food aid was distributed as emergency food). With this, Ethiopia became the largest food-for-work program beneficiary in Africa and the second largest country in the world following India. Eighty hundred fifty workdays were devoted to the conservation work between 1982 and 1985 through food-for-work. In Wollo, a household head was providing on average 93 days per year and a women working approximately 69 days per year (Campbell,1991). Between 1976 and 1988, soil and stone bunds were constructed on 350,000 ha of cultivated land for terrace formation, and 600,000 ha of steep slopes were closed for regeneration (Wood, 1990). This environmental rehabilitation endeavor was described as "impressive" (Pretty and Shah, 1996; Wood, 1990; Woldeamlak, 2003).

However, this was not a long-term success and these structures had little long-term impacts in preventing soil erosion. Almost all the soil and water structures and practices were destroyed shortly after the construction in almost many place of the country. The project expected that the local people would bear all the costs of maintenance. Yet, farmers had few incentives to maintain structures or continue with practices (Pretty and Shah, 1996; Woldeamlak, 2003). Seldom were structures maintained and all often-impressive new structures and practices slowly disappeared leaving little evidence of intervention. Because of the failure of the local people to maintain the conservation measures, the introduced conservation measures that were originally designed as a protection against erosion rather exacerbated the problem (Habtamu, 2006).

During 1980s, the government of Ethiopia launched a massive program of soil and water conservation and rehabilitation. As Herweg, (1993) stated in his study after 1989 soil and water conservation practices have mainly been undertaken in a form of campaign and quite often farmers have not been involved in the planning process. It is after this period that national efforts for soil-water conservation expanded rapidly. Farmers in the northern, central, and southern parts of Ethiopia construct stone terrace on their sloping lands to protect them from erosion and land sliding.

In most cases, the terraces are not protected with vegetable cover. Between 1976 and 1990, 71,000 ha of soil and stone bunds, 233,000 ha of hillside terraces for afforestation, 12,000 km of check dams in gullied lands, 390,000 ha of closed areas for natural regeneration, 448,000 ha of land planted with different tree species, and 526,425 ha of bench terrace interventions were completed mainly through food-for-work (FFW) program incentives (USAID, 2000). The FFW and CFW programmers were fundamentally top-down, with little involvement of local beneficiaries. Moreover, the programs focused on promoting conservation practices on community lands with minimal consideration given to individual farms. During this period, it was normal to follow any technical guideline developed and tested elsewhere without integrating it into the local socio-economical or environmental conditions (Shiferaw and Holden, 1998 in Addisu, 2011).

Despite the rich indigenous knowledge of soil-water conservation throughout Ethiopia, the FFW-based soil and water conservation programmers were aimed at promoting new or improved soil-water conservation practices, which were based on little prior research and scientific base. Nevertheless, the achievements fell far below expectations, the country still loses a tremendous amount of fertile topsoil, and the threat of land degradation is alarmingly broadening (Gebremedhin, 2004). The difficulties encountered by the programmers during their initial stage of implementation led to the realization of need for beneficiary's participation in the planning and implementation of conservation programmers and projects, including the adaptation of conservation technologies to local conditions. As a result, several participatory approaches were used for soil and water conservation (Addisu, 2011).

However, they expect of farmers participation and the impact of these approaches on adoption of conservation practices were limited. A real involvement and participation of farmers could not be realized the lack of prior research and scientific base of soil and water conservation programmers was also manifested by the little consideration given to conservation needs at the waters shad level. The physical appropriate special units for research on resource conservation issue are watersheds. The watersheds context provide the natural framework for investigation into the complex and reciprocal linkage among land use, soil and water resource; the inter dependence of people in their resources (Girma, 2001).

2.3 Significance of soil and water conservation

The implication of land degradation is extremely challenging since the livelihood of many Ethiopian are dependent on the land resource. Land resources degradation reduce the production potential of land and this make it difficult to produce enough production to supply the food demand of growing people. The country is mainly linked to the prevailing degradation problem caused by continuous cultivation with limited amendment and wide spread use of dung and crop residue for household energy which substantially contribute to the loss of soil organic matter (Aklilu, 2006).

The soil and water that we use is integral to our livelihood. Most people know that they need clean air and clean water to health. Fewer people realize that their well being also depends on the health of the soil. Soils and waters are supports the growth of most of our food and fiber; so, its productivity is a major factor in the overall development of all nations of the world. As part of development and modernization, trees are cut and vegetation is chopped off, leading to large-scale erosion (Addisu, 2011). Soil and water conservation is important now that the soil has to be preserved and the environment kept neat, tidy, and productive in order to preserve our human health and nutrition. The roles of soil-water conservation in increasing agricultural productivity have been indicated in many studies. Sutcliffe (1993) concluded that physical soil-water conservation activities are justifiable in moisture stressed areas of Ethiopian highlands, where moisture conservation plays an important role in increasing yield. Joyce (1999) confirmed that the benefits of soil-water conservation in agriculture is proven and they offer small holders the opportunity to increase their productivity, safe guard, their land and reduce the risks of total crop failure in drought years.

2.4 The Role of Indigenous soil and water conservation practices

Indigenous practices have a considerable degree of sustainability with the local environment. Because of this, they have been developed in line with the laws of natural ecological system. They are within the scope of the farmers acquired or inherited culture, tradition and knowledge (Belay,1998; Yilkal,2007). Indigenous knowledge important on three levels for the development process (Grenier, 1998 in Habtemariam ,2013) firstly, it is obviously important for the local community in which the bearers of such knowledge live and produce .secondly, development partner such as CBO's, NGO's, private sector initiatives, government's donors and local leaders need to recognize it in their interaction with the local community. Before incorporating indigenous knowledge in their approaches, they need to understand it and critically validate it against the use of fullness for their intended objectives and lastly IK forms parts of the global knowledge. In this context, it has value and relevance in itself IK can be preserved, transferred or adopted to ecological ,social ,cultural and economic conditions of particular community (Grenier 1998,Yilkal,2007).

Indigenous knowledge is shared, and communicated orally by specific examples and through cultures. Indigenous forms of communications are vital to local level decision- making process and to the preservation, development, and spread of IK, i.e., indigenous knowledge has broader meaning (Grenier, 1998). Such knowledge evolves in the local environment so that it is specifically adapted to the requirements of local people and conditions. It is also creative and experimental, constantly incorporating outside influences and inside innovations to meet new conditions. Thus, it is usually a mistake to think of indigenous as 'old-fashioned; 'back-ward', static' or unchanging' (Warren, 1992). Indigenous knowledge (IK), indigenous knowledge system (IKS) and indigenous technical knowledge (ITK), traditional knowledge are interrelated concepts (Warren, 1993; Yilkal 2007).

2.5 Constraints of Land Degradation in Ethiopia

Degradation on the earth surface is one of the most sever global problem of our times, which affect 33% of the land surface; with consequences for more than 2.5 billion people. About 40% of the world's agricultural land is seriously degraded, were 80% of this degradation is caused by

soil erosion. This worldwide depletion of land resource continues to be serious hazard particularly, in the main pillar of their economy. Land degradation in Ethiopia account for 8% of the global total (Mazengia, 2010).

The most serious problem concerning country's land resources, is the removal of fertile top soil by water and wind .This much more sever in the highland area where 85% of the human and 77% of livestock population are living and agricultural is intensive (Mazengia,2010). As estimates from national level studies indicates more than 2 million hectares of Ethiopia's highlands have been degraded beyond rehabilitation and additional 14 million hectares severally degraded ,which is reflected in cereal yield reduction averaging less than 1.2 tons per hectares in most of the highlands (IJEMA, 2013). As result of this extensive land degradation, which in turn caused by various intermingled factors; soil productivity has been negatively affected and agricultural production has not been meeting the basic food requirements of the growing population. This has significantly contributed to the hunger faced by some five to seven million people in the country, there by requiring external assistance every year for their survival and more than 45% of the total population to toil below the absolute poverty line (Gete *et al.*;2006).

In response, government and development agencies have invested substantial resource in promoting soil-water conservation practices as part of efforts to improve environmental conditions and ensure sustainable and increased agricultural production. Despite the increasing efforts made and the growing policy interest, adoption of those technologies by smallholder farmers outside of intensively supported project location has generally been. Regardless of all those, effort the natural resource base is deteriorating from time to time and becomes major cause for food insecurity and vulnerability (Berhanu et al.; 2009).

The north shewa and its districts are among the most strongly affected by soil erosion induced degradation and drought in the northern highland (Dejene, 1990; Mazengia, 2010). Most biophysical conditions of the area such as climate, geomorphologic and geo-hydrologic characteristics, human and livestock population and agricultural practices exacerbate (aggravate) soil erosion and land degradation. The diversified topographic set up, which ranges from lowland valley plains to very high mountains and deeply incised gorges, resulted in a complex drainage system, which facilitates degradation processes. Climatic differences, particularly rain fall and

temperature influence the bio-physical features such as soil formation, biomass production and diversify (Gonfa,1996). Soil erosion is severing in the weyna-dega and dega (cool) zones, which mainly have rugged topography and cover over 60% of the area. However, wuchale district of north shewa which have more flats (plains)are less affected by soil erosion by water except some kola area of the district but because of having large number of livestock more of the farmland was degraded(WDNRMD,2013).

Owing the high human population, the land-holding size is below the minimum and the livestock population exceeds the caring capacity of the land. The population of the district were increasing from year to year; for examples, the population of the Wuchale district grew at annual rate 44.03% between 2000to 2005 i.e. the population was 87352 in 2000 and 125815 in 2005(Wuchale district CSA of 2012/13). Although agriculture is the major economic sector, which is still traditional. The agricultures are largely based on cereal-livestock farming system (ANRS-BFED, 2008) where they have complimentary and competitive effects to each other. Farm lands used to supply crop residue as animal feed without putting manure back to farm lands while following practice have been greatly reduced. These increased soil-nutrient export out of the ecosystem, exacerbates the degradation processes and contributed to crop production loss (Omiti *et al* 1999; Hailelassie *et al.*,2005). Due to the above numerous limitations and increasing demand for agriculture, marginal lands have been converted to cultivation and grazing. As a result, agriculture in the region has been unable to provide sufficient food for its population. Thus, food insecurity remains persistent, which indicates the need for continued remedial measures. It has been reported that if the resource are not managed according to its potential, land degradation problems will remain cyclic (Tekle, 1999).

2.6 The Failure of Soil and water Conservation Efforts in Ethiopia

Studies conducted in different parts of the country come up with different factors that explain the low level of success of conservation initiatives. These studies attributed the low level of success of the initiative to institutional and technological factors.

Institutional factors

During planning soil and water conservation intervention, top-down approach was pursued where government officials tell peasant association (kebele) what to do to get the food aid. This approach have local people little opportunities for discussion and participation on the initiative.

The local people did not have a say on the design and their role was limited to provision of labor for the payment they get from the work. This made the local people see the initiative as imposition from the government and additional burden farmers are made to bear (Wood, 1990).

The conservation endeavor was linked to food-for-work payment. This made the conservation intervention to be concentrated in areas that are accessible. Hence, the coverage by the initiative was limited. This made the initiative to be hardly able to address the problem of soil erosion. Besides, farmers construct conservation structure mainly to obtain food payment. This payment made farmers see the conservation measures belonging to the government rather than themselves. This in turn resulted, in poor quality of conservation structure constructed on farmlands. Very often, farmers destroy these structures to obtain additional food for maintaining destroyed structures (Wood, 1990 in Woldeamlk, 2003).

Technological factors

Different conservation measure such as biological and agronomic conservation practices that could have potential to provide incentives for adaption have been over looked. In addition to this, these conservation measures have not been linked to indigenous conservation measure for which the local people are well-acquainted (Pretty and Shah, 1996). The return from these measures was in general negative at least in short term (Wood, 1990). They take large proportion of area out of production. According to Campbell (1991), introduced conservation measures through bund and terraces took up to 10% of the precious resources of farmers. Nevertheless, the benefits these structure increase from infiltration and reduced soil loss do not outweigh the loss of land to conservation works and the reduced yields caused by vermin living in terraces, water logging, and disturbance of the soil profile. These structures also require frequent maintenance, which is high labor demanding. These all resulted in negative attitude towards soil-water conservation (Years work, 1988 in wood, 1990).

Social Factors

Personal characteristics of the household head like age, educational attainment, sex and family size were hypothesized to influence the decision to adopt conservation practices. The age of a farmer can enhance or prevent the retention of conservation structure. With age, a farmer may get experience about his/her farm and can react in favor of retention of structures. Exposure to education will increase the farmers' management capacity and reflect a better understanding of

the benefits and constraints of soil and water conservation. Education also increases the ability to obtain and apply relevant information concerning the use of soil and water conservation practices. Education is thus hypothesized to increase the probability that a farmer will retain soil-water conserving structures. Gender of farmer is also hypothesized to have an effect on adoption of conservation structures. Female headed or male-headed households can have different conservation behavior. Thus, this variable can take both positive and negative signs.

Physical Factors

Farm size is often related to the wealth of a farmer and is expected to be positively associated with the decision to retain conservation structures. Farmers having larger farm size can afford to leave the structures while the small farmers cannot and tend to destroy the structures to allow them to produce more.

Attitudinal Factors

Perception of soil erosion and recognizing it as a problem is an important factor that influences the application of erosion controlling practices (Bekele and Holden, 1998). Thus, the perception variable is hypothesized to influence the retention of conservation structures positively. The role of perception of technology attributes in enhancing or eroding adoption decisions is well acknowledged. In this study, it is hypothesized that farmers' expectation of the effectiveness of conservation structures in retaining soil from erosion will have a positive effect on retention soil-water conserving structures.

Economic Factors

Off-farm employment generates income to the household and it may positively or negatively influence soil conservation. Off-farm income-generating activities compete for labor resource that the household uses as an input in conservation activities. Hence, those households that have off-farm income are less likely to engage in activities that conserve soil and water. On the other hand, off-farm income may ease the liquidity constraints needed for soil and water conservation investment or purchase of fertility enhancing inputs (Bekele and Holden, 1998).

4.7 Factors influencing the implementation of Soil and water Conservation Practices

A number of factors are hypothesized to affect soil and water conservation effort. As indicated in Journal of Agricultural and resource economics of (2008) reported that the perception of farmer on adopted conservation impacts positively on soil and water conservation practices and effort. The level of net farm income was expected to affect soil and water conservation effort because farmers with higher net income are less likely to be financially constrained to adopt soil and water conservation measures. Previous studies also have shown that farmers who own their land are more likely to adopt soil-water conservation and expand more conservation effort than those who do not own their land (Journal of agriculture, 2008). Additionally, many factors bear on farmers' decisions about adopting soil and water conservation measures. Following Ervin,(1932) in Addisu, (2011), it is possible to hypothesize the decision making process to adopt soil and water conservation measure starts from farmers' perception of soil erosion problem as shown in fig 4.1 below.

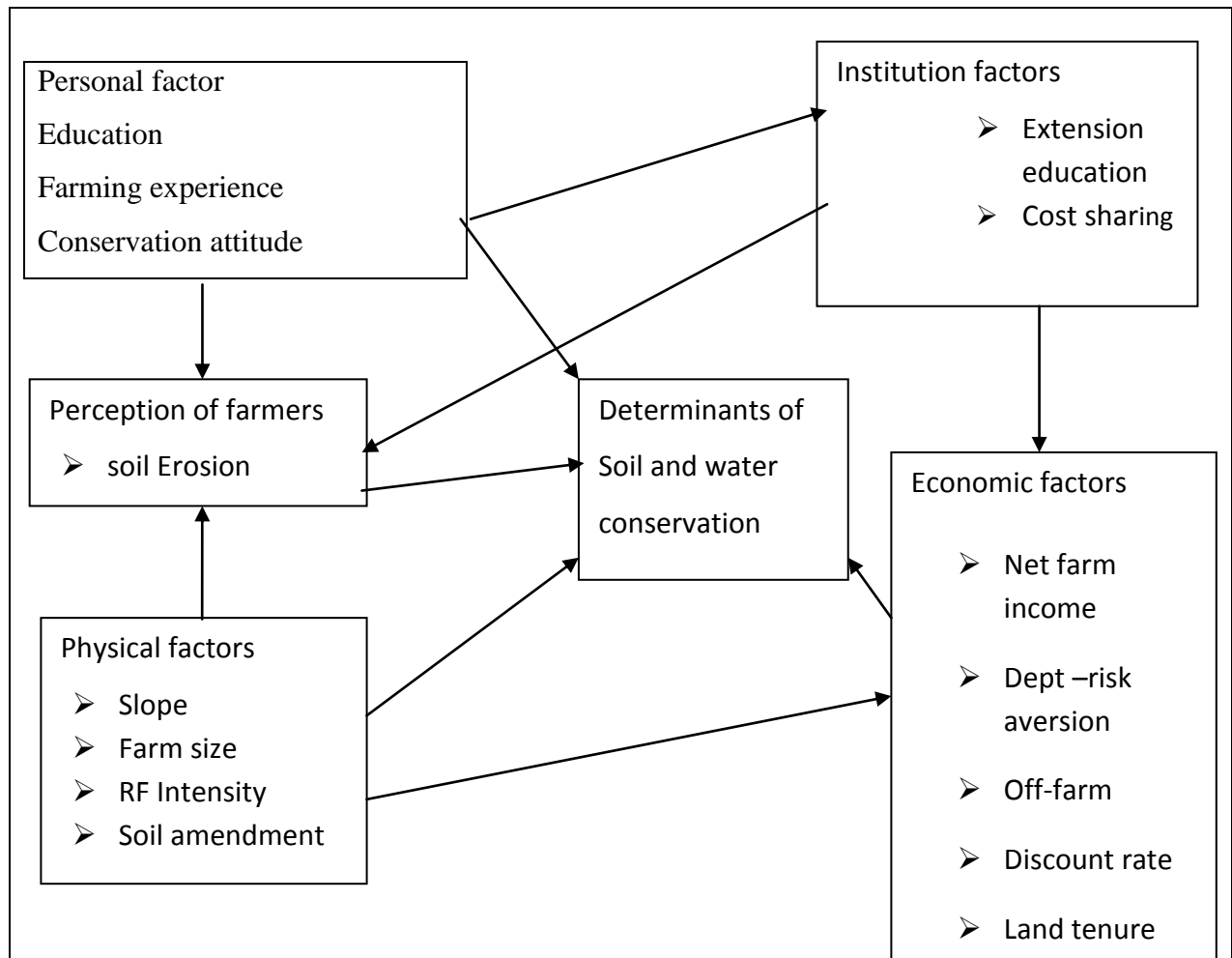


Fig4.1:- Determinants of soil and water conservation practices (adopt from Addisu, 2011).

The adoption and use of soil and water conservation practices was conceptualized as the discussion determinants of soil and water conservation measure. Each category of factors hypothesized to influence one or more of the decision-making process components. Each component can be visualized as a major step in the decision to control erosion.

Personal factors: personal factors such as education level , farming experience , conservation attitude and family size are factors which influences adoption of soil and water conservation and its practices. Higher education levels are hypothesized to be associated with improved knowledge about conservation measures, the productivity, and effects of erosion. Those personal characteristics involving acquisition cost can be associated with improved as human capital .The degree of physical land structure and erosion potential of farmers land may persuade him to choose particular practices (Addisu, 2011).

Institutional factors: An institutional factor portrays the role of educational and technical assistance programs in affecting perception of erosion problems, decision to use practices and erosion control effort. In addition to this, institutional factors like secure land tenure right, access to credit and extension training to farmers affects farmers' decision to conserve soil and water (Eleni, 2008; Gebremedhin and Swinton, 2003).

Physical factors: factors such as farm size, slope, farm terrain, type of erosion, soil amendments, location of farmland and land quality differentials are some physical factors which affect farmers ability to adopt methods of soil and water conservation measure (John, 2008).

Economic factor: Economic factors may either enhance or constrain farmer's dispositions toward erosion controls. For examples, high debt levels may inhibit investment in capital-intensive terraces, while high net farm income will present tax advantages for the same practices. Educational programs, technical assistance, and cost sharing are institution instruments to persuade farmers to use soil-water conservation practices. Economic constraints such as wealth status of the farmers, off -farm income, annual income, cost of the fertilizers and debt status are factors, which tends to increase or reduce incentives for soil-water conservation (Eleni, 2008; John, 2008). All factors categories influence effort but in different ways than they influence the decision to use one or more practices.

2.8 Method of soil and water conservation Practices

Soils and waters are the most important resource on which agricultural activities implemented. Proper management of those valuable resources is vital to sustain long-term agricultural productivity. Soil and water conservation practices are tools the farmers can use to prevent soil degradation and building organic matter. There are number of universal conservation practices that work everywhere. Planning soil and water conservation is like having a large array of techniques and practices set out each in a separate pigeonhole. The objective (importance) of planning soil-water conservation is to make up a system by selecting a set of individual items, which are relevant to the conditions and which can be combined into a workable system (Addisu, 2011). In addition, soil and water conservation and practices should aim at preventing or at least minimizing the soil loss. In order to do, this proper land utilization coupled with agriculture practices should be adopted. Pender (2004) stated that soil-water conservation measure have relied largely on food-for-work programs as an incentive and have been oriented toward labor-

intensive activities such as terracing, bund construction and tree planting. These conservation structures were introduced with the objectives of conserving, developing and rehabilitating degraded agricultural lands and increasing food security through increased food production availability (Adbcho, 1991). Even if different factors influencing the soil-water conservation practices, people across the world apply different methods of soil and water conservation according to their land characteristics, degradation extent, and technology available. The various method of soil and water conservation strategies have been broadly discussed as follows.

Agronomic/biological soil and water conservation methods

The biological measures are again divided into Agronomic, Agrostological and dry farming method. In agronomic practices normally, the land was possess a vegetation covers to prevent erosion by water and wind. These types of Practices are contour farming, mulching, crop rotation, strip cropping etc. Agrostological measures are cultivation of grass in a land, which was heavily eroded. In lay farming, grass is cultivated in rotation with regular crops. This helps in soil and water protection as well as produce fodder to cattle. Dry farming methods may practice where rainfall is low, indefinite, and variable. In dry farming methods only crops are that can sustain a very low rainfall can grow. The most aspects of dry farming are conservation of soil moisture and fertility (Morgan, 1995). Biological practices therefore range from reduced or no-till to more intensive tillage depending on several factors such as; climate, soil properties, crop characteristics and socio-economic factors.

Mechanical soil and water conservation method

The aims of mechanical measures are to maximize soil-water infiltration, minimize runoff, reduce slope length and gradient. It generally minimizes the force of wind and velocity of runoff to reduce soil erosion. Mechanical soil and water conservation methods include soil and stone bunds, terracing, and waterways built on farm and other types of land resources. Ponds ,terrace out let, gully control which are suitable for water conservation measures are to be taken so, as to prevent the formation of gullies and contour terracing are method used to prevent soil erosion. Along the contour series of ridges or bunds of mud are formed to check the runoff. In channel, terrace a shallow channel of dug, and the mud deposited along the lower edge of the canal. In broad base ridge terrace canal is formed on the contour by excavating the mud. These methods

are used as supplements to biological methods. Other methods which check the formation or widening of gullies by constructing bunds ,dams, drains or diversion through which excess runoff water is channeled (Addisu, 2011).

CHAPTER THREE

GENERAL DESCRIPTION OF THE STUDY AREA

3.1 Location of Study Area

Wuchale district is located at approximate geographical coordinate of 9°17'N-9°48'N latitude and 38°45'E-39°13'E longitude. Yaya Gulele borders Wuchale district in west, Debre Libanos district in the North West, Sululta district in the south, Jido district in the southeast, Abichuna geaa district in the East and Amhara region in the North. The district has three major administrative towns as Muke Turi, Wobori, and Gimbichu. The district is located at 78 Km from Addis Ababa, the capital city of Ethiopia, and 34 Km from Fiche, the capital city of north shewa zone. The Wuchale district has total area of 48,880 hectares (488.80km²). The research site include Bole Becho kebele, which is 16 Km from MukeTuri, Bosoke Jate kebele, which is 6Km, Iluna-egu-kura kebele, which is 16 km and Iluna Eteya kebele, which is 36 Km from the town of the district, MukeTuri.

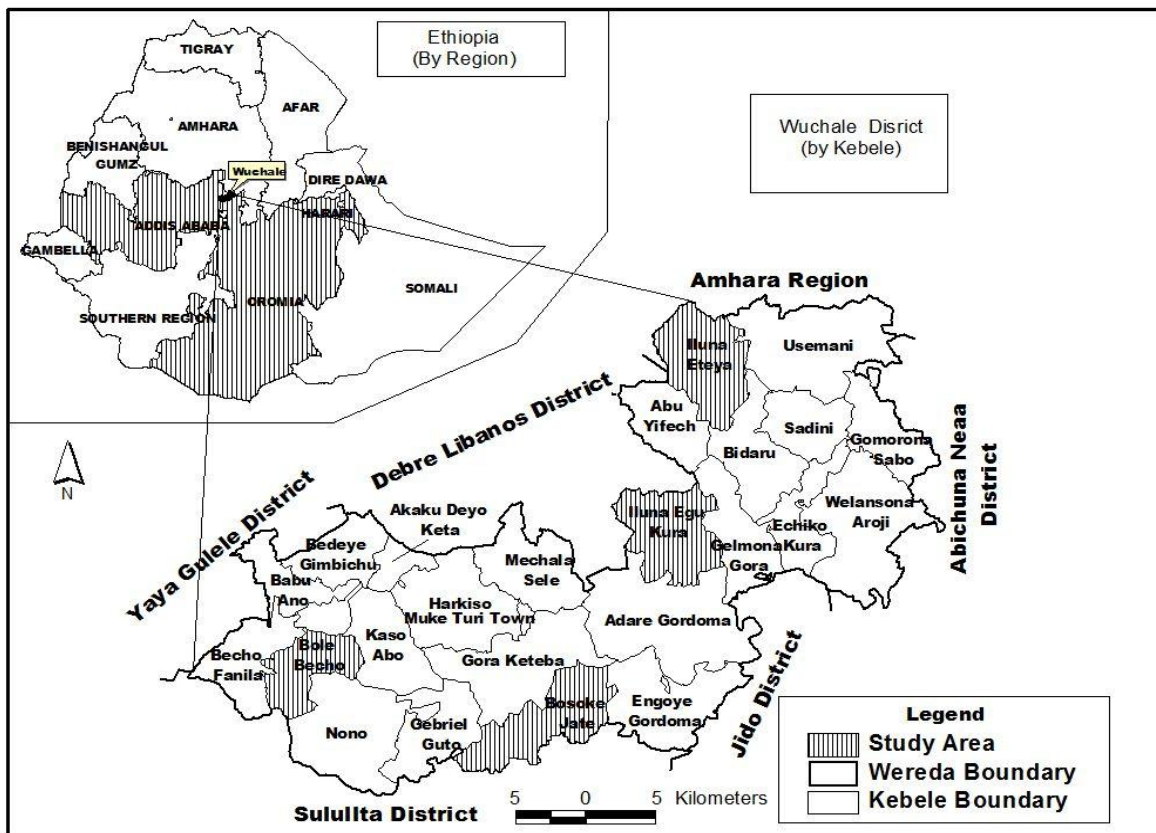


Fig2.1:- Map of study area based on agro-ecology, 2014

3.2 Topography

The district agricultural information office revealed that larger (80%) of Wuchale district are flat or plain while the rugged topography accounts 15% and the remaining 5% was plateaus and mountain. In the district, Borey (2762 m), Becho (2742 m) and Geda (2634m) are the major mountains, which are found in sampled study area. In addition, there are different topographic surface in the district. The highest elevation of the district is 2880m, the lowest is 1200 m, and the average elevation is 2412 m above sea level. That means the districts have the three major classification of landform such as highland, lowland and valley with other minor landform classification (WDRMD, 2013).

Some part of flat and gentle slope and most of the rugged topography was suitable for agriculture but most of the gentle slope and flat area was used for animal grazing. Rugged topography is the place, which has up and down; so, such place in wuchale district has more vegetation and has not affected by water logging like flat area and like the mountain do not seriously affected by erosion. Even if there is the erosion, the eroded materials were deposited at the bottom of rugged and it is not covered by water constantly. Because of this, the rugged areas are better for agriculture in wuchale district than the other places as the data from wuchale district agricultural office indicate.

Like the other district in the zone, the settlement pattern of the district was determined by the diversity of the relief. Since most part of the wereda is plain (about 80%), the influence of water logging was serious. As a result, the people of the study area commonly settled along the hillsides. Hence, the highest concentration of the people in the district was generally on and around sloping grounds, which are free from the water logging and frost that happen mostly during October and November (WDRMD, 2013).

3.3 Soil and Geology

The local geology and its interaction with climate determine the nature and type of soil. The mineralogical compositions of the bedrocks largely determine chemical characteristics of the soils of different climatic regimes. According; WDRMD,(2013) there are three major soil types in the district such as red soil locally named as “*biyyoo diimaa*” , brown soil locally named as “*biyyoo boraalee*” and black soil locally named as “*biyyoo gurraacha*”. From the three major

types of soils, the red soil, which is mostly located around lowland of Bole Becho, Bosoke Jate kebele etc which are suitable for cereal production than animal grazing.

However, SERA project (2000) classifies the soil of the district into six dominant soil types. These were Vertisols (68.4%) which developed on the flat highland of the district and suitable for cultivation of cereals and pulses, Leptosols (26.3%) which was low in agricultural potentials, Cambisols (3.6%) which was well drained and has relatively good organic content, Luvisols (0.6%), Fluvisols, and other soil types constitute the remaining (1.1%) from the district soil type. Of the total area of the district, about 86 percent of the land is poorly drain but 14 percent of the land was estimated well drain (SERA project (2000)).

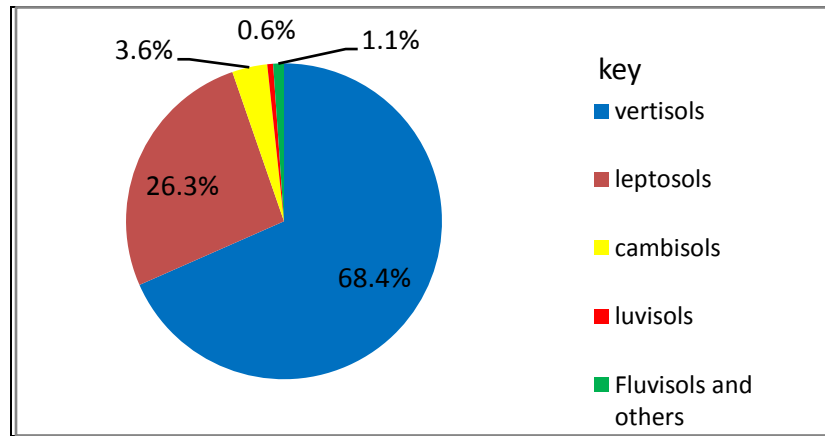


Fig2.2:- Type of soil in the district (Field survey, 2014)

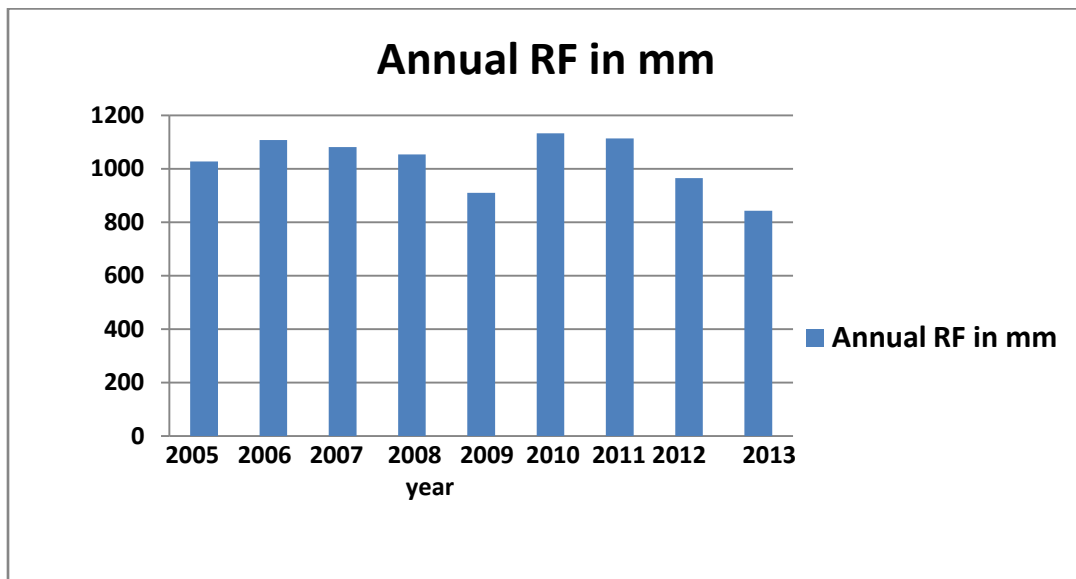
3.4 Climate and physical Resources

According to the traditional classification of climate, the Wuchale district is classified into three agro-ecological zones such viz. temperate, which covers 85.54 percent; sub-tropical covers 11.06 percent, and tropical covers 3.4 percent from the total area of the district. The district has four distinct seasons locally named as ‘Bega’, ‘Belg’, ‘Kiremt’, and ‘Tseday’ (WDNRMD, 2013).

The climatic of the district experiences different temperature and rainfall patterns that explained as follows.

3.4.1 Rainfall

Though not regular, the district experiences a bi-model rainfall during summer and spring seasons. The summer rainfall starts from June to August and sometime extends to the end of September while the spring rainfall starts from March to May. The summer rainfall is more reliable in terms of onset and in its total amount. However, the rainfall pattern of the area is irregular and high fluctuating from year to year. Early cessation and late on set and declining trend characterize the nature of rainfall in the area. The lack of rainfall in *Belg* season is one of the causes for the recurrent drought affecting the population of the district during the last six years (SERA project, 2000). As Wuchale natural resource management department office of the district, (2013), the mean annual rainfall is ranged from 1000mm-1800mm.

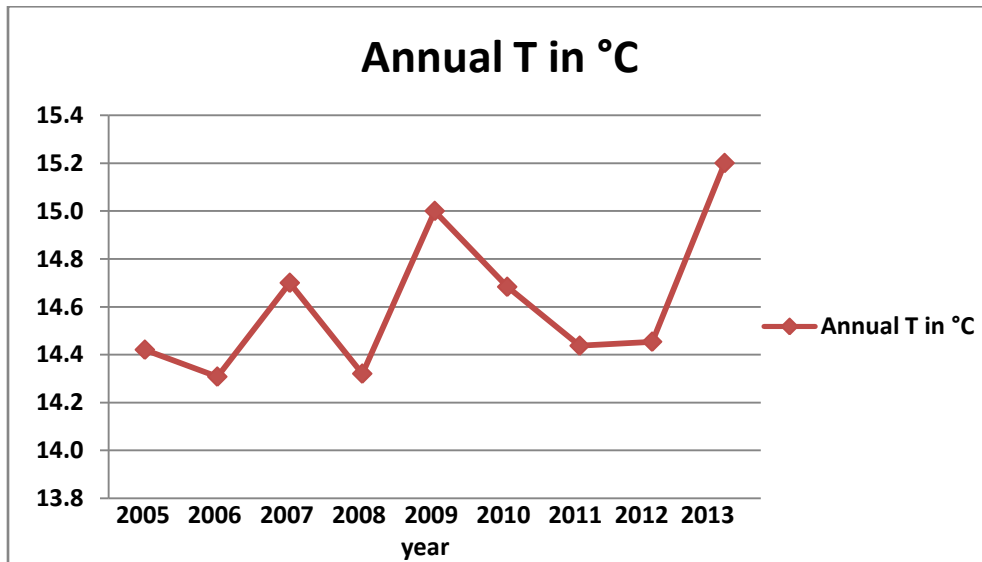


Source: -National Meteorological Service Authority, Addis Ababa, June 2014.

3.4.2 Temperature

There is a strong correlation between temperature and altitude. The highland (2001–2880 meters above mean sea level) has the average annual temperature is 17.5 °C and it comprises about 78.6 percent of the total area. The midland (1880-2000 meters above mean sea level), on the other hand has an average annual temperature of 22 °C by having share of about 14.8 percent of the total area and below 1880 meters above sea level has an average annual temperature of 23.4°C by comprises about 6.6 percent of the district(WDNRMD, 2013).

In the district hailstorm has negative effects on agricultural production. Its frequent occurrence often recorded in number of days per year is the measure of its destructive magnitude on crops, herbs and even trees. The coldest month is November when the temperature drops to 3.4 °C and, the hottest month is May when the Temperature reached around 25.4°C. According to Wuchale natural resource management department office of the district, (2013), the lowest temperature is 3°C, the maximum is 25°C and the average temperature is 13.5°C in wuchale district. The annual temperature distributions of wuchale district of nine years, between 2005 to 2013 years were indicated in the following figure.



Source: -National Meteorological Service Authority, Addis Ababa, June 2014.

3.4.3 Drainage and Water Resources

The district is drained by tributaries of Jama like Alaltu (16 kms), Wasarbi (9 kms) and Alaltu Qallo (7 kms) and tributaries of Mogor like Dubar (13 kms) and laga Bole. There are also some important streams like Bulbula, Lami, and Finchawa. Besides these, there are springs like Burqa Chaffe, Lago, Burqa Dikko, and Gabbisa. The total length of all rivers (permanent and intermittent) is about 413.5 kms in the district. Hence, the drainage density is about 0.35 kms of rivers and streams per km². Its drainage basin is categorized under Abbay basin. Most of the rivers and streams are used for drinking (animals and human). However, these water sources have large potentialities; they are not currently in use. (SERA project, 2000; WDNRM, 2013).

3.4.4 Vegetation cover

The spatial distribution of natural vegetation depends on many factors such as climate, drainage pattern and soil types play a pivotal role. In Ethiopia temperature and rainfall, which were largely altitude dependent, determine the type and density of vegetation (Tewolde-Birhan, 1991). Much of natural vegetation has destroyed (altered) by unwise use, prolonged cultivation, and human settlement. As the result, much of the natural forest except some forest area, which was protected around church, the other changed into secondary forest or replaced by other trees such as eucalyptus tree. The study area including the present settlement and agricultural land were once covered with indigenous trees and fabricated trees mainly Juniperus, Olea abssinica, Hagenia forest, white acacia, Saligim acacia, some podocarpus, thorn forest, Eucalyptus globules etc are the major vegetation found in the district (WDNRMD, 2013).

From this different vegetation, Eucalyptus tree cover the largest percentage and planted around homestead, around farmlands (on the boundaries of farmlands) and used by farmers for generation cash income, for fuel and for construction materials source. Inappropriate farming practice manifested by over cultivation and over grazing of hillside and steep slopes, changed forest into cropland by clearing. Clearing these indigenous trees resulted in several land degradation, climate change, deforestation, and soil erosion. Generally, as data from district agricultural office data indicate; from total land of wuchale district, only two percents (2%) of the land is covered by forest.

3.4.5 Agriculture and farming system

Like other parts of the Ethiopian highlands, the major farming systems of wuchale district were mixed farming; cereal crop cultivation and livestock rearing. The farming system was diverse and determined by different agro-ecology. Some kebeles located around urban area, which have dominant black soil mostly practice livestock husbandry. The other kebeles of wuchale district that is far from the urban (town of the wuchale district) practice crop production rather than the livestock production because of the ecology of the environment such as climate, soil type, and availability of rain fall in the study district. Livestock production was the most important agricultural activity next to crop production in the district, which supports the traditional subsistence farming of cereal crops. The primary purpose of animal rearing was for fraction power, meat, and milk, cash income as a hedge against disaster risks. In addition, they are the

major assets of the household and play an important role in crop production. The other main reason was because of the distance of rural kebele have from urban of the district, they cannot sell their milk to the market; so the rural people select practicing crop producing rather than practicing livestock. The crops such as wheat, teff, beans, barley, Chickpea, Lentil, Pea, Flax etc are the major crop in the study area. To raise agricultural productivity, it is important to carry out sustainable soil-water conservation strategies, as there is no crop insurance or guarantee for a poor farmer in times of drought and poverty (WDNRMD, 2013).

CHAPTER FOUR

RESEARCH METHODOLOGY

4.1 Type and Source of Data

To achieve the objectives research mentioned above data have been collected through primary and secondary sources. The primary sources of data have been generated through questionnaires, interviews, focus group discussion, and personal and field observation. Various published and unpublished documents such as reports, plans, and governments documents have been used as secondary sources of information for this study to make the study complete.

4.2 Research Design

The study aims at exploring the various challenges affecting the participation of SWC practices and examines the measure under taken as grassroots actors to achieve the objectives of the program. Hence, the study used simple quantitative and qualitative methodology of data collection techniques were selected by the researcher for both data analysis and presentation. This methodology of data collection was chosen to get the detail information on the issue under study.

4.3 Sampling Size and Techniques

Wuchale district has 27 kebeles, of which 24 of them were peasant associations and 3 urban administrative kebeles. The district has total population of 125,815 people with 3,628 households. Two stage-sampling techniques were employed to select sample kebeles and respondent farmers. The first stage was used to identify the sample study kebeles, from the large number of Wuchale district association kebeles, while the second stage was used to identify sample households. In the first stage, purposively based on their ecological location, four sample peasant associations namely Bosoke Jate, Iluna-egu-kura, Iluna-Itaya, and Bole Becho were selected. In the second stage, the sample households (farmers) from four kebeles, which include 1249 households, were selected. Because of large number of households, it is difficult to administer questionnaires and conduct interviews to all of the household heads of the sampled kebele households. Thus, the researcher-selected representative samples i.e. 10% (125) farmer's household from 1249 household. In this percentage seven-development agents, four government officials (natural resource experts and NRM heads), three non-governmental organization (NGO), and two development team leaders who have been working and practice the adoption of soil-water conservation methods have been selected as sample population. Out of this, three

households were not interested to give their responses for the researcher; so these households were considered as missing.

To get each individual farmer's household; researcher used simple random lottery method from their total households available in the selected kebele

Table3.1:-selection of sample HH from four selected kebeles

Samples kebeles	HH size	Sample HH	Total %	Sample %
Bosoke Jate	257	26	20.8	2.08
Iluna-egu-kura	318	32	25.6	2.56
Iluna-Itaya	423	42	33.6	3.36
Bole Becho	251	25	20	2
Total	1249	125	100	10

Source:-field survey, 2013.

4.4 Method of Data Collection

Questionnaires

Closed and open ended (mixed) as well as simple and contingency items questionnaires were used to collect data since this was appropriate data gathering tool from respondents that were scattered over larger geographical area. To design the questionnaire very well, an assessment of the entire necessary document, related literature and other questionnaires were consulted. The questionnaires were prepared first in English and translated to the local language of the study area that is 'oromigna' and distributed to the farmers.

Key informant Interview

Structured and Semi-structured interview was consulted with people of three working on related field or experts, four DAs, one NGO and eight model farmers of the district to elicit information that makes the study comprehensive. The interview was designed in such a way that it possible to react accordingly; this format allows the researcher respond to the situation at hand, to the

emerging worldview of the respondent and new ideas on the topic. Short notes were taken during the interview and full account of the story was written immediately after the interview.

Focus Group Discussion (FGD)

Two ways of communications were conducted between farmer and interviewer in order to make the process of data collection is more effective. In this way, farmers could also ask questions on problem of soil-water conservation practices, soil erosion, practice of soil-water conservation and solution for the problem. Focus group discussion was conducted for the study with 12 farmers selected from four kebeles of study area. The selection include; three farmers from each four sampled kebeles of the study area. The selection of those farmers was purposively based on their land holding, on their economic (production) and on their activity to conserve the soil-water and the method they use to hinder the problem of soil-water conservation. Generally, the focus group discussion includes one model farmer, one medium and low farmer who has included in sample household of each kebeles based on the activity of conservation of soil-water practices and on their economy from each kebele of sampled area

Field Observation

Field observation was conducted throughout the whole process of the research in order to make sure the validity of information obtained. It was done with the purpose of getting guidance for development, for the formal question, and to be acquainted with the values of local people especially the “goods” “bad” and “worst” of the society’s idea on soil-water conservation practices and its challenge. The fact that local people fail to articulate the details of what they do (Girma,2001) necessitated the need for maintaining through observation throughout the research. In this regard about 20% (25 farmers) out of 125 respondents were observing. These observations were taking randomly from selected farmers to assess what they did to conserve the soil-water; the problems face them on their fields and measure they take to mitigate the problems.

4.5 Method of Data Analysis and Presentation

As stated above a wide array of data collected strategies were employee together with vast amount of evidences during a case study for analysis. The major task during analysis was organization, generating categories of them and patterns, coding the data, reviewing the

emergent ideas, summarizing, and searching for alternative explanation. Based on the scale, type, and nature of topic, the data collected was discussed, interrelated, and analyzed by using both quantitative and qualitative method of data analysis to assess the challenge and practice of SWC with measure undertaken in wuchale district of North shewa zone. The quantitative used to analyzed and present questionnaires and different economic data, which were gathered from respondents were simple statics (basic statics) like frequencies, cross tabulation, tables, graphs, pie charts of SPSS 20 (statistical package for social science). In addition, figure indicate best SWC practices taken through field observation were present and discussed based on their durability and their importance for soil fertility increments and so on. Discussion held with farmers, field observation, and key informant interview on soil erosion problem, deforestation; practice of structural soil and water conservation, challenges face, and measure, was analyzed qualitatively by using percentages, figures and tables.

CHAPTER FIVE

RESULTS AND DISCUSSION

5.1 Introduction

The results from the household survey, key informant interviews with the representatives of the community and focus group discussion with the farmers of the district are discussed under this chapter. Additionally, field level observation and expert judgment by the researcher, with skills

from previous education and experience in the field of soil erosion, overgrazing, over cultivation, deforestation etc; have been incorporated. The level of soil and water conservation practices and its challenges with the measure undertaken to decrease the problem are analyzed in this chapter. At the last areas where soil and water conservation practice and reforestation activities have been undertaken, was compared with areas where soil-water conservation practices and reforestation have not been addressed. The overall results show that the challenges of soil and water conservation practices and measure undertaken to decrease the problems are discussed here under.

5.2 Socio-demographic characteristics

5.2.1 Age-Sex characteristics

From the sampled households, 87.7% were male-headed households and 12.3 % were female-headed households. Females were family headed when their husband have been died or migrates from their original residences. As the questionnaire survey indicates, most of the females' household heads manage their land through share cropping or renting to families with male household heads and contract with other men to plough for which service they had to pay.

Farmers of the study area are classified under different age group; about 48.4% of respondent were aged between 46-65 years old, 27.9 % between 26-45 years, 19.7 % over 65 years, and 4.1 % between 0-25 years. Most of the HH heads were aged from 26-46 groups. As explored through interview, development agents¹ view the, farmers of these age groups to have a good understanding on the problem of soil-water conservation, and usually interested in implementing soil and water conservation practices than the other age group. The proportion of elderly people (over 65 years) and young farmers (between ages 0-25 years) was an age group in which labor shortage can be a hindrance to practicing soil-water conservation measures. However, these farmers especially the elderly age groups usually implement and accepted soil and water conservation practices because of having access to money for rented oxen as well as hired labor with the young age group (Addisu, 2011).

¹ Mr Fikire Muleta was district DA worked in Iluna-egu-kura kebele graduated in natural science. He has four years of experience. Interviewed in the field on February 2014

In the sample study area of wuchale district more people have different religion, those religion were mostly Christianity (86.9%), Muslim (7.4%) and others (5.7%). As response from group-discussion and key informant, indicate that having this different religion in one district have no any influence on the practice of soil-water conservation.

Table5.1: Age and Religion Cross tabulation distribution of SHH in the study area

Age group	Religion			Total	Percent
	Christian	Muslim	others		
0-25	5	0	0	5	4.1
26-45	27	5	2	34	27.9
46-65	52	2	5	59	48.4
>65	22	2	0	24	19.7
Total	106	9	7	122	100
Percent	86.9	7.4	5.7	100	

Source: - Field survey, 2014

5.2.2 Household Size

This is number of household members living together in the study area (Addisu, 2011). As clearly known soil and water conservation structure is labor intensive, households with larger household size make decision to retain structures. On the contrary, in the families with large household size to feed, most of household members should engage in other food generating activities. Hence, household members fail to make decision to maintain and retain conservation structures. The same study did by Habtamu, (2006) in Hadiya zone on adoption of physical soil and water conservation structure indicate this result.

In most Ethiopian rural areas, the main sources of labor are the family members, including wife and children (Alemayehu, 2007). As Wuchale district health office report of (2012/13) shows, there are more children than older people; this is because of poor health care, poverty, shortage of clean water etc, people die at a relatively young age and this decrease the number of old age group. As survey of this study indicate 33.6% of households have 8-12 children, 30.3% have 4-7 children, 17.2% have 1-4 children, and 15.6% have greater than 13 children and 3.3% of the household have no children at all.

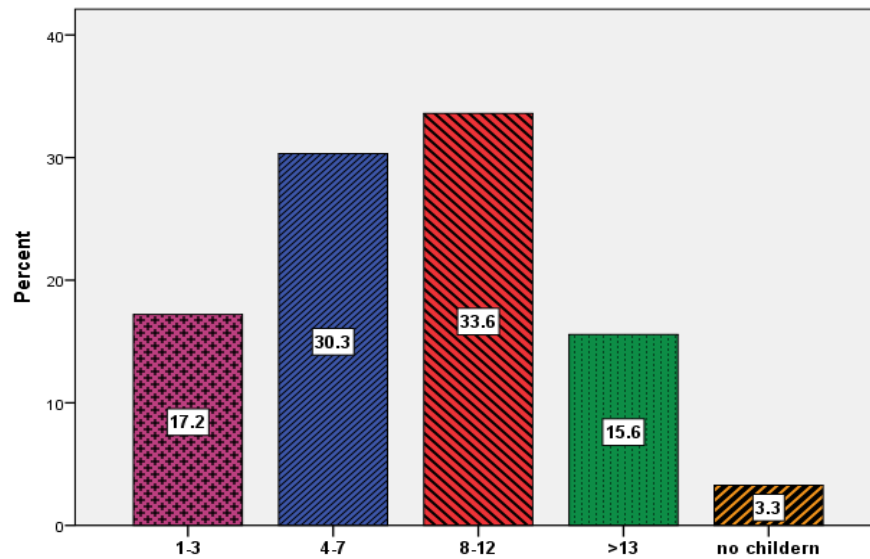


Fig5.1:- Distribution of family of household in sampled study area (Field survey, 2014)

5.2.3 Education Status

The study has identified six educational levels in the study district: illiterate, can read and write, elementary schooling (grade 1-8), secondary schooling (grade 9-12), and diploma (grade 10+3 or 12+2), and degree. From the survey result, about 63.9 % of the household heads had no formal education, 15.6% of the respondent can read and write, 8.2% have completed elementary schooling, 5.7 % secondary schooling, 4.1% diploma, and 2.5 % of the respondent have degree. Most of the farmer household heads in the study area were not educated; because of this, they have little information about newly introduced SWC practice. The surveys results indicate, better-educated households have more perceptions that are realistic about soil erosion problem, have more knowledge on SWC, and can easily involve in conservation activities. Also survey from group-discussion and key informants indicate the same result. Similar studies have been conducted in *Koga* watershed (highlands of Ethiopia), and *Goronti* watershed shows the same

result(Fikru,2009;Addisu,2011).

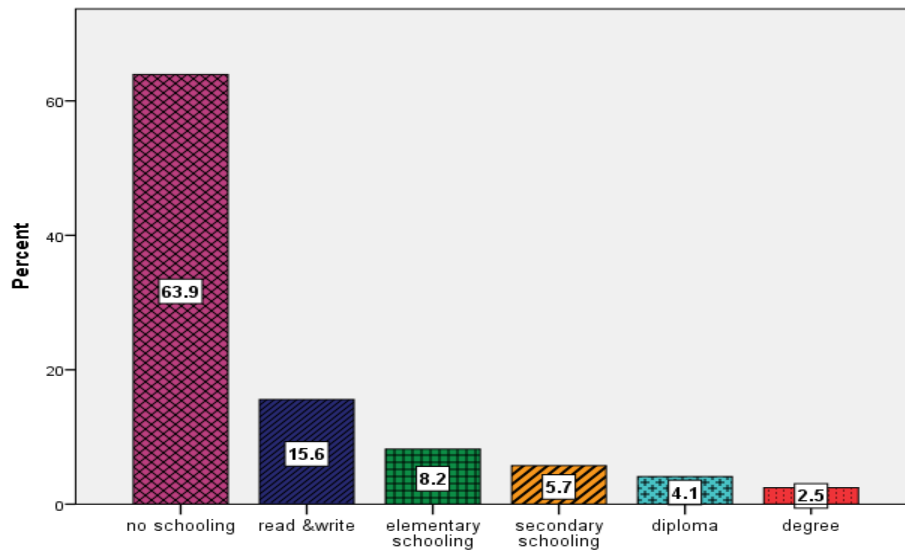


Fig5.2:- Sampled household educational level (Field survey, 2014)

5.2.4 Land holding size

Land is one of the most important factors that determine the level of agriculture. According to the view of focus group discussion, there was no fair distribution of farmland in the study area. This was due to religion, household status, and ethnic discrimination in the dergue regime and before. From sampled total household of the respondent about 28.7% have 0-1 hectares, 22.1 % have 1-2 hectares, 16.4% have 2-4hectares, 11.5% 6-8 hectares , 9.8% 4-6 hectares, 7.4 % no farm land, and 4.1%, have > 8 hectares farm land. As the view of focus group discussion shows that, more soil and water conservation practices adoption were practiced on larger plots as the farmer have more flexibility in their decision making, greater access to discretionary resources ,more opportunity to use new practice of SWC structures and have more ability to deal with the risk takes place on their farm land.

Table5.2:- Distribution of sample household farmland size

Landholding size (ha)	Frequency	Percent
0-1	35	28.7
1-2	27	22.1
2-4	20	16.4
4-6	12	9.8

6-8	14	11.5
> 8	5	4.1
no farmland	9	7.4
Total	122	100

Source:-Field survey, 2014

5.3 Practices of soil and water conservation

To decrease the problem of SWC in the study area of wuchale district, the development agents, and experts of the natural resource of the area advice farmers as it is not important to destroy the terrace bench. They also advise farmers, as it would be better to redevelop the existing terraces and supporting them with other soil fertility and SWC measures such as use of compost, farmyard manure, improved fallows, and use of grass strips in areas that are intensively cultivated, with high population density and high levels of land fragmentation. The costs and benefits related to the structural soil-water conservation measures have role on farmers' decision to practice the structure. Relatively, structural soil and water conservations are widely used in arresting soil erosion by water in the area. The practiced structural soil and water conservations measure and soil fertility increment practiced in Wuchale district are explained under here.

5.3.1 Traditional Cut-off Drains (*Boraatii qotuu*)

A traditional cut-off drain is the most important and widely practiced structural indigenous soil conservation measure in the study area. In the focus group discussions and key informant interview, farmers were asked on how to and when to construct the structure. They said that the structures were constructed across the traditional waterways, which were prepared on farm plots parallel to the slope during rainy season. The idea was to change the flow of powerful runoff coming from one known direction at the top of the farm plot. Because of this, farmers describe the structure as traditional cutoff drain or locally "*boraatii bishaanii*". The structure was production-oriented as well as conservation-oriented. Farmers have the intension of avoiding seed loss mainly cereal crops like 'teff' and to increase yield per unit area (production-oriented) and to conserve soil from the erosive power of runoff (protection-oriented). Farmers of more

villages of sample study area whose farmlands threatened by runoff do practice this traditional soil-water conservation method.

5.3.2 Traditional waterways (*Daangaa qotuu*)

This structure is a widely practiced form currently throughout the country to reduce soil loss by runoff on higher altitude. It is a common practice in the study area also to protect crop fields from being damaged by run-off that comes from certain direction. From the discussion and key informant interview, it has been generalized that small number of the farmers from sample area have long years of experience in preparing the water ways due to their nature of topography but more farmer could not practice this method on flat area (when the slope of their land is at the same altitude).

It looks like cutoff drains but it relatively covers wider area at the top of a hillside to drain runoff coming from any direction to the nearest riverbank. The structure are constructed mainly by neighborhood peasant house hold who own neighbor farm plots with the family labor as an input or by the farmers in group in the form of campaign. In the group discussions, farmers also emphasized the advantage of working in groups are that the constructed structure can serve for a long time. There were two-type waterway structures constructed by the farmer in the study area. These structures are stone waterway and grass/soil waterways. The stone paved waterways were used for a long period than the grass waterway, which was eroded by runoff. By doing so, they protect their farm plots from the damaging effect of runoff.



Fig5.5:- Stone water way (a) and traditional grass waterway (b) (Field survey, 2014)

5.3.3 Soil bund

Soil bund is an embankment constructed from soil along the contour with water collection channel or basin at its upper side. It was constructed by throwing soil dug from basin down slope. It used to control runoff and erosion from cultivation fields by reducing the slope length of the field, which ultimately reduces and stops velocity of runoff. Usually, it was constructed in fields that have slope greater than 10%. Development team in the watershed mainly advises the farmer to constructs this conservation structure but the farmers do not apply this method. Soil bund is effective in controlling soil loss, retaining moisture, and ultimately enhancing productivity of land (WFP (2005)).

5.3.4 Compost

It is also one of the modern soil fertility improvement measure is rarely practiced in the area because of low awareness of people on compost. The preparation of compost involves the use of ash, leaves, grasses, cow dung etc with two or three holes. This material firstly saved (collected) in one hole and transferred to the second hole after ten or twelve days and it transferred to the first hole after other ten days, this process continue at list for three months; after that, the compost was taken to the farmlands. In the district, this measure has introduced recently by the force of rural development agent extensions. However, in spite of its recentness, farmers due to the relatively lower cost of the inputs quickly adopt it. For instance, it is prepared at homesteads with lower labor and materials cost. According to the key informant and two models farmer from Bole Becho and Bosoke Jate village further strengthens the idea that farmers have keen interest to prepare and apply compost. However, the major constraint which was raised in the issue was the shortage of animal dung and transfer of compost from one hole to the other untimely (after compost was expired), since the largest portion of it used as source of fuel. In any way compost as part of manure has wider acceptance on the side of farmers. It has been playing an important role in improving the fertility level of croplands, which eventually helps to increase crop productivity.



Fig5.6:- Compost preparation method in Wuchale district (Field survey, 2014)

5.3.5 Check Dams

Some of the interviewed farmers said that they have been using such barriers to prevent the effect of runoff. They noted that they are preparing check dams using stones, plant materials, gabion, and sometimes using sacks filled with soils. In same part of the study area, stone was hardly enough to make check dams in most of sampled area and it was highly changing the direction of runoff. Farmers attempt in protecting gullies (erosion) which occurs on small land of the sample area was minimal. Diverting runoff from cultivation field to the main and community road was very common in the study area kebeles.

Farmers Tolcha, Yohanis and Dechasa viewed in their group discussion that, nowadays creation of awareness among community supported the gully rehabilitation and use of some brushwood and stone check dams (if available) in the community roads and in farm fields but this is not enough to bring

5.3.6 Micro basin

These are small structures constructed by excavating half circle shaped basins for tree planting. For the construction of micro-basin, soil was excavated in 1m diameter to conserve water for plantation. The spacing/ distance between basins along contour line are 2.5 m and the distance along the slope, (distance perpendicular to the contour line) was 2.5 m. The alignment of micro

basins was made by line-level. In some micro basin the farmer, prepare the improved pit for planting the tree in the hole of improved pit.



Fig5.7:-Micro basin practiced in some of part the study area (Field survey, 2014)

5.3.7 Drip irrigation

Drip irrigation, also known as trickle irrigation or micro irrigation or localized irrigation, is an irrigation method that saves water and fertilizer by allowing water to drip slowly to the roots of plants, either onto the soil surface or directly onto the root zone, through a network of valves, pipes, tubing(hose) , and emitters. It was done through narrow tubes that deliver water directly to the base of the plant form the 'tanker', which the DA's and farmer use, as source of water in the study area. Water is delivered at or near the root zone of plants, drop by drop. The tubes which join with tanker is stretch on plant land and under each plant or root of plant and it have the hole at list by 10 cm interval in which the water is drop to the root. According to the view of district, resource management experts, drip irrigation for garden available in drip kits is not popular for the homeowner in the study area but it is only confined to farmer training center.



Fig5.8:-Drip irrigation practiced in same area of SHH (Field survey, 2014)

As one of the foreign² individual Saied that, Properly designed, installed, and managed, drip irrigation may help to achieve water conservation by reducing evaporation and deep drainage when compared to other types of irrigation such as flood or overhead sprinklers since water precisely applied more to the plant roots. In addition, drip can eliminate many diseases that were spread through water contact with the foliage. Finally, as plan of the district, in regions (areas) where water supplies are severely limited, there may be no actual water savings, but rather simply an increase in production while using the same amount of water in the future if all farmers adopt the method.

5.3.8 Hand-dug wells

Hand-dug wells are method used to conserve water and constructed during dry weather for several reasons: the water table was be at or near its lowest level, allowing the required depth to be adequately determined, and dry soil was less likely to collapse during excavation. Wells should be placed where large supplies of clean groundwater are likely to be available but not in riverbed. For sustainable and meaningful conservation based land development program, it is essential that the runoff water being disposed through cutoff drains and water ways is let into water harvesting structures for domestic use and minor irrigation activities. The constructions of

² Miss J. Rutha was foreign women from Spain worked in Wuchale district as non-governmental organization by bringing new species of plant for the hard worker farmer without payments and lives in district for five years. Field interview on march 2014

water harvesting structures are done when all catchment activities are properly implemented and the water to be stored is in reduced risk of being silted up (Daniel, 2002). A layer of gravel may be placed at the bottom to prevent the soil from silting up. Any concrete used should properly mix and allowed to cure, to ensure its strength, and longevity. After digging the hole, the farmers should be provide by an above ground wall around the well to prevent children and animals from falling into the well, and provide a child-safe, heavy, secure cover at ground level or over the hole. If this measure not takes place over the hole, the people and animals can fall into the holes. In generally, hand-dug wells pose unique challenges, but when properly constructed, maintained and inspected, they can be picturesque and advantageous. In most of the sample study kebele, as district, agricultural head³ said the aim of digging hand-dug well and collecting the ground water into the hole was the way in which the HH get the excess water.



Fig5.9:-Hand-dug well constructed in SHH area to get the excess water (Field survey, 2014)

Some challenge face the farmer when they construct hand-dug wells; among them greater effort, high cost, and longer construction time, difficulty in preventing contamination, lack of ownership, and spare parts availability, and at the last hand-dug wells near a river can be contaminated by pollution from agricultural runoff in river water etc are the major constraint with hand-dug well.

5.3.9 Improved pit

3 Mr. Habtamu Dula was wuchale district agricultural office head and next administrative man in this district with having administrative experiences for nine years.

Rehabilitation of degraded land through manured planting pits, in Combination with contour stone lines. The combinations of planting pits with stone lines were used for the rehabilitation of degraded, crusted land. This technology is mainly applied newly in areas on sandy/loamy plains, often covered with a hard pan, and with slopes below 5%. These denuded plains are brought into crop cultivation by the combination of plant pits and stone lines. Improved planting pits are holes of 20–30 cm diameter and 20–25 cm depth, spaced about 1 m apart in each direction. The overall aim of the system is to capture and hold rainfall and runoff, and thereby improve water infiltration, while increasing nutrient availability. Stone lines are small structures, at most three stones wide, and sometimes only one stone high. This method improves plant growth on higher altitude of the area if it practiced by all farmers. As one of the district expert said that in the coming five year the district have plan to increase the method of SWC in area which influenced by deforestation, soil erosion etc. Generally method of improved pit is practiced around DA's house and by small number of farmers whose get the training and whose their land is influenced by erosion, deforestation and overgrazing.



Fig5.10:- Improved pit practiced in the sampled study area (Field survey, 2014)

5.3.10 Stone terraces

Stone terraces were constructed in areas where construction material like stone is available. It is the conservation measure of soil and water practiced highly over farmland of Bole Becho, and Iluna-egu-Kura village of the study kebeles. The construction of stone terracing is labor demanding. Therefore, farmers of the area construct the structure in groups mainly during the dry

season or 'bona'. During those season farmers have relatively more free time to work in groups along with their families. Nevertheless, these structures are not widely practiced by all farmers of the study area. The most practical reason obtained from the farmers themselves during the discussion has been the problem of the availability of larger stones around their farm plots. The other reason was the labor-intensive nature for the construction and maintenance of the structure and lack of awareness etc, were the reason behind the farmer from construction.



Fig5.11:- Terracing constructed by contribution of farmer sample study area (Field survey, 2014)

5.4 Challenge of Soil and water Conservation practices

Different problems identified by respondents included strong rainfall, poor soil fertility, small size (shortage of land), rainfall variability (coming late and going earlier), the adaptation of most cultivated land for inorganic fertilizer and its inability producing without it and high cost of fertilizer and unavailability at the time of cropping. Steep slope, remoteness of the plots from the residence, crop failure, and sometimes shortage of oxen are also identified as important problems. It was evident that a single plot could have one or more problems that are interdependent and equally important.

The sample farmers were asked to identify the major problems of structural soil-water conservation techniques. Among major factors as many surveyed farmers repeatedly mentioned age, gender, household size, income, soil type, and depth, topography, overgrazing, over cultivation, education status of farmers and land size were the major constraints in the study area. In addition, lack of information on benefit and cost of structural soil-water conservation measures, lack of technical knowledge in designing SWC related activities, level of contact with

DA, lack of technical support, size of expert, training on soil erosion and soil-water conservation techniques and length of food secured months have significant influences on practicing structural soil-water conservation measures. Among these factors, some have influence practice of structural measures negatively whereas the other factors affect the practice positively. The same study conducted in east Wellega by Teklu and Gezehagn, (2003) presented in Conference of International Agricultural Research for Development and in Soro district southern Ethiopia by Kibemo, (2011) view the same result.

5.4.1 Deforestation (Decrement of Forest)

As survey of this study indicates in Wuchale, district trees have been removed from the upland plateaus higher altitude of Bole Becho and Iluna-egu-kura. Study by Mulugeta and Yilma (1999) in North Shewa indicate the same result. The outcome was a mass movement of topsoil down the slope during the main rainy season leading to flooding and sedimentation at the valley bottom. The hills also failed to retain soil and water leading to the drying up of the springs at the foothills. Overgrazing has further contributed to the land degradation exposing the soil to wind erosion during the dry season. Hence, erosion and land degradation can bring a total change of the agro-biodiversity to a village, e.g. diversity in soil organisms, crop and livestock genetic diversity, and wild life, at medium and lower elevations from time to time and caused severe water and wind erosions mostly in northern and eastern part of the district.

Ato Jilo Gameda is farmer living in Bole Becho for forty years and has farmland around the following farmland. As his suggestion before 15 years, the following lands (place) were totally covered by forest but from time to time farmer clearing the forest and use the land for cultivation.



Fig5.3:- Deforested area of Wuchale district (Field survey, 2014)

5.4.2 Training on soil erosion and conservation practices

According to interviews made with natural resource management expert⁴ and farmers have some knowledge on causes, extents, and consequences of soil erosion on their living with varying level. Training and education on soil erosion and conservation need to provide and create further awareness on resources conservation practice. Farmers require training on soil and water conservation, crop production and yield maximization, yield storage system, enhancing soil fertility and land use. The construction of structural soil-water conservation requires relatively frequent training and appraisal. In the study area, the training on controlling soil erosion has significant contribution on application of structures; the level of training was at higher stage. Farmers who have not accessed to training have gained experience from their neighbors and

⁴ Mr Derje Dida was the district natural resource management expert, and in district agricultural office head of human resource management with an experience of 14 years in the concerned office.

Interviewed in the office on April 2014

traditionally from their elders etc. Farmers adjacent to each other can acquire experience in either strength or weakness of specific soil and water conservation measures from nearby farmers and neighboring kebeles. About 69.7 % of surveyed farmers get training on soil-water conservation applications and 30.3% do not have training on soil and water conservation and its challenge at all. This percent indicates as most of the farmers get training on soil and water conservation practice and on the challenge of soil and water conservation but the less percent that cannot get training influence the more farmers whose get the training.

Moreover, giving training on soil and water conservation measures improves the relationship between farmers and DAs, district agricultural offices, NGO leaders etc and encourages them to implement new conservation measures. As survey of this study indicated that more of the training about 64.8% was given by DA's, 11.5% was learn traditional, 9.8% from media, 8.2% from neighbors, and 5.7 % was given by NGO. The main problem farmers raise in their group discussion is that, mostly we get the same training by the same person for many times and this have the impact on our interest to accept the training because we see the same face for two or three times from year to year.

From focus group discussion, two model farmers stated that, the training must not be only on newly introduced conservation measures, but also the experts should provide awareness on traditionally practiced ones. Because the latter one served as the ground for the effectiveness of the former one in terms of creating awareness and addressing the importance of soil-water conservation measures in controlling erosion and enhancing soil moisture.

5.4.3 Land (Farm) size

As land is further fragmented, it becomes uneconomical in size and left with little room for implementing structural soil and water conservation measures. Land size and practice of structural soil conservation measures have strong positive relationship. The small farm-size holders have negative attitudes towards structural soil and water conservation measures. These farmers lack trust on structural soil-water conservation measures as they were poorly participated in the planning and designing of soil and water conservation program. Hence, farmers perceived structural soil-water conservation methods as described here under.

Firstly, farmers fear loss of land for construction of soil bunds, terraces, check dams etc. Almost all farmers who have land below one hectare consider this as major reason to reject structural soil-water conservation measures. As they view, there was the loss of farmland when they constructing soil bunds, terraces, check dams etc. Secondly, the discussion with other farmers supported the aforementioned opinion and they argued that structural soil and water conservation measures restrict free movement in the field. Before the introduction of structural soil and water conservation measures, there had no problem of moving up and down in the field and farmers used to plough without any obstacle. However, with the introduction of these structures there was division of plot into small pieces mainly because of the increasing height of the bunds that cannot be crossed easily. This was the main problem of aged farmers in the study area. Thirdly, almost all the Ethiopian farmers plough their lands by pair of oxen. Soil bunds, terrace etc, were created difficulties when the interval between the bunds become narrower while turning back the oxen and fatigue of the work increased to farmers, especially for the aged farmers. This low awareness of farmers on structure was the major constraints affect the soil-water conservation practice and measure under taken in the study area.

5.4.4 Participation of Household members in SWC practice

Farmers of the study area were participating in different method of SWC practice. However, the participation of farmers in SWC methods was not uniform in all level of kebeles of sample study area and households. The following figure shows, about 47.5 % of the sample respondent participate on soil and water conservation practice by their interest (voluntarily) but about 52.5 % of the sample respondents participated on soil and water conservation practice by the force of development agents, SWC expert and kebele community leaders. The second percentage of respondents participated unwillingly only to fulfill the local government, DA, and community leader orders. In this particular analysis participation is to mean genuine cooperation of beneficiaries right from identification of soil and water conservation methods to final stage i.e. selection, designing, implementation, and evaluation. DA, SWC experts, and district agricultural office, mostly conduct all stages of SWC but only small number of farmers participating on this all stage. Rather than participating in all stage farmers were show some interesting only on implementation of field rather than on all stages. These have the impact on the quality of soil and water conservation structure on farmland of the district.

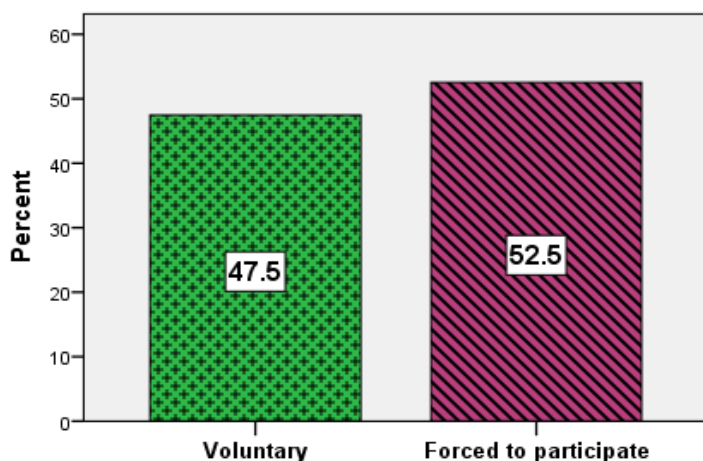


Fig5.4:- Participation of household in sampled study area (Field survey, 2014)

In general, the participation of soil and water conservation measures in the study area with full awareness helped in overcoming the problem coming at adoption stage and guarantee sustainability. To create farmers awareness DAs, community leaders, and district agricultural expert work highly with the farmers who have negative idea in their mind about terracing, soil bund, waterways, compost micro basin etc.

5.4.5 Distance from Homestead

All respondents suggested that for a frequent observation and construction of soil and water conservation measures distance to farm fields would be advantageous. About 56 % of the farmers land is distant from homestead and 44% of respondents indicated that as their cultivation fields exist close to residences. Distance to cultivation land from homestead is found to influence negatively the practice of structural soil-water conservation measures. As all respondents perceived, leaving crop residues and adding manure on the cultivation field improve soil fertility. However, when the cultivation land exists away from residences, other people take residues of the land for home use (fuel energy); for animal feed, for sell and use for overgrazing. In other side of these, the field that exists far from homestead has been given for share cropping, and left for grazing mostly without soil-water conservation practices. Shiferaw and Holden (1998) found that some farmers undertake SWC work during the evening if farmland is located around homestead but making it difficult to go to the fields that are located far from the home. The feasible clarification is that the nearer the cultivation fields to the homestead, the frequent the

management and the higher will be the protection of soil from erosion. When runoff comes, farmers are ready to protect soil, maintain the damaged bunds, terraces, and check dams in the nearer fields and vice versa. This shows to somewhat adaptation to soil and water conservation practice become limited and minimum to only on few cultivated land of the study area.

5.4.6 Lack of basic social services

Basic social services are necessary for human being for living the better life. Road and communication is one of the most important basic social services that facilitate movement of people and goods from one place to the other. The quality and length of road in the study area remains very low and give advantage only during the winter (dry) season. There is only three-gravel road, which connect Muke turi town with Jida district, Gimbichu town and Kara kebele district. The other roads, which connect the town with its kebele, are poorly constructed. Except the formers three roads the other cannot gives service during summer season. In addition, the communication (network) of the study area is poor for transmitting both business and administrative information from higher administrative to local. The other series problem (challenge) in this sample area was problem of electric (light). This brings the other problem like shortage of water and disconnection of network. Especially in Muke turi town this three basic social service (electric, water and network) are connected with each other. At the last, in Wuchale district farmers were faced by the problem of animal market. There are only three animal markets for this large district, which is located in Gembichu, Wobori, and Duber. Therefore, this and the other challenge in the study district influence directly and indirectly the practice of soil and water conservation practices.

5.4.7 Destruction of Terraces

The other series problem (challenge) in the study area was destruction of constructed terraces by different farmers. More number of the respondents had ever destroyed the terrace bench, while the remaining of them had never. Farmers especially those have small farm plots in the study district revealed that they destroyed the terrace bench after it was constructed by the campaign because of the narrowing of cropland which in turn makes farming difficult. Few of them said that, they destroyed the terrace bench when it becomes big to distribute the fertile soils

accumulated at the terrace bund all over the plot by constructing another at the place where it is highly eroded.

As can be seen from table5.4, most farmers vertically dug the terrace risers to Search for fertile soil on farming land. They (farmers) said that when the risers become big, it cover large area that makes the cropland narrower, fertile soil were used for construction, and it allows weeds to cover the farmland. In this case, they were subject to dig the risers of terracing. This practice of digging may lead the terrace bench to be unstable and to be more prone to soil erosion since inappropriate break may lead to the crops (nutrients) being easily washed away. Generally, 27.9 % of the farmer destruct the terracing to search fertile soil, 23.8 % to join their plot of land, 16.4 % for need to avail more land, 13.9 % to destroy hiding places of rodent pests, 9 % for destroying bad weeds, 4.9% removing a bund about to collapse and etc(table5.4).

Table5.4:-Reasons for the destruction of the SWC practices in the study area

Reasons	Frequency	Percent
Search for fertile soil	34	27.9
Planned to construct a new terrace bund	1	.8
Joining plots	29	23.8
Removing a bund about to collapse	6	5
Destroy hiding places of rodent pests	17	13.9
Destroying weeds	11	9.0
Reducing the bund height	2	1.6
Need to avail more land	20	16.4
Lack of value for the bunds	2	1.6
Total	122	100.0

Source: Field Survey, 2014

Because of the above constraint, different measure of soil-water conservation structure terraces, soil bunds, traditional cut-off drains, improved pits, drip irrigations, micro basin, check dams etc;

were not practiced equally over all part of the study area of Wuchale district in north shewa zone.

5.5 Cause and consequences of Soil and Water conservation challenges

5.5.1 Causes of the Challenges

Lack of knowledge

Lack of information, scientific knowledge, and extension services are barriers to adopting conservation practices. Social learning, whether it occurs at a village festival or during coffee shop chats, is vital to promoting the adoption of new techniques or technologies. Custom and culture also play a role. Producers may be discouraged from adopting new technologies or practices by time-honored practices because of low awareness's of farmers on soil and water conservation. People are often more comfortable doing things as they have always been done, including methods for growing crops and managing land or allocating government resources and operating programs. In addition, conservation method developed and used in developed countries do not always transfer well to developing countries, particularly when farming occurs on small plots and institutions and infrastructure to support the conservation method are not in place Tekelwold (2010). The awareness's of farmers are directly related to deforestation, gender bias, participation of the household on SWC practices, training given on SWC practices etc.

The nature of agriculture

Nature agriculture as a whole is characterized by unique combinations of soil, climate, topography, hydrology, and biological diversity as well as a diversity of crops and production systems. Add to this unpredictable weather and market conditions, and together, these factors require flexible, adaptive, and localized management systems that are not easily covered by one-size-fits-all policies. The Wuchale district has different agro-ecology, as the result nature of the agriculture is also different from one kebeles to the others. Because of the soil, climate, relief structure etc, the SWC practices are not experiences all over the area of the districts; so, this is the cause for the challenge of SWC practices.

Cost of conservation practices

Cost of conservation practices is also the reason for the incident of soil-water conservation challenges. Keeping biologically sensitive or highly erodible lands out of production can reduce short-term revenue and profit, and adopting conservation systems and technologies can be expensive. For example, the costs of installing grassed waterways and buffer strips to keep sediment and nutrients out of rivers and lakes are not recouped in commodity prices. Farmers frequently also depend on financing through the existing banking system, and securing credit for projects that do not encourage the producer's base line is difficult. Not surprisingly, well-off farmers and ranchers than by smaller producers with fewer financial resources practice conservation to a higher degree. Farmers and ranchers, especially those with smallholdings or precarious finances, tend to be highly risk averse when it comes to yields. Generally, most of the conservation method needs high cost to construct and to maintain it but the government and district agricultural offices cannot budget for this practice. Therefore, this is the cause for the low participation of household on SWC practice, destruction of terraces, bunds etc.

5.5.2 Consequences of the Challenges

Almost all farmers understand the decline in the fertility of their plots before adoption. Due to low adoption of improved SWC practices, miss management of farmland, deforestation, overgrazing, low training on soil erosion, low participation of household, destruction of terraces etc. results in a decline in the productivity of plots by decreasing soil depth and a change in the pattern of the crop production. In addition, Land preparation became difficult to some extent and cultivated land becomes out of production, sever erosion, land fragmentations and migration increases are some of the consequences of the challenges of SWC practices.

5.6 Natural Resource base and management

In the effort to reverse the impact of soil erosion, deforestation, and land degradation, intensive soil, water and forest conservation measure have been carried out in the district. As the district agricultural office revealed, the large proportion of the lands with moderate steeper slopes used for cereal crop production. A comparison of the area covered by soil, water, and forest conservation interventions with the area that demands interventions based on slope indicates that

still a lot has to be done. Information obtained from agriculture offices shows that construction of soil-water structures and their maintenance operation require a large labor force, high financial investments, and a great amount of material (WDNRMD, 2013).

The following table shows soil, water, and forest conservation of Wuchale district in 2013 years as annual report of Wuchale district agriculture offices views that the conservation include cultivated land intervention and hill side protection (such as stone band, soil terracing, and mountain terracing) are practiced over 6086km from the total area of the district. Specifically stone band was practiced over 2219.8 km, soil terracing 1715.55 km and mountain terracing over 2150.65 km from total area of the district. In addition, check dam (Gabion dam 75 m³, wood dam 14136 m³ and stone dam 13035 m³) cover 27246m³ from the total area. At the last, the environment (place) saved from touching of human being and animals was practiced over 632 km by cutoff-drains and waterways and 22136m³ by harbor side, eyes brown, improved pit, and micro basin. Even if different method of soil-water conservation were practices in wuchale district, still farmlands are influenced by running of water and overgrazing. But, this eroded materials and soil of the farmland cannot cross-large distance from the original place except the soil which eroded from mountain/higher altitude can transported to the lowland area and to the neighboring country by running water.

Table 2.3:- Soil, water, and forest conservation interventions in Wuchale district in 2013

Resources conservation interventions	Total Area covered
Cultivated land intervention & hill side protection -Stone band (<i>daaga dhagaa</i>) -Soil terracing (<i>daaga biyyee</i>) -Mountain terracing (<i>daaga garaa</i>) Total	2219.8 km 1715.55 km 2150.65 km =6086 km
Check Dam -by Gabion (<i>shiboon</i>) -by Wood (<i>Mukaan</i>) -by Stone (<i>Dhagaan</i>) Total	75 m ³ 14136 m ³ 13035 m ³ =27246m ³

Place Saved from touching		
- Harbor side	1220 m ³	} = 22136m ³
- Eye brown	1175 m ³	
- Improved pit	17665 m ³	
-Micro basin	2076 m ³	
-Cut off drains	352 km	} =632 km
-Water way	280 km	

Source: District agricultural office, 2013

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

Natural resources degradation at large and soil erosion in particular is a global environmental problem. Soil erosion results in the loss of fertile top soil, reducing the productive capacity of the land and thereby raises the risk of global food security. To overcome the problem of land degradation, soil erosion, and deforestation; the various periods of the Ethiopian, governments have attempted to implement soil-water conservation activities. Soil-water conservation is fundamentally attempt to practice sustainable conservation strategies and techniques. Soil-water conservation intervention has shown an inconsistent adoption trend over time in sampled kebeles of Ielu-Iteya and Bosoke Jate. Among the constraints of soil-water conservation structures, considering the mechanical structures such as terraced, stone bunds etc on the farmlands as reducing the area of cultivable land, harboring rodents, overgrazing, over cultivation and the labor-intensive nature of the constructions are common problem raised by different farmers in the study area.

To circumvent the challenge of soil-water conservation practice, the current Government of Ethiopia has taken different measures such as policy interventions, conducted studies, and has implemented massive soil-water conservation (SWC) and capacity building programs. In Wuchale district, there are many challenges farmers face in adopting soil-water conservation structures. These problems are of diverse in nature, such as skill, technical, financial,

infrastructural and lack of awareness on the benefit of conservation structures. Generally, the major findings of the study are summarized here under.

- ❖ Farmers who perceived soil-water conservation structures to be more effective in controlling soil erosion and ensuring sustainability of yield make decision to adopt modern conservation methods.
- ❖ Even though farmer participated on the protecting, the gully erosion, on some part of sample area still gully erosions were widening and encroaching the nearby footpaths in some sampled area of Iluna-egu-Kura and Bole Becho.
- ❖ The study shows that adopted soil-water conservation structures were limited to small area of the district and sampled kebeles. However, adopted ones are effective in arresting the level of erosion and flooding on farming plots.
- ❖ The study shows that small number of farmers in the area adopted soil bund, terrace, cut off drain, water way, micro basin, check dam and improved pit among the physical soil-water conservation structures over some farmland located to their homes.
- ❖ The study also found/identify the factors such as slope of the area, training, and contact with extension workers, tenure status, age, sex, awareness, size of household and farm size influences farmers to adopt SWC methods and practices.
- ❖ Soil-water conservation structures take the scarce farming land out of cultivation. Farmers who perceive the structures to reduce farm plot made decision not to maintain conservation structures or even remove structures completely. Furthermore, lack of hand tools required to maintain the structures, labor constraint and some technical failures are some of the major constraints of soil-water conservation in the study area.
- ❖ As with any agricultural production system, soil-water conservation also requires certain exogenous inputs to achieve better production. Many farmers in the study area use credit scheme from different institution mostly from micro financial institution (MFIS) and local traders.
- ❖ Older farmers tend not to retain conservation structures in the original state as old age negatively and significantly influence farmers' decision to retain conservation structures. This is because

older farmers lack the required supply of labor to maintain and retain conservation structures in the original state as physical conservation measures are very labor demanding.

- ❖ The result from study view that having large number of livestock in wuchale district was the cause for the decline of soil fertility followed by decline in production.

6.2 Recommendation

The adoption of newly introduced soil-water conservation strategies in the study area at present signify in addressing multi dimensional socio-economic and institutional constraints of farmers. Adoption of soil-water conservation practice and methods does not happen at equal level in all part of the study area of Wuchale wereda. There are good reasons for individual farmers not to adopt soil-water conservation methods in her/his specific farm situation. Knowing the respective bottlenecks and problems allows developing strategies to overcome the problem of soil-water conservation practices. Thus, based on the findings, the following recommendations are important to be considered to enjoy more benefits by addressing the constraints farmers in adoption soil-water conservation practices.

- ✓ The study found that different constraints influence farmers to adopt soil-water conservation methods. Therefore, it is reasonable to recommend that adequate consideration from community themselves and district agricultural officials should greatly contribute to increase the sustainable use and widespread adoption of soil-water conservation structures in the study area and elsewhere in the country, which might have a more or less similar physical set up.
- ✓ Small land size influenced farmers' decision to maintain soil-water conservation structures. To realize success in this regard, agricultural research, extension, expert, and district agricultural officials have to help them by providing improved seed and fertilizer. As hand tools, fertilizer, and improved seeds are found to be major resource constraints in area. Therefore, government should supply such resources in enhancing the implementation of soil-water conservation structure in the study area.
- ✓ Farmer's knowledge gained through training had positive impact on sustainable adoption of soil-water conservation methods. However, frequency of contact between the farmers and the extension agents was quite low; seem to have high influence on adoption of this method. Hence, it is recommendable that extension agents have to be provided with adequate trainings that

enable them to properly fulfill their responsibilities. Government also should assign more DAs and experts with different specialization in each Kebele. This is because, it can help to resolve many of the soil-water conservation constraints that the farmers face in the study area and in the district at large.

- ✓ Practical action is needed to increase farmers' awareness about the importance of soil-water conservation structures through demonstration and training in all kebeles of study wereda. This should be an integral part of soil-water conservation initiatives, and helps to foster positive perception and shapes the attitude of farmers towards soil-water conservation practice efforts.
- ✓ To decrease the problem of overgrazing, the farmers of study area should decrease the number of livestock per household. This can be done by using more productive animals rather than simply following the traditional method which accepts to have large number of livestock than quality
- ✓ Government, district agricultural officials, and DAs are recommend in integrating the promotion of yield enhancing inputs together with conservation activities and take the measure for every problem farmers face. They have to introduce and train farmers to use technologies that does not only reduce soil erosion but also substantially improve agricultural yields.

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APPENDIX: A

Household Questionnaire

Dear respondents,

This questionnaire was designed to collect data that are intended to investigate Challenges of soil-water conservation practices and measures to be undertaken: the Case of Wuchale District. To achieve this purpose your response to the questions presented below has a great value. Thus, you are kindly requested to read and respond the following question clearly and genuinely. **Mark (√)** against the provided question below.

Name of Peasant Association _____ Date _____

Name of the Agro ecological Zone _____ Questionnaire Code No _____

I. Personal Data

1. Age _____ 2. Sex: A. Male [] B. Female []
 3. Educational level A. No schooling [] B. read and write [] C. Diploma []
 D. Elementary [] E. Secondary School [] F. Higher education [] G. Others []
 4. Household size _____ 5. Religion _____

II Farmers Perception towards Soil-water conservation and their Response

1. What measure do you take when the productivity of your plot declines?
 A. Change to other plot [] B. Improve the fertility [] C. Both []
2. If you change to other plot, what kind of plot do you opt?
 A. Clear forest [] B. Fallow land [] C. grazed land D. Both []
3. How do you keep the fertility of soil in your field?
 A. By using manure [] E. Gay system (burning) [] B. Crop rotation []
 F. By compost [] C. Fallowing [] G. Fertilizer []
 D. If other please mention _____
4. Were did you get information about the SWC measures (if they are more than one, give one to the most important source)?
 A. Traditionally (learnt by self) [] B. From neighbors [] C. From media []
 D. From DAs [] E. Other NGOs [] F. Other source, specify _____
5. Have you ever attended trainings related to soil and water conservation? A. Yes [] B. No []
8. If your answer is yes for how many times _____

9. What advantage you get from the training? _____

10. If you have made any form of destruction of terraces, what is/are reasons for the destructions ? (If they are more than one, give the most important reason)

- A. Search for fertile soil [] B. Planned to construct a new terrace bund []
C. Joining plots [] D. Removing a bund about to collapse []
E. Destroy hiding places of rodent pests [] F. Destroying bad weeds []
G. Reducing the bund height [] H. Need to avail more land []
I. Lack of value for the bunds [] J. Construction of a house []
K. I do not know [] L. If others _____

11. If you are not maintaining terraces constructed in your farmland, what are factors that discourage you from maintaining (If they are more than one, give one for the most

- appropriate) A. Work is very tedious[] B. It harbors rodents and moles []
C. Causes loss of land to the bund [] D. High maintenances cost []
E. Inadequate household labor to maintenance []
F. Neighbors are not willing to implement conservation measures[]
G. If Others _____

12. If you have not constructed terraces, what is behind you?(if they are more than one, give one to the most appropriate) A. Shortage of labor[] B. Shortage of land[]

- C. I do not believe in the use of soil and water conservation structures []
D. There is no one who is to design for me[] E. I do not have implements []
F. My land do not require these structures [] G. Other specify []

13. Did you or your parents put any traditional SWC structure in the plot of land?

- A. Yes [] B. No [] C. I do not know []

14. If your answer to question No 17 is yes, what were such methods?

- A. _____ B. _____

15. Is your farm plot treated with new soil conservation measures currently?

- A. Yes [] B. No []

16. If question No 19 is yes, what are the newly method of soil-water conservation in your area? List them:-_____
17. From the following Physical conservation structures which one was mostly practiced in you area? Put in their rank.
- A) Stone and stone-faced terracing [] B) Fanya juu [] C) Soil bund []
D) Cut-off drains [] E) Waterway [] F) Other_____
18. On which plot do you practice specific type of conservation?
- A. On Cultivation field [] B. On grazing field [] C. On both [] D. Other _____
19. Put the following Biological conservation methods practiced in your area from most Practiced methods to lowest.
- A) Compost in main plot []
B) Bund stabilization (on, below and above bund plantation) []
C) Live fence around homesteads and farm lands[] D) Gulley stabilization or re-vegetation[]
E) Area enclosure and enrichment plantation[] F) Agro forestry including trees on farmlands[]
G) Other _____
20. Who constructed the SWC structures? A. Community participation []
B. Family (hired) labor [] C. Labor exchange [] D. If other _____
21. What is the major occupation of your household?
- A. Crop farming only [] B. Livestock only []
C. Mixed farming [] D. Other/Mention_____
22. What are the major problems of your farm plot? Sequence it according to their severity
- A. Flooding [] B. Insect [] C. Erosion [] D. Hail storm []
E. Rodents [] F. Shortage of rain [] E. Overgrazing G.Others_____
- G. Animal trampling [] H. If other please specify_____

III. Major issue: Livestock

This includes; resources, land holding, access to credit, social infrastructure, and income.

1. Do you have livestock? A. Yes [] B. No []

3. How often have you obtained extension advice on the problem and solution of land degradation? A. Once per month [] C. Three times per month []
 B. Twice per month [] D. Once per three month [] E. If others_____
4. Did you visit demonstration or farm experiment regarding how to conserve soil and water?
 A. Yes [] B. No []
5. Who provided such training and Demonstrations?
 A. District office of agriculture [] B. NGOs [] C. DA's [] D. If other _____
6. Was such training and demonstration is useful in SWC? A. Yes [] B. No []
7. If yes how do you express its usefulness?_____
8. Have you acquired enough technical knowledge, which motivates you to continually use method of soil-water conservation? A. Yes [] B. No []
9. Did you believe that investment in the soil conservation practices is profitable in the long run?
 A. Yes [] B. No []
10. What do you say regarding the supply of crop varieties, which tolerate soil erosion?
 A. Sufficient and expensive [] B. Sufficient []
 C. Insufficient [] D. If other please specify_____
11. How do you describe the contact you have with soil and water conservation experts (DAs experts natural resource department head etc. A. None [] B. low []
 C. moderate [] D. High [] E. very high []

VI. Major issue:- Benefits and constraint of adopting method of SWC

1. What Constraints of adopted method of soil-water conservation Indicators was common in your area from highest to lowest?
 A. Constructing physical conservation [] B. Breed place of rodents []
 C. Lack of incentives [] D. Labor shortage Take high labor force []
 E. Decrease the size of the plots [] F. Problem related to drainage []
 G. Difficult to plough and turn the oxen [] H. if Others_____
2. In your opinion what should be done to mitigate the aforementioned constraints?_____

APPENDIX: B

Interview protocol for key informant

Interview on the overall condition of the challenge of SWC practice and measure undertaken.

1. How do you evaluate the socio economic condition of the village in terms of the level of education, income, health, and other with SWC practices?
2. What experience does the village community have in the past in terms of collectively managing natural resource in general and soil-water conservation in particular?
3. How SWC structures introduced and on what type land SWC method practiced in sampled study area? Why the farmers use those methods?
4. How community participate in SWC in your local area?
5. How do you see the extension workers service in your village? Is that adequacy/ sufficiency?
6. How do you evaluate the visit of development agents in giving/creating awareness especially regarding SWC and what is the importance of increasing the farmer awareness?
7. What are challenges/constraints face the farmers when they practice SWC, and not practicing SWC?
8. What do you advise the farmer to decrease the challenge face them on SWC? _____
9. If the farmer destruct the constructed SWC method; what is the reason of their destruction?
10. If there is problem in your area; what is the plan of DAs, experts, district agricultural office for the coming five years to decrease the problem that occurs in the study area? _____

APPENDIX C

Points of discussion for Focus Group Discussion

Issue related with challenges of soil and water conservation practices and measure under taken are discussed with farmers randomly based on the interest of the farmers.

1. Is that having different religion on the same environment have any influences on SWC Practices?
2. How do you evaluate the socio economic condition of the village in terms of the level of education, income, health, and other with SWC practices?
3. How SWC structures introduced and on what type land SWC method practiced in sampled study area? Why the farmers use those methods?
4. How you explain the participation of the farmers on SWC practice and agricultural agents?

Thank you for your response!