ADDIS ABABA UNIVERSITY

COLLEGE OF DEVELOPMENT STUDIES

CENTER FOR ENVIRONMENT AND DEVELOPMENT

COMPARATIVE ANALYSIS OF FARMERS' PARTICIPATION IN INDIGENOUS AND MODERN SOIL AND WATER CONSERVATION PRACTICES IN RAYA- ALAMATA AND ATSBI-WOMBERTA WOREDAS, TIGRAY, NORTHERN ETHIOPIA

By

Kibrom Tadele

JUNE 2017

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Lists of Acronyms

AAU	Addis Ababa University
C^0	Degree Centigrede
FDRE	Federal Democratic Republic Of Ethiopia
FFP	Food For Work Programme
Ha	Hectar
HHs	Households
IK	Indigenouse Knowledge
INSWC	Integrated Soil and Water Conservation
ISWC	Indigenous Soil and Water Conservation
KAs	Kebeles
Masl	Metres Above Sea Level
MSWC	Modern Soil and Water Conservation
NGO	Non Government Organization
Obs	Observation
SSA	Sub Sahran Africa
SSWC	Sustainable Soil and Water Conservation
SWC	Soil And Water Conservation
TLU	Tropical Livestock Unit
UNEP	United Nation Environmet Programe

ABSTRACT

In Ethiopia, public campaign on SWC practices has long history but still a day now, adopting of the new SWC technique has presented difficulty to implement at local level. This is why the thesis has dealt with problem of what make them farmers of the study areas getting confusion to participate in what kind of soil and water conservation practices. To obtain the intended objectives of the study; mixed approach i.e. the research was used both deductive and inductive approach to answer the research questions. These approaches are the broad division of comparative research design. The data for this study was collected from both primary and secondary sources. The primary data generated from 150-sample household survey from two sample kebeles as well as from the focus group discussion and interview. The questionnaire was translated from English into the local language (Tigrigna). Descriptive statistics and inferential statistics were conducted to analyze the data. Binary logistic regression model had used for the strength of relationship between independent and dependent variables. The finding revealed that terracing (stone bund), 'Gedeba,' 'Armo' and 'deret' wrere the most indigenous SWC practices in AtsbiWomberta woreda; Whereas dendes, Dugay (soil bunds) and traditional waterway diversions were the two main traditional soil and water conservation practices in Raya Alamat woreda. The findings of regression estimation result on farmers' possibility for participating in integrated SWC Practices in Atsbi Womberta Woreda, sex of respondents ($P=0.003^{xxx)}$, farming experience that have above 70 years old, ($P=0.065^{x}$), livestock holding size($P=0.088^{x}$), access to information from neighbor ($P=0.016^{xx}$) and access to information from parents ($P=0.006^{xxx}$) were determinant variables. In Raya Alamata Woreda, farmers' possibility for participating in integrated SWC practices, livestock holding size ($P=0.096^{x}$), access to information from neighbors ($P=0.034^{xx}$) and access to information from parents ($P=0.004^{xxx}$) were determinant variables. Inconsiderable implementation of new technologies to need of agricultural growth was the most cause in the gradually decline of the indigenous soil and water conservation practices. Finally, farmers need to integrate indigenous SWC practices but due to low attention of their indigenous practices by development agents, they disobey to accept the new practice.

Key words: *Indigenous Soil and water conservation practices, modern soil and water conservation practices, farmers' participation, integrated soil and water conservation practices, determinant factors.*

CHAPTER ONE

1. Introduction

1.1. Background of the Study

Soil degradation in the form of water erosion is one of the most severe and widespread environmental problem (Lulseged et al. 2014:408). This is the main concern of sub-Saharan Africans because of its consequences for subsistence agriculture, from which not less than 75% of the population moves their livelihoods (Zerihun et al., 2017:401).

In response of that, several soil and water conservation practices have since seen initiated. However, effect of the campaign have been failed down because of the techniques that have been introduced in soil and water conservation were with little attention whether the local community could apply easily the techniques on their own existed practices (Warren, 1995:371).

In addition, over the past several decades, Ethiopia government agencies have been trying to support better land use and promote SWC technologies to stop soil degradation and improve peoples' living. Reports, however, have indicated a relatively low level of success in this respect across the winder countryside (Zerihun et al., 2017:401).

Furthermore , in the past development efforts had given less attention to indigenous practices and farmers' participation to solve their enviromental problems. Evidently, in the past 10 years have shown the severe soil degradation in Ethiopia. This was the case that the indigenous paractices in current land management have been challenged. Hence, indigenous communities develop and allocate land use systems closely interconnected within their culture and well adapted to their ecosystem(Abebe et al., 2011:3).

However, recently practices of indigenous people is gaining strong attention and its importance in sustainable development is well recognized. In different consultation in the world, scientists and indigenous people are working together to build linkage between modern practices and indigenous practices; along with others, one is to improve ecological management of a particular area (Abebe et al., 2011:2; Abebe et al., 2013:79).

Therefore, the aim of this study was to analyze the varouse of indigenous and modern soil and water conservation practices . Whereby to justify whether indigenous soil and water conservation practices were significance or not, in comparison with modern soil and water conservation practices in terms of its effectiveness, in Raya-Alamata and Atsbi- womberta Woreda.

1.2. Statement of the Problem

Any development efforts that disregard indigenous practices have wasted large amount of time and resources. In Comparison of many modern techniques, indigenous techniques have been practiced as they are effective, inexpensive, locally available, and culturally appropriate; and in many cases they are based on preserving and building on the patterns and processes of nature. Whereas, Western techno- scientific methods are *"in themselves"* an insufficient response to today's complex system of socio-economic, political, and environmental challenges (Grenier, 1998:11).

Ignoring existed indigenous agricultural practices of farming communty by considering incapable of solving food insecurty for the rapidly growing population of the country and giving great attention to transfering "*high-input technology*" from the North was the common experiencein Ethiopia. But,the outside farming techniques are being challenged from the viewpoints low environmental and social considerations, and in meeting the challenge of sustaining food and livelihood security in Ethiopia.This is the case that, Ethiopia has experienced with the dilemma between producing secure food for its hastily growing population and preserving the resource base upon which that is dependent. Bring a sustainable balance between these two has been a major challenge for the country, which at present is also adapting the Western model as one way to increase its food production (Zenebework, 2001:8-10).

In Ethiopia, it is evident that agricultural sector is the main economic source. However, it has characterized by low productivity due to sever soil erosion leads. By identifying land and soil

degradation as most problem of environment and Socio-economic, the Ethiopian government has made several interventions after the famines and droughts of 1973/74.Thus, large areas of the country have been covered by stone bunds and soil bunds, closed area closures and planted with millions of tree seedlings. Nevertheless, the realizations have gotten a little success. The country still loses great amount of fertile topsoil, and the threat of soil degradation is increasing at alarm rate (Debebe et al., 2013:1; Anteneh et al., 2014:3; Birhan, 2014:1).

Specifically, in Tigray, like other highland areas of Ethiopia, soil degradation is severe in all parts of the region and causes a major threat to continued agricultural production in the area. Practically, all topsoil, and in some places parts of the subsoil, has been removed from sloping land leaving stones or bare rock at the surface. In order to feed the increasing population, steeper and more marginal lands are brought into cultivation (Yibabe , 2002:6-7).

Years ago, to solve the region soil degradation problem active soil and water conservation intervention have practiced in Tigray, mainly in the northern Tigray (Mitiku et al., 2007:1). yet the massive intervention in SWC practices was less significance in Tigray, like other highland of Ethiopia ,the soil conservation campaign was failed to win acceptance by the land users because the newly introduced didn't fit to the long experience of the indigenous people (Belay ,1998:2). This problem was true to the study Area of Tigray region.Thus, it exhorts to develop a data base on indigenouse SWC practices thenby to integrated it with the modern soil and water practices and both would have used as envaronmental tools in order to have suatain soil and water conservation paractices.

Therefore, the locall community what maks them into a dialemma of choice in what kind of soil and water conservation practices to have used in the study Woreda was among the gaps that were the motivational factors behind this study. In an attempt to contribute in linking a research gap**,** the study have focused on the comparative analysis of local participation in indigenous and modern soil and water conservation practice in Raya- Alamata and Atsbi- Womberta woredas, in Tigray region.

1.3. Objectives of the Study

Overall objective:

The general objective of the study was to investigate various indigenous and modern SWC practices whereby to make comparative analysis on the farming community of the two woredas in their considerable practices of indigenous and modern soil and water conservation.

The study has the following specific objectives

- To identify the indigenous and modern SWC practices in each woreda
- To compare the indigenous and moden SWC practices in terms of effectiveness
- To compare the two study areas in their model practices of soil and water conservation
- To identify factors affecting farmers' participation in the integration of indigenouse and modern SWC practices

1.4. Research Questions of study

- What are the historical and current indigenous and modern soil and water conservation practices in the study areas?
- How is the knowledge of the community /communities towards soil and water conservation practices in the study areas?
- What are the determinant factors affecting farmers' participation in the integration of indigenous and modern soil and water conservation practices in the study areas?

1.5. Significance of the study

The study was identified the varouse indigenouse and modern soil and water conservation practices of the selected Woreda and its baseline contribution to well integrated soil and water conservation. It was also assessed the determinants factors affecting farmers' participation in the integration of indigenous and modern soil and water conservation practices. Hence, the findings of the study could necessarily contribute to formulate inclusive land management policy in Ethiopia. As a result, policy makers, experts and development agents to design strategies, investment programs and projects that can bring positive effect in land management in general and soil and water conservation in particular will be benefit from the study. Furthermore, the study will contribute to the general literature by informing what was happening on the ground towards the local participation in indigenous and modern soil and water conservation practices in the study Woreda. Finally, the study will have a long-term benefit for those who are interested to know about the varouse of indigenous soil and water conservation practices.

1.6. Scope and limitation of the study

Since it was difficult to cover the whole features of the study area with the available time and resources, it was desirable to limit the study size and the scope of the problem to a manageable size. For this reason, the study has conducted in two representative sites of Raya-Alamata and Atsbi -Womberta Woreda, in Tigray Region.

In particular, this study have enclosed to one village of each selected Woreda of farmers' soil and water conservation practices. More distinctively, the study have explored the indigenous and modern soil and water practices that the local community employed in the conservation of soil degradation in their efforts of environmental friendly agricultural farming systems.

CHAPTER TWO

2. Literatrue Review

2.1. Soil Degradation

Soil, the most basic of all resources, is the essence of all terrestrial life and a cultural heritage but it was sentenced to degradation by natural and anthropogenic factors, and is non-renewable over the human timescale (Lal, 2015:5878).

Degradation means adverse changes in attributes leading to a reduced capacity to function. Thus, soil degradation means adverse changes in soil properties and processes over time. These adverse changes can be set in motion by disturbance of the dynamic equilibrium of soil with its environment either by natural causes or by human causes. The natural causes shift in vegetation, glaciations, climate change) are often slow, allowing soil to adjust or adapt to the new conditions (Iivari et al., 2004:4). Whereas some human induced causes are deforestation, cultivation of marginal lands, intensive farming, excessive and indiscriminate use of chemicals, excessive grazing with high stocking rate, population transmigration and infrastructure development in ecologically sensitive areas, etc. (Lal and Stewart, 1990: xvi).

In addition to that, according to UNEP (1982), Soil degradation has defined as "*the decline in soil quality caused through its misuse by humans.*" It is a broad and vague term, however, and refers to a diminution of the soil's current and/or potential capability to produce quantitative or qualitative goods or services because of one or more degradation processes (All and Stewart, 1990: xiii). In line with this, Soil degradation is a process, which lowers the current and/or future capacity of the soil to produce goods or services (S.Aulakh and S. Sigh, 2004:1).

In process, soil degradation types are consists of physical, chemical, and biological soil degradation (Lal and Stewart, 1990: xiv; Iivari et al., 2004:5);The physical degradation process affects soil’s mass to volume relationship, air to water relationship, gaseous exchange between soil and the atmosphere, and resistance against disruptive forces of air and water. These processes affect the soil’s physical, mechanical, rheological (flow), and hydrological properties. Chemical degradation processes refer to adverse changes in soil reaction or pH, reduction in

reserves and availability of plant nutrients, the ability to inactivate toxic compounds and reduce excessive buildup of salts in the root zone. Changes in soil biological processes can increase soil degradation and adversely affect the quantity and quality of the SOC pool activity and species diversity of soil biota, and increase in relative proportion of soil borne pathogens.

While the problem of soil degradation has been ever since cultivation of soils started (S. Aulakh and S. Sidhu, 2004:1). Today, however, due to the global trade in food, the global implementation of "exploitative farming methods" (Young and Orsini, 2015:2) and the extent to which forests and natural grasslands have converted to crop production; it is the entire global civilization that is threatens by progressive soil degradation (Young and Orsini, 2015:2).

Based on archaeological evidence, soil degradation was responsible for destruction of many ancient civilizations. For example, the destruction of the Harappa civilization in western India, Mesopotamia in western Asia, and the Mayan culture in Central America (Lal and Stewart, 1990: xiii). Yet, the available statistics on the extent and severity of soil degradation are not reliable. Some statistics in the literature indicate that the world is indeed running out of high quality soils (Iivari et al., 2004:23).

In the Ethiopia history,serious soil degradation problems had firstly experienced in the northern part of the country. This is true because of its long history of sedentary agriculture and human settlement. In that time, Butzer (1981) recorded Soil erosion as one of the major causes for the downfall of the ancient Axumite Kingdom. As the process of soil degradation advanced in the north, people had to move southwards. This process had accompanied by the same spread of soil degradation, partly accounting for the fall of civilizations that flourished further south. Hence, Hurni (1987) describes land degradation due to soil erosion as one of the elements in the decline of the civilizations of Lalibela in the 14th century, of Gonder in the 17th century, and of Shewa in subsequent years (Thomas, 1991:1-2).

The reason for agriculture sector is the main source of income and livelihood of the country's population in Ethiopia (Tesfu, 2011:3), and it is evident that agriculture sector is activated by converting forests and natural grasslands to crop production ,which leads to progressive soil degradation(Young and Orsini, 2015:2). This implies that, Ethiopia is one of the many developing countries of Africa that have affected by soil degradation caused through human –

induced process (Lal and Stewart, 1990: xvi). In line with this, soil degradation diminishes economic growth, especially in countries where agriculture is the engine for economic development (Rattan Lal, 2015:5876).

Similar to that, not less than since three thousend years, highlands of Ethiopian have degraded by agricultural expansion. The driver causes of high soil erosion by water and tillage as well as by land sliding are the combination of erosive rainfall and steep slopes. This happens due to the rapid tectonic uplift during the Pliocene and Pleistocene and human impact by deforestation, overgrazing, agricultural systems where the open field dominates, impoverishment of the farmers, and constant agricultural techniques (Nyssen et al., 2015: 369).

Conventionally, Tigray region, the northern part of Ethiopia regarded as the most degraded part of the country (Hailu and Edwards, 2006:7). Since several incidents have severely degraded the land and caused the death of humans and livestock (Aklilu, 2014:113). Thus, in all of Tigray region and Ethiopia in general, severity of soil erosion has made cultivation of old farmland impossible, this is due to the result of the mountainous and hilly topography, torrential rainfall, and low degree of vegetation cover (Yibabe, 2002:5).

Soil is a vital resource for the future of humanity (Young and Orsini, 2015:2).Thus, because of numerous ecosystem services provisioned through soils (e.g., food, feed, fiber, climate moderation through cycling, waste disposal, water filtration and purification, elemental cycling), soil quality must be protected or restored to enhance these services.

2.2. Soil and Water Conservation practices

Soil and water are indispensable natural resources for agricultural production. For this reason, there is an imperative need for research to develop ways to conserve soil and water resources in a more sustainable manner (Cox et al., 2004:49; Amit et al., 2016:156)

According to Norton et al., (1999) as cited in Kebede(2014:188), elsewhere he was explained Soil and water conservation practices as an important to:

- ✓ control the loss of nutrients from agricultural land,prevent pollution of water bodies,

- ✓ Minimize rate of sedimentation in reservoirs, rivers, canals and ditches
- ✓ Control crop damage by wind –blown deposits or burial beneath by renewed awareness that soil is vital to both the production of food and fiber ecosystem function

Practically, techniques of Soil and water conservation are broadly categorized as biological measures and mechanical measures (Warren, 1995:376): The Biological measures are; contour tillage, farming on the grade cultivation, fallowing, mounds, mixed cropping, surface mulching, fertilization, and agro-forestry. Whereas; the mechanical measures are: structures on the contour/stop wash lines, Tied ridging, contour bounds, and pitting.

In proportion to that, biological measures are activities made to manage vegetation (rope, trees and grass), and animals, for example the establishment of a grass level cover or increased crop density. Mechanical measures are activities generally constructed to reduce the steepness of a slope, which allows better control of run-off (Ayer, 1995:372).

2.2.1. Indigenous Soil and Water Conservation practices

To define the term "indigenous" is difficult (Reji, 1996:4). From the western point of view, the concept indigenous knowledge associated with the term "primitive" (M.Semali and L.Kincheloe, 1999:4). But for others, especially those of indigenous people of Africa, Latin America, Asia, Oceania(M.Semali and L.Kincheloe,1999:4),indigenous knowledge is the way of knowing similar to Western science in that it is based on an accumulation of observation but it is different from science in some fundamental way(Fikret etal.,2000:1251). Here, indigenous knowledge is a product of the culture and cognition of people that operate independently of Western ideas (G. Hewson, 2015). Indigenous soilconservation practices are common in many indigenous peoples of the world. Thus, it is common to see different forms of soil conservation practices across the various indigenous societies and peoples of Africa (Yeshambel, 2013:1).

In Sub-Sahara Africa, soil conservation has a long tradition. Indigenous techniques from the pre-colonial era focused on erosion control in combination with water conservation by ridging, mulching, constructing earth bunds and terraces, multiple cropping, fallowing, and the planting of trees (Abaidoo et al.,2008 :2).

For centuries, Ethiopia has known indigenous people and developed indigenous knowledge in a wide range of fields like soil and water conservation, seed selection and preservation, advancement of traditional farm implements, development of appropriate farming systems, and adaptation of effective coping mechanisms withstanding food insecurities through time. It has well appreciated indigenous technologies that have been devised by the community, using their own indigenous knowledge to cope up harsh time and be able to sustain the livelihoods (Haregeweny et al., 2015:2, Tizita , 2016:244).

According to Camplainia et al., (2012) as cited in Haregeweny et al., (2015:3), soil and water conservation techniques have been practiced for centuries, most likely first implemented during the Aksumite kingdom (400BC to 800AD) in the axum(*Aksum*) area of Tigray region. Thus, Terracing was developed under traditional agricultural in the highland of Tigray(haregeweny etal.,(2015:3).In line with this, "*Dagets"* are the common traditional techniques of SWC in Tigray(J.Nyssen,1998:2).

In Eastern Hararghe remnants of the Harla Civilization could be observed (near Dire Dawa) where improved soil and water conservation practices are still traceable. Advanced soil and water conservation in Konso is a well-known living example of strategy to cope up with moisture-deficient soils and is still sustaining the livelihoods of the ever-increasing population. Farmers in Kindo Koisha woreda (southern Ethiopia) mitigate the problem of declining soil fertility through organic manuring, a succession of specific crops and short fallow at the lowland (Tizita, 2016: 245)

In addition, SWC practices of farmers in Maybar, south Wello and indigenous irrigation system in Amaro Special Woreda, southern Ethiopia; where farmers constructed waterways over gullies using grooved big logs and the diversion structure is constructed of thrash and tree branches (personal communication) are some of the indigenous technologies that can be cited(Tizita, 2016:245).

Furthermore, traditional SWC practices are well recognized in Ethiopia, for example in Gojjam, ditch drain surplus runoff, in the people of Konso application Terracing have practiced on their agricultural farm land long period of time (Hurni etal.,2016:11).

However, in general, indigenous SWC practices in Ethiopia have poorly documented and not considered by experts and policy makers as important (Haregeweyne et al., 2015:3).

As a result, the study was exemplified the various indigenous SWC practices at Raya -Alamata and Atsbi- Womberta Woreda, Tigray, The study also illustrated and reinforced the value of indigenous soil and water conservation as the basis for modern conservation of soil water resources.

2.2.2. Modern Soil and Water Conservation practices

During the 19th century, development attention focused on the need to "*Modernize"* and transformation supposedly backward agriculture productivity. Large projects area across Africa became the "experimental laboratory" for ambition engineers with a vision. However, a sudden modernization of agricultural development other problem created in the way of dramatic transformation (Reji.1996:3).

In many African countries, during colonial times considerable efforts had made to conserve soil and water resource. However, most soil and water conservation projects in sub-Saharan Africa have failed (Reij, 1991:3). The reason for its little success was due to poor planning, poor design of structures, lack of participation by the communities, inappropriate conservation methods, poor linkages with livelihoods of the poor and lack of an integrated approach that goes beyond soil conservation to address the interlinked productivity, market access, land policy and resource management problems (Abera,2003:2; Temesgen, 2015:45).

Similar to this, insecure land system also affects SWC practices. According to Yeraswork Admassie(1995), having only certificate for land ownership is not sustain to soil and water conservation practices , rather secure of land system is the main important in the fertility of the land (JRoodt, 1997:125).

In addition to that, SWC projects have had relatively long history in Africa, beginning in the 1930s when the colonial governments became concerned with the impact of soil erosion on the productivity of the land. However, increasingly aware of soil and water conservation by researchers and development practitioner was gaining in 1980s (Mazzucato and Niemejer, 2000:832).

The SWC projects had guided by a top down "transfer of technology paradigm" in which technologies were developed by scientists and extended to a population that was expected impatiently to accept them. Yet in practices, it was not the case that, the result became less than the expected. This little success has challenged researchers to find another way to study Soil and Water conservation (Mazzucato and Niemejer, 2000:832).

In Ethiopia following the devastating drought of the mid-1980s, the Derge regime was initiating soil and water conservation programme in the highland by the help of international aid and fund and food relief. For this case and other political needs , around US 20 million dollar had distributed annually as food for work between 1980 and 1990.The result was with two extreme sides, on the one hand long kilometers of bund were built, hillside were closed off, steep slope agriculture was abandoned and millions of trees were planted. On the other hand, it was with very high cost (Reji, 1996:4).

After the many wars and sever famine participation, Since the down fall of feudal system in 17th century SWC is at high level in Tigray region (Jan Nyssen, 1998:2).Due to the severity of soil erosion, steep slope and high stone content of the soils in the region, construction of Stone terrace is often the only realistic option(Yibabe,2002:10).

2.3. Farmers' participation in Integrated SWC practices

In order to create balance, experts on the indigenous practice stated that indigenous soil and water conservation like scientific soil and water conservation should become possible as a result of a more general intellectual processes of creating order out of disorder not simply as a response to practical human needs. In fact, there is clear boundary between indigenous and scientific soil conservation mechanisms in which indigenous soil conservation is more of general and relies almost exclusively on perception and experience whereas scientific once characterized by a

greater ability to break data presented to the senses and reassemble it in different ways (Yeshambel ,2013:*2)*

During 1950s and 1960s, indigenous agricultural practices of least developed countries had considered as backward and insufficient to manage their natural resources due to the high fetish of science and technology, which widely had perceived as capable to solve all human problems. Thus, indigenous resource management system had taken as an obstacle and irrational to the growth of productivity. Today, however, the opposite is true, number of empirical studies have been done that the existence of a wide variety of local level resource management systems that are both environmentally sustainable and efficient (UNRISD, 1994:7).

In comparison of colonial exponents, today exponents of SWC emphasizes on the participation of people. In 1960s onwards, the planners and policy-makers do not work and teach the imposed project which is in the long term. They argue forcefully the development to be participatory that insists "people at first" (Reji, 1996:5)

In line with the above, currently, there is growing consensus that conservation strategies be supposed to build at local knowledge (Aklillu, 2014:113). Bottrall(1981) as cited in Aklilu(2014:113), he notes that "development activities should employ indigenous knowledge and socio-cultural expression." This implies that, development projects should be based on an understanding of local knowledge and innovation.

The modern SWC techniques should built its ground on the baseline of indigenous SWC practices and it will widespread easily and cheaper. Because they fit better in to the local environment and socio economic conditions. Therefore, to be acceptable and sustainable the technologies recommended by the Ethiopian soil conservation project should incorporate the indigenous erosion control practices of the various agro-ecological zones through participatory and adaptive research (Belay, 1998:2).

Elsewhere, Singh (1992) cited in S.DABA (2002:70) argue that investment of Soil and Water conservation practices will gain acceptance among farmers only socio economic consideration adequate addressed. For that reason, Adoption technology separately cannot be sufficient in response of social, economic, political, and environmental challenges(Grenier,1998:11).Techno-

SWC should not only structure defined by strictly engineering measurements, they are the sum of practices included in monitoring SWC in agricultural setting (Reji, 1996:6). Thus ,indigenous (i.e., indigenous flood water diversion practices) of local community is important as base line.

2.4. Determinant Factors affecting Farmers' participation in Integrated SWC Practices

Since several empirical researchers examined the determinants to integrate of soil and water conservation technologies, i.e., to adopt new soil and water conservation in to existed indigenous soil and water conservation practices. Here, the research tried to review some of them for identifying the relevant variables to be included in the analysis.

Technological applications of imposed a new technology into existed knowledge of the local community it may have a direct effect on the decision making process. It appears that the more technically with complicated innovation, the less attractive it maybe for many farmers (Colman and Young, 1989:60).

Soil and water conservation activity of farmers is influenced by various range of institutional, socio-economic and physical factors (Eshetu, 2014:96). Similiarly, analysis made by Dessallew (2014:1) shown that, educational level of the household head; land insecurity, extension contact, slope of the plot, distance of the plot from residence and plot size are the determinants of farmers' perception of conservation practices.

In the study of Addisu et al.,(2015:173),in Goromiti watershed, the bivariate correlation analysis shows that age of household heads, tenure status of sampled house hold heads, slope of a plot, access to training and visiting demonstration has appositive correlation with adopted methods of soil conservation. Nevertheless, the educational level of sampled household head and adoption of new soil and water conservation measures has appositive sign with insignificant relationship.

Having this highlight information from the above listed empirical study that introduce factors affecting farmers' decision to integrated i.e., adoption of new SWC in to existed one , it is vital to discuss the influence of each variable on farmer's integrated use of SWC practices.

2.4.1. Socio-Economic Factors

Sex of households: In Abera and Desale (2016:333) findings of study, the percentage distribution and chi-square test analysis indicate that there was no significant variation between respondents' gender(,i.e., male or female) and their participation in soil and water conservation practices. However, in Anteneh et al., (2014:10) findings of study, sex of house hold head was found to have a positive and significant in participate of SWC activities.

Age of households : When Abera (2003:35) has analyzed household characteristics in their adopting and non adopting of new technology in soil and water conservation practices, there was no statistically significant difference in age between the two groups(adopter and non adopter). However, Dessallew (2014:6)was studied at Ankesha district in Ethiopia age of the household head has negative relationship in the influencing of soil and water conservation activity.A unit increase in age of HH head decreases the farmers' perception of being involved in soil and water conservation activities by 0.56 .This could suggest that younger farmers are more likely to have longer planning perspective to justify investments in technologies whose benefits have realized over time. In contrast to this, Fikru (2009:20) had found in the Koga watershed highland of Ethiopia that younger farmers do not expend more effort on soil and water conservation measures compared to older ones, which was motivated by the view that older farmers have experience.

Family size of households: In Abera and Desale (2016:333) chi-square test analysis of study indicate that there was significant relationship between household size farmers' participation in SWC. Large family size is normally associated with a higher labor endowment that will enable a household to accomplish a various agricultural activities on time bases. On the other hand, in the descriptive findings of Million and Kassa (2004:54) study at Gununo catchment the large family size farmers were not active in soil and water conservation practices. This is so true because households with larger family size are likely to face food shortage in periods of drought. As a result, they try to maximize short-term benefits and would be less interested in soil conservation measures whose benefits can be reaped in the long run.

Education of households: According to study Abera(2003:36),significant difference was not found in the education level in the conservation practices. In his Chi-square, analysis showed no

systematic association between the literacy status and the adoption of conservation structures. In contrary to this, according to Aklilu et al., (unknown: 534) econometric analysis education has significant correlation with farmers effort in SWC. This could attributed to the fact that household heads with relatively better formal education are more likely to use appropriate SWC practices and they able anticipate the consequences of soil erosion than non-educated farmers. In addition, they have better understanding of their environment and risk associated with cultivation of marginal lands. In line with, in Dessallew (2014:7) findings of study also, education of households head significantly and positively determined farmers' perception of soil and water conservation practices.

Livestock holding size of households: Livestock holding influence on SWC decision has mixed evidences. A study in central highlands of Ethiopia by Aklilu (2006) as cited in Tsegaye(2014:20) explained that livestock ownership has negative influence to adopt stone terrace. However, Chilot (2007) as cited in Tsegaye (2014:20) described that a number of livestock owned, positively and significantly conditioned the likelihoods and intensity of stone/soil bunds. The same to this, in the findings of Tsegaye (2014:53) in Kundudo mountain catchment, Jarso Woreda, east Hararghe zone, Oromia National Regional State asserted that these who was holding greater livestock unit were more participants of soil and water conservation practices and the sample t-test analysis for the difference in mean was significant.

Farming experience of households: In Eshetu's (2015:96) findings of study at Borena Woreda, South Wollo, farmers' SWC was influenced with farming experience positively and significantly. In addition to this, in Dessallew (2014:7) findings of study, a significant positive relationship was found between farmers' previous soil and water conservation experience and their current perception of SWC practices.

2.4.2. Institutional Factors

Land Tenure security: In the study of Dessallew(2014:7) ,land tenure security of the household has found to positively and significantly influence SWC practice. The result indicated that own managed plots tend to be more conserved than rented or sharecropped plots. This is because besides the shortage of resource, farmers were not secure for sharecropped and rented plots in the study Area.In line with this ,in the analysis of Eshetu(2015:96)in Borena woreda ,south Wollo,farmers'SWC was influnced with land tenure positively and significantly.

Access to training: In findings of Akililu et al.(2016:631),training on SWC is positively related to the actual and final adoption phases of SWC measures. The marginal effect confirms that farmers who received trainings on SWC are 3 and 10 % more likely to fall in actual and final adoption phases of SWC, respectively. Training (e.g., training delivered by the Agricultural Office) is one means to create awareness about the problems of erosion and the benefits of SWC measures to motivate farmers to invest in SWC measures. Similar findings, in Dessallew (2014:7),training in soil and water conservation has a positive and significant effect on conservation perceptions. Farmers who participated in training by development agents on SWC works were more aware of soil erosion and conservation than those who did not participated.

Access to Information: In the findings of Aklilu (et al.,unknown,532) study, access to information on SWC practices was very significantly and positively affected the decision on use of introduced stone bund. Similarly it has a significant and positive correlation with both introduced check dams. Moreover, it has a significant and positive correlation with use of soil bund. The possible explanation for these is farmer who get extension message on SWC from development agent will be more encouraged to use physical SWC practice on their farm plots. In line with this ,in Dessallew(2014:7) findings of study Contacts with extension agents positively and significantly influenced the perception of farmers on conservation practices.

2.4.3. Physical Factors

Plot size: In the study of Abera(2003:38)Chi-square analysis to test if there is an association between susceptibility of a plot to erosion and adoption of conservation structures, there was a strong and significant association between the two at 5% level of significance. But statistically,

the difference is not significant. However, through Pearson correlation between farm size and adoption is significant at the 10% level of significance and it is 19.2%. In line with, in Million and Kassa(2004:58) analytical result , plot size has a positive and significant influence on the farmers' decision to participate in soil and water conservation practices. Similar to this in Abera and Desale (2016:333) findings of study, Chi-square analysis indicated that a relationship between Farm size and participation in SWC activities. However, the relationship is not statistically significant between land holding and participation in SWC activities.

Quality of plot:Quality level of the plot is positively and significantly correlated with both stone bunds and soil buds. Moreover, it is positively and significantly correlated with check dams. This may be attributed to farmers' perception of visual impacts and consequences of soil erosion on fertile plot than less fertile plot(Aklilu et al.,unknown:532).In contrary to this, in the findings of Eshetu(2015:96) farmers' soil and water conservation participation was negatively and significantly influenced with fertility of a plot i.e., the quality of plot.

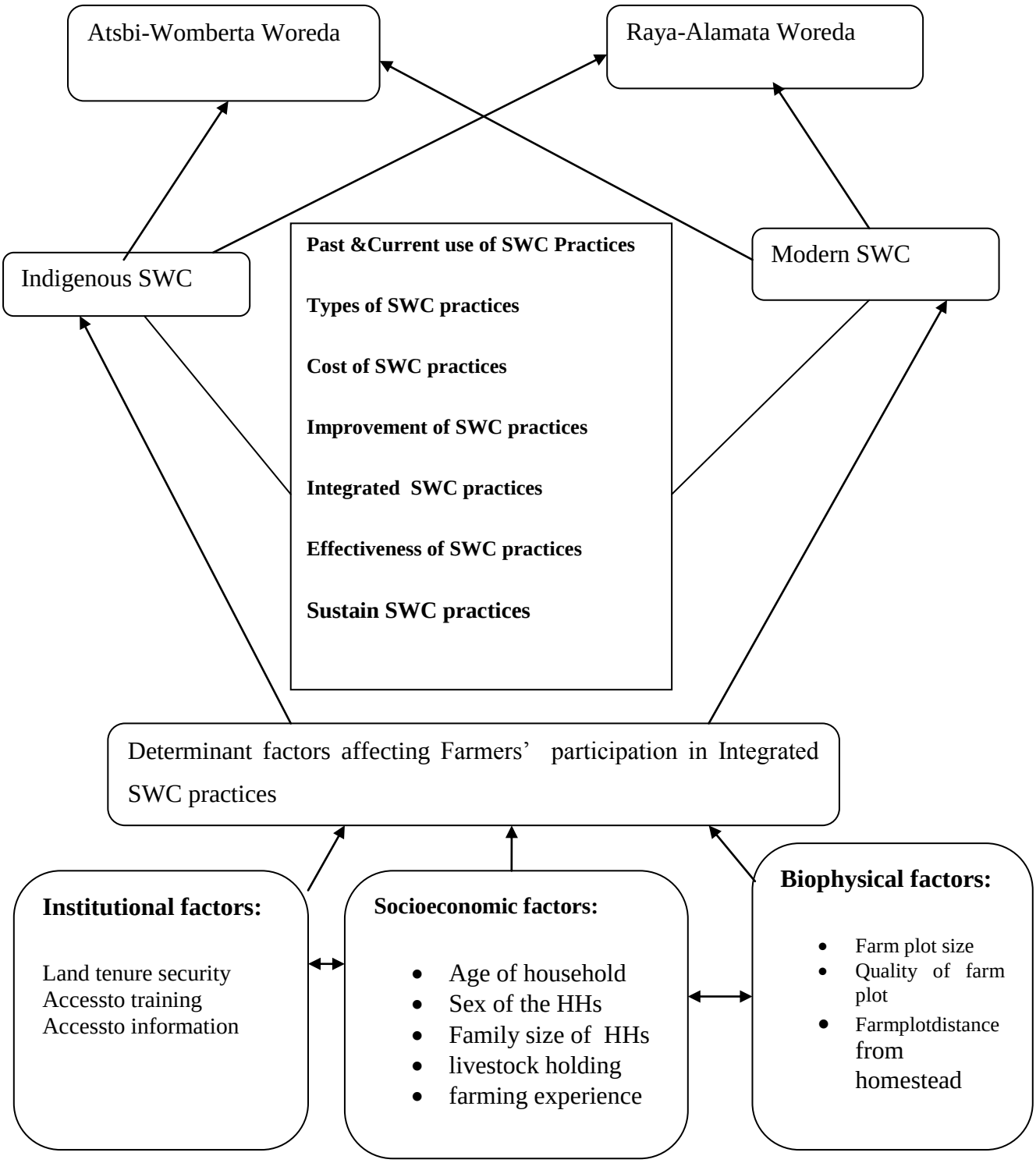
Distance of plot from home: In Abera (2003:57) findings of study, distance of a plot from homestead has found to be negative and highly significant. It implies that farmers with plots that are far from residential area had lower probability of adopting soil conservation structures. This can be attributing to the fact that farmers give more attention to nearby plots and the care given to distant plots is low. Therefore, the greater distance of a plot from homestead may have discouraged farmers from giving the necessary care and maintenance .This is similar with the study of Dessallew(2014:7) at Ankesha district in Ethiopia, the slope of a plot shapes the farmers' perception of conservation practice negatively. As the slope of the plot increase, the distance between two consecutive conservation structures will decrease and this creates disincentive to invest in soil conservation practice. This is because the structures of soil and water conservation take more area of land and it will create inconvenience for farm operation like oxen plough.

Generally, giving low attention to local level factors of a community, as if socioeconomic, institutional, and biophysical affects their new and existed knowledge of participation in the investment of soil and water conservation practices (Dessallew, 2014:2).

2.5. Conceptual Framework

The conceptual framework below speculates a comparative research design. The comparative design has formulated to deal with farmers' participation in indigenous and modern soil and water conservation practices of the two Woredas as model. This is to explore; the indigenous and modern SWC practice, cost of SWC practices, need to improvement of SWC practices, need to integrate indigenous and modern soil and water conservation practices, need to compare effeteness of SWC practices, need to get sustain soil and water conservation practices in Atsibi Womberta and Raya Alamata Woredas of Tigray region. This was doing through identification of determinant factors of local participation in SWC practices. These determinate factors has categorized as institutional factors, socioeconomic factors, and biophysical factors. The institutional factors are those that related with governing policy in general, environmental policy in particular. The socioeconomic factors are those that referred to household characteristics. The biophysical physical factors are those that related with topography, ecology of a given area.

Figure: 1. Conceptual Framework



Source: own, 2016/2017

CHAPTER THREE

3. Research methodology

3.1. Rationale for selection of two Woredas and Description of the Study Area

3.1.1. Rationale for selection of the two Woredas

The study has conducted in two Woreda of Tigray region, northern Ethiopia. These were Raya-Alamata and Atsbi-Womberta woredas. The rationale for selection of these two Woreda to comparative case study was because of their topography, severity of soil erosion problem, and agro-ecology difference and other historical practices.

3.1.2 Description of the Study

3.1.2.1.Raya-Alamata woreda

Geographically, Raya-Alamata district is located between 1362240 meter and 1371780 meter north and 526941 meter and 582966 meter east longitude, in Southern Tigray. It is about 182 km south of the city of Mekelle and is bordered by the Amhara region to the south and west and to the east by the Afar region.

Altitude of the Woreda ranges is from 1,178 to 2,300 metres above sea level (masl). 70% of the *Woreda* can be expressed as lowland (1,500 masl or less), and the remaining 25% is in the mid-highlands range (between 1,500—2,300 masl). The lowlands have surrounded by a chain of mountains to the east, west and part of the north. As a result, even if sufficient rainfall wasnot received in the valley, flash floods from the surrounding mountains can be used as the main source of supplementary irrigation using spates.

Rainfall is bimodal—between March and May there is a short rainy season, and between June and September there is the long rainy season. The annual mean precipitation ranges from 615—927 mm, with mean maximum and minimum temperatures of 23 °C and 14 °C, respectively.

Total area of the *Woreda* has estimated at 72,550 hectares (ha). The total cultivated area is 34,199 ha of which 33,345 ha is rain-fed and the remaining 854 ha is irrigable. *Teff*, sorghum and

maize are the major crops grown in the *Woreda*. Mixed crop-livestock farming is the dominant farming system of the *Woreda* .The main livestock reared in the *Woreda* are cattle, sheep, goats and camel. Livestock provide draught power, food and a source of income. Pasture is available in communal grazing lands and other sources of livestock feed during the dry season are crop residue (mainly the stalk of maize and sorghum and the straw of *teff*) and chopped cactus (Abrhaley et al., 2014:2).

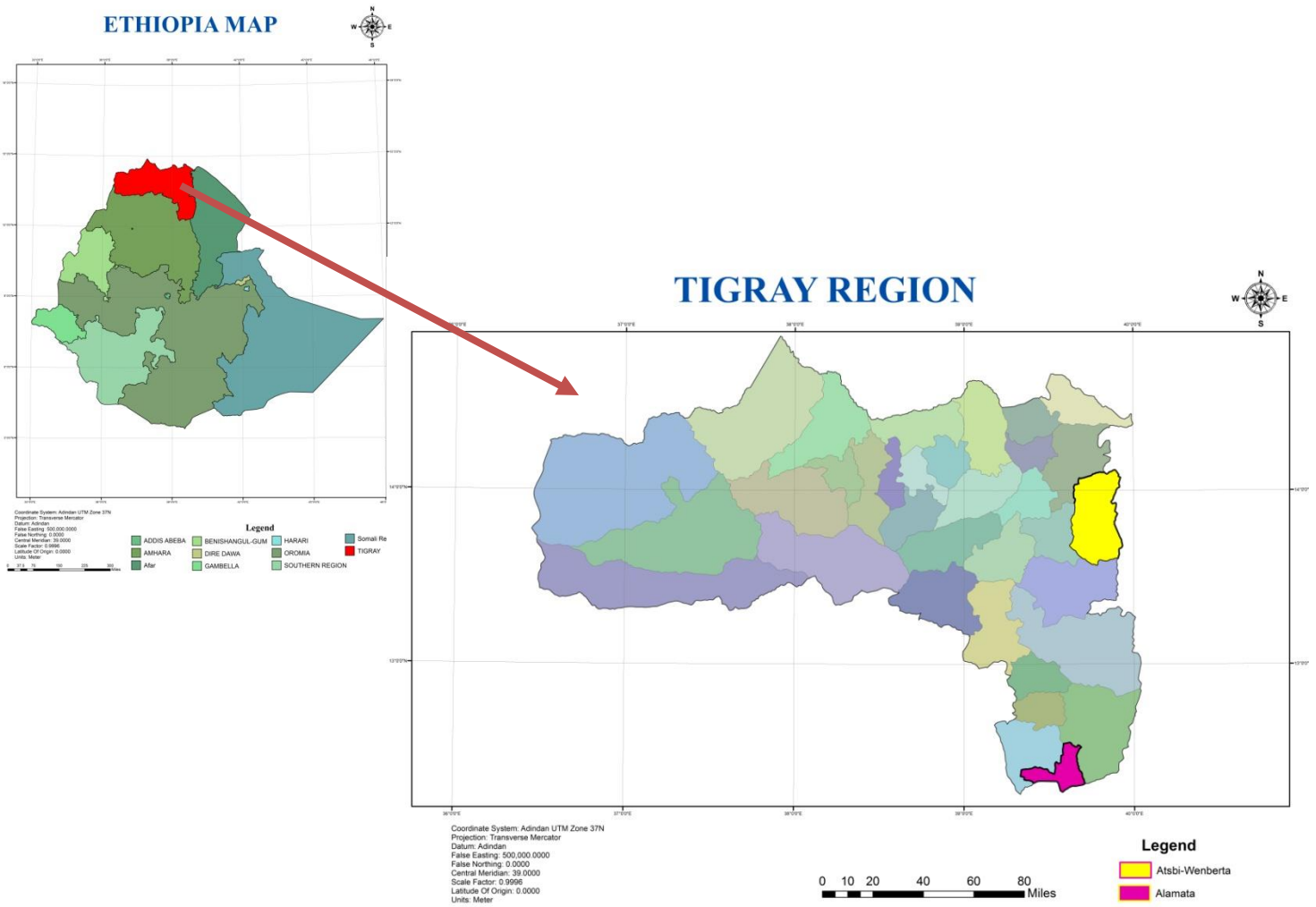
3.1.2.2.Atsbi-Womberta woreda

Locatection of Atsbi-Womberta district is about 80 km north of the regional capital, Mekelle, in Tigray region. Due to more rugged topography and recurrent droughts, it is the most severely degraded district.

Rainfall in Atsbi-Womberta is usually erratic, intense and short in duration, lasting for less than three months (June–August), with an annual average of about 668 mm. About 75% of the district landmass is located at an altitude of more than 2200 masl.

The total land area of the district is about 122,300 ha, with about 13,050 ha cultivated land, 16,301 ha non-cultivable hillsides, and 8802 ha grazing land. Average land holding in the district is estimated at 1 ha per household. The district is known in supplying of highland sheep and high quality honey to the surrounding markets. Despite the historical importance of the district in these market-oriented commodities, shortage of fodder has reduced the supply of these commodities. Communal grazing lands and hillsides have been degraded for generations due to the uncontrolled and free grazing system that was prevalent in the area (Berhanu et al., 2009:5).

Figure.2. Location map of the study areas (Raya-Alamata and Atsbi-woberta Woreda), Tigray, Ethiopia



3.2. Research Design

To obtain the intended objectives of the study such as,the historical and current indigenouse and modern SWC practices of the local communities in the two Woreda, local participation towards soil and water conservation practices, determinants of local participation in integrated soil and water conservation practices,mixed approach i.e. the researcher was used both deductive and indective approach to answer the research questions.These approches are the broad division of comparative research design.

Comparative research design is the most stuible research design.Its main goal is to search for or identify variance or similiarity.This may be reliy on what to compare,how to compare the comparative resarch in which deductive or inductive approarch is embeded(Viola and Heidi,2012:4). Similar with, comparative research design focuses on the explanation of differences, and the explanation of similarities of SWC practices in the two Woreda. However, what counts as a similarity or a difference depends not only on the observed values but also on the analyst as a social construct rather than as an objective reality.

3.3. Data type, Source and Methods of Data Collection techniques

Data had conducted from primary and secondary sources. The primary data sources include farmers, development agents of the kebeles and soil and water conservation experts of the two site selected Woreda. Secondary data was collected from published and unpublished materials that are being available in different libraries of AAU and other relevant institutions that have direct related to the study. These source materials were journals, workshop proceedings, thesis, dissertation and books. Primary data collection was conducted through following data collection techniques:

Questionnaire: Structured questionnaires with close and open-ended type have pre-tested by administering it to selected respondents. Based on the results was obtaining from the pre-test, necessary modifications had made on the questionnaire. The questionnaires have translated from English into the local language (Tigrigna). The questionnaire had covered a wide range of information including household information, farming system and asset endowment, landholding

systems, types of SWC technologies have used. Sample Respondents of this study were household heads.

Field Observation: Observation have done to the type of farmers' indigenous and modern soil and water conservation practices and their integration on their farm lands, topographic situatins was observed. This was activated with the assitance of chairperson of the kebeles and development agents of the selected areas.

Focus Group Discussions (FGD): To get Qualitative data Focus Group Discussions had carried out with farmers practicing different soil and water practices on their farm land. Two Focus Group Discussions have undertaken in each representative site kebeles of the two woredas. The number of participants in each group ranged from 5–8 farmers. The selection of participants have made based on their landholding, farm experiences, farm characteristics, age and sex. In addition, it concentrated on kowledge of soil fertility, skill, challenges and restraints on indigenous and modern SWC, local participation in integrated soil and water conservation in their farming experience.

Key Informant Interview: Interview made with key informants (elderly farmers, peasant association of the kebeles working on SWC. In depth interview was presented with development agents of the kebeles and soil and water conservation experts of Raya-Alamata and Atsbi-WomnertaWoreda. Types of indigenous and modern SWC activities, major Challenges in relation to soil and water conservation practices, lessons traing in the implementation of SWC was discussed.

3.4. Sampling Procedure and Sampling Size determination

In this study, a multistage sampling procedure had applied to select the sample households. In the first level, a purposive sampling method had employed to identify representative kebeles from the Woreda. From the total of rural kebeles of the Woreda, each of one rural kebeles have selected purposively by considering topography, severity of soil erosion problem, and agro-ecology. In the Second level, lists of households in each kebeles have obtained from the respective offices of development agents. With the lists, using simple random sampling procedure has used to select a total of sample households. By using probability proportional to

size sampling technique, the sample size from each KA was determined. Lastly, the Sample Size has calculated by the following formula provided by Yamane (1967), as follows

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

Where, n=the required sample size

N=total households

e= level of precision (at 8%)

Table1. Distribution of sample household heads by Kebele in the site selected Woreda

Woreda	keble(tabia)	N	% of kebele to N	n
Raya-Alamata	**Gerjele**	**2068**	**58**	**87**
Atsbi-womberta	**Barka adi-sbha**	**1496**	**42**	**63**
Total		**3564**	**100**	**150**

Note: N= total number of household heads, n= number of sample household

Source: Own sampling design (2017)

3.5. Methods of Data Analysis

Descriptive statistics,inferential statistics and econometric methods were employed to analyze the data. Details of the procedures used to analyze the data are presented as follow.

3.5.1. Descriptive statistics and inferential statistics

The process of data analysis carried out by using comparative analalysis in which qualitative and quantitative data analysis was conducted. The qualitative data analysis was used thematic analysis. The quantitative data analysis of the study was used both descriptive and inferential statistics. However, except the data that has acquired through Focus group discussion, key interview data and field observation data, the study was relied on quantitative method of data analysis. All the collected data has entered into SPSS version 16.0. Descriptive analysis has

included,avarage,percentage and cross-tabulation. In inferential statistics analysis (continuous data) was analyzed through mean, independent t-test**.**

3.5.2. Econometric model specification

In integrated studies, the response to a question such as whether farmers have used integrated a given SWC practices could be yes or no, is a representative case of dichotomous variable. The model that is suggested for such binary dependent variable is the linear probability model. However, the use of this model is not appropriate to evaluate the effect of explanatory variables due to well-recognized econometric problems associated with this model. Linear probability model assumes that most of the observed values of the outcome variable will fall close to those predicted by the linear regression equation and will have an approximately normal distribution.Linear equestion represents as:

$f(e)(y)=a+bx_i$----------equation (2)

where f=link function that links e(y) and $a+bx_i$

e(y)=expected outcome

$a+bx_i$ =predicted value/variable

Non-linear is a function where the value of dependent variable is dummy or the exponent independent variable is greater than one.

Therefore, the outcome of this thesis was dummy which was integrated SWC denoted by(1) and not integrted SWC denoted by (0)and the function is non linear function. To get the probabilty:

P=integrted SWC

1-P=not integrated SWC

P has the following characteristic:

(1)P>0 or always positive*;(2)p≤1*

P=a+bxi is a linear function. Assume that *p* as dummy variable *p=a+bxi* will be non linear

- *To satisfay crateria (1)that was p>0 or p* must be positive multiply both side by exponatial function :

$ex(p)=e^{(a+bxi)}$---------- equation (3)

- To satisfay crateria (2)that was p≤1;p must divided by p+1

Therfore, $e(p)=\frac{ex^{(a+bxi)}}{ex^{(a+bxi+1)}}$

Re-aregments for equation:

$$ex(p)=\frac{ex^{(a+bxi)}}{1+ex^{(a+bxi)}}$$ ---------- equation (4)

P=1-*p*;for those who did not integrated

1-*p*=1-*p*

$1-p=1-\frac{ex^{(a+bxi)}}{1+ex^{(a+bxi)}}$

$1-p=\frac{1}{1+ex^{(a+bxi)}}$---------- -----equation(5)

- The odds to be used can be defined as the ratio of the probability that a farmer integrated the practice *p* to the probability that he or she would not *1- P:*

$$\frac{P}{1-p}=\frac{ex^{(a+bxi)}}{\frac{1+ex^{(a+bxi)}}{1}}=\frac{ex^{(a+bxi)}}{1+ex^{(a+bxi)}}\times\frac{1+ex^{(a+bxi)}}{1}$$

$\frac{P}{1-p}=ex^{(a+bxi)}$---------- equation (6)

- Taking the natural logarithm of the odds ratio of equation (6) will result in what has known as the logit model as indicated below:

$Ln\left\{\frac{P}{1-p}\right\}=$ **Ln**$ex\,(^{a+bxi})$

$Ln\left\{\frac{P}{1-p}\right\}=a+bxi$---------- equation (7)

3.6. Hypothesis and Definition of Variables

Empirical studies have considered a broad range of factors, but not all factors might have equally important in different areas and for farmers with different soil and water conservation. The independent variables of the study are those, which have expected to have association with farmer's participation in the integration of soil and water conservation practice, integration of indigenous and modern soil and water conservation practices. From the findings of various empirical studies on the farmer's participation in participation of soil and water conservation practices, the existing theoretical explanations, and the researcher's knowledge of the farming systems of the study areas have used to select 11 explanatory variables. The definition and units of measurement of the dependent and explanatory variables was used in the logistic regression model is alleged on the below Table.2.

Table.2.Definition and unit of measurement of variables used in the binary logistic model

Independent Variables code	Definition	Variable type	Unit of measurements	Expected sign(-+)
SEXHHS	Sex of the household head	Dummy	1 if male, 0 if female	-
FPLOTSIZE	Farm Plot size	Continuous	Hectare	-/+
FAMSIZE	Family size of household head	Continuous	Number	-
AGEAHHS	Age of the household head	Continuous	Year	-
EXPER	Farming experience	Dummy	1 if past and current SWC works and having previous experience; 0 otherwise	-
TENURE	Land security	Dummy	1 if the farmer considered	-
LIVHD	livestock holding	Continuous	Number	-
QUFAPOT	Quality of farm plot	Dummy	1if fertile;0 otherwise	-
ACTRAIN	Access to Training	Dummy	1if get training in SWC ;0 otherwise	-
PLOTDST	Plot distance from the homestead	Continuous	Measured in walking minutes	+
ACINFO	Access to information	Dummy	1if informed;0 otherwise	+
Dependent variable code				
INTEWSC	Integration of SWC Practices	Dummy	1 if he/she integrated SWC;0 otherwise	

CHAPTER FOUR

4. Result and discussion

Tabe 3.Statistical parameters of households information and assets holding

Variables	Atsbi-womberta	Raya -Alamata	t-value	significance	Total avarage
Sex					
Male	76.2%	86.2%			82.0%
Famale	23.8%	13.8%			18.0%
Age					
Mean	39.05	43.60	-1.848	.067	41.69
SD	13.665	15.700			15.002
Educational level					
Ilitrate	82.5%	67.8%			74.0%
Litrate	17.5%	32.2%			26.0%
Family size					
Mean	4.25	4.20	.184	.854	4.22
SD	2.008	1.860			1.917
Farmplot holding					
Yes	84.1%	94.3%			90.0%
No	15.9%	5.7%			10.0%
Farmplot size					
Mean	1.06	1.97	-4.669	.000	1.59
SD	.828	1.367			1.252
Slope ofplot					
Flat	19.0%	23.0%			21.3%
Gentle	22.2%	72.4%			51.3%
Steep	58.7%	4.6%			27.3%
Plot Distance					
Mean	17.59	16.09	.946	.346	16.72
SD	9.542	9.567			9.553
Plot quality					58%
Fertile	40%	76%			42%
Infertile	60%	24%			
TLU					
Mean	4.64	8.74	-8.153	.000	7.02
SD	2.674	3.284			3.651
Farming Exp.					
Less than 25	31.7%	27.6%			29.3%
26-30	28.6%	31.0%			30.0%
31-70	19.0%	21.8%			20.7%
Above 70	20.6%	19.5%			20.0%

Source: Field survey, 2017

SD*= Standard Deviation

4.1.Households information and asset holding

The Cross tabulation survey indicates that 23.8% and 76.2% of the sex distribution of the sampled respondents in Barka Adi-sbha is female and male, and 13.8%, 86.2 of the sampled household head in Gerjele were female and male respectively (Table 3). In both site selected of Woreda of the sampled household heads, Male sex distribution is the dominant. From this, one can propose in the imbalance of sex distribution can affect the decision to participate in soil and water conservation practices.

The result shown that the age of sampled household heads ranged from 24 to 70 years old, with an average of an average of 41.69 years old(Table 3).The average age of sampled household heads in Barka-Adisbha and Gerjele was 39.05 and 43.60 years old respectively. The t-test analaysis indicates there was no statically significant age difference between Barka Adisbha and Gerjele. This might have suggested that the age group distribution could not make difference in the participation of soil and water conservation practices

As Table 3 shown in, about 82.5%, 67.8% of the sample household heads were unable to read and write, and 17.5%, 32.2% were cable to read and write, in Barka Adi sbha and Gerjele Woreda respectively. Sound difference was existed in the number of respondents who attended informal education (literate). In sum, 74% of sampled household heads were illiterate and the remains 26% were educated. From the survey result, one can guess educational status can make slit difference in the activity of livelihood in general and in the soil and water conservation practices in particular. Because, educated farmers and illiterate may differ in their better position to get information and use it in their farming practices about soil and water conservation practices

The average family size of all sampled household heads was 4.22. In the regional report in 2007, population survey of the Tigray regional state average family size was 4 people per household (Abebe, 2015:45).This is might be true what has been reported for the Region. As demonstrated in Table 3 the average family size of Barka Adisbha is 4.25 whereas in Gerjele is 4.20.I nline with, result of t-test indicates that there is no significance in family size difference between the family size of the two Woredas. Here, one can imagine that family size may not determine to have effective application of soil and water conservation practices.

As asserted in table 3, most of the sampled houses hold heads do own farm plot. 84.1%, 90% of respondents in Barka Adisbha and Gerjele own farming land respectively.15.9percent and 10percentof respondents do not own farm plot in Barka-Adisbha, and in Gerjele correspondingly comparatively, the farm plot owner of sampled household heads in Gerjele has slit difference from the farm plot owner of sample respondents in Barka-Adisbha. This might have its own positive impact on the investment of soil and water conservation practices. Because, being owner of farm plot can make to increase the willing to conserve soil and water resources

The average farm plot holding of both Woreda was 1.59 heaters per household(Table 3).This is greater than the national average farm plot holding of 1.0 ha per household reported in 2012(Abebe, 2015:45). As displayed in Table 3, the average farm plot holding in Brka Adisbha was 1.06 ha which was approximately similar with the national average of farm plot size per household. Whereas, an average farm plot holding in Gerjele was 1.97 ha, that was not as such relative to national report about the size of farm plot. There was a slight difference in the size of farm plot holding between Atsbi-womberta and Raya Alamata Woreda and independent sample t test for farm plot size indicated that the difference in mean was significant. The difference between the sampled households of the two Woreda might have resulted from the typography setting and continuous division of land from their ancestors and land distribution.

The survey result in Table 3 indicates, the average plot distance from the residence in mean was 16.7`. 17.59`and 16.09` mean of the plot distance from homestead was in Barka Adisbha and Gerjele Woreda respectively. The independent sample t test of plot distance from residence shows that the difference in mean association between the two Woreda was not significant. Here then one can propose that, the distance to plots from the homestead may not affect the application of soil and water conservation practices because it seems to depend on the willing of the households.

Based on the knowledge of sampled household heads they had ,the slope of their form plot were classified as flat, gentle, and steep slopes(Table 3),58.7% and 4.6% of sampled respondents have owned steep slope type farm plot in Brka Adisbha and in Gerjele respectively. In line with, 22.2% and 72.4%of the sampled house hold heads have own gentle slope of type farm plot, and 19.0% and 23.0% of the sampled house hold heads have own Flat slope type in Barka Adisbha

and in Gerjele chronologically. Accordingly, majority of farm plots own by the sampled household heads were gentle and steep sloped farm plot in Gergele and Barka Adsbiha. Thus, the percentage of gentle and flat-sloped farm plot were higher in Gerjele than in Barka Adisbha. Most of the farm plot in Barka Adisbaha was steep and gentle sloped. This in slope difference might have brought soil degradation in motion. It is evident that the steeper farm plot was easy to degradation by which high soil and water conservation practices have needed. Here, one can generalized the farm plot of Atsbi womberta district was highly degraded than Raya Alamata district.

As shown in table 3, about 60 % and 24% of sampled respondents' farm plot was infertile in Barka Adisbha and Gerjele respectively.Whereas,40% and 76% of sampled households'farm plot was fertile in Barka Adisbha and Gerjele orderly. This indicates that the slope of farm plot of respondents in Barka adisbha was steeper than the slope of farm plot of respondentsof Gerjele district. This might be the reason for the low fertile soil in Barka adisbha . This have supported by the focused group discussion of the study areas, they were aware of soil fertility was being depleted.They said that the productivity of the soil and its capacity to infltrate raining water was low.

The livestock type found in the study area are cattle, goat, sheep, donkeys, mule, horse and poultry farming. To display the livestock owning of each sample household heads in terms of TLU (tropical livestock unit), the TLU per household was calculated(Appedix 6.1)

The average holding of livestock in the study areas vary between 4.64 in Barka Adisbha TLU to 8.74 TLU in Gerjele district(Table 3). The total average was 7.02 TLU. The t-test result supports for the difference in mean was significant at less than 1% confident level. This might have implied that TLU per household vary among the sample study areas and household TLU have relationship with over all of soil and water Conservation practices.

As it has displayed in the Table 3, the range of farming experience lies between less than 25 and above 70 years.With the increase of age of farm experience, from 26-30 to above 70 years, the percentage of sampled household heads in Barka Adisbha and decrease from 28.6% to 20.6 % and the percentage of sampled household heads Gerjele decrease from 30.0% to 20.0%

respectively. From this one can suppose, the farming experience of households can bring slit change in the performance of the households in the practices of soil and water conservation .

4.2. Soil and Water Conservation practices

Respondents have asked whether they had experince on practices of soil and water conservation before government intervention. Most of respondents have replied with 'yes'answer

Table 4.Response of sample households on SWC practices before government intervention * Kebeles of sample household heads Crosstabulation

			Kebeles of sample household heads		
			Atsbi-womberta woreda(BarkaAdi-sbha)	Raya-Alamata woreda(Gerjele)	Total
	no	Count	14	7	21
		%	22.2%	8.0%	14.0%
	yes	Count	49	80	129
		%	77.8%	92.0%	86.0%
Total		Count	63	87	150
		%	100.0%	100.0%	100.0%

Source: Field survey, 2017

As indicted in Table 4, 86.0% of the sampled household heads in both Woreda had practiced soil and water conservation before the curent government intervention(i.e., before 1984 E.C). Separately, 77.8% and 92.0% of sampled respondents had practiced soil and water conservation, in Brka Adisbha and Gerjele respectively. There was slit difference between the respondents of the two Woreda in their experience of soil and water conservation practices. Despite the difference, from the average experience of sampled household heads in both Woreda in their past practices of soil and water conservation, one could be suggest that introduced soil and water conservation can easily integrate if planners make the existed knowledge of the community in consideration.

4.3.Response of sample households on current use of Indigenous soil and water conservation practices

An indigenous soil and water conservation practice develops in the locality of a community (Tizita , 2016:244). The degree of Indigenous knowledge of individual in the community can differ from one another. Because, due to the fact that, human by nature they do not have equal specialization in the knowledge of an object.

Table 5.Response of sample households on current use of indigenous SWC practices * Kebeles of sample household heads Crosstabulation

			Kebeles of sample household heads		
			Atsbi-womberta woreda(Barka Adi-sbha)	Raya-Alamata woreda(Gerjele)	Total
	No	Count	22	19	41
		%	34.9%	21.8%	27.3%
	Yes	Count	41	68	109
		%	65.1%	78.2%	72.7%
Total		Count	63	87	150
		%	100.0%	100.0%	100.0%

Source: Field survey, 2017

Currently, as shown in Table 5, 72.7% of the respondent use indigenous soil and water conservation practices(Table 6). This shows that, most of the respondents in the study area are not willing to adopt new methods of soil and water conservation. Comparatively, 65.1%and 78.2% of the sampled household heads still use their indigenous knowledge of soil and water conservation practices in Barka-Adisbha and Gerjele respectively. Descriptively, there is slit difference between the respondents of the two Woredas in current use of indigenous soil and water conservation. This might have the reason not willing to use the new introduced soil and water conservation because of their expensiveness. This supported by the Focused group discussion of the study areas, the case of not willing to construct modern soil and water

conservation practices was the development agents do not treat the existed in digenouse soil and water conservation of the local farmer community in their application of modern soil and water techniques. For example, the indigenous ploghing had forced to stop; traditional soil and stone bund and waterways had changed with modern soil and water conservation techniques. This might have caused to decrease the interest of local farmer community to the accepting of new introduced land management system.

Table 6. Response of sample HHs on type of indigenous soil and water conservation practices * Kebeles of sample household heads Cross tabulation

			Kebeles of sample household heads		
			Atsbi-womberta woreda(Barka Adi-sbha)	Raya-Alamata woreda(Gerjele)	Total
	Contour plowing	Count	9	16	25
		%	14.3%	18.4%	16.7%
	Crop rotation	Count	10	22	32
		%	15.9%	25.3%	21.3%
	Inter-cropping	Count	6	3	9
		%	9.5%	3.4%	6.0%
	Terracing(stone bunds)	Count	19	14	33
		%	30.2%	16.1%	22.0%
	Planting trees	Count	9	11	20
		%	14.3%	12.6%	13.3%
	All	Count	6	7	13
		%	9.5%	8.0%	8.7%
	0ther	Count	4	14	18
		%	6.3%	16.1%	12.0%
Total		Count	63	87	150
		%	100.0%	100.0%	100.0%

Source: Field survey, 2017

As indicated in table 6, the indigenous type of soil and water conservation practices, in average ,22.3% and 22.0% of the sampled respondents in the two district have practiced ,crop rotation and terracing(stone bund) indigenous type of soil and water conservation respectively. However, in comparison, 14.9% of sampled households in Gerjele have practice terracing(stone) while 31.7% of respondents in Barka Adisbha have practices terracing (stone bund).This is maybe the fact that the area has distinct features of geographical setting, it has

covered with Rocks and stones and this force them terracing in the conservation of their farm plot.

In the group discussion and interviews with Farmer community of Atsbi Womberta Woreda, terracing (stone bund) which is locally called '*Gedeba'(*Tigrgna word see figure 3) has long history in civilization of human induced agricultural settlement.

Figure 3: Traditional stone bund in Barka Adisbha district

In addition to terracing, there is indigenous soil and water conservation practices in the Woreda so called locally as 'Armo' (Tigrna word see figure 4) which is unploughing land gap between or before farm plot. It is a gentle slope type of land. *armo* has many contribution to the farmer community of the area. It protects water runoff, which causes soil erosion. Moreover, because of it is not ploghing, there are grass which use for their animal feed. However, now a day, most of the *armo* have destructed and changed in to farming plot due to the need of agricultural expansion.

Figure 4: Traditional land gap(‘*Armo’)* in Barka Adisbha district

In line with, result of focused group discussion and in –depth interview asserted that soil and water conservation practices have been begun many years ago, so called ‘***deret’(***Tigrgna word esee fugure 5). ‘deret’ is used as boundary built between farm plot and by which conserve soil and water resource.

Figure 5: Tradtional land boundary between farmplot(‘*deret*’) in Gerjele district

In Gerjele, 25.3% of the respondents have practiced crop rotation type of indigenous soil and water conservations, 15.9% of respondents have practiced crop rotation in Barka Adisbha. Distinctly, 16.1% of respondents in the Woreda of Raya Alamata in general and in Gergele area

in particular, soil bunds and traditional waterway diversions are the two main traditional soil and water conservation practices.

In the group discussion, floodwater diversion to farm plot techniques had practiced before long period of time, the farmer community of Raya Alamata woreda. They have evaluated it as the most effective in comparison of modern flood diversion to farm plot in terms of the role water absorption and soil sediment conservation in the farmland.

In line with, the interview made with elder farmers, development agents and soil and water conservation expertise in Raya Alamata Woreda, the most indigenous soil and water conservation practices was floodwater diversion to farm plot, i.e., *Feses(*Amharic),or '*Feleg'* **(**Tigrigna Word**)**.

As soil and water conservation expert said that, 'the indigenous knowledge based floodwater diversion to farm plot have constructed during January up to June that has its own normative institution. In the time of construction, there are 'normative rules' that forced all farmer communities to participate in floodwater diversion activities. Nobody allowed using the banked water if he did not participate in the conservation activities.' And also he said that "from the modern floodwater diversion which is based on scientific water level analysis, the indigenous one is more effective and well matched to the slope of the land and this was because of farmer community of the area are well known with slope setting of the farm plot.'

The soil sediment created by the indigenous floodwater diversion activities locally is named as'*dugay'(local* Raygna *word**)***. *dugay* is scientifically called soil bund and this later become a '*dendes' (*Tigrigna word, see figure 6),which is the baundry between farm plots. This *dendes* has its own instrumental value to the life of the community and intrinsic values to the land in itself. To the former, it uses as strip grass to the source of their animal, to the later it has protected the land from being eroded.

Figure 6: Tradtinal soil bund (locally, '*dugay')* in Gerjele district

Table 7. Response of sample HHs on evaluation of indigenous SWC practices in terms of cost * Kebeles of sample household heads Crosstabulation

			Kebeles of sample household heads		Total
			Atsbi-womberta woreda(Barka Adi-sbha)	Raya-Alamata woreda (Gerjele)	
	most costy	Count	1	2	3
		%	1.6%	2.3%	2.0%
	Costy	Count	24	24	48
		%	38.1%	27.6%	32.0%
	less cost	Count	32	46	78
		%	50.8%	52.9%	52.0%
	I do not know	Count	6	15	21
		%	9.5%	17.2%	14.0%
Total		Count	63	87	150
		%	100.0%	100.0%	100.0%

Source: Field survey, 2017

Duing the application of soil and water conservation practices it might has a cost . However, the type of cost may be differing in terms measuring in amount, for instance, money, labor and Material. This might have understood interns of cost benefit analysis of an activity at local level. It is evident to say that indigenous soil and water conservation practices are less costy than modern soil and water conservation for the reason that the indigenous soil and water conservation are easily accessible to the rural local community.In comparison of modern soil and water conservation, respondents have asked to evaluate indigenous soil and water conservation practices in terms of cost (Table 7), above 50% of the sampled household heads evaluates indigenous soil and water conservation as less costy. 2.0%, 32.0 %, 14% of the respondents have answered, more costy, costy, I do not know respectively.

It was not the case in the past, but now a day, indigenous soil and water conservation needs some improvement. Because indigenous soil and water conservation practices existed for centuries at this time, they are insufficient to manage the present severity of soil degradation. For that reason, technical support allows from the modern experts of soil and water conservation, this is the reason why 60.7% of the total respondents agree in the improvement of indigenous soil and water conservation (Table 8). Distinctly, 58.7% and 62.1% of the respondents on the opinion on the improvements of indigenous soil and water conservation is in Barka Adisbha and Gergele .

Table 8. Opinion of sample household heads on indigenous SWC improvement * Kebeles of sample household heads Crosstabulation

			Kebeles of sample household heads		
			Atsbi-womberta woreda(Barka Adi-sbha)	Raya-Alamata woreda(Gerjele)	Total
	No	Count	26	33	59
		%	41.3%	37.9%	39.3%
	Yes	Count	37	54	91
		%	58.7%	62.1%	60.7%
Total		Count	63	87	150
		%	100.0%	100.0%	100.0%

Source: Field survey, 201

4.4 Response of sample households on current use of Modern Soil and Water Conservation Practices

In the rural part of Tigray region in general and the site selection areas in particular, acceptance and application of modern soil and water conservation is not strong as such it was introducing. This might be because of its expensiveness and difficult accessibility at local level.

Table 9.Response of sample households on current use of modern SWC practices * Kebeles of sample household heads Cross tabulation

			Kebeles of sample household heads		
			Atsbi-womberta woreda(BarkaAdi-sbha)	Raya-Alamata woreda(Gerjele)	Total
	No	Count	44	65	109
		%	69.8%	74.7%	72.7%
	Yes	Count	19	22	41
		%	30.2%	25.3%	27.3%
Total		Count	63	87	150
		%	100.0%	100.0%	100.0%

Source: Field survey, 2017

With exception, still modern soil and water conservation are not well implementing. Currently, this have witnessed that, 72.0% of the respondents in the two distracts are not use modern soil water conservation in their farm plot. Even if they have constructed by any means, it has not in existence after a year later they have abandoned. This might be because of it was not constructing based on the willing of the local community. As it was cross cheched from the development agents of the kebele some farmers were even destructing the already constucted, fore instance stone bench in stead of use them. This indicates that there is procedural error in introducing of modern soil and water conservation.Orderly, 69.8% and 30.2% of the sampled household heads in current application use of modern SWC is in Barka Adisbhan and Gerjele correspondingly (Table 9). This cross tabulation analysis shows that modern soil and water

conservations practices have more accepted in the sampled household heads of Gerjele area than the sampled household heads of Brka Adisbha district. In the field observation, it was observed that modern SWC practie in the communal land terrance bench, half moon, and different biological SWC practice.

4.5. Response of sample household heads on type of modern soil and water conservation practices

In the introduction of modern soil and water conservation, it is importance to consider and to assess the typography of a space provided area if not implementation of the modern techniques and methods will be insignificant. This might be the reason for the failure of the past soil and water conservation proramme that had constructed at high cost

Table 10.Response of sample household heads on type of modern soil and water conservation practices * Kebeles of sample household heads Cross tabulation

			Kebeles of sample household heads		
			Atsbi womberta woreda(Barka Adi-sbha)	Raya Alamata woreda(Gerjele)	Total
	Stone bund	Count	22	14	36
		%	34.9%	16.1%	24.0%
	Soil bund	Count	10	34	44
		%	15.9%	39.1%	29.3%
	Flood water diversion to farm plot	Count	8	18	26
		%	12.7%	20.7%	17.3%
	Modern Waterway	Count	3	10	13
		%	4.8%	11.5%	8.7%
	All	Count	13	4	17
		%	20.6%	4.6%	11.3%
	Other	Count	7	7	14
		%	11.1%	8.0%	9.3%
Total		Count	63	87	150
		%	100.0%	100.0%	100.0%

Source: Field survey, 2017

As shown in the Table 10, 34.9% of sampled household heads in Barka Adisbha have applied stone bund(figur 7) in their farm plot.This might be the reason that the district is accessible to stones. Whereas, 39.1% of sampled household heads in Gerjele have applied soil bund**(**figur 8) in their farm plot. This is because of the reason absence of stone and soil is the most accessible in the area. Despite of the difference, in both Woreda all kinds of modern soil and water conservation, i.e.,17.3%,8.7%,11.3% and 9.3% of the respondents applies, flood diversion waterway to farm plot, modern water way, all type of modern soil and water conservation and other kinds of soil and water conservation including all categories of biological measures. In the group discussion, they argued that the modern flood diversion water way is less effective than of the existed traditional one. Because, the introduce one is not compatible with ecological features of the district. Accordingly, the types of modern soil and water conservation have been constructed consists slit difference between Atsbi Womberta and Raya Alamata Woreda of Tigray Region. Because of the most probability, Atsbi Womberta's Woreda geographical Setting is full of stone Highland. Whereas; most like Raya Alamata Woreda is a lowland Area. For this reason, the need in the construction type is somehow differe.

Figure 7: Modern stone bund in Barka Adisbha district

Figure 8: Modern soil bund in Gerjele district

4.6. Response of sample HHs on current Integration of Indigenous and Modern SWC practices

In this section, integration among the two soil and water conservation practices was tried to explorer in the study Woreda. It is evident that the present sever soil degradation could not solve with indigenous soil and water conservation practices only for the reason that the knowledge of local community in soil and water conservation that existed for centuries were ignored and destructed long till today. However, by identifying the middle ground of the two conservation practices that can integrated, it might have gained sustainable soil and water conservation practices.

Table 11.Response of sample HHs on current integration of indigenous SWC practices with Modern SWC practices * Kebeles of sample household heads Crosstabulation

			Kebeles of sample household heads		
			Atsbi-womberta woreda(Barka Adi-sbha)	Raya-Alamata woreda(Gerjele)	Total
	No	Count	52	69	121
		%	82.5%	79.3%	80.7%
	Yes	Count	11	18	29
		%	17.5%	20.7%	19.3%
Total		Count	63	87	150
		%	100.0%	100.0%	100.0%

Source: Field survey, 2017

Sampled respondents have asked if they were integrating of indigenous soil and water conservation practices with modern soil and water conservation practices, only 19.3% of sampled household heads were integrating. However, 80.7% of sampled respondents in both Woreda (Barka Adisbha and Gerjele) were not integrating(Table 11). This cross tabulation result asserts that there were farmers who practices indigenous soil and water conservation and modern soil and water conservation practices separately. This was true because in table 8, 72.7% of the sampled respondents had suggested as they were highly practicing indigenous soil and water conservation in their farm plot. Whereas, 27.3% of sampled household heads were using modern soil and water conservation practices. However, there was an indication of soil and water conservation practices integration in the Woreda of Raya Alamata woreda, the indigenous soil bund costructed from the flood water diversion locally called '*dugay*' and the modern soil bund(see figure 9). , one could generalize the integration level of the two soil and water conservation practices was very low

Figure 9:Integration of indigenous soil bund and modern soil bund in Gerjele district

Table 12.Perception of sample HHs on the effectiveness of indigenous SWC practices in comparison of modern SWC practices * Kebeles of sample household heads Crosstabulation

			Kebeles of sample household heads		
			Atsbi-womberta woreda(BarkaAdi-sbha)	Raya Alamata woreda(Gerjele)	Total
	very effective	Count	6	1	7
		%	9.5%	1.1%	4.7%
	Effective	Count	30	39	69
		%	47.6%	44.8%	46.0%
	less effective	Count	9	16	25
		%	14.3%	18.4%	16.7%
	I do not know	Count	18	31	49
		%	28.6%	35.6%	32.7%
Total		Count	63	87	150
		%	100.0%	100.0%	100.0%

Source: Field survey, 2017

Sampled Respondents had asked to rank the effectiveness of indigenous soil and water conservation in comparison of modern soil and water conservation practices based on the accessibility and profitability of the techniques. As depicted in table 12, in average, 46.4% of the sample household had replied indigenous soil and water conservation more effective than modern soil and water conservation practices, whereas 4.7%,16.7%,32.7% of sampled respondents was responded as very effective, less effective, and I do not know respectively. From this one could suggest that most of the sampled household heads have good perception in indigenous knowledge of soil and water conservation practices

Table 13.Opinions of sample household on the needs to sustain soil and water conservation practices * Kebeles of sample household heads Crosstabulation

		Kebeles of sample household heads		
		Atsbi-womberta woreda(Barka Adi-sbha)	RayaAlamata woreda(Gerjele)	Total
IndigenousSWC techniques	Count	6	14	20
	%	9.5%	16.1%	13.3%
Modern SWC techniques	Count	15	25	40
	%	23.8%	28.7%	26.7%
Integration of both techniques	Count	28	44	72
	%	44.4%	50.6%	48.0%
I do not know	Count	14	4	18
	%	22.2%	4.6%	12.0%
Total	Count	63	87	150
	%	100.0%	100.0%	100.0%

Source: Field survey, 2017

As indicated in table 13, 48.0% of the sampled household in both Woreda have suggested, as integration of both techniques are sustainable. However, 26.7% of respondents recommended as modern soil and water conservation practices are preferable. Whereas, 13.3% and 12.0% of the sampled household heads answered as indigenous SWC are sustainable and do not know which practices are sustainable respectively. Based on the degree of difference in perception, 42.9% and 50.6% of the respondents acknowledged as integrated soil and water conservation practices are sustainable, in BarkaAdisbha and Gerjele Woreda respectively. It seems evident that the

existed knowledge of farmers in soil and water conservation is insufficient to give response to the present sever soil degradation, for this reason its integration with new adoption of soil and water conservation techniques is necessary to bring sustain and healthy environment. This why, 23.8% and 28.7% of household heads responded as modern soil and water conservation practices are sustainable, in BarkaAdisbha and Gerjele respectively.

Furthermore, in the informant interview, development agents and soil and water conservation experts explained that integrated soil and water conservation techniques are the most stable to the eternity of fertile environment. Nevertheless, this is activating by considering the introduction of modern soil and water conservation where it fits with the existed knowledge of community, the slope of the plot land, soil conditions and the amount of runoff to be preserved. If so, the application of soil and water conservation practices would be more effective to overcome the problem of soil degradation.

4.7. Land Tenure security

Table.14.Response of sample HHs on the impacts of present tenure and land use system decision to SWC practices * Kebeles of sample household heads Crosstabulation

			Kebeles of sample household heads		
			Atsbi womberta woreda(Barka Adi-sbha)	Raya Alamata woreda(Gerjele)	Total
	No	Count	28	30	58
		%	44.4%	34.5%	38.7%
	Yes	Count	35	57	92
		%	55.6%	65.5%	61.3%
Total		Count	63	87	150
		%	100.0%	100.0%	100.0%

Sampled household heeds have asked whether the present land tenure security influence their willing to implement soil and water conservation practices. As indicated in 14, about 55.6% and 65.5% of the sampled respondents were feeling secure with present land tuner system in Atsbi

womberta and Raya Alemata Woredas respectively. This might for the reason that the present tenure land system have guarantee to the risky of farmer's land holding, because it was provided land certificate which farmers make them to became self-evident by their farm plot owning. Thus, it could assume that the more secure tenure system brings interest formers to decide on the use of soil and water conservation practices.

4.8. Accesses to training

Government and NGOs operating in the area gave training of farmers on SWC together. It assumed that the information obtained and the skill gained through training accelerates farmers' decision on SWC practices.

Table 15.Farmer's Participation in SWC Training in the The Past Ten Years

			Kebeles of sample household heads		
			Atsbi womberta woreda(Barka Adi-sbha)	Raya Alamata woreda(Gerjele)	Total
	No	Count	1	14	15
		%	1.6%	16.1%	10.0%
	yes	Count	62	73	135
		%	98.4%	83.9%	90.0%
Total		Count	63	87	150
		%	100.0%	100.0%	100.0%

Source: field survey, 2017

Training has significant contribution on soil and water conservation practices adoption. Thus, access to training in the study district was very high. As shown in table 15, 98.4% and 83.9% of the respondents gained training in the past ten years in Baka Adisbha and in Gerjele Woreda respectively. On average, 90.0% of the sampled household heads in both Woreda have gotten training. There was slit difference between the respondents of the two Woreda but it is not significant in percentage difference. In line but differently, in the focused group discussion with the farmer community of the study areas, they have said that it is true that we had a training about soil and water conservation practices, but quality of the training was low, because it was

not provided by considering of our indigenous knowledge, cultural and Socio-economic situation. Beside the development agent, for whom that training belongs to was not done well. Thus, the training makes it non-sense in acceptance by the farmers of the community.

4.9. Access to information

Access to information can play a significance role in the participation of soil and water conservation practices. To support this, in the findings of Aklilu (et al., unknown, 532), access to information on SWC practices was very significantly and positively affected the decision on use of introduced stone bund.

fferent ways; you might have obtained information from development agents, NGO, Mass media, Neighbor farmers and inherited information from family. However, the degree of acceptabilty and preferability the of community could be differing. In this regard, sampled farmer household were asked about their source of information in related to soil and water conservation practices.

Table 16. Sample HHs on the source of information on SWC practices

		Kebeles of sample household heads		
		Atsbi womberta woreda(Barka Adi-sbha)	Raya Alamata woreda(Gerjele)	Total
Development agents	Count	11	5	16
	%	17.5%	5.7%	10.7%
NGOs	Count	13	20	33
	%	20.6%	23.0%	22.0%
Mass media	Count	11	14	25
	%	17.5%	16.1%	16.7%
Neighbor farmers	Count	14	29	43
	%	22.2%	33.3%	28.7%
Parents	Count	14	19	33
	%	22.2%	21.8%	22.0%
Total	Count	63	87	150
	%	100.0%	100.0%	100.0%

Source: field survey, 2017

As displayed in table 16, 22.2% and 22.2% of sampled respondents in Barka Adiabha had obtained from their neighbor farmers and parents. Here the neighbor farmer and parents had equal contribution in transmission of indigenous practices to the new generation about traditional practices of soil and water conservation. In line with, 33.3% and 21.8% of the sampled household heads in Gergele have gained information about soil and water conservation practices from neighbor farmers and parents respectively. The rest of sampled house hold have acquired information regarding soil and water conservation practices from development agents(17.5%),NGO(20.6%),mass media(17.5%) in Barka Adisbha and development agents(5.7%),NGO(23.0%),mass media(16.1%) in Gerjele. There is slit difference between the sampled respondent of the two site selected areas in their acsseing information about soil and water conservation but it was not sound significant in the average percentage difference. Thus, one could assume that farmer communities have informed about soil water conservation before the introduction of new techniques of conservation. Nevertheless, both dimension of information obtaining about soil and water conservation methods were mutually inclusive to the sustained soil and water conservation.

4.10. Determinant factors affecting farmers' participation in integrated Soil and Water Conservation Practices

4.10.1. Result of Logistic regression Model

Logistic Regresion Dignostics

In order to have valid analysis, the model has to satisfy the assumptions of logistic regression. When the assumptions of logistic regression analysis are not met, one may have problems, such as biased coefficient estimates, and these problems may lead to invalid statistical inferences. Therefore, before using the model to make any statistical inference, there is need to check that the model fits sufficiently well and check for influential observations that have impact on the estimates of the coefficients.

Specification Error

In the building of a logistic regression model, one should assume that the logit of the outcome variable is a linear combination of the independent variables. In addition, one has concerned with whether the model has all the relevant predictors and if the linear combination of them is sufficient.

The model to have specified error, the *linktest* command must bring with the variable *_hatsq* insignificant (p-value). Therefore, the variable *_hatsq* in the logit model result of this thesis (Appendix 6.2) was insignificant (p=0.340). The result asserted that neither omitted relevant variable(s), nor the link function have not specified.

Multicollinearity

Multicollinearity occurs when two or more independent variables in the model are approximately determined by a linear combination of other independent variables in the model. The assumptions that needed to be tested the multicolinearity problem amogn explanatory variables was the variance inflation factors test was conducted. A vif> 10 or a 1/vif< 0.10 indicates existence of problem amogn explanatory variables. The Variance inflation factor resutle of the

logit model in the paper indicated that, Because of the value of VIF for each independet variable is less than 10 (vif <10), multicullinearity problem was not found (Appendix 6.3).

Goodness-of-fit test Estimation

A good fit as measured by Hosmer and Lemeshow's test will give in a large p-value. Meaning,It tests the null hypothesis that the model is a good enough fit for the data. As usual, we only reject the null hypothesis if p<.05. So, in this case the model is a good fit if the p value is greater than .05 (p>.05).With a p-value of .90 (Appendix 6.4), one can say that Hosmer and Lemeshow's goodness-of-fit test in this analysis indicates that the logit model fits the data well.

Model Fit test Estimation

In this estimation, it has assessed that what percent of observation the model correctely classified predicts. In this case, 82.67% of the cases are correctly classified (Annex 6.5). The proportion of correctly classified predicts have interpreted as a measure of how good the model is.

The ROC curve has usually plotted in reference to a baseline model. The base model is represented by the diagonal line starting at (0, 0) and ending at (1, 1). The area under the ROC Curve is the indicator of the quality of a model. The larger the area under the ROC curve, the higher the likelihood that an actual positive case will be assigned a higher probability of being positive than an actual negative case. For the Base Model, the area under the ROC curve is equal to 0.5. An area of 1 represents a perfect model. A curve with an area of 1 will have Y=1 and X=0, which indicates that all cases are classified correctly. Conversely, if Y=0 and X =1 the model identifies only false positives. From this, the area under the ROC curve of the model in this paper was 0.8078(Appendix 6.5). Hence, it has shown, the model does better at predicting actual positive cases.

The Sensitivity versus Specificity chart is an alternative ROC curve, with Sensitivity being the true positive rate (the count of true positives, that is, cases with response = 1, divided by the count of positives) and Specificity being the true negative rate (the count of true negatives, that is, case with response =0, divided by the count of negatives). It enables you to judge whether the prediction is better on the positive or on the negative side of the response variable.

This plots sensitivity (the true positive rate) against the specificity (the true negative rate), as shown in (Appendix 6.5).

Linearity test of the logit model

To say the model was free from lineartity problem, the p-value of the the *lrtest* needs to be insignificant. Thus, the logit model result in this analysis was insignificant with the p-value 0.1656(Appendix 6.6).This shows that the model has not a linearity problem**.**

un-standardized coefficients

Strong cases remain in favor of using un-standardized coefficients. The practical meaning of un-standardized coefficients when the predictor variable has a meaningful natural metric (like time, in years), or if the predictor is a Boolean category, the interpretative power associated with un-standardized coefficients and their related parameters (e.g. odd ratios) promotes intuitive understanding and easy communication of the results. In comparison to this, over using standardized coefficients is their '*sample specificity*.' Even when studying the same phenomena, the standardized coefficients will have a different practical unit depending on the sample variance. This can cause significant challenges in interpreting the data, particularly when comparing models. For these reason un-standardized coefficients have used to interpret the data in the logit model of this thesis.

Table 17. Determinant Factors affecting farmers' participation in integrated SWC practices (logit model) in Atsbi Womberta Woreda

In **Obs. =1/63:**

Logistic regression				**Number of obs**	=	**63**
				Wald chi2(16)	=	26.05
				Prob > chi2	=	0.0534
Log pseudo likelihood	=	-22.06517		Pseudo R2	=	0.4586
		Robust				
_IINTEWSC_1	Coef.	**Std. Err.**	**z**	**P-value**		**Odds Ratio**
AGEAHHS	-0.028	0.036	-0.77	0.439		0.972
_ISEXHHS_1	-3.065	0.048	-2.99	0.003***		0.047
FAMSIZE	-0.261	0.219	-0.91	0.36		0.770
_IEXPER_2	-0.084	0.673	-0.12	0.908		0.919
_IEXPER_3	-1.933	0.297	-0.94	0.346		0.145
_IEXPER_4	2.245	11.467	1.85	0.065 *		9.436
FPLOTSIZE	0.354	0.589	0.85	0.393		1.424
_IQUFAPOT_1	-1.120	0.285	-1.28	0.199		0.326
PLOTDST	-0.115	0.063	-1.62	0.106		0.892
LIVHD	-0.412	0.236	1.71	0.088 *		1.349
_ITENURE_1	-0.583	0.689	-0.4	0.692		0.662
_IACTRAIN_1	-2.140	0.735	-0.44	0.657		0.558
_IACINFO_2	-0.642	0.184	-1.37	0.17		0.118
_IACINFO_3	-4.538	0.963	-0.35	0.726		0.526
_IACINFO_4	-5.911	0.021	-2.41	0.016 * *		0.011
_IACINFO_5	0.299	0.006	-2.73	0.006***		0.003
_cons	7.588	64.479	2.34	0.019 * *		20.091

Note: *** p<0.01, ** p<0.05, * p<0.1
Source: Model Output, 2017

Definitional name of the coded items(in both observation):

_IINTEWSC_1=respondents who have participated in integrated SWC practices

AGEAHHS*= Age of household heads

_ISEXHHS*_1= Male sex of respondents

FAMSIZE* =Family size of respondents

_IEXPER_2*=farming experience of respondents between 26-30 years

_IEXPER_3*= farming experience of respondents between 31-70 years

_IEXPER_4*= farming experience of respondents between above 70 years

FPLOTSIZE*= respondents' farm plot size holding

_IQUFAPOT_1*= respondents' farm plot fertility

PLOTDST*=respondents' farm plot distance from homestead

LIVHD*=livestock holding size of respondents

_ITENURE_1*=positive response of respondents feel land tuner secure in SWC practices

_IACTRAIN_1*= access to information of respondents from their parents

_IACINFO_2*= access to information of respondents from Development NGOs

_IACINFO_3*= access to information of respondents from Mass media

_IACINFO_4*= access to information of respondents from their Neighbor farmers

_IACINFO_5*= access to information of respondents from their parents

The regression estimation result shows from hypothesized explanatory variables, sex of respondents , farming experience that have above 70 years old, Livestocke holding size, access to information from neighbor and parents has significant association with the probability for particpting in intagrated soil and water conservation practice.

4.10.2.Interpretation of logistic regression model result (Obs.=1/63)

Gender and farmers' participation in integrated SWC practices

Male sex household heads has negative relationship with the probability for particpating in integrated SWC practice and statically significant at less than 1% confident interval keeping other factors constant. It indicates that as Male sex household heads increases, the probability of male sex households for participating in integrated SWC practes tends to decrease. Thus, the odds ratio in favor of participating in integrated SWC practices decreases by a factor of 0.047 for a unit increase in respondents' male sex.This finding is inconsistent with the findings of Anteneh et al.,

(2014:10), sex of house hold head was found to have a positive and significant in participate of SWC practices.

Farming experience and farmers' participation in integrated SWC practices

As expected sign, farming experience that were above 70 years has positive relationship with the probability of being particpate in integrated SWC practice and statically significant at 5%confident interval keeping other factors constant. It shows that as farming experience that were above 70 years household heads increases, the probability of farming experience that were above 70 years households for participate in integrated SWC practes tends to increase. Thus, the odds ratio in favor of participating in integrated SWC practices increases by a factor of 9.436 for one extra unit increase in respondents' farming experience that were above 70 years household heads. This finding is consistent with the findings of Eshetu's(2015:96) (2014:7),a significant positive relationship was found between farmers' previous experience and current perception of SWC practices.

Livestock holding size of household heads and farmers' partcipation in integrated SWC practics

It was as expected sign, livestock holding size of repondents has negative relationship with the probability for particpating in integrated SWC practice and statically significant at 10% confident interval keeping other factors constant. It indicates that as livestock holding size of repondents increases, repondents' probability of great livestock holding size for participating in integrated SWC practes tends to decrease. Thus, the odds ratio in favor of participating in integrated SWC practices decreases by a factor of 1.349 for a unit increase in respondents' livestock holding size. This finding is inconsistent with the findings of Tsegaye (2014:53) repodent's holding greater livestock size unit were more participants of soil and water conservation practices.

Access to information(neighbor, parents)and farmers' participation in integrated SWC practices

Information from neighbor has negative relationship with the probability for particpating in integrated SWC practice and statically significant at 5%confident interval keeping other factors constant. This implies that as access to information from neighbor of repondents increases, repondents' probability of access to information from neighbor for participating in integrated SWC practes tends to decrease. So, the odds ratio in favor of participating in integrated SWC practices decreases by a factor of 0.011for a unit increase in respondents' access to information from neighbor.

Information from parents has positive relationship with the probability for particpating in integrated SWC practice and statically significant at less than 1% confident interval keeping other factors constant. This shows that access to information from neighbor of repondents increases, repondents' probability of access to information from parents for participating in integrated SWC practes tends to increase. So, the odds ratio in favor of participating in integrated SWC practices increases by a factor of 0.003 for a unit increase in respondents' access to information from parents. This finding is consistent with the findings of Aklilu (et al.,unknown,532), access to information on SWC practices was very significantly and positively affected the decision on use of introduced stone bund.

Table 18. Determinant Factors affecting farmers' partcipation in intgrated SWC practices(logit model) in Raya Alamata woreda

In Obs.=2/87:

Logistic regression			**Number of obs**	=	**87**
			Wald chi2(16)	=	20.97
			Prob > chi2	=	0.1799
Log pseudo likelihood		-38.445294	Pseudo R2	=	0.2632

		Robust			
_IINTEWSC_1	Coef.	Std. Err.	z	P values	Odds Ratio
AGEAHHS	-0.038	.029	-1.23	0.218	.963
_ISEXHHS_1	-0.874	.242	-1.51	0.131	.417
FAMSIZE	-0.148	.146	-0.88	0.38	.862
_IEXPER_2	0.559	1.181	0.83	0.407	1.749
_IEXPER_3	-0.529	.478	-0.65	0.514	.589
_IEXPER_4	-0.186	.897	-0.17	0.863	.830
FPLOTSIZE	0.021	.290	0.08	0.94	1.022
_IQUFAPOT_1	-0.209	.503	-0.34	0.735	.811
PLOTDST	-0.007	.042	-0.16	0.874	.993
_ITENURE_1	-0.487	.434	-0.69	0.49	.614
_IACTRAIN_1	0.143	1.459	0.11	0.91	1.154
_IACINFO_2	-1.579	.237	-1.37	0.17	.206
_IACINFO_3	0.087	1.126	0.08	0.933	1.091
_IACINFO_4	-2.336	.107	-2.12	0.034**	.097
_IACINFO_5	-0.038	.031	-2.85	0.004***	.024
LIVHD	-0.874	.168	1.66	0.096*	1.249
_cons	-0.148	25.539	0.79	0.428	9.144

Note: *** p<0.01, ** p<0.05, * p<0.1
Source: Model Output, 2017

The result shows from hypothesized explanatory variables, access to information from neighbor and parents, Livestocke holding size has significant association with the probability for particpting in intagrated soil and water conservation practice.

4.10.3. Interpretation of logistic regression model result(Obs.=2/87)

Access to information(neighbor, parents)and farmers' participation in integrated SWC practices

Information from neighbor has negative relationship with the probability for particpating in integrated SWC practice and statically significant at 5% confident interval keeping other factors constant. This shows that access to information from neighbor of repondents increases, repondents' probability of access to information from neighbor for participating in integrated SWC practes tends to decrease. So, the odds ratio in favor of participating in integrated SWC practices decrease by a factor of .097 for a unit increase in respondents' access to information from neighbor.

Information from parents has negative relationship with the probability for particpating in integrated SWC practice and statically significant at less than 1%confident interval keeping other factors constant. This implies that as access to information from parents of repondents increases, repondents' probability of access to information from parents for participating in integrated SWC practes tends to decrease. So, the odds ratio in favor of participating in integrated SWC practices decreases by a factor of .024 for a unit increase in respondents' access to information from parents.

Livestock holding Size and farmers' partcipation in integrated SWC practics

It was as expected sign, livestock holding size of repondents has negative relationship with the probability for particpating in integrated SWC practice and statically significant at 10% confident interval keeping other factors constant. It indicates that as livestock holding size of repondents increases, repondents' probability of great livestock holding size for participating in integrated SWC practes tends to decrease. So, the odds ratio in favor of participating in integrated SWC practices decreases by a factor of 1.249 for a unit increase in respondents' livestock holding size.

4.10.4. Variance and Similiarity of the Logistic RegressionModel Result of the two Observation

This aims at comparinng the Logistic RegressionModel Result of Obs.[1]=1/63(Table16) with Obs.[2]=2/82(table 17) based on the causal relation betewen the explonatory variables and dependent variable,i.e.,farmers' praticpation in integrated SWC parctices. This was to identify which variable affects farmers' participation in integrated SWC practices in the study Woreda. In Obs.=1/63,variables that has significant association with the probability for particptaing in intagrated SWC practice were respondent's Sex , respondent's farming experience that have above 70 years old, respondent's access to information from (neighbor and parents);whereas in Obs.=2/87,variables that has significant association with the probability for particpting in intagrated SWC practice were Livestocke holding size and access to information from(neighbors and parents).

Here, In both Woreda, Livestocke holding size, access to information from(neighbors and parents) has significant relation with the probability for particpting in intagrated SWC practice in each study area. However, access to information from parents of the respondents in Atsbi Womberta and Raya Alamata Woreda was different. Access to information from parents in Atsbi Womberta has positive relationship with the probability for particpating in integrated SWC practice;whereas access to information from parents in Raya Alamata district has negative relationship with the probability for particpating in integrated SWC practices.

[1]Obs.=1/63 refer number of observation in Barka Adisbha

[2]Obs.=2/87 refers number of observation in Gerjele

CHAPTER FIVE

5. Summary of Findings , Conclusions and Recommendations

5.1. Summary of Findings

This study was coducted to deal with various indigenous and modern SWC practices. It was also presented to make comparative analysis on the indigenous and modern soil and water conservation practices of farming community of the study Woreda.To this end, an empirical analysis had done using descriptive, inferential statistics and logistic regression analysis in comparative fashion between sampled household heads of AtsbiWomberta and Raya –Alamata Woredas.

I. Household heads information and asset holding

The Cross tabulation survey analysis of sex distribution of the sampled respondents in Barka Adi-sbha in Gerjele indicated that, Male sex distribution is the dominant.The t-test analysis of age of sampled household heads shown that, there was no statically significant age difference between Barka Adisbha and Gerjele.The t-test result indicated that, there was no significance in family size difference between the sampled household heads of the two Woreda.There was a slight difference in the size of farm plot holding between Atsbi-womberta and Gerjele Woreda and independent sample t test for farm plot size indicated that the difference in mean was significantThe independent sample t test of plot distance from residence shows that the difference in mean association between the two Woreda was not significant.The cross tabulation analysis on the slope type of farm plot indicated that, there was slope difference between the two woredas.Thus,most of farm plot in Raya Alamata were falt and gentle slope type.where as,the slope of farm plot in Atsbi womberta were steep type.The cross tabulation anlysis on soil fertility of the two woredas indicated that,soil fertility more decline was in Atsbi womberta district than Raya Alamata waoreda.The t-test analysis in livestock holding of the two woreda shown that, the difference in mean was significant at 1%confiedent level between the two woredas. Thus ,HHs of Raya Alamata was the more owned.

II. Soil and water conservation practices

The Crosstabulation analysis shown that, 86.0% of the sampled household heads in both Woreda had practiced soil and water conservation before government intervention. Separately, 77.8% and 92.0% of sampled respondents had practiced soil and water conservation, in Brka Adisbha and Gerjele respectively. There was slit difference between the respondents of the two Woreda in their experience of soil and water conservation practices

Comparatively, 65.1%and 78.2% of the sampled household heads still use their indigenous knowledge of soil and water conservation practices in Barka-Adisbha and Gerjele respectively. Descriptively, there is slit difference between the respondents of the two Woreda in current use of indigenous soil and water conservation.

The most indigenouse soil and water conservation practices in Atsbiwoberta district were terracing (stone bund) which is locally called '*Gedeba'* ,'Armo'and '*deret'.* Crop ratation,water way diversion,plating tree,and inter croping were also practiced.Distinctly, the Woreda of Raya Alamata in general and in Gergele area in particular, *dendes, dugay(* soil bunds) and traditional waterway diversions are the two main traditional soil and water conservation practices.

In comparison of modern soil and water conservation, indigenous soil and water conservation practices in terms of cost (Table 7), above 50% of the sampled household heads evaluates indigenous soil and water conservation as less costy.

In both Woreda ,60.7% of the total respondents agree in the improvement of indigenous soil and water conservation (Table 8). Distinctly, 58.7% and 62.1% of the respondents on the opinion on the improvements of indigenous soil and water conservation is in Barka Adisbha and Gergele .

Currently, 72.0% of the respondents in the two distracts are not use modern soil water conservation in their farm plot. Even if they have constructed by any means, it has not in existence after a year later they have abandoned. This might be because of it was not constructing based on the willing of the local community. Orderly, 69.8% and 30.2% of the sampled household heads in current application use of modern SWC is in Barka Adisbhan and Gerjele correspondingly (Table 9).

According to the focus group discussion with farmers and interview with the chair man of the Kebele, most farmers they construct Modern SWC practices which are made in group by fearing the panashment if they got absent. From this it is possible to generalize that sufficent awarness were not given for farmers.

In Atsbi womberta Woreda, 34.9% of sampled household heads have applied stone bund(figur **7**) in their farm plot.This might be the reason that the district is accessible to stones. Whereas, 39.1% of sampled household heads in Raya Alamata Woreda have applied soil bund(figur 8) in their farm plot. This is because of the reason absence of stone and soil is the most accessible in the area.

Despite of the difference, in both Woreda all kinds of modern soil and water conservation, i.e.,17.3%,8.7%,11.3% and 9.3% of the respondents applies, flood diversion waterway to farm plot, modern water way, all type of modern soil and water conservation and other kinds of soil and water conservation including all categories of biological measures.

In the group discussion , they argued that the modern flood diversion water way is less effective than of the existed traditional one. Because, the introduce one is not compatible with ecological features of the district.Because, the introduce one is not compatible with ecological features of the district. Accordingly, the types of modern soil and water conservation have been constructed consists slit difference between Atsbi Wombwrta and Raya Alamata Woreda of Tigray Region.

In group discussion with farmers, most of were not willing to construct modern soil and water conservation practice because the indigenous conservation practices of the local farmers little or no value for developmetn agents in the process of constructing modern soil and water conservation practice.

I. Current Integration of Indigenous and Modern SWC practices

In both Woreda, 80.7% of sampled respondents were not used integrated soil and water conservation (Table 11). This cross tabulation result asserts that there were farmers who practices indigenous soil and water conservation and modern soil and water conservation practices separately.

From informant interview, development agents and soil and water conservation experts point of view, integrated soil and water conservation techniques are the most stable to the eternity of fertile environment. Nevertheless, this is activating by considering the introduction of modern soil and water conservation where it fits with the existed knowledge of community, the slope of the plot land, soil conditions and the amount of runoff to be preserved. If so, the application of soil and water conservation practices will be more effective to overcome the problem of soil degradation.

In both Woreda, in average, 46.4% of the sampled household heads had replied indigenous soil and water conservation more effective than modern soil and water conservation practices.

In both Woreda, 48.0% of the sampled household in both Woreda have suggested, as integration of both techniques are sustainable.

II. Determinants factors affecting farmers' participation in integrated Soil and Water Conservation Practices

The regression estimation result on determinants factors which associates with farmers' participation in integrated SWC practices in Atsbi womberta Woreda wrere sex of respondents , farming experience that have above 70 years old, livestocke holding access to information from neighbor and parents(table 16). Access to information from parents, farming experience that have above 70 years old has positive relationship with the probability for particpating in integrated SWC practice and statically significant;whereas the rest has negative relation with the posibility for participating in integrated SWC practices . In comparison**,** the regression estimation result on the determinants factors which associates with local participation in integrated Soil and Water Conservation Practices in Raya Alamata were dtermined by Livestocke holding and access to information neighbors and parents(table 17) All has negative and significant with the probability for particpating in integrated SWC practice.

5.2.Conclusions

The central focus of this thesis was to investigate various indigenous and modern soil and water conservation practices and to make comparative analysis on the farming community of Atsbi womberta and Raya Alamata woredas in their considerable practices of indigenous and modern soil and water conservation,then by to assert the difference in effectiveness between indigenous and modern soil and water conservation practices.

The majority of the respondents had different types of indigenous and modern soil and water conservation practices . However , due to the ecological setting difference of the two woredas,There were soil and water conservation type and slope of farm plot variations among the selected Woreda.

The most indigenouse soil and water conservation practices in Atsbiwoberta district were terracing (stone bund) '*Gedeba'* ,'Armo' '*deret'.* Crop ratation,water way diversion,plating tree,and inter croping were also practiced. Distinctly, the Woreda of Raya Alamata in general and in Gergele area in particular, *dendes***,**soil bunds and traditional waterway diversions are the two main traditional soil and water conservation practices. However,because of the incosiderable implementation of new technologies and need to a gricultural economic growth most of the indigenouse soil and water conservation practices were gradually in decline.

The main modern soil and water conservation practices in Atsbi-womberta Woreda was stone bund.Where as,in Raya Alamata Woreda , the main modern soil and water conservation practices was soil bund and modern water way diversion. Despite of this extereme emphasize of the of few soil and water conservation practices,crop rotation inter cropping ,tree planting also exist in both Woreda.

However,in most probablity,farmer community of the study areas have not interest to construct modern soil and water conservation practices,they were expliened that , the case of not willing to construct modern soil and water conservation practices was the development agents do not treat the existed indigenouse practices of the local farmer community during application of modern soil and water techniques. For example, the indigenous ploghing had forced to stop; traditional soil and stone bund and waterways had changed with modern soil and water conservation techniques. This might have caused to decrease the interest of local farmer community to the accepting of new introduced land management system.

Based on the majority of respondent, indigenous soil and water conservation practices were more effective than modern practices. This was for the reason that, indigenous SWC was locally available, ecologically matched and not expensive in terms of cost.

In Raya Alamata Woreda, there were cultural rules and regulation that are helpful to construct floodwater way diversion and other type of soil and water conservation practices.

In Atsbi womberta Woreda, there were statically sex distribution imbalances of farmer's participation in integrated SWC practices

The regression estimation result on determinants factors which associates with farmer's participation in integrated SWC practices in Atsbi womberta Woreda wrere, sex of respondents , farming experience that have above 70 years old, livestock holding, access to information from neighbor and parents.whrereas the regression estimation result on the determinants factors which associates with local participation in integrated Soil and Water Conservation Practices in Raya Alamata Woreda were Livestocke holding and access to information(neighbors and parents).

5.3. Recommendations

Based on the findings, the following recommendations are made:

- A development efforts that ignores indigenous practices should not be allowed, rather the modern SWC practices must built its ground on the baseline of indigenous practices.
- Based on the information from FGD, in study area, access to training on soil was high but poor in quality of giving and this is recommend for improvement of polices aimed at individual household participatory technology development.
- In the study areas, there was dustructive activities of new SWC practices on indigenouse soil and water conservation practices and This is recommanded formulating policy and strategies must be in consideration of participation and their practices.
- It is expensive and unprofitable for farmers to adopt modern soil and water conservation practices unless these modern practices are constructed base on the ecologicla setting of the district.
- Indigenous SWC practices should be respect an recognized particularly on he side of experts and development agents. As a result farmers may creat self belonguess to the newley introduced SWC practices.
- Limitation of indigenous SWC practices should be filfull with modern to gain sustainable land.
- Awarness creation and enhancement of farmr's motivation should be take the first place than forcing them to applay modern SWC practices.
- Development agents should provided opportunities in sharing of indigenous and modern experience of soil and water conservation practices between the two woredas.

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6. Appendix

Appendix 6.1: Conversion Factor for Tropical Livestock Unit (TLU)

Animal Category	Tropical Livestock Unit (TLU)
Ox	1.10
Cow	1.00
Bull	0.60
Sheep	0.01
Goat	0.09
Donkey	0.50
Horse	0.80
Mule	0.70
Poultry	0.01

Source: Storck, et al. (1991)

Appendix 6.2: Specification Error in the logit model

. linktest

Logistic regression — Number of obs = 150
LR chi2(2) = **37.45**
Prob > chi2 = 0.0000
Log likelihood = -56.336638 — Pseudo R2 = 0.2494

_IINTEWSC_1	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_hat	.689232	.3615464	1.91	**0.057**	-.0193859	1.39785
_hatsq	-.1488653	.1559681	-0.95	**0.340**	-.4545572	.1568266
_cons	.0173085	.3049618	0.06	0.955	-.5804056	.6150225

Appendix 6.3.Multicollinearity test result for the INTEWSC Regression Model

. vif

Variable	VIF	1/VIF
ACTRAIN	1.20	0.832725
FPLOTSIZE	1.16	0.862595
LIVHD	1.15	0.871870
QUFAPOT	1.12	0.890726
ACINFO	1.12	0.892841
SEXHHS	1.10	0.905753
FAMSIZE	1.07	0.932254
TENURE	1.07	0.933554
EXPER	1.05	0.950374
PLOTDST	1.04	0.963451
AGEAHHS	1.04	0.964738
Mean VIF	1.10	

Appendix 6.4: Goodness of fit test of logit model

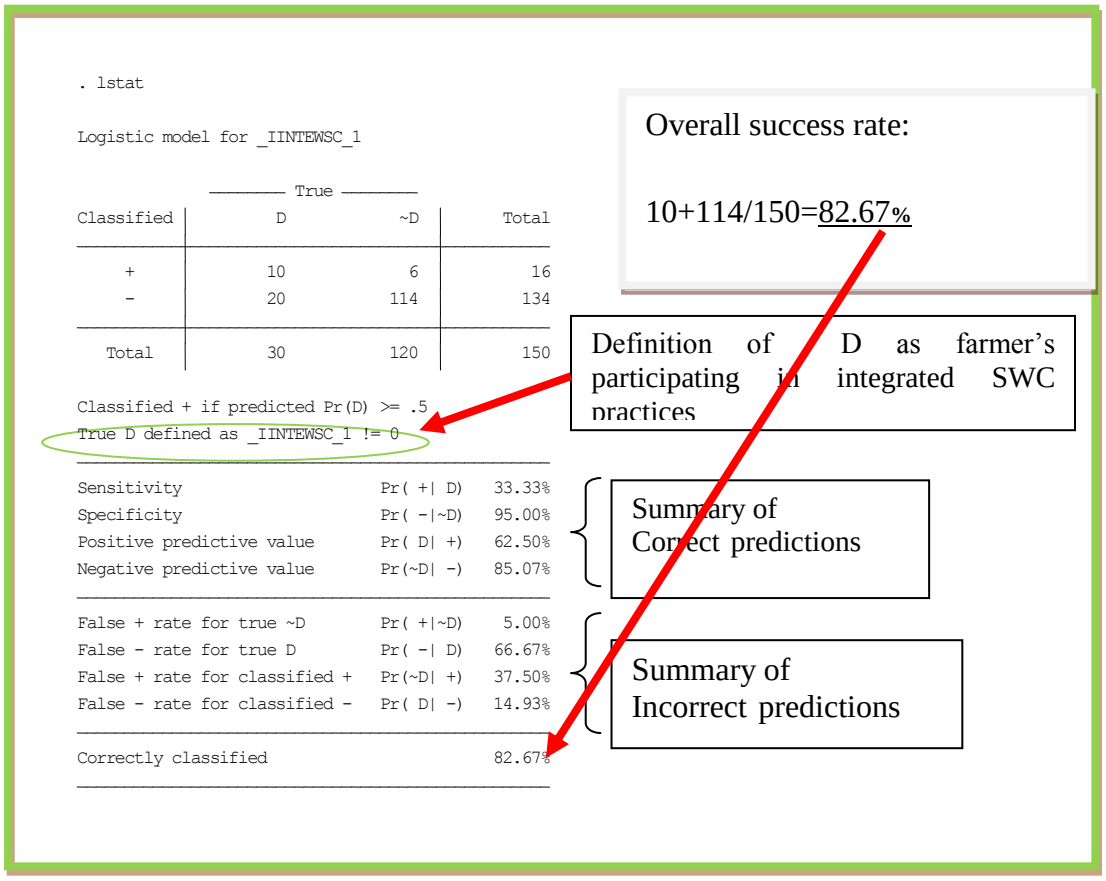
. lfit, group(10) table

Logistic model for _IINTEWSC_1, goodness-of-fit test
(Table collapsed on quantiles of estimated probabilities)

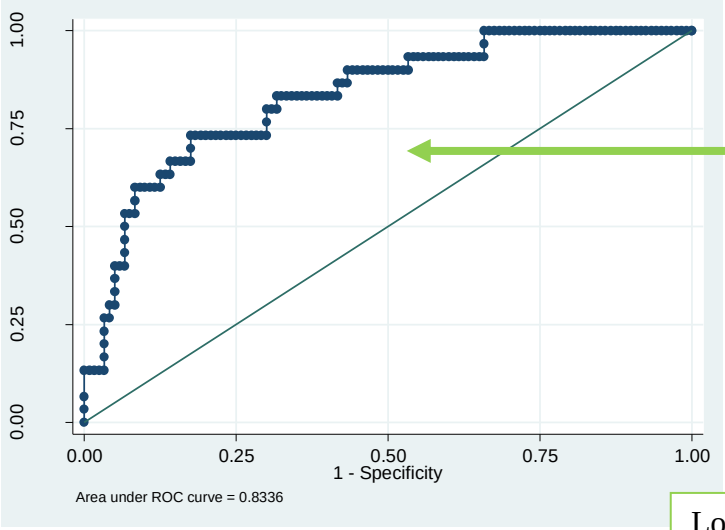
Group	Prob	Obs_1	Exp_1	Obs_0	Exp_0	Total
1	0.0153	0	0.1	15	14.9	15
2	0.0304	0	0.3	15	14.7	15
3	0.0562	0	0.6	15	14.4	15
4	0.0946	2	1.0	13	14.0	15
5	0.1206	2	1.7	13	13.3	15
6	0.1738	2	2.3	13	12.7	15
7	0.2524	2	3.2	13	11.8	15
8	0.3577	6	4.5	9	10.5	15
9	0.5272	6	6.3	9	8.7	15
10	0.8169	10	9.8	5	5.2	15

number of observations = 150
number of groups = 10
Hosmer-Lemeshow chi2(8) = 3.55
Prob > chi2 = **0.8953**

Appendix 6.5. Model Fit test



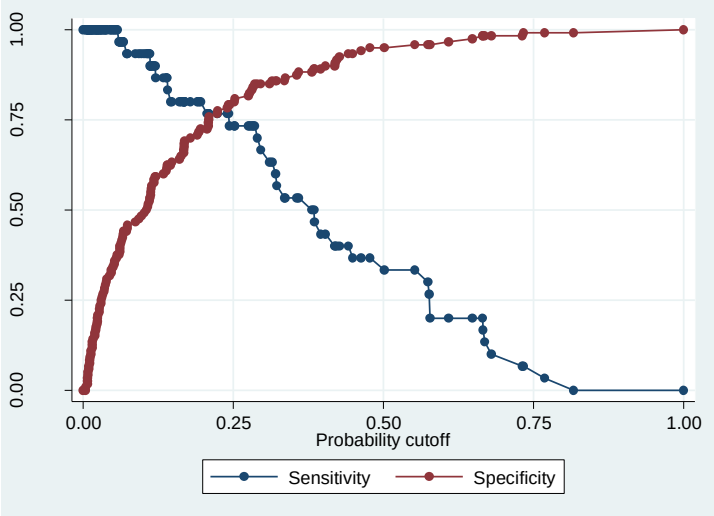
```
. lstat

Logistic model for _IINTEWSC_1

              -------- True --------
Classified |         D            ~D |     Total
-----------+--------------------------+----------
     +     |        10             6 |        16
     -     |        20           114 |       134
-----------+--------------------------+----------
   Total   |        30           120 |       150

Classified + if predicted Pr(D) >= .5
True D defined as _IINTEWSC_1 != 0
--------------------------------------------------
Sensitivity                     Pr( +| D)   33.33%
Specificity                     Pr( -|~D)   95.00%
Positive predictive value       Pr( D| +)   62.50%
Negative predictive value       Pr(~D| -)   85.07%
--------------------------------------------------
False + rate for true ~D        Pr( +|~D)    5.00%
False - rate for true D         Pr( -| D)   66.67%
False + rate for classified +   Pr(~D| +)   37.50%
False - rate for classified -   Pr( D| -)   14.93%
--------------------------------------------------
Correctly classified                        82.67%
--------------------------------------------------
```



Area under ROC curve = **0.8078**

Logistic model for _IINTEWSC_1
number of observations = 150
area under ROC curve = **0.8078**

. lroc



. lsens

Appendix 6.6. Linearity test of the logit model

. lrtest A

Likelihood-ratio test		**LR chi2(5)**	**=**	**7.83**
(Assumption: . nested	in A)	Prob > chi2	=	**0.1656**

Appendix 6.7. photo shows interview with Elder Farmers

Appendix 6.8. photo shows group discussion with Farmers

Appendix 6.9

ADDIS ABABA UNIVERSITY

COLLEGE OF DEVELOPMENT STUDIES

CENTER FOR ENVIRONMENT AND DEVELOPMENT

Dear respondents

Kibrom Tadele Redae is currently studying at Addis Ababa University in partial fulfillment of the requirements for the degree of master of art in environment and development. This research questionnaire is prepared to make *'**Comparative Analysis of farmers' Participation in Indigenous and Modern Soil and Water Conservation Practices in Raya-Alamata and Atsbi-Womberta Woredas of Tigray Region, Northern Ethiopia.**'* I thoughtfully request you to read all the questions in this questionnaire and give your response clearly. I assure you that your response will be used for academic purpose.

I. General information

Questionnaire code: _____

Name of district Administration _____

Name of the kebele _____

Date of interview _____

Interviewer name _____

II. Households Information

1. Sex of the household head : A.Male _____ B. Female _____
2. Age of the household head: _____
3. Educational Level of the household: A.Ilitrate_____ B. Educated _____
4. Family size of households(in number) _____

5. Farming experience of household heads_____year

III. **Farm plot holdings**

6. Do you have your own farm plot now? A.Yes B.No

7. What is the total area of your farm plot? _____*Ha*

8.How is the soil quality of your farm plot?_____A. fertile B. infertile

9.what is distance of farm plot from homestead (in minutes)_____

10.what is the slope of your farm plot?_____A.Flat B. Gentle C. steep

IV. Information on livestock holding

11. Write the number and types of livestock you own at this time?

No.	Livestock Type	Total Number owned
1	Oxen	
2	Cows	
3	Bull	
4	Goats	
5	Sheep	
6	Horse	
7	Mule	
8	Donkey	
9	Honey bees	
10	Poultry	

V. Land Tenure security

12. Do you feel tenure secure of soil and water conservation?_____A.Yes B. No

13. Do you think the present land tenure and land use system affect your decision to practice soil and water conservation?_____ A. Yes B. No

14. If Yes how?_____

VI. Access t o Training

15. Did you participated in soil and water conservation training for the past five years? Did you found that the training was helpful to get new knowledge of soil and water conservation practices? _____A. yes B.No

16. If no, what is the reason?_____

VII. Access to information

17. What are your sources of information regarding soil and water conservation practices? (Multiple answers are possible)

A. Development agentsB. NGOs

C. Mass media D. Neighbor farmers E. Parents

VIII. Soil and Water Conservation practices

18. Did you practice soil and water conservation in your farm plot before government intervention? _____ A.Yes B. No

19. Are you currently using indigenous soil and water practices in your farm plot?

A. Yes B. No

20. If yes, what kind of indigenous soil and water practices do you use? (Multiple answers are possible) please mark "x" on the space provided.

Indigenous knowledge based soil and water conservation practices	
Contour plowing	
Crop rotation	
Inter-cropping	
Terracing(stone bunds)	
Traditional cut-off drain	
Planting trees	
Other	

21. Which indigenous soil and water conservation practices are more important in preserving of soil in your farm plot? _____

22. How do you evaluate indigenous soil and water conservation practices in terms of cost?

A. more costy B. costy C. less costy D. I do not know

23. Are currently using modern soil and water conservation practices in your farm plot?

A. Yes B. No

24. If yes, what kind of modern soil and water conservation techniques do apply?

A. Stone bund B. Soil bund C. Flood water diversion to farm plot

D.Modern Waterway E. All F. other,specify_____

25.Of the modern soil and water conservation practices ,which is more important in preserving soil of your farm plot?_____

26. How do you describe the effectiveness of your indigenous soil and water conservation practices in comparison to modern measures of soil and water conservation in managing erosion?

A. Very effective

B. effective

C Less effective

D. I do not know

27. Are you currently integrating your indigenous soil and water conservation practices with modern soil and water conservation practices? A. Yes B. No

28. What factors that affect you to integrate indigenous and modern techniques of soil and water conservation?_____

29. Do you think that your indigenous soil and water conservation practices needs some kind of improvement? _____A. Yes B. No

30.If yes, how?_____

31.Which kind of soil and water conservation technique do you think sustainable to preserve fertility of soil?

A. Indigenous soil and water conservation techniques

B. Modern soil and water conservation techniques

C. Integration of both techniques

D. I do not know

32. What intervention must be needed for better implementation of soil and water conservation in the future?

_____

_____

Thank you so much!

Appendix 6.10.General Guideline for key informant Interview

1. For Development agents (DAS) and soil conservation Experts

- What are the indigenous and modern SWC activities that are practiced in the area?
- How is the effectiveness of indigenous SWC practices in the area?
- How is the knowledge of the community/communities towards SWC practices in the area?
- What determinants are hindering communities /community's participation in the integration of indigenous and modern SWC practices in the area?
- How do see the contribution of development workers in the process of creating awareness for integrating indigenous and modern SWC activities?

2. **For chairman of the kebele**

- How do you explain the effectiveness of indigenous soil and water conservation practices in the kebele?
- How do you see the participation of communities in integrating of indigenous and modern SWC practices in the kebele?
- How do you describe the contact between the kebele administration and communities for SWC practices that are made in group?
- What are factors that affect integration of indigenous and modern SWC practices?

3. For elderly farmers of the kebele

- What are the indigenous and modern SWC activities of your area?
- What are factors that affect you to integrate indigenous and modern SWC practices in your farm plot?
- Are you currently using both indigenous and modern SWC activities in your farm plot?

4. General Guideline for focused group discussion of farmers

- How do you describe the level of soil fertility describe?
- What are indigenous and modern SWC practices of your area?
- What is the level of integration between indigenous and modern SWC practices?
- What are the factors affecting the integration of indigenous and modern SWC practices?

DECLARATION

I declare that this THESIS is my original work and has not been presented in any other university/institution for consideration of any certification. This Thesis has been complemented by referenced sources properly acknowledged.

Name _____

Signature _____

This Thesis has been submitted for examination with my approval as University advisor

Advisor name	Signature	Date
_____	_____	_____