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DETERMINANTS OF FARMERS' ADOPTION ON SUSTAINABLE AGRICULTURAL PRACTICES; THE CASE OF KAFA ZONE, GIMBO DISTRICT, ETHIOPIA.

BY;

YOHANNES BEKELE SANIMO

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As members of the Board of Examining of the final MA thesis open defense, we certify that we have read and evaluated the thesis prepared by Yohannes Bekele under the title "DETERMINANTS OF FARMERS' ADOPTION ON SUSTAINABLE AGRICULTURAL PRACTICES." We recommend that the thesis be accepted as fulfilling the thesis requirement for the Degree of Master of Arts in Development Economics.

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DEDICATION

This thesis is affectionately dedicated to my mother Hiwot G/Silasse, for her unthinkable to pay, spiritual encouragement and many sacrifices for me to reach this level.

Table of Content **Page**

List of Table

List of Figure

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Above all I would like to thanks for their continuous guidance rendered by my advisors Wondimagegn Chekol (PhD) and Paulos Aserat (PhD) deserves high appreciation next to GOD. It is my sublime privilege to express my deepest sense of gratitude and indebtedness for their scientific guidance, and ceaseless support throughout the course of the research work. Their material support and inventive comments have also been extremely helpful. My sincere thanks goes to my best friend Getachew Sisay during writing the thesis his Technical support was very valuable.

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ACRONMYS

CC	Contingency Coefficient
CSA	Central Statistics Authority
DA	Development Agent
DAP	Di-Ammonium Phosphate
EEA	Ethiopian Environmental Authority
EMA	Ethiopian Mapping Agency
GDP	Gross Domestic Product
GO	Government Organization
GTP	Growth and Transformation Plan
NGO	Non-Governmental Organization
HA	Hectare
MDGs	Millennium Development Goals
MOA	Ministry of Agriculture
SAP's	Sustainable Agricultural Practices
SCRP	Soil Conservation Research Project
SWC	Soil and Water Conservation
SNNPRS	South Nation Nationalities Peoples Regional State
TLU	Tropical Livestock Unit
VIF	Variance of Inflation Factor

ABSTRACT

Agriculture is an engine for Ethiopian economy. However, its productivity still low due to land degradation and poor Agricultural practices. The recommended treatment for land degradation may be shift the all previous conventional farming in to Sustainable Agricultural Practices. Sustainable Agricultural Practices (SAP's) is a set of practices that increase productivity while conserving soil, which put on firm foundation of conservation tillage, use of compost, fallowing farm, legume intercropping and crop rotation. Despite use of Sustainable Agriculture is panacea for aggravated land degradation particularly. This study therefore assessed factors that influencing farmer's adoption on SAPs' in Gimbo district, South Region, Ethiopia. The multi stage sampling procedure was used to identify kebeles and sample respondents. In the first stage the study area was purposively selected because of the presence of SAPs' and researcher references. Then sample rural kebeles in the district were stratified in to agro ecology, woinadega and kola, of which, tulla and kutti kebeles were selected randomly and a total of 120 sample respondents were selected randomly proportion to size from identified kebeles. Both qualitative and quantitative data were collected from sample respondents. While qualitative data were generated from observations, focus group discussion using checklists. Quantitative data were collected from selected sample respondents using structured interview schedule during survey time from 2019. The questionnaire were pre-tested, revised and administered by well-trained enumerators recruited from the study area. Descriptive statistics such as frequency, mean, standard deviation, T-test and chi-square were used to summarize the data while binary logit model used to identify the most important factors that determine households decision to invest in SAPs'. Among total sample respondents 80 were adopter the rest 40 were non-adopters. Sex, Age, Educational status, participation in local kebele Administration, farm size, plot distance, Labour availability, Livestock owned, Number of Plot, Soil fertility Status, and Land Tenure were had significant mean difference between non-investors and investors, to invest in SAPs'. Results of binary logit model indicate that, Farm Size, Educational Status , Soil Fertility Status, Slop of the Plot, Total Livestock Owned and Walking distance from the Residences to the plot, had significant influence on farmers adoption on Sustainable Agricultural Practice. Generally the result of this study indicates that Agricultural Land Management Practices is the aggregate of many factors which should be given due attention in the innovation and transfer of agricultural technologies like SAP's.

***Key words**: Sustainable Agricultural Practices, Gimbo district, Binary Logit.*

CHAPTER ONE

INTRODUCTION

1.1. Back Ground of the Study

Ethiopian Economy is based on agriculture. Which accounts, the share of agriculture in gross domestic product (GDP) was 34.12 percent and 85 percent's of total employment (MOA,2017). Moreover, agriculture is a single most important source of food for the nation (World Bank,2013). In countries where agriculture is the mainstay of the economy, land degradation in smallholder farming is one of the fundamental consequences of environmental problems causing low agricultural productivity. The dependency of livelihoods of majority of the people on agriculture results in fast and vast land degradation. Land degradation mainly in the form of soil and nutrient depletion from the top horizon of soil has become one of the most important environmental problems (Genene,2006).

Coupled with fast growing population, erratic rainfall and poverty; land degradation poses a serious threat for declining of agricultural Productivity of the nation (Bekele and Holden,1998). This sector also suffers from poor farming practices and frequent drought (Genene. 2006; Mesfin , 2010).Land is the most important natural resource. It is a place from which humans beings are exploiting a number of resources (Taffa. 2002). Almost all necessary inputs and source of food found from land. However, land is losing its productivity due to a rising trend of land degradation (Woldeamlak,2003; Genene. 2006).

The well known proximate causes of land degradation are deforestation, overgrazing, limited soil and water conservation, burning of dung and crop residues, limited use of organic matter and declining use of fallow (Bekele and Holden,1998; F*AO,* 1995; Wagayehu, 2003). Among many reasons inappropriate farm practices manifested by frequently growing cereal crops without using crop rotation, continuous and long term tillage and less planting of cover crops (Guto *et at.,* 2011). The household decision to invest on land conservation may be thus depend on perception on the erosion problem, willingness, knowledge house hold, technology, land, labor and farm attributes (Ervin and Ervin, 1982: Bekele & Holden , 1998).

Significant progress has been made in increasing production over the last four decades;however,productivity has not increased significantly (Pretty et al..2011). The major increase in production comes from expansion of land under cultivation and shorter fallow

periods, Population growth is continuing, however, arable land is shrinking in many areas (Birhanu and Swinton, 2003). Thus, the extensification path and the practice of letting the land lie fallow for long periods are rapidly becoming difficult, making continuous cropping a common practice in many areas. This leads to land degradation, low productivity and poverty in the nation.

Increasing productivity through expansion of agricultural technologies is a key, if not the only, strategy option to increase production (Hailemariam,2012). The new agricultural paradigm concerns on save and grow strategy compatible with idea of sustainable agriculture system. The principles of sustainable agricultural practices (SAPs') are environmentally friendly, resource conserving, technically viable, economically and socially acceptable (FAO,1989). SAPs' is not a single practice instead have multiple components such as reduced tillage, fallowing of land, use of manure or cattle dung and leguminous cropping (Ibid). Among multiple components of SAPs' reduced tillage, legume cropping, fallowing farm and use of compost get focus in this study. This agricultural practice helps to arrest land degradation problems and curb to productivity. Hence, use of SAPs' has deserved the environment, increase soil fertility, and increasing agricultural productivity has been well recognized all over the world.

Moreover, it makes better use of agricultural resources through the integrated management of available soil, water and biological resources. Combined with limited external inputs and additionally contributes for environmental conservation. Empirical studies (Bekele and Holden ,1998; Kass ie et al.. 2012) indicated that to reverse soil erosion and to go optimistic direction fulfilling the needed requirement, adopting and adapting more resilient, intensified and sustainable agricultural production systems is a priority action for small holder farmers. Unluckily, Smallholder farmers may fail to fully accept suggested agricultural technology packages due to many factors including resource and information constraints in line with land tenure right, credit and market (Bekek and Hold en,1998).

Different stakeholders' linkage includes researchers, extension workers and farmers work without or with weak cooperation and consideration of local situation introduction of new technology that exacerbates the problem instead or minimizing the problem (Isaac *et al.*. 2009; Oreszczyn *et al.,* 20I0). Nevertheless, SAPs' is optionless and hospitable to land, water, livestock husbandry and crop management practices that aim to improve productivity, profitability and

sustainability. Cognizant the potential benefits that SAPs' may preserves advocacy for stakeholders specially, the lion-share, smallholder farming households involve in this sector.

Moreover, introduced technology package are disseminated as blanket for all areas without considering agro ecology and farmers participation but should be smart, flexible and adaptable to local conditions (Moti, Bekele and Menale, 2012).

1.2. Statement of the Problem

Transforming agriculture and expanding eco friendly agricultural practices is a precondition for sustained economic growth. In Ethiopia, population is increasing at alarming rate ; farm size had shrink from 2 ha to less than one ha in recent years. This results land degradation in the form of soil erosion and nutrient depletion. The main responsible causes of soil erosion include wind, runoff, overgrazing, expansion of cultivation and improper farming practices manifested by continuous cultivation and plough of highly steep slopes (Haimanot,2012). Soil erosion and related forms now constitute serious problem in many part of Ethiopia, particularly in the Southern Nation,Nationality and people Regional State (SNNPRS) situated on high and step faulted western sides of the Ethiopian rift system (Mushir Ali and Kedru Surur, 2012).

This study will be conduct in Gimbo district, found in SNNPRS of kefa zone which is highly productive area in the kefa zone. This area has a potential of produce all varieties of crops and livestock with both rainfed and irrigation farming. The district was gifted with abandoned fertile soil, natural forest, inclined and highly steep slopes and natural amenities like Bartta waterfall. However now a days the productivity of the area is decreasing from time to time due to land degradation (Tezera Chernet,2008).

Agriculture is the major livelihood activity and source of income generation for Ethiopia, in particular Gimbo district farmers with slash and burn farming, frequent tillage including highly steep slope ends up with soil erosion, moisture loss, low crop and livestock productivity .Nowadays, this area exposed to soil fertility depletion, moisture shortage, erratic rainfall, food insecurity and decline of agricultural productivity. (Tezera Chernet 2008).Unbalance land management interventions with the current level of land degradation is still a growing challenge to smallholder farmers on the degraded area to meet both immediate economic objectives and sustainable environment. Thus, adoption 0f sustainable agricultural technologies and innovations gain due attention because of it is assumed to provide increase productivity to assure food

security and arrest soil erosion, in line with millennium development goals (MDGs) and GTP of the country.

Agricultural technologies like SAPs· (e.g. improved crop varieties, chemical fertilizer, pesticides, fallowing *farm"*. compost use, legume cropping) are quit important to replenish soil erosion, water shortage and food insecurity. These practices play no commensurate role in terms of safeguarding the environment, keeping soil health, moisture, adding humus, increasing productivity and assuring food security. In Sub Saharan Africa indicate that most of adoption studies to date conducted in the country broadly focused on emphasized on green revolution technologies e.g. adoption of improved crop varieties, chemical fertilizer, modern beehives, SWC measures in both arid and watershed areas, and crop protection (Kassie et al., 2011). However, the attention given for adoption of SAPs' up to now is very low. Different SAPs' have been undertaken throughout the country including in the study area by government like reduced tillage, use of fallow, constructing SWC structures, use of manure, compost use, legume cropping and the like. Despite of' this, most of SAPs' have been one season and couldn't so far from becoming buzzword. Furthermore, effectiveness, technical feasibility and sustainability of physical SWC structures also questionable.

Farmers' decision to accept and implement (invest) multiple components of SAPs' which are interrelated activities may be impede by land tenure, farm size, labor, cattle holding and the like. According to (Haiymanot,2012), findings, a soil fertility status of agricultural land had affect the farmers' to invest SAPs. Similarly, labor availability and extension services had also affect the farmers' to invest in SAPs. In other studies according to (Akililu,2006 and Getachew, 2005),findings, a farm size and Distance of the plot affect the farmers' to adopt in SAPs. Currently, farmers condition and know how about SAPs' in Gimbo district is limited because of lack of information on the practices and demand for crop residue as fodder. This inhibits adoption in SAPs'.

Meanwhile, most of the researches conducted were only focused on land degradation and soil water conservation. Moreover, similar studies were not conducted in the study area. On the other hand, the previous studies didn't attempt to further illustrate the multiple components of sustainable agricultural land management (SAPs), such as, reduced tillage, use of fallow, constructing SWC structures with regular maintenance, use of manure and legume cropping etc..

Given this reality and the importance of the research, the study explored the determinantal factors that affect the farmers' adoption in sustainable agricultural technologies and practices.

1.3. Objectives of the Study

The overall goal of this study is to explore the factors that determine farmers' adoption on SAPs' in Gimbo district, specifically this study intended to address:

- To identify SAPs' that the farmers' commonly implement and
- To assess the factors that influence farmers adoption in different agricultural land management practices (SAPs') in the study area.

1.4. Research Questions

- What are the commonly implemented types of SAPs'
- What are the major factors that determine the application of SAP's by farmers in their agricultural land?

1.5. Hypothesized Explanatory Variables

1.5.1. Dependent variable:

It is a dummy variable that represents the observable adopter of farmers on SAPs' it takes 1 for farmers non adopter in SAPs and 0 otherwise.

1.5.2. Independent variable:

It has hypothesis as farmer's decision to invest or reject multiple components of SAPs' to gain its profit were highly influenced by different factors. On the basis of previous studies, the researcher hypothesis these factors categorized as personal, socio-economic, institutional and plot characteristics were determine farmer's decision behavior to adopt in SAPs'. Based on the previous findings and the research *objectives* in the study area, the following 13 potential variables were hypothesized to determine farmers' decision of adoption in sustainable agricultural practices.

Sex (SEXHH): It represents sex of household head. Male headed households may have more experiences of different agricultural activities, technology use that increase productivity because of their position on Kebele's and other social association. They can easily get training while new agricultural technology introduced and may have more exposure in practical farming fields as compared to counterpart female headed households. Thus, Sex of household head hypothesizes as being male is positively correlated to adopt on SAPs' and, whereas, female is opposite of this. (Green 1993) had found and reported that male- headed households are more likely to be adopter

in SAPs' than female headed households. The possible explanation for this would be male headed house holds have better access to farm land , labour, agricultural technologies and improved practices which all these increase crop yield and thus more adopt on SAPs' than female headed house holds

Age (AGEHH): It is a continuous variable measures age of household head in years. Rural households mostly devote their time for farming activities. As age of household increases, they can acquire more knowledge and experience about SAPs' benefits and its feasibility direction. Hence, in this study increased age is hypothesized as positively related to adoption in SAPs'. According to (Haimont, 2012), found that the age of household has positive and significant difference with adoption of SAP's.

Education Status (EDULEVEL): It is a discrete variable defined as the level of grades or schooling years attained the household heads. This variable is an important determinant of household adoption of SAPs' in that, educated households have a better chance of gaining information adopting soil conservation practices. crop rotation and/*or* intercropping, use of manure which in turn increases crop production. Thus, education status were hypothesized to have a strong positive impact on household head's decision to adopt in SAPs' that match his/her farm land.

Role in Local Kebele Administration (PARTADMIN): This variable defines whether respondent has an assumed any type of responsibility in his/her village or kebele level during in this survey. If the household head assumed any type of responsibility, the chance of access to information may increase and thus become adopter and extent of use of the technology positive. Therefore, this variable is expected to associated positively to adopter in SAPs' and otherwise.

Farm Size (FARMSIZE): This is a continuous variable which may determine individual household's decision of adopting and not adopting of SAPs' in his/ her farm. A Farmer who own more plot of land may help his/ her to fallow, crop rotate from cereal to leguminous and mulching of crop residues. Hence, this would positively hypothesize to adopter in SAPs'. (Aklilu,2006), found and reported that farmers who hold large farmers were found to be more likely to practice in conservation technology.

Land Tenure (LANDTENURE): A dummy variable, which is a feeling and attitudes farmers towards land tenure that takes a value, 1 if the farmer perceive as secure and, 0 otherwise, The incentive to land improvement decision is based in part on secured future access to land. In many

studies, insecurity of tenure has been found to be a deterrent factor to conservation practice (Reardon and Vosti,1995).In this study, the farmer's feeling of using a given plot at least during his /her life time was hypothesized to have a positive effect on his/her decision to participation in conservation activities.

Distance of the Plot from the Residence (PLOTDIST): It refers to the average distance of a given plots from the residence of the house hold in minute. Farmers whose plots are nearer to their residence apply organic matter to substitute soil nutrient loss and soil conservation structure to minimize soil erosion, because the time and energy they spent is lesser for nearer plots than distant plots. Compared to plots closer to homestead, collection of crop residue from distant plots for livestock feed and other purposes could be laborious (Moti, Bekele, and Menale. 2012). Thus, the close distance were be hypothesizes as have positive relation with investment in SAPs'. (Wogayehu and Drake, 2003; getachew, 2005) had found distance from the plot has a positive relation for land degradation yet for adopter in SAP's related negatively.

Soil Fertility Status (SOILFERT): It is represents the status of soil fertility. The current level soil fertility hostility determines farmers will grow the type of crop and the amount of yield gain. Due to this farmers may be selective in adoption decision in SAPs' as measure on the basis of their past experience they got from their plot fertility status. Thus, the level of soil fertility as changes from fertile to less fertile would be hypothesized as had positively affect on practicing conservation activities and otherwise, negatively.

Slope of the Plots (SLOPE): slope of the field is the only indicator used as a proxy for the erosion potential. Although erosion potential depends on the rainfall pattern, soil physical characteristics and slope. In addition, rain fall may not vary much from field to field with in the study area. The land surface configuration that relates to topography is described in terms of slope. The slope of the plot affects soil erosion or soil development. Steep slope are subject to more rapid runoff surface water and need large number of' soil conservation technology (Ervin and Ervin,1982; Hurni,Wagayehu and Drake, 2003). Thus the slope of the plots is hypothesized to directly affect severity of land degradation. Therefore, increase the degree of slope was hypothesized as have positive association with practicing in land conservations. (Wogayeh and Lars,2003; Aklilu,2006) were reported the positive association between slope and farmers decision to adapt and implement SAP's.

Number of Plot (PLOT): Considering all other things the same (equal) adoption/investing of the multiple components of SAPs' on their different number of plot. Soil conservation structure may take some area especially that would have been used for cultivation. Farmers who managed larger number plots could use SAPs' than those who have small number of plot on their farm (Wagayehu and Drake, 2003).

Livestock owned (TLU): This variable is a continuous variable defined as the total livestock (cattle, donkey, horse/mule, sheep, goat. and chicken) owned by a household heads measured in Tropical Livestock Unit (TLU). Live stock is an indicator of wealth, which requires more grazing land to rearing, ranch and use is important source of income, draught power and organic fertilizer. Those farmers who have large number of livestock may have more animal dung to improve the fertility of the soil and more capital to practice in soil conservation practice. This affects the use of conservation agriculture measures positively ILRI (2003). Moreover, most of the time livestock rearing creates burden on communal grazing land. Thus, livestock owned will be hypothesized as have both positive and negative relation with adoption decision in SAPs'.

Labour Availability (LABOUR): This is a dummy variable referred that the household's access of' labour based on his/her farm operation requirement and with peak agriculture seasons (land preparation, seeding, weeding and harvesting of yield). This determines farmers' decision on adoption of more labour consuming technologies at the very scratch like compost preparation.

More economically active labour accessed farmers will perceive positively and make sound decision on adoption of compatible soil fertility maintained and increasing crop yield. Therefore, according to the researcher observation, household head's have more number of productive labour would influence positively for implementing of soil conservation technologies like SAPs' and for non- adopters, otherwise.

Extension Services (EXTENSION): it is a dummy variable that indicates whether a farmer gets visited by development agents (DAs) and /or practioners, training about new technology and practices. The farmer involve and get such may be highly weigh new technologies benefits and losses of particular technology and fast to adoption decision. Thus, this variable will be hypothesized as positively associated with adoption of SAPs'. According to (Haimanot 2012) This variable had significant and positive impact on farmers motivation to adopt on SAPs '

1.6.Significance of the Study

This study is important for the Agricultural office of Gimbo District by providing information and good opportunities to extend for other areas having the same agro ecological and some other characteristics with slight modification.

The study also generate information for farmers' adoption in components of SAPs' such as crop rotation, use of compost, reduced tillage, and legume cropping which provide calls for the need to bring on desk various stakeholders including farmers, farmer organizations, government and its agents, NGOs and the private sector in Gimbo district.

1.7. Scope and Limitation of the Study

Since the study were focus in investigating the implementing status locally viable SAPs' components in Gimbo district is the first of its kind. The study were carried out by surveying a sample of 120 farm households from two rural kebele administrative.

The study was generate information on sample households by assessing mainly four factors such as personal and demographic, socio- economic, plot characteristics and institutional factors that may hinder farmers adoption in SAPs' in order to taste the fruit of it. Since this study take assuming representative sample of the district population because of budget and time the study may or not representative of the entire population of the district, from the variable selection a time preference and climate were not considered in the explanatory variables. Therefore, its scope is limited in terms of coverage and depth owing to financial and time resources.

CHAPTERE TWO

LITERARUTE REVIEW

2.1. Theoretical Review

2.1.1. Definition and Concepts of Land Degradation

Land Degradation: It is defined as the loss of utility or potential utility through the reduction of or damage of physical, socio-cultural or economic feature, and/or reduction of ecosystem diversity. There may be a single cause or a complex mix of causes. According to (FAO.1994). Land degradation is the temporary or permanent lowering of productive capacity of the land.

2.1.2. Nutrient Depletion:

nutrient depletion refers to the deterioration in soil physical, Chemical and biological properties. Soil nutrient depletion occurred when the inflows of nutrients to the soil through manure, chemical fertilizers, biological nitrogen fixation, addition of waste or plant materials from outside the system. Atmospheric deposition, and sedimentation are less than out flows due to the crop harvesting, removal of crop residues, Erosion, leaching and gaseous losses (Stoorvogel and Sillaling, 1990).

2.1.3. Soil Degradation /Soil Erosion/:

soil degradation is caused by natural and human factors. According to (Oldeman et al.. 1991) soil degradation is a process that describes human induced phenomena. which lower the current and/or future capacity of the soil to support human life. In a general sense soil degradation could be described as the deterioration of soil quality, or in other words the partial or entire loss or one or more functions of the soil.

2.1.4. Soil and Water Conservation:

are not simply structures defined strictly by engineering parameters: they are the sum of practices involved in managing soil and ,·water in agricultural setting also include agro-forestry, agronomic and tillage practice (Reij, 1991).

Land being the critical agricultural resource (Carlson et al.. 1993), it is the basis for survival of most people in Ethiopia. The largest proportion of the GOP and employment for labour is contributed from the agriculture sector. Despite of this. land is seriously threatened by land degradation throughout the country, threatening both the economic and survival or the people.

Land degradation in Ethiopia is a severe problem that leads to low agricultural productivity. which enforces the government to introduce land conservation technologies. Natural resource

degradation in general and land degradation in particular has a great effect on the economies of developing countries (Ayalneh. 2002).It is one of the most critical environmental issues facing many countries today (Genene, 2006).Land degradation and soil degradation are often used interchangeably: however land degradation has a broader concept and refers to the degradation of soils, water, climate, and fauna and flora (Alemeneh et al., 1997). Land degradation refers to changes in the qualities of soil, water and other characteristics that reduce the ability of land to produce goods and services that are valued by humans (Wiebe,2002). Though there are many forms of land degradation, soil degradation is the main focus of this research work. Soil degradation is a specific subset of land degradation that describes a decline in the soil quality encompassing the deterioration in physical, chemical, and biological attributes, which commonly manifest itself through soil erosion, soil fertility depletion, soil compaction and soil pollution (Alemneh et aI., 1997; SADAOC, 2002).

Soil erosion is not a new phenomenon: it has been a problem since human beings started cultivating the land (Gete,2000). In much of the Ethiopian highlands soil degradation that is caused by soil erosion has reached a stage where it is increasingly difficult to even maintain the present day production of basic foods , a level that is already insufficient in some regions (Gete,2003). Soil degradation is a major environmental problem causing wide spread and serious impacts on water quality, biodiversity and the emission of climate changing green house gases,

In African context the introduction of conservation practice as an aspect of public policy IS related to colonial history (Atakil et al, 2003).

2.1.5. Causes of Land Degradation

There are four major causes of land degradation: deforestation, overgrazing, agricultural activities, and over exploitation (McClelland, 1997). The well known proximate causes of land degradation include deforestation, overgrazing, limited SWC measures, limited application of nutrients/organic matter, burning of dung and crop residues and declining use of fallow (FAO,1995: Wagayehu 2003). In Africa, the contribution of different management factors towards land degradation is estimated to be 49%, 24%, 14%, 13% and 2% for overgrazing, mismanaged agricultural activities, deforestation, over exploitation and industrial activities (Vanlauwe, place,F et al.,2002),respectively. Agricultural mismanagement of soil and water resources include non-adoption of soil and water conservation practices, improper crop rotation, use of marginal land, insufficient and/or excessive use of fertilizers, mismanagement of irrigation

schemes and over pumping of ground water (FAO, 2001). Lack of early awareness about soil erosion and soil fertility decline by farmers is another possible cause of land degradation (Bekele, 1998). These all are direct causes of land degradation primarily caused by human intervention exposing natural resources to depletion and loss. Human interventions expose the soil to erosion and induce depletion of natural capital asset of society (Wagayehu. 2003) . In the sub-Saharan Africa, the major agents of land degradation are water erosion, wind erosion and chemical degradation that affected soil loss by 47%, 36% and 12 % respectively (Tilahun, 2002). Population increase, land shortage, insecure land tenure, poverty and economic pressure are indirect causes of land degradation (FAO, 2001: Terefe, 2003). Population growth has long been considered a prime cause of environmental degradation. It forces farmers to cultivate marginal land (FAO, 1995). With current trend of population growth there is a poor prospect for ecological sustainability and economic viability of the current agricultural practice unless an effort is made to integrated development in family planning, environmental rehabilitation, and agriculture supported with enabling policy (Yohannes,1999). Following the dire predictions of Thomas Malthus, population pressure is a cause to poor soil fertility leading to decreasing crop yield (Million, 1996). As a result of reduced size of land holding owing to high population density, intensive cultivation, steep slopes, over grazing, and intensive rainfall have resulted in much of the topsoil being washed away (Ibid). Through intensive mismanaged cultivation, man has destroyed the original crumb structure and depleted the nutrient make up of soils. Significant numbers of studies from Africa have also presented the optimistic view that the population Increase leads to intensification of production, tree planting and conservation Activities, for example the Kenyan Machakos district (Yohannes, 1999: Atakilit e, 2003).

A study made in north western Ethiopian highlands by (Gete, 2000) concluded the absence of sound land use tenure policies (frequent changes in the tenure systems and frequent distribution of land),population pressure, weak economic development strategies, unstable institutional frame works, and weak link between research and extension have all been found to be root causes of soil degradation and are major policy constraints discourage the farmer from making any sort of investments in the land to use it in a suitable way (Ibid).

A study made by (Dione,2002), on land tenure systems in Africa reported that, farm land held under exclusive and secure land rights (e.g. titled land) is more productive than farmland under other forms of rights (e.g. coml11una l land s). He reported that, when families believe that the

land tenure system is unfavorable to them, they are reluctant to invest in good agricultural practices, such as soil and water conservation and management (Dione ,2002).In similar fashion , in Ethiopia with the lack of land ownership, farmers have the tendency to make the land less attractive to others (FAO, 200I). The current land policy of Ethiopia , i.e .. the right to use and transfer to their children is expected to affect long term investments including construction of conservation bund,. planting trees, short term fallowing and the like (Tilahun,2002). In addition to insecure tenure, communal grazing land and wooded areas for the extraction of fire wood give rise to land degradation. There are many indicators and early warning signals of land degradation, which lend themselves to remote sensing, based monitoring. These include (1) loss of vegetative cover; (2) wind and water erosion; (3) soil salinization; (4) soil structure deterioration; (5) less soil moisture; (6) increases in albedo; (7) higher land surface temperatures; and 8 land cover type changes and Soil salinization. The drivers of land degradation in the region are numerous, highly complex and interrelated (Pender et al. 2009). The major proximate causes include unsustainable agricultural practices, the expansion of crop production of fragile and marginal areas, inadequate maintenance of irrigation and drainage networks, and overgrazing near settlements (Pender et al. 2009; Gupta et al. 2009; Kienzler et al. 2012).

2.1.6. Consequences of Land Degradation

Land degradation has a negative connotation that implies the loss of value within the environmental-economic system (Gretton and Salma, 1997). Land degradation effects on agricultural productivity are manifested through their impacts on both, the average and variance of yield, as well as the total factor productivity of agricultural production (FAO, 200I). It affects agricultural productivity, leads to clearance of forests and native grasslands as existing land loses productivity, and leads to off-site pollution and loss of productivity and amenity values (Gretton and Salma.,1997). Soil degradation has resulted in decreased food production, droughts, ecological imbalance and consequent degradation of the quality of life (FAO, 1995).

2.1.7. Sustainable Agricultural Practices

2.1.7.1 Definition and Concept of Sustainable Agricultural Practices

Sustainable agriculture can be broadly defined as an agricultural system involving a combination of sustainable production practices in conjunction with the discontinuation or the reduced use of production practices that are potentially harmful to the environment (De Souza et aI.1993; FAO 2008; Kassie et al.. 2009). The Food and Agricultural Organizations (FAO) argues that

sustainable agriculture consists of five major attributes: it conserves resources (e.g. land, water, etc) , and it is environmentally non-degrading, technically appropriate, and economically and socially acceptable (FAO. 2008).

Sustainable farming means farming using sustainable methods based on your understanding of the ecosystem. The primary goal of this type of farming is to meet our textile and food needs without compromising the capability of the future generation to provide for their needs. A sustainable agriculture focuses on promoting the economy through increased productivity while protecting the environment. It must deal fairly with all the workers while fostering a mutually beneficial relationship between neighbors.(Vidogbéna, et al. 2016).

2.1.7.2 Different Sustainable Agriculture Practices

1) Rotating Crops Monoculture, a widespread practice in many developing countries, is the primary cause of increased super-weeds and poor soil which results in decreased productivity. Planting different varieties of crops can be quite beneficial to your farm. Rotating crops helps improved pest and weed control, and healthier soil. Some of the crop diversity practices you can adopt include complex multi-year crops rotation and inter-cropping (planting different types of crops on the same farm).

2) Embracing Diversity Although planting numerous plant species is a great sustainable farming method, it is not an option for commercial farmers with a market for specific crops. Therefore instead of substituting their main crop, a farmer can plant diverse varieties of the same plant. Farming different varieties make your crop stronger since they are genetically distinct. Crop diversity protects the crops from pests and diseases which favor a specific crop variety.

3) Planting Cover Crops Planting cover crops like hairy vetch or clovers during the off-season times when the farm is left bare can be beneficial. Cover crops build and protect the health of the soil by replenishing the soil nutrients, preventing soil erosion and also hindering the growth of weeds which reduces the need for herbicides in future.

4) Eliminating or Reducing Tillage Although traditional plowing methods prevent weed problems and also help prepare the farm for planting, plowing causes soil loss. Therefore instead of plowing your farm before planting, you can use reduced till or no-till farming methods. By inserting all the seeds directly into the unplowed farm you can improve the quality of the soil while preventing soil erosion.

5) Appling Integrated Pest Management Methods Although pesticides help with pest management and improve crop production, over-usage of a specific pesticide results in a pest-resistant breed of pests. Therefore you can employ the use of numerous biological and mechanical pest control methods while reducing the use of pesticides. Different plants attract a wide variety of pests and birds among other creatures; some of these small animals can predate on the ones destroying crops. A farmer can release a group of numerous beneficial insects like lacewings and ladybugs into the farm to help control pests. Planting trees around the farm will attract birds who will nest there and even feed on the insects thus controlling the population of insects.

6) Integrating Crops and Livestock Industrial agriculture keeps animal and plant production separated with the livestock grazing away from the farm and the crops away from manure. Although keeping the animals away from the crops can protect the crops from being consumed by the animals, evidence shows that smart integrating of livestock and crops production can be a perfect recipe for a more efficient and profitable farm. Managed grazing can also be a great way of crop rotation. Instead of alternating crops, you can allow your livestock to graze on different pastures on your farm so that the animals can consume different plants. Managed grazing will provide your cattle with a wide range of nutrients. Moving the livestock is also perfect for the soil since the excessive foot fall will help compact the soil thus preventing soil erosion while the manure left behind will help fertilize the farm.

7) Adopting Agro-forestry Practices Addition of shrubs of trees in the farm can help provide shelter and shade to the plants, water resource, and animals. Trees and shrubs can help prevent soil erosion while potentially giving the farmer an additional income. Planting trees around your water source can help prevent loss of water through evaporation during the dry seasons.

8) Managing Entire Landscapes and Systems Sustainable farming treats the less intensively cultivated and the uncultivated area as part of the farm. The role played by the uncultivated areas, in reducing nutrient runoff, controlling soil erosion and supporting the pollinators among other diversity is valued. Therefore make sure you tend to this area as you would tend to your farm. (Lydia Wafula, Judith Oduol..et al,2016)

2.1.7.3 Benefits of Sustainable Agriculture

As much as we want to maximize the profits from our farms; over-exploiting the farm can affect your production in the future. Therefore investing in sustainable farming methods can help you

increase your productivity without over-exploiting the farm. Sustainable agriculture aims at providing food for the present generation while making sure that the future generation will enjoy same benefits from the environment. Sustainable agriculture also benefits the environment by maintaining soil quality, reducing soil degradation and erosion, and saving water. In addition to these benefits, sustainable agriculture also increases biodiversity of the area by providing a variety of organisms with healthy and natural environments to live in. (Lydia Wafula, Judith Oduol..et al,2016)

2.1.7.4 Advantages and Disadvantages of SAPs

1. Sustainable are farming practices that are conducted with three main aims; environmental conservation, economic profitability, social equity. It can merely be referred to as responsible farming. It is farming with a goal of obtaining better yields and protecting the environment as well. This will support farming even in several years to come.
2. Benefits of Sustainable Agriculture It does not advocate for the use of chemicals and commercial fertilizers. This reduces certain harmful effects on the environment that can pollute it. This preserves the natural ecosystem, thus, healthy produce. It promotes the culture of raising animals through feeding on natural feeds. There is better protection of animal species, creating a natural balance in the ecosystem.
3. Farmers are able to bring up healthy animals. These can fetch the best prices in the market. Biodiversity is yet another advantage of sustainable agriculture. It advocates for the production of various kinds of plant and animal species. Plants are cultivated in rotations. This leads to enriched soil and also prevention of the spread of diseases and pests outbreaks.
4. Disadvantages of sustainable agriculture It limits the proper use of land. it also hinders the full exploitation of land, labor and capital. This is because it advocates for the use of productive resources sparingly. It is also hard to maintain the fertility of soil by simply rotating crops. Income that is generated from farming is also very limited due to sparingly use of land (The Journal of Development Studies, 10.1080/ 00220388. 2018. 1443210 , 55, 2, (177-190), (2018).

2.2. Empirical Review

It is widely perceived to be a major problem in sub-Saharan Africa (Scoones, et aI.,1996). In Ethiopia the exact time when accelerated erosion became a human problem is not known

(Thomas,1991). Among the different human interventions that accelerate soil erosion process, agriculture is the most important and most soil erosion occurs on cultivated lands (Hudson. 1986; cited in Wagayehu, 2003). A potential consequence of more intensive agricultural production is increased soil erosion from cropland (Carlson et al.,1993).

In Ethiopia where the agriculture sector, the most important sector for poverty reduction has been undermined by lack or adequate plant-nutrient supply, depletion of soil organic matter, and soil erosion (Grepperud, 1996). In an effort to overcome these challenges, the government and non-governmental organizations have consistently promoted chemical fertilizer as a yield-augmenting technology. Despite this promotion, chemical fertilizer adoption rates remain very low (Byerlee et al., 2007), and in some cases, there is evidence suggesting a retreat from fertilizer adoption (EEA/ EEP RI. 2006). Possibly due to escalating fertilizer prices and production and consumption risks (Kassie, Yesuf, and Kohlin, 2008; Hailemariam, 2012).

Moreover, the water- retention characteristics of conservation tillage (Twarog, 2006) make it especially appealing in water-deficient farming areas, as is the case in one or our study areas. Consequently, since 1998, Ethiopia has included conservation tillage as part of its extension packages to help reverse

extensive land degradation (Sasakawa Africa Association, 2008).

Although encouraging adoption of conservation tillage is important, an equally if not more important aspect is whether or not it enhances productivity. In Ethiopia the economic returns to soil and water conservation investments, as well as their impacts on productivity, are greater In areas with lower rainfall than in more humid areas (Sutcliffe, 1993; Benin, 2006).

For this paper, the researcher examined the productivity gains associated with farmer's investment decision on sustainable agricultural practices, with a particular focus on use of reduced tillage, use of manure, fallow and legume crop rotation and legume intercropping. A finding suggested in areas with lower rainfall, reduced tillage had significant impact on crop productivity, and in higher rainfall areas, chemical fertilizer had higher significant productivity impacts (Kassie et al..2012). This implied that technology performance varies by agro ecology.

Conservation agriculture and the use of organic fertilizers (e.g., compost) are two examples of sustainable agriculture practices. Conservation agriculture seeks to achieve sustainable agriculture through minimal soil disturbance (i.e., zero- or minimum-till age farming- stubble tillage), permanent soil cover, and crop rotations (Kassie et al.. 2009). The potential benefits

from conservation agriculture lie not only in conserving but also in enhancing the natural resources (e.g .. increasing soil organic matter) without sacrificing yield levels. This makes it possible for fields to act as a sink for carbon dioxide, increases the soil's water-retention capacities, and reduces soil erosion. It also cuts production costs by reducing time and labor requirements, as well as costs associated with mechanized farming, e.g .. costs of fossil fuels (FAO, 2008). Despite to this, it s adoption status in this study area has been limited.

The agriculture sector in Ethiopia is the most important sector for sustaining growth and reducing poverty. However, lack o f adequate nutrient supply, the depletion of.' soil organic matter, and soil erosion are major obstacles to sustained agricultural production (Grepperud,1996; Kassie e t aI., 2008). The key to a prolonged increase in agricultural production is to improve productivity, which can be achieved through better technology and efficiency. In organic fertilizer remains the main yield-augmenting technology being aggressively promoted by the government and institutions. Despite this, inorganic fertilizer adoption rates remain minimal. Thus, given the aforementioned challenges to inorganic fertilizer adoption, a key policy intervention for sustainable agriculture is to encourage adoption of agricultural technologies that rely, to a greater extent , on renewable local or farm resources. Organic farming practices, such as compost and conservation tillage, are among such technologies. The water retention characteristics of these technologies (Twaro g, 2006) make them especially appealing in water deficient farming areas, such the Tigray region of Ethiopia, most countries in sub-Saharan Africa , including Ethiopia, heavily depend on agriculture that is dominated by subsistence smallholder farmers. The fate of the agricultural sector directly affects economic growth, food security, poverty alleviation, and social welfare. The performance of agriculture in this region has not lived up to Expectations, characterized by decades of ups and downs. Its low level of productivity is emphasized by the statistic that while the sector employs about 67 percent of labor force, it contributes only about 17 percent of the total gross domestic product. The average intensity of fertilizer use in sub-Saharan Affrica is only 8 kilo grams per hectare of cultivated land, much lower than in other developing countries (Morris et a l. , 2007).

The soil conservation research project (SCRP) has estimated that about 1.5 billion tones of soil are eroded every year in Ethiopia (ibid). Similarly, the Ethiopian high lands reclamation study estimated that between 1985 and 2010 the rates of land degradation will cost 15.3 billion Ethiopian Birr, most of which 78% is due to crop failure or low yields and 22 % is due to

decreased live stock population (Thomas, 1991; kruger, 1996). The natural capital asset depleting effect, soil erosion also induces immediate on site effects, those that happen at the site where erosion occurs, and off-site effects which have positive or negative effects as the soil leaves the boundary or the field due to erosion and */or* watershed (Wagayehu, 2003).

The adoption and diffusion of specific sustainable agricultural practices (SAPs) have become an important issue in the development policy agenda for sub-Saharan Affrica (Aiayi. 2007), especially as a way to tackle these impediments. These practices are conservation tillage, legume intercropping, legume crop rotations, improved crop varieties, use of animal manure, complementary use of organic fertilizers, and soil and stone bunds (De Souza et aI., 1999; Kassie and Zikhali , 2009; Wol lni et aI. , 20 10). The potential benefits of SAPs' lie not only in conserving but al so in enhancing the natural resources e.g. Land and water without sacrificing yield levels.

Further more, by retaining fertile and functioning soils. SAPs can also have positive impacts on food security and biodiversity (Wollni et al. .20I0). Crop rotation and diversification via intercropping enable farmers to grow products that can be harvested at different times and that have different climate or environmental stress-response characteristics (Hailemariam, 20 12). The same is true in Ethiopia, where ,despite accelerated erosion and considerable efforts to promote various soil and water conservation technologies, the adoption of many recommended measures is minimal and soil erosion continues to be a problem (Bekele and Holden. 1998). Moreover, relatively little empirical work has been done to formally examine the socioeconomic factors that influence the adoption and diffusion of SAPs, especially conservation tillage, legume intercropping, and legume crop rotations (Arellanes an d Lee, 2003).

Given that resource degradation and climate change can irreversibly destroy the resources needed for food production and agricultural income generation, it is critical to identify the factors, incentives and policies that promote farm level adoption of SAPs. Many studies have been performed on the adoption of new technologies by agricultural producers. However, relatively little empirical work has been done to formally examine the socio-economic factors that influences the adoption of SAPs (Hailemariam. 2012).

In general, cognizant of the problems land degradation motivates farmers decision to invest in sustainable agricultural practices. Disappointedly, farmers decision of adoption in sustainable agricultural practices may be hindered by intertwine and interrelated factors like personal and

demographic factors,socio-economic factors, plot characteristics and institutional support as Shown below diagrammatically.

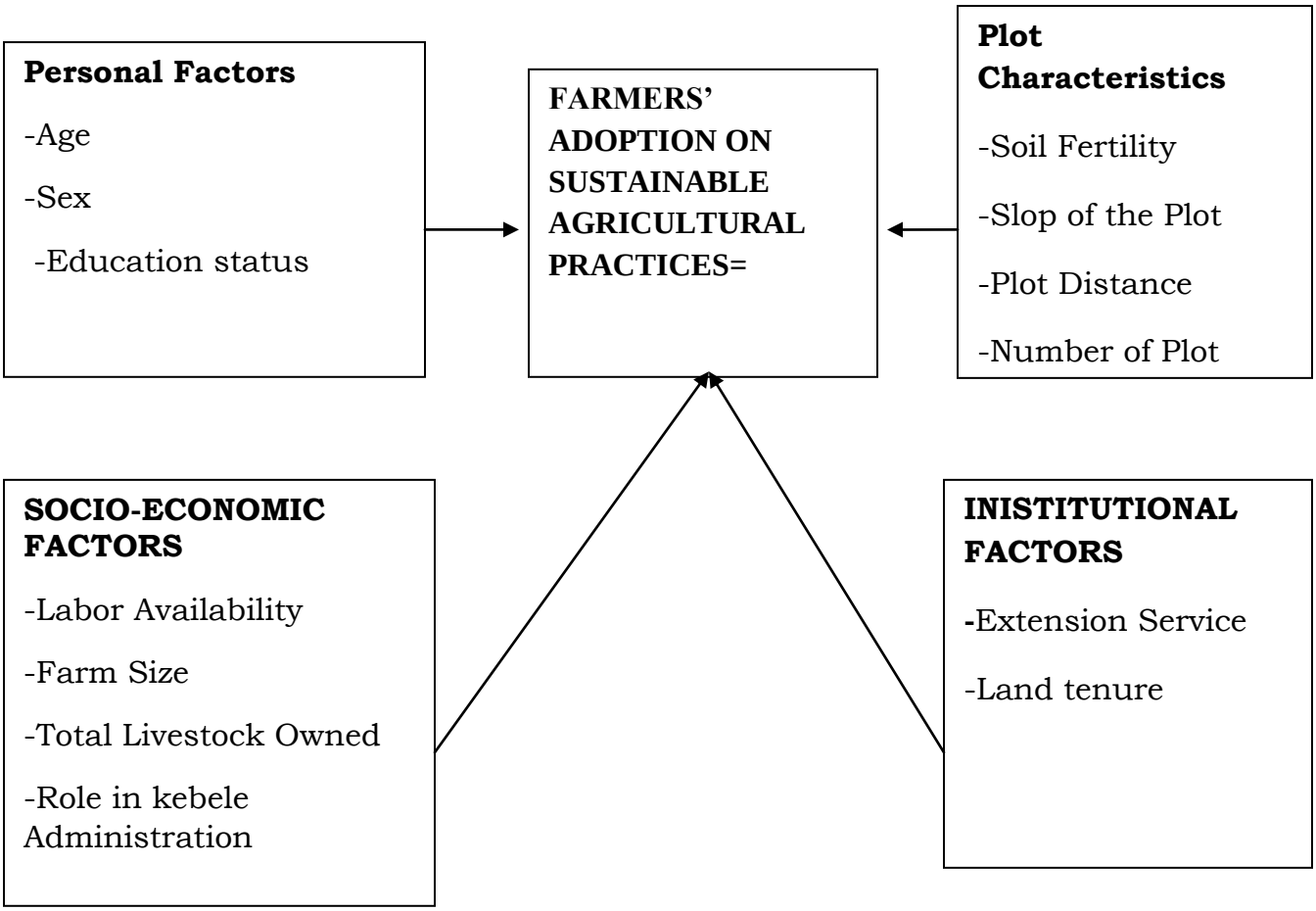

Figure 1: Conceptual framework on farmers decision to invest in SAP's.

Source : adopted and modified from Bekele , Holden and Haimanot (2012).

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Description of the Study Area

Ginmbo (sometimes spelled **Gimbo**) is one of the woredas in the Southern Nations, Nationalities, and Peoples' Region of Ethiopia. The name Ginbo comes from one of the provinces in the former Kingdom of Kaffa. That province, as well as the Kafficho provinces Bonga and Manjo, became districts with the Ethiopian conquest in 1896, and these districts were later merged to form the modern woreda.

Part of the Keffa Zone, Ginbo is bordered on the south by Decha, on the west by Chena, on the northwest by Gewata, on the north by the Gojeb River which separates it from the Oromia Region, and on the east by Menjiwo. Towns in Ginbo include Diri, Gojeb, Ufa and Wushwush. Ginbo surrounds Bonga town. The western part of Ginbo was used to create Gewata woreda. The capital city of Gimbo district is Uffa town and located 21 kms from kaffa zone town. 716kms from SNNRS city Hawasa and 446 kms to the South west from Addis Ababa, the capital city of Ethiopia. The district has 31 rural kebele administrative and four-urban kebele administrative.

The study was conducted in Gimbo district, Kaffa zone, southern Ethiopia. It is found within the southwestern plateau of Ethiopia. The area lies within 07°00'- 7°25'N Latitude and 35°55'-36°37'E Longitude. Its altitude ranges from 1600 to 1800 m.a.s.l. The topography is characterized by slopping and rugged areas with very little plain land (Matheos, 2001). Climatically, the area experiences one long rainy season, lasting from March /April to October. The mean annual rainfall ranges from 1710 to 1892 mm. Over 85% of the total annual rainfall, with mean monthly values in the range of 125 to 250 mm occurs in the 8 months long rainy season. The mean temperature ranges from 18 to 19.4°C (Matheos, 2001). The area is known by its dense natural forest with diverse tree and wild life species

The primary food crops include enset and maize; other staple foods include wheat and barley. A major cash crop in this woreda is tea; there is a large tea plantation at Wushwush.[1]Notable landmarks include a Christian monastery 12 kilometers from Bonga which dates to 1550, and the Bonga Forest Reserve covering some 500 square kilometers of the surrounding hillsides.[2]

Ginbo was selected by the Ministry of Agriculture and Rural Development in 2004 as one of several woredas for voluntary resettlement for farmers from overpopulated areas, becoming the new home for a total of 7800 heads of households and 31,200 total family members.

Based on the 2007 Census conducted by the CSA, this woreda has a total population of 89,892, of whom 44,774 are men and 45,118 women; 9,611 or 10.69% of its population are urban dwellers. The majority of the inhabitants practiced Ethiopian Orthodox Christianity, with 87.17% of the population reporting that belief, 5.14% were Muslim, 4.01% were Protestants, and 3.14% embraced Catholicism.

In the 1994 national census Ginbo had a population of 99,847, of whom 49,364 were men and 50,483 women; 17,976 or 18% of its population were urban dwellers. The three largest ethnic groups reported in this woreda were the Kafficho (76.74%), the Amhara (15.19%), and the Oromo (4.25%); all other ethnic groups made up 3.82% of the population. Kafa was spoken as a first language by 76.49% of the inhabitants, 18% spoke Amharic, and 3.16% spoke Oromiffa; the remaining 2.35% spoke all other primary languages reported.[5]Concerning education, 36.29% of the population were considered literate; 25.8% of children aged 7–12 were in primary school; 13.05% of the children aged 13–14 were in junior secondary school; and 7.81% of the inhabitants aged 15–18 were in senior secondary school. Concerning sanitary conditions, about 50.28% of the urban houses and 21.90% of all houses had access to safe drinking water at the time of the census, while about 67.08% of the urban and 24.95% of the total had toilet facilities.[6]

The life expectancy was estimated at 51.35 and 53.45 year for males and females, respectively. Population growth rate per annum was estimated at 2.9 percent. The average number of persons per household was approximately 4.4 persons for the same year.

The subsistence crop production of the study area is traditional and rain-fed. Depending on the prevailing agro-ecological conditions, different crops are grown, and of these, maize, sorghum, barley, wheat and teff are the main cereal crops. Pulses grown are field pea, horse bean and haricot bean. From perennial crops “enset”, Ensete ventricosum is found in abundance and mostly around homestead, and sugar cane.

Fruits like banana, avocado, mango,and papaya, vegetables such as Ethiopian cabbage and root crops like carrot, beet root, onion, “Anchote” Coccinia abyssinica, “Godere” Colacasia esculanta L.,Colacasia esculanta L., nd potato are also planted nearby homesteads.

Agricultural inputs are not widely practiced, nevertheless, in some places fertilizer is applied for maize and teff and improved seed varieties of maize, wheat and barley are used. Pesticides are also applied for sorghum and teff in certain localities.

Cattle rearing are one of the sources of livelihood in the studied woredas. It is a source of draught power, milk, meat, and income. Equines are used as means of carrying load or personal transport. Although there is 57,810 Cattle, 18,965 Sheep, 13,900 Goat, 93,732 Poultry Horse , 1,174 Horse, 747 Donkey, 402 Mule and 2,323 Equines.(Tezera cherent ,2008)

Agricultural supporting services

In each kebele administration there are three development agents who provide extension works to the farming community at large. Of these agents, one dwells on forestry activities, another one in livestock and the third in crop development. One of these three agents acts as a supervisor and is in charge of the coordination and reporting of activities.

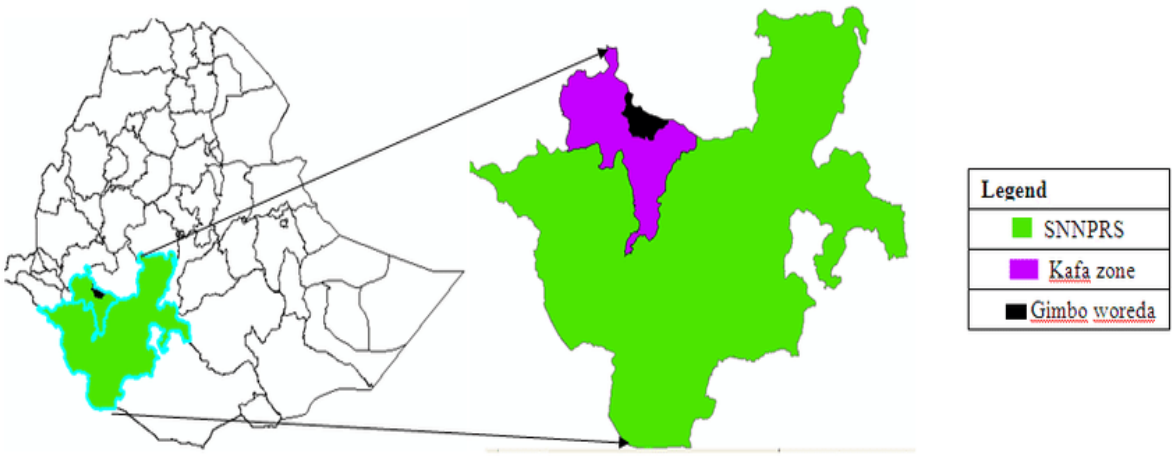

Figure 2: Map of Gimbo District adopted and modified from topographical Map of EMA(1987).

3.2. Research Design

3.2.1. Types and Source of Data

In this study, both qualitative and quantitative data were collected to hit the stated objectives from primary and secondary data sources, Primary data was collected from Focus group discussion and questionnaire (to pre-test the questionnaire and to get in depth knowledge of farmers decision to invest in SAPs' and accept new technology from survey by using structured interview schedule.

3.2.2. Method of Data Collection

The researcher employed both primary and secondary data collection techniques**.** Primary data was collected through face to face individual interview with help of structured questionnaire, transect and Focus group discussion to generate both qualitative and quantitative data. Individual interview was done after a couple of days training enumerators about the questionnaire details

and how they administered the structured questionnaires used to collect primary data from selected sample households, at house hold level, the necessary data related to the personal information, socio-economic, plot characteristics and institutional factors that explain farmers level of understanding and attitude develop about land degradation and attributes that facilitate or hinder investment in SAPs was collected using structured questionnaire through interviewing the household heads. Interviews were conduct at early morning and late the afternoon and full working day time during holiday between March-April, 2019.The enumerators was selected on the basis of their educational status. Local knowledge, colleagues, close to farmers in their work and the like criteria.

To investigate deeply and get adequate information on the farmers' decision to invest in SAPs' the researcher employed focus group discussions. A total of 7 discussants (Gimbo District Agricultural Experts) was selected on the basis of their educational status and work experiences. The discussion took place on Gimbo District Agriculture office.

The researcher himself made informal (on site observation) of sample kebeles land use and patterns, cropping system, animal husbandry, vegetation, landscape and biophysical conservation structures made previously by local farmers through systematic walking.

Whereas, secondary data was reviewed and collected from related to institutional, Bio physical and socio-economic features of the trend SAPs'. Hence, to get such important data the investigator was collected information on SAPs such as Gimbo District Agriculture Office, Kefa Zone of Agricultural Office, Ministry of Agricultural Library (both documentation and internet) as well as published and unpublished documents and other pertinent documents.

3.2.3. Sample and Sampling Techniques

For this study a multistage stratified sampling techniques had been applied by a researcher. In the first stage, purposive sampling utilized to select Gimbo district because of the researcher preference. In the Second stage, from this district among 31 rural kebeles administrative (RKA) stratified based on the previously implemented more than two SAP components. Accordingly two kebeles' was selected. In Tulla and KUTTI kebele the number of total households are 320 and 430 respectively. Out of this 140 and 260 house hold were selected based on their on farm activities, the rest of households livelihood depend on off farm activities. Finally, 120 sample households were selected by use of Gender and random sampling technique; from the two RKAs according to proportion to size the sample took

Table 1: Sample household selection proportion to size

Name of Rural Kebele Administrative	Total households	Total sample taken	
		No of sample households	Percent
'TULLA'	320 (140)	42	30
'KUTTI'	439 (260)	78	70

3.2.4. Method of Data Analysis

Both Descriptive Statistics (frequency, percentage, mean, standard deviation, t-test, and x^2 -test,) and Econometric model were used. A binary logit model was applied to explain factors impede or facilitate farmers' investment decision on SAPs and helps to identify key variables determine farmers' decisions to invest in this practice with the support of SPSS software utilized to analyze the data.

3.2.5. Descriptive Analysis

Descriptive statistics like frequency, percentage, mean, standard deviation , t-test and x^2 -test were employed [or analysis, summarize and compare results of demographic, socio-economic, plot characteristics and institutional data to have a clear picture and used to know differences between investors of SAPs and non investors. The result obtained is an indicator of the relationship between explanatory Variables and dependent variables.

3.2.6. Econometric Model and Descriptions

The logit model was selected for the following reasons: 1) Probit and logit models are non linear (in the parameters) statistical models that achieve the objective of relating the choice probability Pi, to explanatory factors in such a way that the probability remains in the (0, 1) interval (Griffiths, et al..1993). 2) The logistic function is used because it represents a close approximation to the cumulative normal and is simpler to work with. The close similarity between the logit and probit models is confined to dichotomous dependent variables and; 3) In many cases logistic regression is preferred to the probit due to its link to other models such as linear probability model, and its simpler interpretability as the logarithm of the odds ratio and its eminence effort to retrospectively collected data analysis (Mcculaah and Nelder,1998). Whether or not a farmer invests a new technology assumes a yes or no answer, a typical case of

dichotomous variable. For such type of response, a discrete model is a popular tool of analysis. In this model, the dependent variable is a binary assuming two values, 0 and 1. Hence, for a farmer who adopter, the SAPs', the value (y= 1) and for a farmer who does not adopt , a value (y=O) is assigned.

Several models such as simple correlation, linear probability function, etc, can be used to analyze adoption behavior of farmers. But these models have limitations in that the t-ratios are incorrect, exhibit hetroscedasticity, non -normality, their estimated probabilities (Pi) may be greater than one or below zero, and assume Pi increases linearly with X (Maddala,1983 ; Gujarati , 1995). The logit and probit models overcome these problems since both are based on a cumulative distribution function.

Following (Gujarati,1995; Aldrich and Nelson,1984) the logistic distribution for the investment of SAP's can be specified as ;

$$Pi= \frac{1}{1+e^{-zi}} \text{----------} \quad (1)$$

Where, Pi is the probability of farmers invest in SAPs' for the i^{th} farmer, e represents the base of natural logarithms and Zi is the function of a vector of n explanatory variables (X's) which is an underlying and unobservable index for the i^{th} farmer (when Zi exceeds some threshold level (Z*), the farmer is observed to be an investor; otherwise he is a non-investor when Zi falls below the threshold value), and ex pressed as:

$$Zi=a+ \sum BiXi \text{..----------} \quad (2)$$

Where *a* is the intercept, Bi is a vector of unknown slope coefficients and XI, X2 . .. Xn represent the n explanatory variables.

The logit model assumes that the underlying stimulus index (Zi) is a random variable which predicts the probability of investment of SAPs'. The slope tells how the log-odds in favor of investment on SAPs change as independent variables change.

One way of approaching the (0, 1) constraint problem that is imposed on the probability is to transform P to eliminate one or both constraints (Aldric and Nelson,1984) in a ratio form. If p is the probability of investing on SAPs then 1- Pi represents the probability of not investing and can be written as :

$$1 -pi = 1- \frac{1}{1+e^{-zi}} = \frac{e^{-zi}}{1+e^{-zi}} - \left(\frac{1}{1+e^{zi}} \right) \text{----------} \quad [3]$$

Dividing equation (1) by equation (4) and simplifying gives

$$\frac{pi}{1-p} = \left(\frac{1+e^{zi}}{1+e^{-zi}}\right) = e^{zi} \text{----------[4]}$$

Equation (4) shows the odds ratio, which defines the probability of investing relative to non-in vesting.

Finally, the logit mode l is obtained by taking the logarithm of equation (5) as follows:

$$Li = In\left\{\frac{pi}{1-pi}\right\} \text{----------(5)}$$

Where, Li is log of the odds ratio in favor of SAPs' adoption, which is not only linear in Xj. But also linear in the parameters. Thus, if the stochastic disturbance term, (Ui), is introduced, the logit model becomes:

$$Zi = \beta + \beta 1Xi + \beta 2X2i \ldots + \ldots + \beta nXni + ui \text{ ---------- [6]}$$

3.2.7. Parameter Estimation

When using either probit or logit model with individual observation the most suitable estimation technique is that of maximum likelihood (Pindyck and Rubinfeld,1981). The estimation procedure has a number of desirable statistical properties. All parameter estimators are consistent and also efficient asymptotically, i.e., for large sample. In addition, all parameter estimators are known to be (asymptotically) normal, so that the analog of the regression t- test can be applied.

As noted by (Pindyck and Rubinfeld,1981:Gujarati,1995),the method of maximum likelihood consists in estimating the unknown parameters in such a manner that the probability of observing the given Y's is as high (or maximum) as possible. Before computing the models, it would be necessary to check whether there is multicollinearity among the candidate variables and verify the degree of association among discrete variables. The reason is that the existence of multicollinearity will affect seriously the parameter estimates.

According to (Gujarati, 2003), There are various indicators of multicollinearity problem of various indicators of multicollinearity, the variance inflation factor (VIF) is used in this study to check whether there is multicollinearity or not among continuous explanatory variables. Where each continuous explanatory variable is regressed on all the other continuous explanatory variables and coefficients of determination for each auxiliary or subsidiary regression will be computed. Furthermore, (Gujarati,1995) stated that a high R^2 obtained could only be a serious

indicator of multicollinearity. Hence, a measure of multicollinearity associated with the variance inflation factors is defined as:

VIF (Xj) = 1/ (I-RR^2) $^{-1}$

Where R2 is the coefficients of determination when the variable; Xj is regressed on the other predictor variables. A VIF value greater than 10 is used as a signal for strong multicollinearity (Gujarati,1995). In similar fashion, there may also be interaction between two qualitative variables, which can lead to the problem of multicollinearity or association. To detect this problem, coefficients

of contingency were computed from the survey data. The contingency

coefficients are computed as follows.

C= $\sqrt{\frac{X^2}{N-x2}}$

Where: C = coefficients of contingency

X2= chi- square of random variable

N= Total sample size

The parameters of the model were estimated using the iterative maximum likelihood estimation procedure. This yields unbiased and asymptotically efficient and consistent parameter estimates.

Table 2: Definition and Units of Measurement of the Explanatory Variables

Variables	**Definition and Units of Measurement**
SEXHH	Sex of household head (1 =Female , 2=Male)
AGEHH	Age of household head in years
EDUHH	Educational status of household head (0=illiterate, 1=literate)
PARTADMIN	Household head's role in kebele (0=no, 1 =yes)
DISTPLOT	Distance from residence to the plot (in minute)
FARM1ZE	Farm size in hectare
LAN DTENURE	Land tenure (O= insecure , and 1 =secure)
SOILFERT	Soil fertility status (O =non-fertile, 1 =less fertile and 2=fertile)
TLU	Respondent's owned livestock (in tropical livestock unit)
SLO PEPLOT	Slop of the plot (0= flat 1= Gentle 2= moderate steep slope 3= steep slope)
PLOT	Number of plots (in number)
EXTENS ION	Extension agent visit (O =not-visited and I =visited)
LABOR	Labor availability (O =not-available an d I =available)
Source: from Theory and Empirical.	

CHAPTER FOUR

RESULT AND DISCUSSION

This part is concerned with the description and interpretation of the findings. As already noted, a structured questionnaire was administered to 120 sample households in Gimbo district.

The questionnaire was designed in such a way that it enables to collect data on demographic, Socio–economic, plot characteristics and institutional support of farm households' decision to adopt components of SAPs'. This chapter is categorized in two sections. In the first section the descriptive analysis made use of tools such as percentages, mean and standard deviation. T-test and $\chi 2$ utilized to assess the factors that influence farmers to invest in different agricultural land management practice. The respondents were categorized as adopter and non- adopter to compare the factors affecting farmers to adoption in SAPs'. In the second section the results of econometric model for the farmers' decision to adopt in sustainable land conservation and agricultural yield maximizing practices are discussed in detail.

4.1.1. Demographic Characteristics of the Respondents

4.1.1.1. Sex of the Respondents

Gender of house hold head can influence adoption of new technology either being female headed or male headed. Male headed households have better chance for practicing on land conservation because of the position they have and access of information as compared to their counter parts in the study area. Out of the sample of respondents, female headed household accounted for only 20%, while the rest 80 % were male headed household. Accordingly, from the total sample respondents, 66.7% were adopter and 33.3% were non- adopter. A Chi-square tests revealed that, there is a significant and positive association between male headed household with the probability of the decision to be adopter of SAPs' in the study area (Table:3).

Table 3: Distribution of Household Heads by Gender in adoption Categories

SEXHH	Adopter		Non- Adopter		Total	
	Number	Percent	Number	percent	Number	Percent
Female	8	6.7	16	13.3	24	20.0
Male	72	60.0	24	20.0	96	80.0
Total	80	66.7	40	33.3	120	100.0
Chi-square			15.00			
P-value			.000			

Source: Computed from survey data 2019,

4.1.1.2. Age of the Respondents

The mean and standard deviation age of sample respondents were 50.81 and 12.3, respectively. The age composition of sample respondents were revealed significant difference of the adopter, and non- adopter, 54.28 and 43.8 mean of years, respectively. The maximum age observed was 89 and the minimum was 28 years (Table 4). Increase age of farmers already engaged in farming operation, it gives time for farmers to learning from directly observed and evaluate problems and profits of the crop produce. As the mean of age revealed that adopter in SAPs are relatively older than non – adopter of among multiple components of SAPs. The t- test result indicate that age has positive and significant difference with adopter of SAPs and, otherwise.(Table 4).

Table 4: Distribution of Sample Household Heads by Age Categories

AGEHH	Adopter		Non- adopter		Total	
	Number	Percent	Number	Percent	Number	Percent
20-40	10	8.3	18	15.0	28	23.3
41-64	53	44.2	19	15.8	72	60.0
>65	17	14.2	3	2.5	20	16.7
Total	80	66.7	40	33.3	120	100.0
Mean	54.28		43.8		50.81	
Maximum	89		70		89	
Minimum	28		28		28	
SD	11.73		10.54		12.3	
T-value			4.01			
P-value			.000			

Source: Computed from survey data, 2019

4.1.1.3. Educational Status of the Respondents

As education status of house hold head increases, it is considered to increase the transfer of relevant information, awareness and mutual understanding about new idea, technology and innovation and as a results increase farmers' knowledge about the benefits, constraints and opportunities gain from implementing sustainable agricultural practices. Education provides something for farmers to arrest loss of soil fertility using various ways of soil fertility improving practices, maximizing productivity at the same time keeping soil health, traditional and improved soil conserving technologies, compost and agronomic practices. Out of total respondents 38.3% were illiterate and 33.3 were read and write. Whereas, 28.4% were, educated from grade 1 up to grade 8 (Table 5). This means as sample respondents not educated it may increase the possibility of farmers' rejection of new technology and innovation and if educated more, otherwise is true. The chi -square result revealed that there is positive and strong positive relationship between education and farmers adoption in SAPs'(Table:5).

Table 5 :Distribution of Sample Household Heads' by Educational Status

EDULEVEL	Adopter		Non- adopter		Total	
	Number	Percent	Number	Percent	Number	Percent
Illiterate	21	17.5	25	20.8	46	38.3
Read and write	31	25.8	9	7.5	40	33.3
Grade 1-4	15	12.5	2	1.7	17	14.2
Grade 5-8	13	10.8	4	3.3	17	14.2
Total	80	66.7	40	33.3	120	100.0
Chi-square			15.548			
P-value			.001			

Source: Computed from survey data, 2019

4.1.2. Socioeconomic Factors

4.1.2.1. Role in Local Kebele Administration

The survey results shown in (Table 6), 26.7% were assumed some responsibility at their village or kebele level. Among non- participants 29.2% and 44.2% were non- adopter, and adopter respectively. The higher the figure for respondents may indicate that as the household head assumed some responsibility, the chance of getting information and hence, understanding about uses of SAPs' will increases. This contributes to the decision to implement SAPs'. The result of chi-square indicated that household head had position in kebele administration has significant and positive association with the probability of farmers to be adopter in SAPs' on their farm plot.

Table 6: Distribution of Respondents the role in Local kebele Administration

PARTADMIN	Adopter		Non- adopter		Total	
	Number	Percent	Number	Percent	Number	Percent
Yes	27	22.5	5	4.2	32	26.7
No	53	44.2	35	29.2	88	73.3
Total	80	66.7	40	33.3	120	100.0
Chi-square			6.158			
P-value			.013			

Source: Computed from survey data, 2019

4.1.2.2. Farm Size

The land size holding of the sample farmers ranges from 0.5 to 7 hectares. The average land holding is known to be 1.98 hectares with a standard deviation of 1.2 hectares. The survey result indicated that about 29.4% of the respondents had a farm size of 1 hectare or less. 39.5% of respondents had a farm size ranges 1.1-2.0 hectares and the rest 31.1% of respondents had farm size of greater than 2 hectares of land. On the average adopters hold more land 2.4 hectare, and non- adopters 2.0 hectare of land, respectively (Table 7). The t-test result revealed that there is significant mean difference between non- adopter and adopter households at 1% significance level. This illustrates as household own more unit of land, the household inspired to make decision to adopt a new agricultural technology alternative.

Table 7: Distribution of Respondents in the Land Size

FARMSIZE	Adopter		Non- adopter		Total	
	Number	Percent	Number	percent	Number	Percent
0.5-1.0	6	5.0	29	24.4	35	29.4
1.1-2.0	37	31.1	10	8.4	47	39.5
2.1-3.0	22	18.5	-	-	22	18.5
3.1-7.0	15	12.6	-	-	15	12.6
Total	80	67.2	39	32.8	119	100.0
Mean	2.47		0.96		1.98	
Maximum	7		2		7	
Minimum	0.5		0.5		0.5	
SD	1.2		0.4		1.2	
T-value			9.5			
P-value			.000			

Source: Computed from survey data , 2019

4.1.2.3. Labor Availability

Due to the fact that, SAPs have multiple components, it requires different agricultural practices. As a result this practices require (consume) more labors. As is indicated in table 8: majority of adopters 40.8% replied that, they can get labor, while 25.0% of non- adopter could also get labor. However, as the chi-square test result indicated that labor availability do not have a significant difference between adopter and non- adopter.

Table 8: Distribution of Respondents by Labor Availability

LABOUR	Adopter		Non- adopter		Total	
	Number	Percent	Number	percent	Number	Percent
Yes	49	40.8	30	25.0	79	65.8
No	31	25.8	10	8.3	41	34.2
Total	80	66.7	40	33.3	120	100.0
Chi-square			2.241			
P-value			.134			

Source : computed from survey data, 2019

4.1.2.4. Livestock Owned

Livestock in the study area have been kept for different purposes. They are kept to provide food, draught power, sharecropping, threshing, transportation , wealth status, fiber, as a means of saving due to farmers regard livestock as safeguard for sudden cash requirement as they are considerable liquid resources. These animals are sold in time of need for food, credit repayment, to pay taxes and other expenses. Oxen are kept both for plough and fattening purpose, whereas cows are kepi for dual purpose of give birth of calf, plowing and fattening. As result of animals arc used in farm operations, supplementary between crop and livestock enterprise is a common event for smallholder farmers of the study area. They interact with each other in that animals offer farm power and cattle dung in exchange for fodder from the crop residues and byproducts. The availability of cash from the sale of' livestock and livestock products *serve* as a source of cash when farmers are in urgent need of cash for their crop production activities. These animals are reared in both kebeles due to the suitability of the environment, presence of better feed and farmers' preference. On average, in both kebeles farmers kept 3.75 cows, 2.71 0xen, 1.94 bull, 2.08 heifers. 1.58 calves, *3.09* goats, *3.66* sheep and 1.51 donkeys, 1 mules, 1.27 horses and *7.57* chickens.

The result of t-test indicated that there is significant difference between non- adopters and adopters of SAPs' components. In other words, as the house hold has more livestock, it increase the probability of become adopter of SAPs' and, otherwise. This is because more livestock demand more grazing and pastures land.

Table 9 : Mean Difference Between Total Livestock Owned and Adoption

Livestock owned	Adopter		Non- adopter		Total	
	Number	percent	Number	percent	Number	Percent
<10	2	1.7	16	13.7	18	15.4
11-20	22	18.8	17	14.5	39	33.3
>21	56	47.9	4	3.4	60	51.3
Total	80	68.4	37	31.6	117	100.0
Mean	22.43		12.05		19.15	
Maximum	30		24		30	
Minimum	6		5		5	
SD	5.4		5.55		7.3	
T-value			9.494			
P-value			.000			

Source : computed from survey data, 2019

In the study area, the main sources of feed for livestock are communal grazing, crop residues and by products, purchase of feed from local farmers and use of farm plot before sowing and after harvesting of crops as grazing and source of feed. Accordingly, 45.8% were use communal grazing, 30.8 % were use crop product, 10.0% were use fallow, 8.0% were use other source of feed and 5.0% were use purchase from neighbors and/or other farmers. Similarly, the types of crop residues used as fodder in the survey results indicated that, 56.7 % were used hay, 20.0% were used straw, 14.17 % were used maize husk, 5.8 % were use Atella and 3.3% mowed grass.

Table 10: Types and Main Source of Cattle Feed

Source of feed	N	%	Types of crop residues used as fodder	N	%
communal grazing land	55	45.8	Hay	68	56.7
Fallow	12	10.0	Straw	24	20
crop product	37	30.8	Mowed grass	4	3.3
Purchasing	6	5.0	Maize Husk	17	14.17
Other	10	8.3	Atella	7	5.8
Total	120	100.0		120	100.0

Source: own survey 2019

In the survey result, the availability of feed is serious constraint to livestock production. Furthermore, shortage of grazing land fodder, supplementary feed and animal disease in convenience grass for cattle *Wajima* parasite (Alekit) and were common and terrible problems. Among total respondents in both kebeles accordingly, 37.5%, 17.5%, 15%, 7.5%, 6 7%, 5.8%,5.0 % were respond as shortage of grazing land, supplementary feed ,disease, Barn, Clinic , water , shortage in feed and lack of shepherd are the main constraints, respectively(Table11).

Table 11: Distribution of Sample Respondents Livestock Husbandry Problem

Problem of livestock	Frequency	Percent
shortage in grazing land	45	37.5
Disease	18	15.0
shortage in feed	6	5.0
Barn	9	7.5
Water	7	5.8
supplementary feed	21	17.5
Clinic	8	6.7
shepherded/guard	6	5.0
Total	120	100.0

Source : computed from survey data, 2019

4.1.3. Plot Characteristics

4.1.3.1. Number of Plot

As the number of plot increase, it has the advantage of to protect land from intensive cultivation, used for crop rotation, inter-cropping and possible to make fallow land for farmers. As it shown in the following table…., investors and non-investors had an average of 3.61 and 2.43 number of plot respectively. Similarly, out of the 72 sample respondents, 47.9% investors and 13.7% of non-investor had 3-4 number of plot on their farm respectively. The chi-square test revealed that, there is a significant difference between adopter and non- adopter at 1% significance level regarding the number of plot on their farm land.

Table 12 : Distribution of Sample of Respondents by the Number of Plot

Number of plot	Adopter		Non-investor		Total	
	Number	percent	Number	percent	Number	Percent
1-2	10	8.5	21	17.9	31	26.5
3-4	56	47.9	16	13.7	72	61.5
5	14	12.0	-	-	14	12.0
Total	80	68.4	37	31.6	117	100.0
Mean	3.61		2.43		3.24	
Maximum	5		4		5	
Minimum	2		1		1	
SD	0.92		0.89		1.06	
T-value			6.494			
P-value			.000			

Source : computed from survey data, 2019

4.1.3.2. Slope of the Plot

Slope is one of the farm attributes that aggravate soil degradation. Based on the Natural Resource Management Department classification for construction of SWC technology, plots based on slopes (which is measured in degree) were classified as *) meda* for Flat (0 - 2) and Gentle sloping (3 - 6) plots, *Zekzaka* for moderately steep sloping (6 - 15), and, *Kulkulel* for steep slopes (15-30) and *Gedelama* for very steep slopes and mountain (>30). According to field observation and sample respondents reported as shown in the Table;13, 33.3% of plots were moderately steep slope, 25.5% of steep slope, 21.7% of flat and the rest 20.0% were gentle. The highest portions

of investors' and non-investor plots were moderate steep slope (25.8%) and flat (10.8%) respectively. However, as chi-square result indicated in Table13, there is no statistically significant difference between adopter and non- adopter regarding degree of slope and SAPs.

Table 13 Distribution of sample of respondents by the slope of the plot

Slope of the plot	Adopter		Non- adopter		Total	
	Number	percent	Number	percent	Number	Percent
Flat	13	10.8	13	10.8	26	21.7
Gentle	15	12.5	9	7.5	24	20.0
Moderate Steep slope	31	25.8	9	7.5	40	33.3
Steppe slope	21	17.5	9	7.5	30	25.0
Total	80	66.7	40	33.3	120	100.0
Chi-square			5.700			
P-value			.127			

Source : computed from survey data, 2019

4.1.3.3. Distance of the Plot from the Residence

With reference to distance traditionally land users classified their plots into two. Plot near to homesteads called back yard, whereas the farm stead plots are referred as *Ersha.* Plot distance from the residence of the farmer affects, management attention, of the farmer by affecting the average time need to travel for applying manure and cattle dung, tree planting, and for SWC construction and timely maintenance. The survey result indicated that some plots were located at considerable distance from homestead, that will take up more than 140 minutes walking and the minimum was located at the garden which is 2 minute. About 67.5% of the plots are located at one way walking distance of less or equal to half an hour. The average time for non- adopter and the dwelling was 54.40 minutes and for adopter and their dwelling was 17.24 minutes. The t-test result revealed that there is significant mean difference between non- adopter and adopter with respect to plot distance.

Table 14 Distribution of Number of Plot from Dwelling Residence

Distance to the plot in minute	Adopter		Non- adopter		Total	
	Number	Percent	Number	percent	Number	Percent
0-30	68	56.7	13	10.8	81	67.5
31-60	12	10.0	16	13.3	28	23.3
>61	-		11	9.2	11	9.2
Total	80	66.7	40	33.3	120	100.0
Mean	17.24		54.40		29.63	
Maximum	60		140		140	
Minimum	2		2		2	
SD	13.26		37.37		29.73	
T-value	-6.100					
P-value	.000					

Source : computed from survey data, 2019

4.1.3.4. Soil Fertility Status

In the study area, farmers' perception to new technology can be seen with knowledge and understanding of soil fertility status, especially they compare with crop produce either increases or decreases. Farmers perceive and rated soil fertility of their land as fertile, less fertile and not fertile in the study area. The reason for farmers reach such decision on soil fertility depletion with the amount of fertilizer they use, compost and other organic matter adding nutrient application and the type of crop grown and yield obtain. Gimbo woreda Agriculture office experts explained during focus group discussion, less fertile and non- fertile land is used for cropping of pea, bean and *Bolke* and gives better yield if the soil color is close to red and less moisture land. On the other hand the experts revealed that, the position and knowledge of the farmers on soil erosion and nutrient depletion by actions they will ready for adoption of any soil improving and maximizing crop produce if the soil is highly depleted and decrease crop yield. This indicates that farmers' perception to their surrounding is good to keep soil fertility as the reaction they took to keep the produce in a way they want to produce the amount and type of crop. The survey result indicated that out of total respondents, 29.2% replied as fertile, 44.2% less fertile and 26.7% replied as non-fertile. As the chi-square result (10.43), indicated that there

is positive and significant association between soil fertility decline and investment of sustainable land conservation activities at 1% probability level.

Table 15 Distribution of Soil Fertility Status

Soil fertility status	Adopter		Non- adopter		Total	
	Number	percent	Number	percent	Number	Percent
Fertile	27	22.5	8	6.7	35	29.2
Less fertile	39	32.5	14	11.7	53	44.2
Non-fertile	14	11.7	18	15.0	32	26.7
Total	80	66.7	40	33.3	120	100.0
Chi-square			10.43			
P-value			.005			

Source : computed from survey data, 2019

In the study area, sample respondents ranked heavy rainfall with improper farming practice (cultivation of gentle and steep slopes with high soil disturbance) was the first (1^{st}) cause of soil erosion, intensive cultivation without fallow was the 2^{nd} cause of soil erosion, cultivation of steep slope was the 3^{rd} cause of soil erosion, overgrazing (free grazing of communal grazing land) was the 4^{th} causes of soil erosion, wind (wash away powdered soil and uncovered with crop residues at the time of dry land preparation season) was the 5^{th} cause of soil erosion and lack of ownership feeling was the last ranked cause of soil erosion among the respondents.

Table 16 Distribution of Sample Respondents by Cause of Soil Erosion

Cause of soil erosion	Frequency (n=120)						Mean	Rank
	1^{st}	2^{nd}	3^{rd}	4^{th}	5^{th}	6^{th}		
High rainfall	48	21	2	2	18	5	2.33	1^{st}
Intensive cultivation without fallow	16	32	33	7	6	2	2.59	2^{nd}
Cultivation of steeply slope	18	24	17	25	9	3	2.92	3^{rd}
Wind	7	2	13	16	15	39	4.60	5^{th}
Overgrazing	5	6	25	22	25	13	3.99	4^{th}
Lack of ownership feelings	1	8	6	25	19	33	4.70	6^{th}

Source : computed from survey data, 2019

4.1.4. INISTITUTIONAL FACTORS

4.1.4.1. Distribution of Sample of Respondents by Land Tenure

Land tenure security is important not only for the development of efficient land markets, but also for investment in land improvement (Dessalegn,1994). Land in the study area has been subject to periodic re-distribution with government substitution. The present government re-distributed the rural land in 1997 in the study area.

Farmer's perception to soil erosion and the measures they take will depend on their feelings of security of land tenure. According to the survey results indicated 78.6% of respondents feel secure and the rest 21.4% feel insecure tenure right**,** respectively. As the chi-square (27.46) test revealed that, the investors is feel secure on their land than non –investors. And this is significant at 1% level.

Table 17: Distribution of Sample of Respondents by Land Tenure

LANDTENURE (feeling of land tenure)	Adopter		Non- adopter		Total	
	Number	Percent	Number	percent	Number	Percent
Secure	73	62.4	19	16.2	92	78.6
Insecure	6	5.1	19	16.2	25	21.4
Total	79	67.5	38	32.5	117	100.0
Chi-square			27.46			
P-value			.000			

Source : computed from survey data, 2019

Share cropping, rent-in, rent -out with (different type of renting system), inherited from family and own land are the most common land holding arrangements. In addition, sharecropping and rent-in are important means of land acquisition for young and small farm holders in the study areas.

As population increase the only option for young farmers for acquisition of land is share cropping/ rent-in arrangement from their family members and other households. Land transaction (sharecropping and fixed rent) is widespread in the study area. Out of the 233.93 ha holdings of the sample farmers, 198 ha was cultivated in own plot and 26.8 ha was rented in and the rest 8.9 ha had rented out. From the focus group discussion it is understood that, it could be expected that land quality and expected yield of grains and straw may affect the terms of share cropping arrangements. However, if share cropping serves as a balance. Then land quality may not be

important determinant of share cropping arrangements in the study area. Although there are variations in sharecropping arrangement Erub (one fourth), Siso (one third), Ekul tamisho (two to three) and Gimash (one half), the modal appears to be towards equal share between the owner and the tenant. In sharecropping, Except labour the owner of the land is not required to contribute any input. Sharecropper *covers* all other required input costs. In most cases the reasons for *giving* land for sharecropping are disability (old age, women headed household) and lack of oxen whereas the reasons for sharecropper to take land in are shortage of land, interest to get more production, have excess labor and oxen.

Renting is based on direct cash payment when the term of payment is money and it is based on the fertility of the plot. There are three type of lease in the study area (i) transferring the land with fixed amount of money through long term renting that means using 25 years renting agreement (disguised selling). (ii) legal renting with fixed amount of money for fixed cropping years, and (iii) renting the land until the owner will repay his debt (mortgage) . The reasons for renting in land were almost the same as that of sharecropping. The management attention of renting and share cropping farmers was different from farmer to farmers based on the amount of their own plot holdings. Some farmers *gave* more attention for planting and weeding on his land than for share cropping/rent-in land. On the other hand some others *gave* more attention to sharecrop and rent-in land than his own due to shortage of farm land and being afraid of owner takeover if the sharecropper/ renter doesn't manage properly. However, farmers gave more attention to their own plots for the application of organic fertilizer and maintenance of soil and water conservation (Table 18). The chi- square test indicated that there is systematic relationship between the application organic fertilizer and plot ownership at 1*% level* of significance (X2=19.6).

Table 18: Distribution of Sample Respondents Use of Organic Fertilizer with Tenure Status

			Tenure Status		Total
			own plot	rented in	
Use of organic fertilizer	Yes	Count	61	7	68
		% of Total	54.4%	6.2%	60.5%
	No	Count	25	20	45
		% of Total	21.9%	17.5%	39.5%
	Total	Count	86	27	113
		% of Total	76.3%	23.7%	100.0%
Chi square			19.601		
p-value			.000		

Source : computed from survey data, 2019

The use of seed and ploughing were relatively the same for different plot ownership whereas the application inorganic fertilizer depends on the fertility of the plot. However, there is a significance relation between inorganic fertilizer application and plot ownership (Table 19).

Table 19: Distribution of Sample Respondent's Use of In-Organic Fertilizer with Tenure Status

			Tenure Status		Total
			own plot	rented in	
	yes	Count	80	19	99
		% of Total	70.80%	16.80%	87.60%
Use of in-organic	no	Count	8	6	14
fertilizer		% of Total	7.10%	5.30%	12.40%
	Total	Count	88	25	113
		% of Total	77.90%	22.10%	100.00%
Chi- square			10.867		
p-value			0.012		

Source: computed from survey data, 2019

4.1.4.2. Extension Service

Agricultural extension is of paramount importance to introduce better agricultural practices and improved technologies to small holder farmers in a country like Ethiopia where traditional practices are dominant. In the study area, like the other district of the region, the office of Agriculture through its technical experts and DAs at community *level* provides agricultural extension. The agricultural extension service in the study area mainly focused on providing basic agricultural education, teaching, and demonstration about the use of agricultural inputs, forestry development, soil conservation and livestock production aspects. The result indicated that 60.8% of the respondent had access to agricultural extension agents. The Agricultural Desk under department of Agricultural and Rural Development was the main government institution responsible for implementation, monitoring, and evaluation of the agricultural extension services at zonal *level.* It has a technical expert (SMS) both at the zonal and district *level* to provide technical assistance and trainings for DAs and supervisors. Development agents are responsible for the actual implementation at the extension program at grass root *level*. Extension service is provided by extension workers and to some extent by nongovernmental organizations. Three development agents were assigned at each kebele to give frequent and continuous technical support and advice. Almost all sample households of the survey had responded that development

agents been assigned, but most of them complained that they do not get sufficient agricultural extension services. However, the chi square test also shows there is a significant difference between households visited by extension agents and Investor of SAPs' status in the study area (Table 20).

Table 20: Distribution of Sample Respondents by Extension Services

EXTENSION	Adopter		Non- adopter		Total	
	Number	Percent	Number	percent	Number	Percent
Yes	54	45.0	19	15.8	73	60.8
No	26	21.7	21	17.5	47	39.2
Total	80	66.7	40	33.3	120	100.0
Chi-square			4.477			
P-value			.034			

Source: computed from survey data, 2019

4.1.5. Sustainable Agricultural Practices

4.1.5.1. Types and Common Agronomic Practices

Among the pillars of sustainable agricultural practices, and agronomic measures to defense erosion, both mixed and crop rotation is the prominent one. Mixed cropping is a task of planting the right mix of crops in the same field. Whereas intercropping is a practice of growing two or more crops at the same piece or land, similar to mixed cropping but the pattern is different. Compost can be prepared from cattle dung and manure and plant residues. On the other hand, fallow land is the best way to recover damaged soil fertility. These agronomic practices help the soil to fix nitrogen and increase soil fertility level. On the basis of this practice the sample respondents reported the following commonly implemented agronomic practice. 83.33% were practiced crop rotation, 82.5% were used inorganic fertilizer, 75.83% were practiced mixed cropping, 67.5% were use mulching, 64.17% were implement inter cropping, 59.17% were prepare and use compost, 45% were burn farm and 39.17% were allocate their farm plot for fallow land.

Table 21: Distribution of Sample Respondents by Agronomic Practices

Types of agronomic practice	Frequency (N=120)		% of share applied multiple components of SAP(Agronomic)
	Yes	no	
crop rotation	100	20	83.33
Inorganic fertilizer	99	21	82.5
Mixed Cropping	91	29	75.83
Mulching	81	39	67.5
Inter cropping	77	43	64.17
Compost	71	49	59.17
Burn farm	54	66	45
Fallow land	47	73	39.17

Source: computed from survey data, 2019

Crop rotation is a key component of sustainable agricultural practices because it improves the soil structure and fertility, and it helps to control weeds, pests and diseases that have soundly been practiced in both kebeles. Despite of this, sample respondent farmers had been practicing crop rotation, the sequence of practice is still in question. This is due to, as Gimbo woreda agriculture office experts explained, farmers had been practicing crop rotation is not properly done in exchange of crops season, type of crop and terms of exchange. .According to Ministry of Agriculture of Ethiopia guide line, at maximum one cereal crop can be grown for two cropping season consecutively yet in third season it must be replaced or changed by either pulses or oil seed crops. Among sample respondents experienced in crop rotation,62.5% were rotate cereal to cereal, 19.2% cereal to legume cropping and the remaining 18.3% were practicing leguminous to cereal cropping in the survey year 2019.

Table 22: Distribution of Sample Respondents by Crop Rotation Sequence

Crop rotation sequence	% share
Cereal after cereal cropping	62.5
cereal after legume cropping	19.2
legume after cereal cropping	18.3

Source: computed from survey data, 2019

4.1.5.2. Conservation Tillage Practice

Conservation tillage (includes, Zero tillage / minimum tillage), along with other soil conservation practices is a corner stone of SAPs' can be practiced by small holder farmers. Minimum tillage seems a plateau and feels in convenience for farmers as compared other components of SAPs' in the study area. They had been practicing minimum tillage selectively on the basis of type of crop, especially for leguminous crops. As it has been presented in the Table 23, 50.8% had been practicing minimum tillage in their plot; whereas the 49.2% had not been practicing in their plot. Out of the total sample respondent (61) had been observing changes in crop productivity; 37.7% bring increment, 9.8% decrement, 14.8% no change and 36.1% were said do not know the changes brought in crop productivity.

Table 23: Distribution of Sample Respondent by Experience in Minimum Tillage

Minimum tillage practice		Frequency	Percent	Change observed in crop productivity after MT		
				Change	Frequency	Percent
Valid	Yes	61	50.8	Increased	23	37.7
	No	59	49.2	Decreased	6	9.8
	Total	120	100.0	The same	9	14.8
				Do not Know	22	36.1
				Total	61	100.0

Source: computed from survey data, 2019

However, conservation tillage instrument not known by most farmers other than local moldboard named / *Maresha/* in the study area. Those farmers inherent from their parents or spent a decade's plowing instrument is Maresha. Among sample farmers had not been practicing minimum tillage reasons indicated that 25.42% reduce immediate crop produce, 22.03 % difficult to control weed, 10.17% because insect-pest outbreak, 13.56% because of labor

shortage, 16.95% land shortage and 11.86% because of other reasons (the land provider may cancel the sharecropping agreement). Farmers put these reasons in order; reduce productivity, difficult of control weed, others (cost of technology), land shortage, labour shortage, and in sect-pest outbreak. These factors either individually or interdependently impede farmers from implementing minimum tillage in their plot in the study area.

Table 24: Reasons for not Practicing Minimum Tillage

Reasons not practicing minimum tillage	Not practiced(59)		Rank
	Frequency	Percent	
Reduce productivity	15	25.42	1st
difficulty of control weed	13	22.03	2nd
Insect-pest outbreak	6	10.17	6th
Labour-shortage	8	13.56	4th
Land- short age	10	16.95	3rd
Other	7	11.86	5th
Total	59	100.0	

Source: computed from survey data, 2019

4.1.5.3. Soil and Water Conservation Practices

In the study area, both traditional and improved soil management and soil conservation measures practiced, include trench, grass vegetation (water logging plot), broad bed maker (88M), check dams, compost making, manure use, mulching & crop residues, traditional diversion ditch, terracing and soil bund were implemented by farmers and high run off prone plot Trenches are constructed inside the plot to harvest water as reserve for crops grown with shortage of rainfall in dry lands. Sasbanean and Desho grass(a grass which is used for soil and water conservation in addition it is used for cattle fodder) are planted for multipurpose in water logging farm lands, 813M is also used to as ditch tied with local ploughing instrument *maresha* to form soil bed during plowing time. According to reports of Gimbo district Agriculture office, during the previous four consecutive years (2015-2018); about 11977.75 ha terrace of which 3216.9 were maintained, 636 km covered diversion ditch made of which only 29.5 km maintained ,50.445 km trench constructed of which 7.55 km maintained and 478.45km mask broad bed maker (BBM) were done.

Table 25: Soil and Water Conservation (SWC) majors done in the past four years

Year	Terrace (ha)	maintained	Diversion ditch (Km)	Maintained	Trench (Km)	maintained	BBM (KM)
2015	1137.5	1389.2	234	-	9	-	125.0
2016	120.0	380.0	108	-	3	4.6	91.8
2017	127.0	321.0	156	-	9.25	3.0	125.5
2018	10593.3	1126.8	138	29.5	29.4	-	136.3
Total	11977.8	3216.9	636	29.5	50.6	7.6	478.5

Source: Gimbo district agriculture office, 2019

As the information obtained from focus group discussion held with Gimbo district agriculture office experts explained, the previously constructed SWC structures are destructed. The main responsible causes of destruction were shortage of farm land, expected reconstruction by government, poor quality during construction, difficulty in turning oxen, places of rodents and others like not fenced.

4.1.5.4. Agriculture Production

Major Crops Produced and Comparison with Investment Decisions

As survey result (Table26) revealed that in average sample respondents produce crop 38.6% maize, 14.71% coffee, 11.76% boleke, 10.29% bean and 9.93% teff and millet produced in different plot (Table 26).

Table 26: Major types of Crop Produced in the Study Area

Types of crop	% share
Maize	38.60
Teff	9.93
Fava Bean	10.29
Pea	4.78
Haricot Bean	11.76
Coffee	14.71
Millet	9.93

Source: computed from survey data, 2019

Based on the survey result, the amount of production had been changing due to implementing of SAPs' before the last 2years from 2017/18. As it is indicated in (Table 27),56.3% and 32.8% of investor and non-investor respectively have gained from 1-50 quintal of total production. This

indicated that, investors have gained an average of 36.11 quintal of total crop production. Whereas, non-investors have gained an average of 12.99 quintal of total crop production. The independent t- test was used to check whether there is significant mean difference between non-investors with that of investors. As the results of t-test indicated that there is significant mean difference between non-investors and investors in crop production at 1% probability level. Hence, this tells investment of multiple SAPs'.

Table 27 : Mean Comparison of Total Production and Adoption of SAP's

Total production(Quintal)	Adopter		Non- adopter		Total	
	Number	Percent	Number	Percent	Number	Percent
1-50	67	56.3	39	32.8	106	89.1
51-100	11	9.2	-	-	11	9.2
101-50	1	0.8	-	-	1	0.8
>151	1	0.8	-	-	1	0.8
Total	38	32.8	80	67.2	119	100.0
Mean	36.11		12.99		28.5	
Maximum	204		24		204	
Minimum	5.4		4.30		4.30	
SD	27.8		5.4		25.4	
T-value			7.157			
P-value			.000			

Source: computed from survey data, 2019

4.2. Econometric Result and Discussion

Binary logit model was used to identify potential variables determine farmers adoption decision on sustainable agricultural practices or sustainable agricultural land management practices. Multi-collinearity diagnostics test was done to check the presence of high collinearity among and between each independent variable. Different methods were employed to check the presence of multicollinearity for continuous and discrete explanatory variables. Variance inflating factor (VIF) was used to check for multicollinearity problem among and between continuous variables. For categorical variables coefficient of contingency (CC) was computed using SPSS software. For this case, based on the results of the diagnostic tests for both discrete and continuous

variables, no variable was found to be highly correlated or associated with one or more of other variables (Appendix Table 2 and 3).

Thirteen variables were hypothesized to influence farmers' decision to invest on SAPs' and all variables entered to the model. Out of the variables analyzed, the coefficients of 6 variables, namely educational level, soil fertility, walking distance, farm size, slope of plot and livestock owned were significantly different from zero and found to be significant to affect the adoption on SAPs' of the households in the study area.

The maximum likelihood estimates of the binary logit model result shows that the household adoption in SAPs' is determined by the interaction of several potential plot characteristics factors.

To check measure of goodness of fit in logistic regression analysis, the likelihood ratio test (LR) that follows chi-square distribution with degree of freedom (OF) equal to number of explanatory variables included in the model (Gujarat, 2003). Accordingly, the chi-square computed shows that, the model was significant at 1% significance level. This indicates that the null hypothesis

Stating the coefficients of explanatory variables less the intercept are equal to zero was rejected and the alternative hypothesis of non- zero slope was accepted. Another comparatively simple measure of goodness of fit was the count R^2obtained by dividing the model chi-square by the original -2LL. In this regard the count R^2 was calculated to be 81% (120.143 divided by 148.933) that indicate the model correctly predicts the observed values (Appendix table:1).

Result and Discussion on the Significant Explanatory Variables

Table 28: Result of binary logit model

Explanatory variables	Coeff.	Odd Ratio	S.E.	Wald	Sig.
SEXHH	1.397	0.802	1.521	.843	.359
AGEHH	.100	0.525	.066	2.315	.128
RKA	-4.399	0.012	4.313	1.040	.308
EDULEVEL	1.742	0.851	.740	5.538	.019**
SOILFS	1.686	0.844	.736	5.248	.022**
PLOTDISTANCE	-.048	0.488	.028	2.943	.086*
FARMSIZE	3.226	0.962	1.211	7.099	.008***
SLOPEPLOT	1.452	0.810	.639	5.158	.023**
TOTALLIVESTOCK	.308	0.576	.153	4.035	.045**
LABORSHORTAGE	2.671	0.935	1.645	2.638	.104
EXTENSIONSERVI	-1.126	0.245	1.233	.835	.361
NUMBEROFPLOT	1.274	0.781	.788	2.618	.106
LANDTENURE	-1.162	0.238	1.678	.479	.489
Constant	-24.390	.000	11.928	4.181	.041

Source : own survey, 2019

Education Status: Educational level of the farmers and farmers' decision to adopt in SAPs' was found significant and positive relationship. This positive and significant relation implies that the more educated farmers are more likely to make a decision toadopt in SAPs' than their counterparts with low level of education attainment. All other things held constant, the odds ratio suggests that the more educated farmers have the probability of 0.851 more likely to adopt in SAP's than the farmers who are less educated. The justification of this finding was that education influences farmers' decision to adopt technologies by enhancing farmers' ability to obtain, understand and utilize the practice, and by improving overall managerial ability of farmers. This finding is also in line with (Shitaye,2015) were found the significant contribute of education on the SAP's. On her findings conducted at Dawero Zone,Maraka woreda, SNNPRS, the lowest level of educational status has a negative and significant effect on the status of farm land management practices on the study area.

Soil Fertility Status: This variable was significant at 5% significant level and positively affect adoption investment decision in the study area. This implies that, assuming other things constant, as the soil fertility status increase by one unit the probability of the farmer's decision to adopt on SAPs' is increase by 0.844 and the reverse is true. This is due to major factors that are; by applying crop rotation, by using inorganic fertilizer and by practicing mixed cropping. This finding is also in line with and supported by other previous studies (Bekele1998). He found and reported that, soil fertility status has positive effect on farmers' adoption decision.

Plot Distance from the Residence: This variable was significant at 10% significant level and negatively affects adoption of farmers. This implies that, the remaining things the same, as the distance or the plot to the resident increases by one minute the probability of farmers adopting SAPs' on his/her plot is likely decrease by 0.488 as compared to non- adopter farmers. The farm found at far distant may not be frequently getting visited, difficult to transport compost and manure and overall management. This finding is consistent with previous studies (Shitaye,2015). On her findings conducted at Dawero Zone,Maraka woreda, SNNPRS, She found and reported that the mean distance of farm plot from the home stead had a significant effect to adopting on farm land management practices in the study area. Farmers managed better the nearer plot than distance plot to the close observation of changes on nearer plot as well as the additional time and labour required to reach distant plot.

Farm Size: Total farm size of the households was found to have significant relation with the adopter in SAPs'. Hence, there is sufficient evidences to reject the null hypothesis and can be concluded that farmers having large farm size are more likely to become adopter in SAP's than smaller farm size. Similarly, the model result indicated that, as the farmers farm size increase by one unit, the probability of the farmer's decision to adopt SAPs' is increase by a factor of 0.962 and the reverse is true. Therefore, in the study area large landholders are more sensitive to SAP's than those farmers who have small farm size. This finding is also in line with (Tadele,2016) were found that farmers with large farm sizes can implement different SAP's at relatively lower level of impact compared to farmers with small sized farm lands .On his her findings conducted at Bale Eco- Region, South Western, Ethiopia.

Slope of the plots: This variable was significant at 5% probability level and positively affects the adoption of farmers. This implies that, the remaining things held constant, as the slope of the plot increases by a unit the probability of the farmer become adopting on among multiple

components SAPs' increases. As slope of the plot increase by one unit the probability respondent farmer to become adopting in SAP's by 0.81 as compared to non- adopters. This is in consistent with other studies(Menale and precious et al.,2010) conducted at Semi- Arid Region of Ethiopia. In their findings, the household Farmers choosing to practices conservation tillage declined within increase in slope of the plot.

Livestock owned: Livestock had a significant at 5% probability level and positively affect the household adoption of SAPs in the study area. The positive sign of coefficient indicates that when livestock owned increase by one unit, the probability of a household to become adopter of SAPs', also increase by a factor of 0.576.The possible explanation for this result is that as farmers have large number of livestock (Ox, Cow, Heifer, Calf, Donkey, Goat, Sheep and Chicken) they become in high position to be adopter than farmers who have few livestock. However, livestock holding is not consistent with (ILRI, 2003, Haimanot,2014) finding, which stated, livestock holding is negative related to adoption in SAPs'.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1. Conclusion

This research was designed with the objectives of identifying which types of SAPs' that the farmers' are commonly implement and assess the factors that influence farmers to adopt in different agricultural land management practice (SAPs') in Gimbo district area on Kutti and Tulla kebeles. Despite Agriculture is the leading sector, in the Ethiopian economy, was and still is characterized by low productivity in general and low yield per unit area in particular. Many people attribute the problem with population explosion, immense environmental degradation, limited accessibility and use of technology, insufficient infrastructure, poor traditional practices and ill-thought-out polices.

This outdated and tied with bottlenecks, agricultural sector manifested by coupled with population growth at a faster rate, soil fertility depletion and decrease of crop yield, motivate to adopt multiple sustainable agriculture practices which is agricultural- environmental management at short term or long term will be taken as a panacea.

This study has attempted to look personal factors, socio-economic, plot characteristics and institutional factors, which can influence farmers', decision of investment in SAPs' components. For this, data were collected from 120 farm households drawn randomly by considering purposive inclusion of female headed households from Gimbo district on kutti and Tulla kebeles. The primary data were collected from questionnaire and focus group discussion. Secondary data were collected from Gimbo district agriculture office to supplement the data obtained from survey. Thirteen variables were hypothesized to determine farmers' decision to adoption in SAPs'.

Evidences from descriptive analysis indicated that adopter farmers having more age, being male, better educational status, participated in kebele or village administration , own greater size of farm land, feel secure on their land, minimum distance between the residence and plot, less fertile soil, own moderately steep slope plot, own more number of plots, own more number of livestock and better accessed extension services, on the other hand, non- adopter farmers were affected by those cited variables.

Meanwhile, majority of the farmers in the study area were implemented crop rotation practice of SAP's. This is due to the fact that, it helps them in improving the soil structure and fertility, and control weeds, pests and diseases.

The results of binary logit model analysis indicated that six variables were significantly affecting the farmers' decision to become adopter in SAPs'. Out of which, one variables at ($p<O.01$),four variables ($p<O.05$) and one variable at ($p<O.1$) were found to significantly influence farmers adoption on SAPs'.

Educational status was found to positive and significant impact on farmers decision of adoption in SAPs' at (5%) level of significance implying that farmers who have a better educational status have more information on new agricultural technologies and increase them to be investors.

Farm size was found positively affect the farmer decision to become adopter at 1%. As, the number of farm land increase, farmers found adopter in SAPs increases. Soil fertility status was positive and significant to affect farmers decision on adoption of SAPs' at ($p <0.05$) level of significant and associated with, as soil fertility level changes from less fertile to fertile farmers to be found adopter would be increases. Distance from home to the plot was negative and significant impact at ($p <0.1$) level of significant that indicated as the distance from resident to plot increases, farmers to be found adopter of SAPs' decreases, This means too much nearby and backyard plot is more advantageous to accept and implement SAPs' components: such as transporting compost and cover soil, to make proper crop residue management and top land cover crops and to integrate with soil and water conservation measures.

Total livestock owned was positive and significant to affect adoption of SAPs' at ($p<O.05$) level of significant implying that as farmers own more number of livestock, farmers decision to be found adopter of SAPs' increase. Slope of the plot was found to affect adoption of SAPs' positively and significant at 5% probability *level.*

5.2. RECOMMENDATIONS

Some implications for this study were found to be relevant. Promoting the adoption of sustainable agriculture practices or sustainable agricultural land management practices is important for smallholder farmers for sustainable development of Agricultural Sector through expanding environmental health practices which needs cooperation and integration work by various stake holders especially farmers, development workers, experts, researchers and political leaders.

Sustainable Agricultural Practices have multiple components which require knowledge, skill, attitudinal and behavioral change and management help to save land from degradation. This finding indicated that farmers generate knowledge continuously and shared among them.

However, they are not well adopt in sustainable agricultural technology and sustainable land management practices. Therefore, researchers and extension staffs need to continuously keep in touch with these farmers for further research to address the issues need to resolve.

1. Results of this study indicated that the farm size has significantly affects to adopt sustainable agricultural practices. The result shows that sustainable agriculture components is more likely to be adopted by farmers with crop land suggesting research, extension and planning agencies to be sensitive to the needs of smallholder farmers through developing and disseminating technologies and strategies that are relevant to their needs as well as creating awareness on wood land and grazing land management benefits.

2. It was found that total livestock holding has significant and positive influence to adopt in Sustainable Agricultural practices. According to the findings farmers who have more livestock unit are motivated to invest in SAPs'. The regarding body should offer training for farmers on how to balance livestock with own plot of land and better able to use their manure for land appreciation, because of their cattle needs more grazing land, crop residue (straw) and the farmers who have more livestock difficulty for management..

Generally, it may have other factor more influence on farmers adoption decision. This suggesting that other unspoken factors such as income and return might explain observed differential adoption. Further research on win- win approach relative benefits gain from implementation sustainable agriculture in short term and long term over conventional farming, locally flexible and adaptable, changes in yield, selective and appropriate for the type of agro ecology and soil type, environmentally healthy practices should get attention.

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APPINDIXES

Omnibus Tests of Model Coefficients

	Chi-square	df	Sig.
Step	120.413	13	.000
Block	120.413	13	.000
Model	120.413	13	.000

Appindex Table 1: Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	28.520[a]	.652	.894

Collinearity diagnosis

1. **Continuous variable**

Appendix Table2:value of VIF for continues variables , which were used in Binery logit

Model	**VIF**
Age of household	1.323
walking distance from home to farm in minutes	1.214
Total landholding size of the household in ha	1.498
Total livestock of the land	1.395
NUMBEROFPLOT	1.602

1. Appendix table3: contingency coefficient for discrete variables used in Binary logit

		Sex of the household	Role in kebele administration	Educational level	Soil fertility status	Slope of the plot	Labor availability	extension service	Land tenure
Sex of the household	Pearson Correlation	1	-.123	-.016	-.116	-.093	.025	.002	-.005
	N	120	120	120	120	120	120	120	117
Role in kebele administration	Pearson Correlation	-.123	1	-.108	.042	-.093	-.014	-.158	.128
	N	120	120	120	120	120	120	120	117
Educational level	Pearson Correlation	-.016	-.108	1	-.017	.132	.033	-.069	-.110
	N	120	120	120	120	120	120	120	117
Soil fertility status	Pearson Correlation	-.116	.042	-.017	1	-.024	-.099	-.139	-.044
	N	120	120	120	120	120	120	120	117
Slope of the plot	Pearson Correlation	-.093	-.093	.132	-.024	1	.087	-.016	.046
	N	120	120	120	120	120	120	120	117
Labor availability	Pearson Correlation	.025	-.014	.033	-.099	.087	1	-.133	.079
	N	120	120	120	120	120	120	120	117
extension service	Pearson Correlation	.002	-.158	-.069	-.139	-.016	-.133	1	.117
	N	120	120	120	120	120	120	120	117
Land tenure	Pearson Correlation	-.005	.128	-.110	-.044	.046	.079	.117	1
	N	117	117	117	117	117	117	117	117

General and personal information of the respondent

1.1 Respondents number ----- date(----------) respondent's Name ----------

1.2 Sex: 0 =female, 1 =male

1.3 ` Age ---------- Years

1.4 Marital status 1. Married, 2 single,3 divorced, 4 widow/widower,5 others

1.5 Role in kebelie Administration 1. Yes 2. No

1.6 Position in the peasant association ------- village --------woreda/distict/ -----zone -----Region enumerator Name ----------signature ------1st checked ----------date ----------

1.7 Educational level:

1. =Read and write, 2= Grade 1-4, 3=Grade 5-8, 4 =Grade 9-10, 5= above grade 10

1.9 information of family members

family size (number)	Age category	number	Sex	
			Male number	Female number
	1-7			
	8-15			
	16-29			
	30-45			
	45 and above			

1.9.1 educational level of the family member

Educational level	Number of family member
Read and write	
Grade 1-4	
Grade 5-8	
Grade 9-10	
above grade 10	

1.9.2 Major occupation of family member

Major occupation	Number of family member
Dependent	

student (at school)	
house wife	
farming	
hire labour	
off farm activity	
other	

2. Farm characteristics (land holding use and land tenure)

2.1 In which farm actives you/your family involve ? 1. On farm 2. Non farm 3. Off farm 4. Other specify ----------

2.2 What is the reason you go to off-farm activities?

2.3 Why you your family involve in none – farm activity ?

No	Type farm activity	Plot number	Area timed /ha	Tenure status (A)	Soil fertility status (B)	If rented in/out arrangement (C)	Walking distance from home (min/he/km)

A Tenure status: 1 own plot (received from PA) 2-=rented in 3= rented out 4= gift 5= other –----------

B. soil fertility status: 1= highly manure, 2= very fertile ,3- moderately fertile, 4 = infertile

C specific lease arrangement: 1. = cash (amount /plot) 2= shared cropped-equal 3= shared cropped (1/3 to plot owner)_ 4= shared cropped (1/4 to plot owner 5= other ----------

Type of land use :1 cultivated land 2) fallow land 3) grazing land 4 homestead land 5) other

2.4 farming Experience(for how many years) of the household head ----------years

2.5 total landholding size of the household in (ha):

A farm land ---------ha b/ forest land -------hac/ grazing land ---------ha d others---ha

2.6 for whom do you think that the land belongs? (1) to myself (2) to the government

2.7 if you say land is belongs to the government do you feel secured the ownership of the plot? (1) Yes 2. No

2.8 do you know the right to inherit the entire plot to your children? (1) Yes , 2) No

2.9 do you expect that you will use all the land throughout your life time? (1) yes (2) No

2.10 do you agree if the government allows the farmers to sell their land (1) Agree (2) disagree (3) difficult to decide

2.11 do you believe land tenure right has anything to do with land management/farming practice? (1) (Yes) (2) No (3) No comment

2.12 if yes how?----------

3. Plot characteristics

3.1 Slope of the plot 1) flat 2 gentle 3/ moderate steep slope 4 steep slops 5/ Mountains

3.2 type of soil 1) sandy 2/ clay 3/ loam/silt 4/ other (specify)

3.3 color of soil 1/ Red 2/ Balk 3/ Brown

3.4 Is there any form of soil erosion occurred on your plot for the last five years? 1 /Yes 2/ No

3.5 If yes what is its severity level:1) low 2/ medium 3) high?

3.6 land degradation status: 1) non-degraded 2) slightly degraded 3) moderately degraded 4) severely degraded

3.7 have you practiced any soil and water conservation (SWC) measures? 1. Yes 2. NO

3.8 If No why? (1) No erosion problem (2) shortage of labor (3) Have doubt no method of conservation (4) No needs of SWC (5) any other please specify

3.9 If yes which type if SWC measures you practiced? 1. Improved 2. Traditional

3.10 did you perceive the presence of soil nutrient depletion? (1) Yes (2) No

3.11 If yes in 3.4 what is the major case of nutrient depletion (rank)? (1) Intensive cultivation (2) Absent or low inorganic fertilizer application 3) absence of fallow 4) low or absence of organic fertilizer application 5 absence of crop rotation 6) any other, please specify

3.12 What are the major causes of soil erosion on your all plot(give rank)? 1) heavy rainfall , 2) cultivation of steeper slopes 3). Intensive cultivation with out fallow 4) wind 5) over grazing 6) lack of sense of owner ship 7) other specify----------

3.13 what do you think the consequences of soil erosion (rank)?

(1) Decrease Land productivity (yield) (2) change on type of crops grown 3) land preparation becomes difficult 4) reduced farm size 5) poverty 6) land become out of cultivation 7) Migration 8) if other, please specify ----------

3.14 did you believe that investment in the soil consecration practices is profitable in the long run? (1) Yes (2) NO

4. Crop production and productivity

4.1 How can you explain crop grown and productivity and practices used during the 2017/2018G.C (2010/2011 E.C? 1. increased 2 decreased 3 Remained the same 4. No . comment 5. Other please specify ----------

Plot No	Areas(ha)	Crops grown	Variety used 1= improved 2= local	Land preparation		Herbicide use	Production Kg/Qt
				Method of plowing 1= pair Oxen 2= hand Hoeing 3= other	Frequency	1= Yes 2= No	
1							
2							
3							

4							
5							

4.3 for which crop did you apply organic fertilizer more? (1) --- (2)---- (3) ---- (4)----

4.4 Experience in improving soil fertility culturally in all? (1) soil burning (2) mulching (3) compost manure (4) Green Manuring (5) Crop rotation (6) fallow

(7) Fertilizer (8) any other, please specify ----------

4.5 do you have been heard about sustainable agricultural practices (SAP's)?

4.6 did you have an experience in investment of SAPs? 1, yes 2, no

4.7 How may years you been practicing?----------

4.8 Are you practicing crop rotation 1 Yes, 2 NO

4.9 If you use crop rotation, Specify the rotation sequence and the crops used ---------

4.10 what changes you observe in terns of soil fertility while practicing Gropes rotation

4.11 what changes you observe in terms of soil fertility while practicing Grop rotation? ------

4.12 for how many years practiced it?----------

4.13 Do you used inorganic fertilizer (Urea, DAP) in the last two years ? 1) yes , 2) No

4.14 Did you use it as per the recommendation? 1)yes, 2) No

4.15 Trends in inorganic fertiliter application? (1) increased(2) Decreased

(3) Remain the same (4) No comment

4.16 If the answer for question 4.13 is no what are the factors that affect your fertilizer use?

(1) shortage of supply (2) High cost of fertilizer (3) Transportation problem (4) Low prices of grains (5) Lack of credit (6) Other specify ----------

4.17 How do you access it 1. From GO in terms of subsidy 2. Purchasing in cash 3. Credit basis from kebele 4, credit basis from cooperatives

4.19 How do you compare crop productivity after application of fertilizer?

(1) Increased (2) Decreased (3) remain the same (4) No comment

4.20 How many times you plow your farm before sow seed? 1. Tow 2. Three 3. Four 4. More than four times

4.21 What do you perceive about conservation tillage/minimum tillage. Change brought on crop production

4.22 do you apply in your farm conservation tillage? 1, yes 2, no

4.23 How do explain crop productivity before and after practiced minimum tillage? 1. Increased 2. Decreased 3. The same 4. do not know 5. Others----------

4.24 If your answer is no in 4.22 why? ----------

4.25 Does minimum tillage technology costly? 1. Yes 2. No 3. Do not know

Plot/ ha	Types of crop	Nt/ Mt	Fertilizer 1= DAP 2= Urea 3= other	Labor 1.Save 2.consume 3.No Comment	Herbicide/pesticide 1.Yes 2. No 3. other	Soil fertility 1.Increase 2. decrease 3.Remain the same 4. Don't know	Compost 1. Yes 2. No	Yield of crop in 2016/17	Yield of crop in 2017/ 18

No tillage/ minimum tillage technologies. 1. Hand hoeing 2. Animal draught 3. Knife roller 4. Hand tractor 5. Jap planter 6. Other

4.26 do you use mixed cropping (two or more type of crops) for improving soil fertility?

(1) Yes (2) No

4.27 do you have burnt crop residue (straw) in last two years? 1. Yes 2. No

4.28 If your answer is yes. What was your reason you reach to the decision to burn?

1. to avoid weed 2. To control pest 3. To make plow easy 4. Other (Specify)

4.29 Are you practicing intercropping? 1. Yes 2. No

4.30 If your answer is yes. For how many years you practice?

4.31 Are you mulching your farm land by crop residues or mowed wweeds? 1. Yes 2. No kind

4.32 what is the materials you used for mulching in the last two years 1) mulching by compost 2) mulching by straw 3) mulching by crop residues 4) Others

4.33What did/do you observe from practicing mulching/crop plantation 1) increased crop productivity 2) increased soil fertility 3) minimize soil erosion 4) save labour 5/ reduce weed occurrence 6) reduce cost of draught power 7) others

5. Livestock ownership

Livestock	Category	Local (number)	Improved/number	

Cows				
Oxen				
Heifers				
Calves				
Bulls				
Goats				
Sheep				
Poultry				
Donkey				
Horse				
Mule				
Other				

5.1 Problem related to livestock husbandry (1) Shortage in grazing land (2) disease (3) shortage in feed (4) barn (5) water (6) supplementary feed (7) clinic (8) shepherded/guard

5.2 do you have pasturelands? (1) Yes (2) No

5.3 do you have enough pastureland? (1) Yes (2) No

5.4 did you graze your pastureland by rotation? (1) Yes (2) No

5.5 do you use crop residues as main feed since five years back? 1.Yes 2.No

5.6 Type feed; (1) Grazing (2) Hay (3) straw(4) Maize and sorghum hola (5) Atela (6) cut and carry (7) any other please specify ----------

5.7 source of feed; (1) communal grazing land (2) fallow (3) crop product (4) purchasing (5) from (6) any other ------

5.8 In general for what purpose did you use cow dung (rank)? (1) fuel (2) soil fertility

(3) for sell in form of kubet (4) No used yes

5.9 which mother of cow dung more used for fuel?----------

5.10 Do you prepare compost? (1) Yes (2) No

5.11 If question number 5.1 yes ,what is your reason? ----------

6. Labor availability

6.1 Do you have labor shortage for your farm activates? (1) yes 2) No

6.2 If you say yes which activities are most affected by labor shortage?

1= land preparation (plowing) 2= planting (showing) 3= weeding 4= harvesting 5= in all time 6= in planting and harvesting 7= others

6.3 If the answer to question to 6.1 is yes, how do you solve labour shortage? (1) Hiring labour (2) by cooperating with other farmers (Debo/jigie) (3) other please ,specify -----

6.4 what is the average perdiem during 2017/20018 cropping season? 1) in kind 2) in cash

6.5 Can you easily get labour whenever you need? (1) yes (2) No ---------

6.6 In which farming activates female family members participate? 1= land preparation (plowing 2= planting (sowing) 3 weeding 4= harvesting 5= garden work 6= other

6.7 During which age range farmers work full time farm job? ----------

7. Agrochemicals

7.1 do you use herbicide 1= yes 2= No

7.2 If you say yes what are names of herbicides you frequently use? 1) round up 2(2-4 D , 3) others

7.3 If you say no justify your reasons why you are not using? ----------

7.4 Is there insct -pest out break encounter in grass-crop productive in your lot or local area?

7.5 Do you use pesticide? 1. Yes 2. NO

7.6 What is the name of pesticide you use? ----------

8.Institutional factor

8.1 did you extension service? (1) Yes (2) No

8.2 If yes who provides the extension service (1) development agent (DAS) (2) NGOs (3) Any other please specify

8.3 what the extension agent taught you (rank)? (1) input supply and use (2) improved cultural practice (3) soil and water conservation (4) land management practice (5) water harvest (6) Animal husbandry (7) agro-forestry (8) others specify

8.4 How often have you obtained extinction advice on the problem and solution of land degradation (1) Once per month (2) twice per moth (3) three times per moth (4) once per three moth (5) twice per three month (6) any other please specify –

8.5 during which farm operation extension agent visit you ? 1= Land preparation 2= during input profusion 3. During sowing 4.during herbicide application. S= during credit collection 6= 2nad 4 , 7= other (specify if any)

8.6 Did you get training about minimum tillage?)1) yes 2) No

8.7 if you say yes from whom/which source? 1= ministry of agriculture 2= DA 3=media (radio television brochure), 4, others

8.8 what is the length of time since you first heard about conservation agriculture ---years?

8.9 do you have practiced conservation agriculture? 1= Yes full 2. Yes partially 3. Not total

8.10 If you say yes, for how many years practiced conservation agriculture in your farm years?

8.11 what changes you have observed in fertility of soil crop productivity and moisture holding?

Plot in ha	Type of crop grow	Herbicide 1. User 2. Otherwise	Fertilizer	Produces before adoption of CA in kg/quintal	Produces after adoption of CA in/kg quintal

8.12 If you say no what/is your reason? ----------

8.13 From whom/which source you obtain training? 1 MOA 2/ DA 3/ IPMS 4 Others (specify)

8.14From how many years have you practiced CT technology in your farm?

8.15 Have you ever participated in field days/ visits prepared on CT technology practices in the last five years? 1= yes 2. No

8.16If yes, how many times in number ----------

8.17 who arranged for you? 1= distinct rural development 2= NGO 3= other specify -----

8.18 Indicate your access to and frequency of yes of the following media?

9. Credit sources and availability

9.1 do you receive credits for your farming activities during this cropping season? 1 yes 2. No

9.2 did you use credit for your farming activity? (1) yes (2) No

9.3 for what purpose did you ask credit? (1) to purchase fertilizer (2) to purchase Improved seed (3) for sheep production and fattening (4) oxen fattening (5) any other specify ----

9.4 When did you repay credit? (1) any time (2) at the time of time of harvest season (3) at the end of the budget year (4) based on the credit type

9.5 If no, what matter you ,not use credit? (1) source of credit (2) interest rate (3) absence of collateral (4) distance (5) term of agreement

(6) No credit for this purpose (7) any other please specify.

Marketing information

10.1 From where do you get marketing information?

10.2 what is the distance of the local market from your house (walking minute)?

10.3n what is the distance of the main market from your house (walking minute)?

11 Awareness attitudes and perception of farmers

11.1 Do you know the existing differences among conservation practices 1. Yes 2. No

11.2 If yes mention some of them----------

11.3 which of sustainable agriculture; practices most suit your interest? List in order of importance? 1. Minimum tillage 2. Compost use and/plantation of cover crops 3. Mixed legume cropping and /crop rotation/ intercropping

11.4 Could you have the point to mention about the disadvantage of sustainable agricultural practice? ----------

11.5 If farmer decides to use the conservation technologies/practices? (mark if answer is given)

1. Observed the benefits other farmers obtained from using the technology
2. Persuaded by other farmers
3. Persuaded by change agents
4. persuaded by other specify

11.6 what potential problems one will face under practicing conservation technology?

1. Technology problems
2. Know how
3. Others.

DECLARATION

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Date: --------/------/-------

ENDORESEMENT

THIS THESIS HAS BEEN SUBMITTED TO ST.MARY'S UNIVERSITY, SCHOOL OF GRADUATE STUDIES FOR EXAMINATION WITH MY APPROVAL AS A UNIVERSITY ADVISOR.

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