Sustainable Land Management in Ethiopia: Response to Rural Households' Tenure Insecurity, Land Degradation and Food Insecurity

BICHAYE TESFAYE TESSEMA

Enschede, The Netherlands

February ,2019

Ph.D. proposal submitted to the Department of Urban and Regional Planning and Geo-Information Management of the Faculty of Geo-Information Science and Earth Observation, University of Twente.

PROMOTER (ITC-PGM)

Prof.mr. dr. ir. J.A. Zevenbergen

DAILY SUPERVISOR (ITC-PGM)

Dr.M.N.Lengoiboni

CO-PROMOTER (CDS-AAU)

Dr. Belay Simane

ABSTRACT

Agricultural land is a scarce resource in Ethiopian highlands. Contrary to this fact, Its sustainability is highly threatened by many intertwined problems. Amongst are Tenure insecurity, land degradation, and food insecurity. These problems are the result of many interdependent environmental, social, institutional and economic factors. Comprising 16 woredas, Beshilo sub-basin is found in Amhara regional state of Ethiopia. It is one of the sub-basin of the Blue Nile basin known for high prevalence of land degradation and food insecurity. In the sub-basin, a huge volume of soil, water, and forest resource will be degraded annually, resulting in soil nutrient depletion, poor agricultural productivity and thus food insecurity. Land tenure security is entirely hurdled by poor certification program, and it is now at a preliminary stage.The problems have exposed a large number of people to famine, migration, and destitution.Considering these deep-rooted problems, the Ethiopia government has intervened with the Sustainable Land Management (SLM) project to reduce the negative consequences of the above-mentioned problems. This research intends to study how this intervention has contributed rural households to overcome these problems. The study has four specific objectives oriented towards addressing; i) SWC technologies commonly implemented by farmers ii) contribution of successful land certification to tenure security and agricultural productivity iii) land use and land cover changes that come as a result of the intervention, and iv) food security status of people engaged in SLM activities. It will make use of a case study approach in general and exploratory case study in particular, where a combination of qualitative and quantitative data will be used from both primary and secondary sources. Data will be interpreted and analysed using different statistical, econometrics & ArcGIS software and relevant food security tools, models & measurements. The result of the study provides policy-related information and technically feasible remedies that help to prioritize in overcoming food security, land management, and tenure security problems. More specifically, it will develop common language and currency that should be functional among policymakers, donor organizations, academia and development practitioners in the area of sustainable development.

Keywords: Land degradation, tenure insecurity, food insecurity, sustainable land management, Land use land cover, Beshilo sub basin.

Table of Contents

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

1.1. BACKGROUND

Our planet is severely overwhelmed by two prominent and interlinked problems, namely land degradation and food insecurity. Land degradation has been a major global challenge throughout the 20th century and will remain high on the international agenda in the coming century. Several interrelated forces, for instance, significant increases in grain production have been achieved at the expense of degrading the natural resource base (for example reduced natural vegetation and pollution of both surface and groundwater). Approximately 60 percent of the global ecosystem supporting life on earth has been degraded or exploited unsustainably and the degradation could become significantly worse in the next half-century (Bennett, 2006). Reduction of ecosystem service due to a loss of biodiversity and the prevalence of malnourishment and undernourishment in many parts of the world are among the problems brought about by land degradation.

Unlike naturally occurring land degradation, the loss of ecological productivity caused by human-induced factors are affecting one third of the Earth surface and over a billion people, only 11 percent of the global land surface can be considered as prime land. Yet this must feed the 8.2 billion expected by the year 2020 (UN,2017). In his study done 27 years ago, Oldeman has showed how human induced soil degradations are affecting different parts of the world. It affects 24 percent of inhibited land areas. The value for each continent varies: 12 percent, 18 percent, 19 percent, 26 percent, and 26 percent for North America, South America, Oceania, Europe, Africa, and Asia respectively (Oldeman,1992).

According to Dingane (2003), degraded soil in Africa covers about 494 million hectares. Land degradation in Sub Saharan Africa(SSA) is widespread. According to Diagana, 65 percent of SSA's agricultural land has been degraded due to wind and soil erosion. As reported in (Desa,2014), 28 percent of SSA's population live in areas that are prone to land degradation. In other studies, 40 percent of the grassland, 26 percent of forest land, and 12 percent of cropland are reported to have land degradation (Bao Le et al, 2014).

The findings of Diagana demonstrates that land degradation is negatively correlated with food security. According to (Diagana, 2003), soil fertility decline and nutrient mining lead to reduced agricultural productivity and thus food insecurity. As indicated in the report of Food and Agricultural Organization (FAO), the problem of food and nutritional insecurity continues to increase. Its

latest estimates indicate that the rate of human undernourishment has increased globally. For instance, in 2017 around one person out of every nine on earth (or 821 million people) is undernourished,151 million under-five year children are stunted and 50 million children are threatened by wasting (FAO,2017). The same source indicates that, a high proportion of undernourished, stunted and wasted people are found in Africa, specifically in SSA. A study carried out in West Africa revealed that the proportion of children who die before the age of five year was more than 30 percent in areas of high land degradation (Lefroy et al.2000).

Land degradation does not have a single cause. Many interrelated socio-economic, and institutional factors are its underlying causes. These factors include; population growth, poverty, land shortage, free grazing and the absence of tenure policy (Utuk & Daniel, 2015). . Insecure tenure is believed to contribute to declining soil fertility and land degradation, by negatively influencing farmers to invest in schemes and to improve soil fertility (Mafongoya et al.2006). According to Maxwell & Wiebe (1999), the tenure system is of a pivotal importance to improving agricultural production which in turn improves availability of food.

Tenure insecurity also affects the sustainability and adoption rates of Sustainable Land Management (SLM) practices. For instance, in smallholding in Eastern Africa, investment in soil fertility is more likely when there is security of tenure or ownership(ibid). For instance, in Fiji, land leases issued on native and crown land through the Agriculture Landlords' Tenants Act are found not to be conducive to sustainable land resources management, because the lessee tends to exploit the land for economic gain, knowing very well that, the lease will expire after 30 years of occupation, even though such action often results in high levels of land degradation (Boruff & Cutter, 2007). Similarly, in the Cook Islands, many people own land that is parcelled into small areas where the activities of one landowner affect the neighbouring owner. This has often lead to degradation along the foreshore or/on coastal ridges (Wairiu, 2017). Furthermore, a study done in the Ethiopian highlands revealed that land tenure insecurity was responsible for the poor performance of SLM interventions (Shiferaw & Holden, 2000) and (Selayang, 2004). Therefore, any intervention that aims to avert the problem of land degradation must start by improving tenure related arrangements.

Having taken this into account, the sustainable use of natural resource was therefore introduced by the World Commission on the Environment (WCED);(Rigby et al.2001) and (Debebe,1995). SLM is introduced as a means to meet the requirements of a growing population in the belief that inappropriate land management can lead to land degradation and a significant reduction in the

productive and service functions of the eco-system (World Bank et al.2006). Several success and failure stories on already under taken SLM technologies have been recorded. One study conducted in Tanzania has shown that SLM investment in rainfed agriculture in the Usambara highlands was found to be an essential component of food security (Tenge, 2005). Unlike the previous case, studies conducted in the Ethiopian highlands indicated that the program has been held back by many factors: weak extension service; a failure to incorporate indigenous SWC practices; land tenure insecurity; and policy and other related problems. In addition, a study conducted in Australia identified economic factors, a range of attitudinal factors and belief and self-concept as determining factors for achieving sustainability and the adoption of SLM practices (Macgregor & Warren, 2006). According to Amede (2003), the role of local institutions explained in terms of norms and values, and which in turn govern the use of the natural resources, is partially or totally overlooked. According to the researcher, in most places where there was SLM intervention, the community is neither consulted nor given an opportunity to influence the problem identification and planning process. In most cases, the community seen lacked a sense of ownership for SWC structures established without its' consent.

Although many researches pertinent to SLM have been conducted, the information we have remains scanty. Most specifically, no research has so far examined the back-and-forth effects between the three underlaying factors: tenure insecurity, land degradation ,and food insecurity. Therefore, this research will seek to explore the interplay between these core elements under the big umbrella of SLM. It will primarily study the major biological and physical SWC practices usually employed by the households and investigates major drivers for their adoption and sustainability. Secondly, it studies how land certification, one of the pillars of SLM has contributed to improve tenure security land and agricultural productivity. Thirdly, it will investigate major land use land cover changes observed as a result of SLM interventions. Finally, the research studies how SLM contributed to improving food security of rural households by further examining the main determinants of food security and prominent coping strategies employed within the study area.

1.2. Formulation of the Problem

The problems of land degradation and the resultant food insecurity are becoming increasingly complex. In addition, the high population growth that our world is seeing will make it worse. This is largely brought about as a result of land degradation. The imperative to improve food security at the national, household and individual level has led to policy responses in many countries and

the international arena, for instance goals 1, 2,12, 13, and 15 of the SDG were crafted to address such long standing problems (Francis & Si, 2015). The newly framed Green Economy Strategy by most developing countries, for instance Ethiopia, is an example of such a policy intervention (FDRE, 2011).

Ethiopia is one of the developing countries of Africa which is highly heated by the twin effects of the above mentioned problems. Agricultural land is a scarce resource in the highlands of Ethiopia, it constitutes the fundamental base of agricultural livelihood. The sector accounts for 50 percent of Ethiopia's GDP, 88 percent of exports value, and it is a source of livelihood for more than 80 percent of the country's population (EDHS, 2016). However, its sustainability is seriously affected by many factors, chief amongst of which are land tenure insecurity and land degradation.

The extent and magnitude of land degradations in the country are immense. For instance, recorded measurements of soil loss by water erosion range from 3.4 to 84.5 tons per hectare per year with a mean of 42 tons per hectare per year (Nyssen et al. 2010); (Hurni,2000). According to the same source, there is a loss of 4 mm of soil a year, which is at least twenty times higher than the replacement rates. The country's annual deforestation rate, 62,000 hectares is attributed primarily to the increased demand for farmland, free grazing, fuelwood and expansion of settlement sites. In other studies (Bishaw, 2001); (Hurni,1993); (Berry, 2003), the forest degradation rate is as high as 150,000 hectares per year.

Ethiopia has undergone progressive development which has resulted in double-digit growth over the previous 10 years (Dula&Degefa,2017). Despite this momentous transformation, the number of people seeking food assistance continues to increase. For instance, about 32 percent of its people are food insecure and need external assistance (FAO et al. 2017). As indicated by the Africa Food Security and Hunger Indicator Score card, Ethiopia ranked as having the highest number of people in a state of undernourishment/ hunger, affecting 32.1 million people. This makes it the fourth African country scoring (37.1%) by the number of people who are undernourished (ADBG, 2014). According to Edwards (2010), about 10 percent of Ethiopia's citizens are chronically food insecure, and this figure rises to more than 15 percent during the frequent drought years.

Many interrelated and interwoven factors have long contributed to the food shortages. Chief among these are land degradation and fragmentation; poor infrastructure; high population growth; weak institutions and policies, and land tenure insecurity (Lauren et al. 2017) ; (Alden

Wily, 2018). The Government of Ethiopia (GoE) has fully understood both the root and predisposing causes of these problems. As a remedy to the prevailing problems, SLM is believed to contribute to the improvement of food security through addressing the **'yield gap'** (the difference between actual yield and maximum attainable yield). Closing the yield gap represents an important opportunity for increasing both current and future food and fibre production. This can occur, in part, by introducing more sustainable management practices that rehabilitate areas with decreased productive capacity.

Considerable resources have been mobilized to manage the farmlands' sustainability and promote agricultural productivity with improved natural resource conserving technologies. In 1970 the World Food Program WFP et al. (2013) introduced a MERT[1] program aimed at controlling land degradation by rehabilitating degraded lands and improving productivity (Zeleke et al.2006). Continuing to MERT, the GoE introduced SLM program in 2008 to address three of Ethiopia's most significant development and environmental problems: low agricultural productivity, land degradation and tenure insecurity. As reported by (FDRE-MoA, 2014), the program has four major components:(1) the Integrated Watershed and Landscape Management component; (2) the Institutional Strengthening, Capacity Development and Knowledge Generation and Management component; (3) the Rural Land Administration, Certification and Land use component; and (4) the Project Management.

Research conducted by ILRI-IPMS in Ethiopia revealed that the SLM program has resulted in creating mechanisms for effective production and utilization of forage through a cut-and-carry schemes, as a result of which the botanical composition of species both in grazing and stock exclusion plots increased, this in turn improved the bee forage cover abundance; and other environment and social changes (Gebremedhin, 2010). According to (FDRE-SLMP II, 2013), the program, in its 135 intervention woredas, has resulted the formulation of 670 water catchment management plans by community participation; 390,000 hectares of individual and communal land have been treated with different SWC measures leading to a yield increase by 35 to 80 per cent; Besides, NDVI (Normalised Difference Vegetation Index) has showed a 23 percent increase.

As one of the pillars of the SLM program, the land certification program resulted in positive achievements, (USAID, 2011); (Persha et al. 2017); (Place et al. 2010 ; (Holden & Ghebru,2013).

1 Managing Environmental Resource to Enable Transition to more sustainable Livelihood

Among the key findings are increased investment and improved land productivity (Holden, Deininger, & Ghebru,2009), increased land rental market activity (Deininger, Ali, & Alemu, 2011); (Alemu, 2006); increased women's participation in land market activity, and improved child nutrition. With regard to land certification, 22,229 second level land certificates are issued and 229, 649 surveyed parcels are ready for issue of 2nd level certification(FDRE-SLMP II, 2013). The estimated cost of Ethiopia's first-level certification is reported to be approximately US$1 per parcel, considered to be one of the cost effective in the world (Alemu, 2006);(Deininger et al.2008).

Many researchers have studied on the effects of land certification. These include, improved tenure and investment (Adal,1997) rural landholding adjustment; (Bewket,2007); improved property rights and land management and conservation (Admassie Y.(2000);(Edwards, 2010), scaling up of SLM practices and its determinants and adoption scenarios (Admass & Kessler,2015). For instance, (Wodaje,2016) in his GIS-based land degradation assessment tried to measure in terms of land use land cover changes and soil loss assessment alone, the researcher fails to show the root causes of land degradation and other socio economic parameters that made the area prone to extended soil degradation. None of the above mentioned researchers have tried to study the prevailing linkages between land degradation, food insecurity and tenure insecurity. In the aforementioned researches, tenure insecurity and its contribution to land degradation and food insecurity was totally overlooked. In most researches to date, the interplay between these three overlapping elements has not been well studied. This simply means that, it is absolutely necessary to research how tenure security affects the food security of rural households or vice versa and seeks further effort to interpret and analyse the interplay.

The problem of land degradation cannot be tackled unless its root and predisposing causes are addressed. Tackling the challenges of land degradation, food insecurity, and tenure insecurity require a systematic approach. Any attempt to improve food security must not negatively affect or degrade the environment. That is why, as indicated by the World Bank (2006), nowadays food production systems need to meet three major requirements:(1) an adequately supply of safe, nutritious, and sufficient food for the growing population;(2) significant reduction of in rural poverty by sustaining the farming-derived component of rural household incomes, and (3) reducing and reversing the degradation of natural resource.

It is worth mentioning that a household, aspiring to attain food security requires attention to be paid to the social ,ecological and economic dimensions of SLM and the pillars of food security.

Improved yields for smallholders and greater self-sufficiency in local food production are attainable if the interplay between land degradation, tenure insecurity and food insecurity are adequately addressed.

1.3. Research Objective

The main objective of the research is to study the impacts of Sustainable Land Management on tenure security, land degradation and food security.

Specific Objectives and Corresponding Research questions

To meet the overall objective, the following specific objectives and research questions will be addressed:

1.To identify biological and physical soil and water conservation (SWC) practices mainly employed by the households engaged in SLM activities.

a)What are the prominent biological and physical SWC practices mainly applied by the households engaged in SLM activities?

b)What are the drivers for the adoption and sustainability of the preferred SWC practices?

2.To study how land certification contribute to improve tenure security and agricultural productivity.

a) How does the land certification program contribute to tenure security and agricultural productivity?

b)What are the prominent factors contributing to successful land certification?

3.To investigate major land use land cover (LULC) changes observed as a result of the adoption of SLM activities.

a) What do the LULC dynamics of the study area look like?

b) What are the major drivers for the existing LULC changes?

4. To explore the food security situation of rural households engaged in SLM activities.

a) What does the food security situation of the studied households look like?

b) What are the determinants of households' food security ?

c) What are the major coping & survival strategies employed by households during food shortages?

1.4. Conceptual Framework

The main aim of the research is to show the interplay between SLM, tenure security and food security. The below sketched conceptual framework is drafted as a roadmap to show how the research will be undertaken and how various independent and dependent variables integrate and interact with each other. The foundation concept for this conceptual framework is borrowed from the works of (Maxwell & Wiebe, 1998). The conceptual sketch of Maxwell & Wiebe has been criticized for its linear nature. For instance,(ADB, 2014) criticized the model for having causal flow relationship, and its inability to adequately capture the interrelationships between consumption and investment decisions, household endowments, production and exchange decisions, and household entitlements. Therefore, the modified framework by the researcher tries to show the linkage between the three prominent and interlinked problems under the big umbrella of SLM intervention and its outcomes.

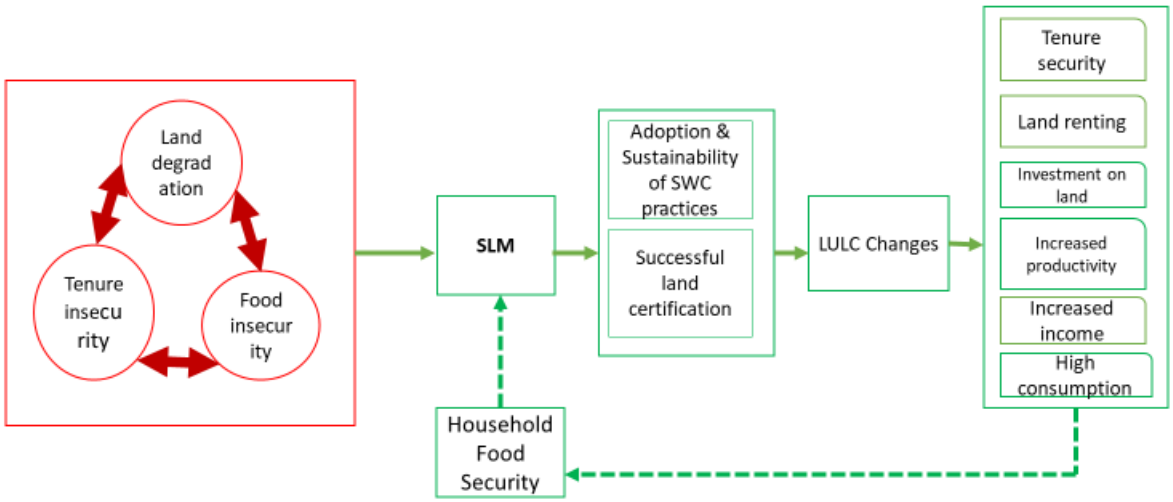

Figure 1.1 Conceptual framework Showing the interplay between tenure security, land degradation and food security under the umbrella of SLM(Source: own construction based on the work of Daniel Maxwell and Keith Wibe,1995)

The first sub-objective of the research is to explore SWC practices mainly employed by studied rural households participating in SLM activities. It will also investigate those socio-economic, physical and institutional factors that have contributed to or/and limited the wide use of these

practices. It will examine further why many farmers remain negligent or reluctant to invest in their land knowing that their plots are at risk of soil degradation; why they prefer one practice to other ; and what drivers determine their preference? Based on this research question, the sustainability and adoption rate of each practice will be measured using the five pillars of sustainability : productivity, security, protection, viability, and acceptability. Therefore, objective one starts from the three problems in a vicious circle, then goes to the SLM box, then to the first box of SLM pillars and after measuring sustainability in the outcome box ends at the household food security box of the framework.

The second specific objective, starts from the SLM box, then it will examine the linkages of land certification to other pillars (SWC and LULC) and other relevant changes . It will further studies the tenure security, through the lens of SLM, changes in land renting, credit availability, agricultural productivity and the magnitude and extent of land and land-related conflicts. It finally ends at the food security box by showing its contribution to tenure security, agricultural productivity and thus household food security.

The third specific objective, has the ultimate goal of exploring how SLM practices have contributed to LULC changes , it starts from the two boxes, adoption and sustainability of SWC practices and successful land certification. With these important things in mind, it will measure changes in agricultural productivity and the resultant food security that occurs as a result of the intervention. It will also investigates major drivers for the resulted LULC changes using pre-established and respondents stated indicators. It further examines how land cover changes occur as a result of SLM and the extent and magnitude of participatory land use plans mapped by the community. After Measuring NDVI and other changes, It ends at the food security box by showing how it contributes to household food security.

The fourth specific objective is to study the food security status of households engaged in SLM interventions. It compares and contrasts the food security status of households engaged or not engaged in SLM intervention, identify major determinants of food security and major coping; and survival strategies employed by the household during the times of food shortage. It finally ends at the SLM outcomes box to show how food secured/in secured households could contribute to the sustainable use of the natural resource. For the sake of brevity and precision, other indicators, and elements under each objective and research questions are not included in the framework.

2.LITERATURE REVIEW

2.1.Sustainable Land Management

The concept of SLM was developed at the 1992 Earth Summit and first used by (Smyth & Dumanski 1995). The foundation of sustainable agriculture is a strategic component of sustainable development and poverty alleviation(Alemu, 2016). The basic concept behind the term **"sustainable land management"** looks rather simple at first glance. It is one of the most ambitious goals in real life, however, its overall intent is to bring sustainable use of natural resource system (Ogbazghi et al.2011). In a local context, high population growth, overgrazing, climate change, land degradation, tenure insecurity and none proper agricultural practices have exacerbated the problem of land degradation and could grow significantly worse and become a barrier to achieving the Sustainable Development Goals (ibid).The challenge of reversing the degradation of ecosystems while meeting increasing demands for their services can be partially met under some scenarios like SLM which involve significant changes in policies, institutions, and practices that are not currently underway (Duraiappah et al. 2005). SLM ensures adequate levels of current production whilst preserving the land resource base over time in order not to compromise or reduce development opportunities for future generations (Gomez et al.1996). Focusing on fulfilling the need of the current generation without compromising the need of the future generation, SLM aspires to bring about balanced change in social, ecological and environmental dimensions of human well-being.

2.1.1. Definition of SLM

SLM is defined as a knowledge-based procedure that helps integrate land, water, biodiversity, and environmental management to meet rising food and fibre demands while sustaining ecosystem services and livelihoods. SLM is deemed necessary to meet the requirements of a growing population. Improper land management can lead to land degradation and a significant reduction in the productive and service (hydrology, carbon Sequestration and other ecosystem services)functions of watersheds, landscapes and biodiversity niches(World Bank,2006). In related manner (FAO,1993) defined SLM as a knowledge-based procedure that helps integrate land, water, biodiversity, and environmental management (including input and output externalities) to meet rising food and fibre demands while sustaining ecosystem services and livelihoods is the use of land resources such as soils, water, animals and plants for the production of goods; to meet changing human needs; while assuring the long-term productive potential of these resources, and the maintenance of their environmental functions. According to the same source, SLM as an entity

need to full fill certain parameters :(1) production should be maintained; (2) risks should not increase;(3) quality of soil and water should be maintained, and (4) systems should be economically feasible and socially acceptable.

2.1.2. Types of SLM Practices

The SLM pillar in general and SWC practices to be implemented in particular depend on objective realities existing at ground level where the intervention intended to take place. Degree and intensity of the problem, slope and topography ,farming system and other socio-economic and institutional contexts are among the factors that limit the rate of acceptability and usability of each SWC practices. According to (Tefera & Sterk,2010), available technical support, suitability of the structure to the existing farming activities, aspiration of short term practice, labour demand tenure security, and slope are a few to mention in this regard. According to (GIZ, 2015), three prominent SWC practices have been identified; biological, physical and combinations of the two. Biological practices, for instance, includes, mixed cropping, grass strips, green manure, intercropping and etc. Physical practices, among other things, composed of soil bunds, stone bunds, waterways spring development, cut off drain and etc. The third practice is a composition of two practice done by mixing two or more practices together (ibid). Furthermore, practices like agroforestry, conservation agriculture, small scale irrigation, minimum tillage and other activities are known to compliment the above-mentioned practices.

2.1.3. Sustainability and Adoption of SLM

With the release of Brundtland's report (WCED 1987), the concept of sustainability has received increasing attention in agriculture, however, researchers have struggled to operationalize the concept. Smyth & Dumanski (1993), subdivided the general concept of sustainability into four main pillars:(a) productivity(b) stability of production(c) soil and water quality, and(d) socioeconomic feasibility. Another work cited in Tisdell (1996) Smyth et al.1993, come with additional elements in the pillars, 'acceptability'. Among scholars there is an ongoing debate, for instance, according to (Lefroy et al.2000), the concept of sustainability is a dynamic concept in the sense that what is sustainable in one area may not be in another, and what was considered sustainable at one time may no longer be sustainable today or in the future because conditions or attitudes have changed'. Nonetheless, Several practical problems arise in undertaking sustainability, including a large amount of data needed to quantify a large number of different sustainability indicators and the challenge of understanding the complex interactions among such indicators. Some researchers have combined indicators into indexes, for example (Farrow & Winograd 2001; (Sands

and Podmore 2000). Sometimes specific levels or conditions of an Indicator attribute are seen to have special significance in sustainability evaluation and are described as 'Thresholds'. A 'Threshold' level might be one at which a significant change in the influence of an indicator occurs or one beyond which further change in the indicator attribute would be unacceptable. The interacting processes and factors which determine 'Threshold' levels are termed "Criteria' (ibid). This procedure raises the question of how indexes measured in different units can be meaningfully aggregated (Smyth & Dumanski,1993).

Recognizing a time period over which sustainability is evaluated permits some flexibility in achieving the 'pillar' requirements so long as these requirements are met over the period as a whole. Patterns of productivity, in particular, must be flexible. In an agricultural context, the time scale might include regular regenerative fallows leading to cyclical changes in productivity, fertility etc. (FAO,1993). The degree of flexibility is essential if SLM overall is to be a realistic objective. Land use 'sustainability' can be seen as an extension of land use 'suitability' into the future. An exact definition of a form of land use suited to present land conditions is the objective of the FAO Framework for Land Evaluation (Smyth & Dumanski,1993).

2.2 Land Tenure Security

2.2.1 Definition of Tenure Security

According to Maxwell & Wiebe(1999) tenure is the system of right and establishment that governs access to land use and different uses of land. In normal assumption, tenure can enable landowners bundle of rights, tenure niches, and extended title. As one of the four elements of land administration, tenure security plays a key role in providing land-related rights to land users. In this regard, different definitions have been forwarded to explain what tenure security means. The definition of tenure security given by Place et al.(1993:19-20), ***"when an individual perceives that he or she has rights to a piece of land on a continuous basis, free from imposition or interference from outside sources, as well as ability to reap benefits of labour and capital invested in the land, either in use or upon transfer of another holder".*** The above definition prescribes the sticks of the right an individual enjoys without compromising its use. Therefore, an individual owner can enjoy many domains of the right like for instance the right to alienate, to bequeath, and, when the right expires, to remove his property, to transfer his title or to claim compensation for it.

As Hardin,(1968) place it, if the land remains communal it will face the **'tragedy of the commons'** syndrome. In his essay Hardin tried to explain how decisions taken by herdsmen to maximize their gain affect the natural resource base. According to him , there are two consequences usually expected while the herders add one additional animal, positive and negative function (Hardin, 1968). His generalization clearly reveals that and can be corelated to the prevailing land degradation in Ethiopia or else in the world. However, Hardin is criticized for its inclination to support privatization and accumulation of land in the hands of a few. Nevertheless, land tenure security enables legal right through land certification which is expected to offer multiple advantages for the resource itself and the owner. It is assumed that breadth or robustness of those rights (such as rights of use, transfer, and exclusion), duration of such rights, and assurance of such rights are important components of tenure security.

2.2.2 Role of Land Certification

According to Maxwell & Wiebe (1999), the linkage between food security and tenure security can be studied or analysed using four important points; tenure security and productivity, farm size and production, agricultural commercialization and natural resource conservation. In addition, environmental conservation in particular and the other three points, in general, will apparently show the cause and effect relation between that tenure insecurity and land degradation. One important mechanism through which one can attain tenure security is through land registration and the resultant land certification. As demonstrated in (Lengoiboni et al.2015), land registration systems form part of the legal framework of a country and play an important role in climate change, natural disasters and conflicts.

Land resource is often a source of conflict. As reported by (Bob, 2010), conflict can happen between households, neighbourhoods and neighbouring communities' over land rights and boundaries, conflict, between traditional and 'non-traditional' local organisations in land management and dispute resolution, inheritance-related conflict among family members, conflict between 'newcomer' households and long-standing residents and conflict arising from household mobility. A study by (Adal, 2002) on legal aspects of agricultural land disputes pointed out that it was generally believed that land in Ethiopia was the subject of numerous disputes and endless litigations. It was mentioned that an estimate made at the number of land cases in relation to the total number of civil cases has put the figure for all land disputes filed in the ordinary courts at 75 % (This applied for the whole country and for all levels of courts, and it appears quite evident that

court cases involving land more than anything else are a basic feature of the Ethiopian legal system). If the system of land tenure is unclear, this should be solved first, even before any kind of adjudication starts (Zevenbergen, 2014). According to the same source, Civil disputes over land included cases such as failure of the tenant to pay rent, mismanagement of farms, collection of crops before assessment, eviction, claims of inheritance, trespass, boundary, and ownership.

Apparently, as an example, those short-run productivity-enhancing investments, like the application of manure &compost, planting of perennial trees and agroforestry and investment on physical and biological SWC practices are seen constrained by in a places where tenure security is not yet implemented. Some empirical evidences substantiate that, in Ethiopia for instance, in a situation where farmers received the land certificates for their plots, there are semi-permanent investments like terracing done by peasants in several part s of the country (Adal, 2002). Studies on experiences of many African countries additionally show that tenure security may be a necessary, however not comfortable condition for successful soil and conservation systems (Reij et al. 1996).

To reduce widespread tenure insecurity and its negative consequences, Ethiopia has started land certification since 2003 in some of its regions (Deininger et al 2008). Many studies were carried out at different spatial and temporal dimensions, most of them overlooked the role of land certification to bring land tenure security in general and reduction of land-related conflicts in particular. Furthermore, no one tried to study the number of productive man-days spent in court and total absentee of productive labour from farming. Finally, questions like how land certification has contribute to tenure security? What was its role in protecting and efficiently utilizing land resource? And how is, its contribution to household food security? These are prominent questions that this research aspires to answer.

The other part that needs to be seen through the lenses of tenure certification is its contribution to land and credit market. According to the Article 40 of the 1995 constitution of the Federal Democratic Republic of Ethiopia (which is about property rights) it is provided that ,***"The right to ownership of rural land and urban land, as well as all natural resources is exclusively vested in the state and in the Peoples of Ethiopia"*** (FDRE,1995). Hence, ownership of land is vested in the hands of government and individuals are not entitled to sell or buy land. In this regard, the only options remaining for farmers are share cropping and contracting. Despite existing constraints that limit the free (and formal) operation of the land rental market, a recent study has found that the size of the land transaction(both fixed fee rental and sharecropping) is high.

Taking limited rental and sharecropping both options , 22 and 23 percent of households in Tigray and Amhara regions, cultivate somebody else's land obtained through the land rental market (Gebreselassie, 2006). At the national level, the figure is 13.4 percent. In general, several surveys indicate that the dimensions of the land rental market is high both in terms of the number of market participants and the size of land equipped to the market(ibid). Similar patterns have been observed in Wolaita, southern highlands of Ethiopia (Carswell et al. 2000).

The land market could play an important role in improving some of the drawbacks of the current land tenure system, and land reform that allows land markets to facilitate the consolidation of plots into larger, commercially viable farms. The wide spread of land renting and share cropping trends will support the cluster based farming system that currently the Ethiopian government is insisting farmers to follow. Cognizant this reality, important questions which were not studied by other researchers e.g. how does land certification contribute to agricultural productivity? To what extent is land certification has paved way for share cropping and credit and loan? How has the certification program contribute to reducing land and land-related conflicts? and generally how the interplay of the above-mentioned variables contribute to household food security? These are among the points that this research will address.

2.2.3 Responsible Land Administration

As a core concept, responsible land administration provides four core functions: land policy framework, institutional arrangements, land information and sustainable development. Cited in (Zevenbergen,2009), the United Nation Economic Commission for Europe's (UNECE,1996,p.6), defined Land administration as ***' a process of recording and disseminating information about the ownership, value, and use of land and its associated resource'***. Due to land use changes, driving forces and actors will result in a significant paradigm shift to responsible land administration. In particular, responsible land administration is flourishing in a world where global challenges such as rapid and massive urbanization and migration, as well as land, food security, water, infrastructure, and other resources conflicts are wide spread existent(Zevenbergen & Vries, 2018).

Fit for purpose land administration promotes alternative approaches to help the process of land tenure security or to improve it. Overlapping or secondary land rights have been lost in many contexts through formal land registration systems (Lengoiboni,2017). Therefore, strong and well

organized Land administration institutions in a given country are so vital to implement and practice the pillars of sustainable development through creating workable and robust land management systems.

2.3. Land Degradation

2.3.1. Definitions of Land Degradation

Land is a basic resource for supporting both biotic and abiotic assets on earth, including the production of food, preservation of biodiversity, facilitating the natural management of water systems and acting as a carbon store (KMENR), 2016). Land, therefore, includes soils and vegetation(both grassland resources and forests), landform, climate and water resources. Land, in the context of land degradation, according to (KMENR,2016) has been defined as ***"all natural resources which contribute to agricultural production, including livestock production and forestry"*** (Blaikie, 2016). Land degradation is described in terms of the loss in natural resources(soil, water, fauna, and flora) or in the biophysical process and functions. Soil can be eroded, salinized or impoverished. Since land is a source of freshwater, its storage capacity is influenced by the it's health , if otherwise land degradation continues and will result in a loss of moisture through evapotranspiration which finally result on the degradation of soil and vegetations. The term land degradation thus involves the quality of both soil and vegetation. Soil degradation refers to negative changes in the physical, chemical and biological properties of the soil, whereas vegetation degradation is the reduction in the number of species and the vegetational composition.

FAO & ITPS (2015) distinguishes land degradation from soil degradation in that ***"land degradation"*** is a broader concept than ***"soil degradation"*** (or water pollution), as it includes components of the ecosystem and of the trade-offs that may exist between them: loss of biodiversity, for example, matched against improvements in economic services under intensive farming. Abdi et al.(2013) define *land degradation as****'' the result of complex interrelationships between biophysical and socio-economic issues which affect many people and their land, especially in the tropics and developing countries''.***

2.3.2. Causes and Types of Land Degradation

Land degradation is a general term encompasses all the processes leading to the soil, water, and environmental deterioration. As such it can be seen with the socio-economic contexts of a given community. Blaikie & Brookfield, (2015) point out that ***"Land degradation should by definition be a social problem. Purely environmental processes such as leaching and erosion occur with or***

without human interference, but for these processes to be described as "degradation" implies social criteria which relate land to its actual or possible use". Land degradation should be a matter of ***"political ecology",*** a discipline that combines ecology with political economy (ibid).

The main causes of land degradation are complex and attributed to a combination of biophysical, social, economic and political factors. There are multiple factors that can cause land degradation at short and long terms. Agricultural use degrades soil in the long run and reduces its fertility if it is not accompanied by appropriate soil and water conservation measures. Only suitable cropping methods and more or less labour-intensive or capital-intensive measures can sustain soil fertility (McNeill & Winiwarter,2004). The major environmental factors that causes significant soil and nutrient loss in a short period of time is water erosion followed by wind erosion. For instance, in SSA the major agents of land degradation are water erosion, wind erosion, chemical degradation and others, each affect soil loss by 47, 36, 12 and 3.5 percent respectively (Amede, 2003). Although the degree of soil erosion is highly related to the interaction of Wischmeier factors[2], the type of land use and management may have played an important role in the highlands. The contribution of different management factors towards land degradation. In Africa it is estimated to be 49 percent, 24 percent, 14 percent, 13 percent and 2 percent for overgrazing, agricultural activities, deforestation, overexploitation, and industrial activities (Place et al. 2003). According to these researchers, land degradation due to natural causes is assumed to occur at a rate, which is almost equal to the rate of natural rehabilitation. However human-related factors account for accelerated forms of land degradation.

2.3.3. Drivers of Land Degradation

As stipulated by many researchers, different socio-political drivers have the capability to accelerate the degree and severity of land degradation. These drivers determine (1) Where; (2) Which; and (3) How many people live in a given region (Katherine et al.2015). Among other things, tenure insecurity, climate change, and rapid population growth are among drivers of land degradation.

As reported by Diagana (2003), high population growth rate which is estimated to be 3 percent and the highest in the world has resulted in land shortage and becoming one of the main contributing factors of land degradation in SSA. The same source reveals that overgrazing, deforestation,

2 An empirical model for predicting erosion on a cultivated field

inappropriate agricultural practices, climate change, and land tenure insecurity have contributed a lot for the prevalence of high rate of land degradation.

The tenure system often determines how land is managed and is labelled as a primary driver of degradation. Rahmato(1994) found that an important factor that affects land management In Ethiopia is lack of appropriate tenure policy. There are convincing data showing that farmers are poorly interested to invest on land for a long time benefits like (application of animal manure and compost, natural fallowing, improved fallowing, planting tree on farm and construction and maintenance of SWC structures) unless they have the ownership card and know that they have the right to transfer the land to their children(Amede,2003).

Other factors like policy, trade barriers, lack of well- functioning institutions, lack of knowledge and education, shortage of fodder and fuel for cooking and heating are among the problems that have a magnifier effect on sustainable use of land (Diagana ,2003).

2.3.4. Theorizing Land Degradation

Subject to debate, a number of theories have been put forward to explain fundamental causes of land degradation (Utuk & Daniel, 2015). According to these scholars , two prominent schools of thought are known with different stands regarding the prediction, severity, and impact of land degradation. The first school is composed of Ecologists, soil scientists, Geographer and agronomists emphasizing on the problems and asking immediate action to curb the problem in the shortest time possible(Eswaran et al. 2001). Therefore, supporters of this school aspire for policy dialogue and government intervention. According to Miranowski 1984), soil erosion, not only affects future productivity but also the terminal value of the land.

The second school, comprising of primarily economists, believes that , if land degradation is a severe issue, why have market forces not taken care of it? Supporters argue that land managers (farmers) have a vested interest in their land and will not let it degrade to the point that it is detrimental to their profits (Eswaran et al. 2001). For instance McConnell (1983), asserts that soil erosion is a result of rational farm decision making. A rational producer, maximizing the discounted net revenue from land over time would not respond to soil loss until the present value of marginal private returns obtained from additional soil loss goes below the implicit marginal private cost of soil loss.

This research follows the argument of the previous school of thought which seek to intervene in the problem through academic and policy dialogue.

2. 4. Food Security

2.4.1 Concept and Definitions of Food Security

The concept of food security has become a focal issue to the academician, development practitioners, and policymakers since the 1948 Declaration of Human Right. According to Article 25 of the declaration, food is considered as one of the core elements of an adequate standard of living (UN,1948). In the mid-1970s, food security was conceived as adequacy of food supply at global and national levels. This view favoured merely by food production oriented variables and overlooked the multiple forces which in many ways affect food access (Debebe,1995).
The widespread problem so far the concept of food security facing is acquiring appropriate and workable definition. According to Smith et al.(1993), quoted in Maxwell,(1996,there are close to 200 definitions of food security. Similarly, (Gentilini,2002) identified about 205 definitions of Food Security Smith et al. (1993) counted about two hundred different definitions. Its definition has considerably been changed over time and recently cited to have reached more than 250 (Degefa,2008).

There are several different ways of defining food security. In the 1996 World Food Summit, when the definition was broadly set as achieving food security "***at the individual, household, national, regional and global levels when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life"*** (FAO, 1996). Similarly (FAO,2002) defined food insecurity in terms of the risk the households face: households become food insecure when they are unable to mitigate the negative impact on food availability, access, and/or utilization. Degefa(2007) conceptualized food security to Ethiopian context as: ***'Household can be described as food secure when its livelihood activities allow to meet its food requirements and other basic needs, either through its own productions i.e. crop cultivation and/or livestock rearing, through having opportunities to run own non-farm ventures or to work with somebody else, or getting access to food through transfers'*** Improved access was redefined by taking into account livelihood and subjective considerations (Maxwell, 1996). Definitions underwent another round of evolution after the 2009 declaration of the World Summit on food security: ***"Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food, which meets their dietary needs and food preferences for an active and healthy life"***(FAO, 2009). Nonetheless, the concept of food security has been formulated from the four building blocks that are emanated from its definition and usually termed as pillars of food security.

2.4.2. Pillars of Food Security

From the definition of food security adopted at the World Food Summit in 1996, four important dimensions can be identified: availability, access, utilization, and stability. Food security is realized if all these four dimensions are fulfilled at the same time.

Availability **:** The availability dimension addresses the supply side of food security, thus, referring to the amount of food that is physically available in a population during a certain period of time (Pangaribowo et al. 2013). Depending on the level of analysis, food availability can be determined: On an international or national level, considering, domestic agricultural production, import capacities, food stocks and food aid using the ratio of total exports to food imports(ibid). Different indicators can be used to measure food availability at a national level. Amongst these data set are, metrological, natural resource, production, market information, pest control, food balance sheet, and agroecological models are to mention a few (FAO et al; Maxwell & Smith 1992). The new paradigm shift done by the food security prescribes the presence of food security at the household level rather than its national or regional level availability.

Access **:** The access dimension of food security embraces the ability of households or individuals to access food from the market or other sources (Webb et al. 2006). Access to food is determined by a physical access or from other livelihood options. Indicators for the access component are related to the availability and quality of infrastructure, i.e. roads, railways, ports or communication networks as well as the accessibility of publicly provided services like health, education and social safety nets (FAO et al.2013). The economic component, on the other hand, refers to ***"any acquisition pattern or entitlement through which people procure their food"*** (FAO 1999, Article 13). An important factor here is the income of people and, in case of subsistence households, the assets necessary to produce sufficient food for consumption, such as land, labour, water, seeds or fertilizer (Ecker & Breisinger ,2012). According to Maxwell & Smith (1992), indicators for households food access are land use practice, dietary changes, livestock sales, sales of the asset, change of food source, access to loan or credit, income diversification and livestock resource are among others.

Utilization**:** This dimension basically embraces concerns about the diversity and nutritional value of the food being consumed and in how far the micronutrients are being absorbed by the body. Important indicators hereby include, for example, how food is being stored, prepared and cooked, the intra-household distribution of food, education, and information about health and nutrition, and health and hygiene conditions (Maxwell & Smith, 1992). According to Barrett(2010), the first

three dimensions of food security are inherently hierarchical, in so far that food availability is a necessary but not sufficient condition to ensure access, and access, on the other hand, is necessary but not sufficient for effective utilization.

Stability : It is a relevant factor for all other dimensions of food security mentioned above. It encompasses considerations about the vulnerability to certain types of risks, thus, recognizing the temporal dimension of food security (Pangaribowo et al. 2013). Sources of risks on a macro level can be, for example, natural disasters (e.g. floods and droughts), macroeconomic shocks (e.g. global food price spikes) health-related shocks (diseases, epidemics) or political instability (Ecker & Breisinger, 2012). On a micro-level, i.e. individual or household-level risks may include, among others, unemployment, illness or death (Maxwell & Smith, 1992). The same source indicates that environmental protection, sustainable use of natural resources, family planning, green economy, and suitable market linkages are among the variables that affect household food stability.

2.4.3. Divergent Theories of Food Security

Food Security, since its emergency has passed through different stages and reached where it is now today. Defining the underlying and predisposing causes of food insecurity requires relevant theories that best address the problems. There exist different theories of food security orchestrated by the diverse schools of thought. However, there is no a full-fledged and stand-alone theory in the field so far. Chief among these theories are, ***'political explanation'*** or '***general explanation'*** and ***'the two modern famine theories'***. The household food security situation in rural areas is about whether the household can produce sufficient food from own production or sale of livestock and purchase food grain. Enough food must be available and household must have the capacity to acquire it (Degefa, 2002). Thus, household food security means the complementarities of food availability and entitlement and the ability of the political-economic structure of the country. Therefore, the researcher decided to define relevant explanations which conceptually fit and are capable of defining the relationships that have existed among food security, land degradation and tenure insecurity.

Political Economy Explanation: This school of thought is not yet considered as a full-fledged theory but seen as a general explanation. The advocates of this explanation do believe that war and civil strife, ecological degradation, government mismanagement, unequal access to resources and unequal exchange, and socio economic and political dislocation are considered as underlaying causes of food insecurity (Da Corta,1985; Deveroux,1993). There is evidence that the recurrent drought-prone famine in Western Sudan is linked to ecological degradation, in particular, the

expansion of Sahara desert into arable land and the exposure of vulnerable people to the famine might be explained for malign intent of the government under the domain of this explanation. Devereux(1993)and Dreze and Sen (1989) argue that many famines in the world have actually arisen from and been sustained by inflexible government policies undermining the power of particular sections of the population to command food. Our world in its history has observed many government made famines. For instance, Sahelian famine of 1984-1985, Chinese famine of 1958-1961, the Bangladesh famine of 1974, the Ethiopian famine of 1974 and 1984, Soviet famine of 1993 and Dutch famine of 1944 are famines created by the government through inappropriate policies and failure of these governments to intervene during the occurrences of famines (Alamgir,1980; Devereux ,1993; De Waal, 1997).

Although there are plentiful general explanations of the causation of famine, the links between them are often imprecise or often unstated. In order to quantify the process of household food security and predict accurate outcomes, the general explanations have to be mediated by other models of food insecurity (Getachew, 1995).

Food Availability Decline Model*:** Food Availability Decline (FAD) model is directed towards the understanding of the main hindrances for an increased agricultural production which in turn leads to a decline in food availability. The central argument of this theory is that anything which disturbs food production, such as drought and flood can reduce the availability of food for an extended period of time and causes famine (Diriba,1995). According to this school of thought, food production is attributed to various factors; population growth and the resultant diminishing of per capita livelihood resource and fragmentation and competition over the resource, and natural hazards like drought, land degradation, flood, pest and crop, and livestock disease. According to Malthus (1798), 'population growth takes place geometrically, while production and means of subsistence increase arithmetically and so unless the population is checked, food production increase cannot keep pace with it'***. Unlike this theory of Malthus, Boserup(1965) forwarded contra-Malthusian idea saying that, there is a positive correlation between population growth and transformation of agriculture. She further elaborated and substantiated by considering the high economic growth recorded by the two highly populated nations of the world, China and India. However, the model is criticized for the availability of food at the global and national level could not bring about food security at the household and individual level. The innermost argument of this model is the mere presence of food in the economy or in the market does not entitle a person to consume and famine can occur without aggregate availability decline (Diriba,1995).

Food Entitlement Decline: Access to food is determined by four sources of entitlement: production, exchange, own labour, and transfer (Sen, 1982). Food Entitlement Decline (FED) has a potential capacity to identify which group of people is affected by various threats of availability or access to food differentiation depending on the degree of vulnerability (Degefa, 2009). Despite its strength, the FED model has also some drawbacks to be addressed before directly applying it as a framework to study food security. This theory failed to consider intra household distribution of food, exclusion of relief entitlement (food aid); heavily focused on food deprivation and the presumption that famine mortality is induced by starvation, neglect cultural preferences and tastes in food consumption and the like.

Food security at household level signifies the complementarity of the political economy explanation and the two models, due to the fact that there must be a favourable and stable political situation, enough food must be available, and households must have the capacity to acquire it.

According to Degefa (2000), one or a combination of these can disrupt food production. However, production failure may or may not result in famine. Due to this fact, the attributes(factors) are not precise explanations of the causation of the process of famine. Hence, model by itself does not guarantee the proper analysis of food security at the household level as it focuses on the availability of food supply than food demand (ibid).

Thus, the framework of this research mixes the premises of the 'general explanations to famine' and the two famine models. It consists of many variables emanated from land degradation and tenure insecurity which adversely affecting farmers food production, which in turn determines the situation of households' food security.

2.4.4.Effects of Land Degradation on Food Security

Soil degradation is causing a decline in crop productivity and huge economic loss, putting the food security and livelihood of farmers at risk (Bhattacharyya et al.2015). In SSA, nutrient depletion is the primary form of soil degradation leading to a decline in crop productivity, and has been linked to hunger and poverty (Tully et al.2015).

According to Amede(2003), there is a direct link between land degradation and rural livelihood through three pathways. Firstly, the decline in soil fertility as a result of land degradation decreases farm productivity and income. As crop/livestock production is the major source of household income, the decline in soil fertility, through nutrient depletion and poor water holding ca-

pacity affects the on-farm income significantly through reduced agricultural productivity. Secondly, the decline in soil fertility affects the productivity of labour; a degraded land requires much more labour per unit area than well-managed land. Operation related to soil and water conservation and soil fertility management may compete with off-farm labour thereby reducing an off-farm income of the household. Thirdly land degradation reduces the underground and above ground biodiversity of the system, which in turn, affects the biochemical process of the rhizosphere and the vegetation cover of the land.

According to the finding of Oldeman(1998), the global crop production was 12.7 percent lower and pasture production 3.8 percent lower than they would have been without degradation and this has resulted in 4.8 percent loss in global agriculture. As a result, high degree and magnitude of land degradation, food insecurity, and malnutrition breed at the highest rate in South Asia and SSA (Utuk & Daniel, 2015).

2.4.5. Coping and Survival Strategies

Food insecure people are not passive receivers of undesirable situations; they employ several strategies to make ease of the situations (Webb et al.1992); (Webb et al.2003). People who migrate from their village in need of food and work during famine/starvation could not be seen as passive victims but losers of a hard struggle for survival. Therefore, when hazards or undesirable conditions happened, people try to cope with and not rely much on outsiders, unless and otherwise, everything becomes out of their control (Heijmens, 2001).According to Geest(2004), Querish(2007) and Patrice(1993), coping strategies represent a set of activities undertaken in a particular sequence of actions by a household in response to shocks, which include famine, drought, and other environmental and man-made calamities.

Most often, it seems quite cumbersome to differentiate between ‘coping strategy’ and ‘adaptive strategy’. However, based on the expected outcome and time dimensions, it is possible to separate these two categories of strategies. Adaptive strategies are applied for longer-term (beyond a single season) that are needed for people to respond to a new set of evolving conditions (biophysical, social and economic) that they have not previously experienced(CIGAR. 2009). According to ICTSD (2009), adaptation can be both autonomous and planned. However, coping strategies, according to (CIGAR. 2009), have evolved over time through peoples’ long experience in dealing with the known and understood natural variation that they expect in seasons combined with their specific responses to the season as it unfolds.

2.4.6. Determinants of Food Security

Various studies have been conducted on factors that determine food security at a different level, location, and temporal dimensions. Abafita & Kim (2013) found that, per capita landholding, livestock availability, education level of the household head, farm and non-farm income, soil fertility and conflicts identified as a determinant for household level food security. Similarly, empirical research carried using the Food Balance Sheet by Ramakrisha and Demeke(2002) in North Wollo, Amhara region of Ethiopia has identified almost similar factors as a determinant for household food security.

The bulk of studies have been confronted by certain methodological problems. For instance, Food Balance Sheet, one of food security measurement tool was used to measure food security at the national and regional level seen employed to measure household food security by some researcher, for instance the study done by Ramakrisha and Demeke (2002). Using this model cannot give a guarantee to measure food security at the household or individual level. Secondly, most studies are carried out on a specific location without giving due emphasis to livelihoods, agroecology and other location-related contexts. Most literature consulted so far used specific tool which only measures one pillar of food security.

This research, therefore, attempts to undertake the study using different food security tools which are capable of measuring at least three of the four pillars of food security, by complementing with appropriate analytical methods ,and data collected from different woredas and agroecological contexts.

2.4.7. Food Security Measurement tools

Measuring food security requires two important things; having an appropriate and workable model ,and the selected model need to be capable of effectively and efficiently measuring at least one of the pillars of food security. Cognizant of these facts, the following food security models are briefly discussed.

Household Food Balance Model: The Household Food Balance Model (HFBM) is used to determine the food security/insecurity status of the households in terms of food availability. A modified form of a simple equation termed as Household Food Balance Model, originally adapted by Degefa (1996) from FAO Regional Food Balance sheet. It also used by other researchers like Messay,(2010); Tegen (1999), applied to study food security situation of different communities in Ethiopia. The model was employed to quantify the net available food grain owned by each of the

rural households for one year period. The following formula is commonly used to calculate the availability of food at the household level:

NGA=(GP+GB+GO)-(HL+GR+GS+GG)

NGA=Total Grain Available /year/household

GP=Total Grain Produced /year/household

GB= Total Grain Bought /year/household

GO=Total Grain Obtained/year/household

HL= Total Post Harvest loss/ year/household

GR= Amount of Seed Reserved for Seed/ year/household

GS= Amount of Grain Sold/ year/household

GG=Grain Given to Others/ year/household

Post-harvest loss, which is 5 percent to Ethiopia context (Seyoume,2010) will be reduced and then NGA will be converted to net Kcal available at an individual level using a food Composition table for use in Ethiopia (Agren et al,1968); (ENHRI, 1968). Based on the output of HFBM analysis, a household whose daily per capita calorie available less than demanded or 2100 kcal will be regarded as food insecure and a household that did not experience a calorie deficit during the year under study will be regarded as food secure.

Household food insecurity access scale (HFIAS): raises generic questions that apparently represent universal domains of the household food insecurity (access) experience and can be used to assigning households along a continuum of food security severity to serious food insecurity. The information generated by the HFIAS will be used to assess the prevalence of household food insecurity in terms of access. This is used based on geographic targeting and to detect changes in the household food insecurity situation determined by the access of population over time to food, particularly for monitoring and evaluation purposes (FANTA, 2007). Each of the nine HFIAS questions will be asked with a recall period of four weeks (30 days). The respondent for this part of the survey will be women member of the households who directly participate in food preparation and delivery to household members. The respondent will be first asked the occurrence questions in order to identify whether the condition in the question happened at all in the past four weeks with yes or no answer. If the respondents answer ‘yes' to the occurrence questions, a frequency

of occurrence question will be asked to determine whether the condition happened rarely (once or twice), Sometimes (three to ten times) or sometimes in the last four weeks (more than ten times). The questions address the situation of all members of the household and do not differ between adults and children or adolescents. The entire occurrence question will be asked whether the respondent or other household members either felt a certain way or performed a particular behaviour over the previous four weeks. Food access concerns and the ability of a household to acquire adequate amounts of food by means of one or a combination of home production and stocks, purchases, barter, donations, borrowing, and food assistance. The HFIAS module produces food insecurity (access) information at household level.

Household Dietary Diversity Scale: The Household Dietary Diversity Scale (HDDS) is a measure of the total number of different food groups eaten in the previous 24 hours by any household member at home, and measures utilization pillar of food security. The food groups covered by the HDDS are meant to reflect a range from those that do not contribute to a nutritious diet but require resources to acquire, such as sugar, sweets, beverages and condiments, to foods that contribute to the quality of the diet in terms of essential nutrients (Sibhatu et al. 2015). These latter foods group include staples, fruits and vegetables, fats and oils, vegetable and animal source of protein. Respondents will be asked to recall all foods consumed by any household member in the previous 24 hours. The tool inquired about 16 food groups which are then aggregated to twelve (12) for analysis. The score is a simple sum of food groups consumed by any household member from the total of twelve (FAO, 2007). Households were classified into terciles based on the overall distribution of the dietary diversity (DD) score. Low DD= three or fewer groups of food; medium= four; and high= five or more.

3. MATERIALS AND METHODS

3.1. Description of the Study Area

3.1.1 Beshilo Sub-basin

The study will be carried at Beshilo Sub-basin of the Blue Nile basin. The main intention behind selecting Beshilo sub-basin as a study area lies on four important facts. Firstly, the watershed has undulating topography which makes it prone to the high rate of land degradation; Secondly, the sub-basin is known for high prevalence of food insecurity, migration and all forms of destitution. Third, Beshilo, the main river of the sub-basin, is the largest river which drains to the Blue Nile, the highest feeder of GERD[3], any scientific contribution regarding SLM will prevent the dam from unnecessary siltation and environmental mismanagements. Finally, due to its remoteness, the place was not well studied as far as land degradation, food insecurity, and tenure insecurity are concerned.

The Sub-basin covers 16 woredas of Amhara Regional state namely: Ambasel, Tach Gayint, Esite, Waldiya, Dewunt Delinter, Guba Lafto, Lay Gayint, Debre Sina, **Dessie Zuria**, Sayint, Mekdela, **Kutaber**, Tenta, Simada, Meket and Leg ambo. It is located between $10^0$33'06'' and $10^0$50'24'' latitude North and $37^0$42'36'' and $37^0$58'24'' longitude East. It lies in the altitudes range of 2100 to 4413 m.a.s.l.

The total population of the sub-basin is estimated to be 3,309,439 (CSA, 2016), while the total area is about 13,243 km^2. Population density is in between 50-250/person/km (Aster and Yilma (2009) .The Sub-basin has an annual rainfall ranging approximately between 825 mm and 1470 mm. It is characterized by lower annual rainfall (i.e. less than 1000 mm in its western lowlands) and higher rainfall ranging between greater than 1100 mm up to 1470 mm in its highlands (WRDA, 1993). According to Aster and Yilma(2009) , the annual maximum and minimum temperature in the sub-basin varies between13^0c -30^0c and 10^0c-15^0c respectively. Temperature is higher in the western lowlands with a maximum of 26^0c –30^0c and minimum of 11^0c – 15^0c and Potential Evapotranspiration (PET) in the sub-basin is generally between 1060 mm and 1920 mm per year. PET is greater than 1700 mm/yr. in the lowlands and along the river where high temperature is observed. The highlands of the basin show lower PET, i.e. less than 1500 mm/yr. (Mowers, 2008). The land use in Beshilo Sub-basin is dominated by crop cultivation. Only small parts of the sub-

[3] Great Ethiopian Renaissance Dam

basin are used as pastoral land. The watershed is characterized by tepid to cool moist and sub-moist mid highlands, and cold to very cold moist/sub-moist sub-afro-alpine to afro-alpine in parts of the highlands, the lowlands in the south-eastern parts of the basin being hot to warm moist lowlands (Aster&Yilma,2009). The geology of the sub-basin is mainly dominated by Basalt. There are Rhyolite and Alluvium deposits in the area. The dominant soil in the basin is Leptosols, Cambisols, Vertisols, and Luvisols (World Bank, 2006).

3.1.2. Study Woredas

The research is planned to take place in two woredas of Beshilo sub-basin; Dessie Zuria and kutaber (see fig. 2 map C &D). Based on CSA,2017, Dessie Zuria and Kutaber have a population of 178,791 and 107,988 respectively. The average rural household has 0.7 hectares (compared with the national average of 1.01 hectares and an average of 0.75 hectares for the Amhara region) and 0.6 heads of cattle. Six kebeles representing three different agroecology have been selected as a study kebeles from the two woredas (see map.D of Figure 2.).

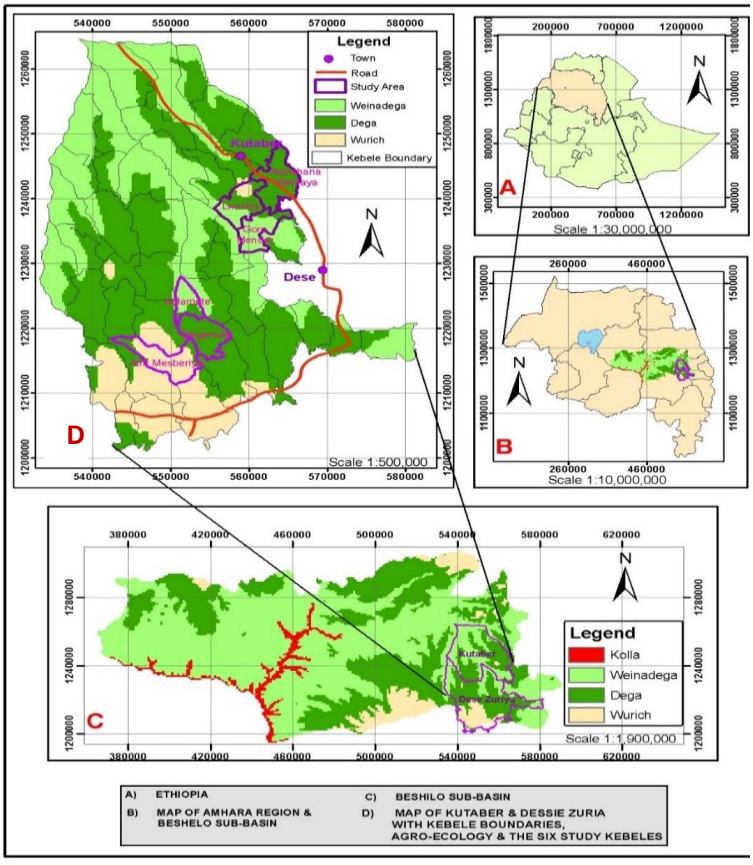

Figure 3.1Study area

3.2. Research Approach

The choice of a research approach is mainly dependent on the nature of the issue or issue being studied , the researcher experience, and the interest and willingness of the end user of the investigation (Creswell, 2014). Any researcher who is keen to embrace an investigation should concentrate and stress on the problem as opposed to focussing on research approach that he/she is proposing to pursue (Wilson & Rossman, 1985). Applications and solutions to problems are concerned (Patton, 1990). The other controversy in the world of research is that the researcher is not willing enough to indicate their stand and philosophical orientation regarding the phenomenon that they are planning to research. Creswell (2014) suggest that individuals preparing a research proposal should make him/her self-explicit to the philosophical ideas he/she is following and supporting. Creswell(2014)added that this information will help to explain why he or she chose qualitative, quantitative, or mixed methods approach for their research.

This research is planning to follow pragmatist way of world-wide thinking which seeks to answer questions which are by nature problem-centred, pluralistic, real-world practice and consequence of actions. As the main objective of the study, it will investigate the social, economic and environmental aspects of people living in Beshilo sub-basin and this makes that pragmatism philosophical thinking as best fit to this study. Yet, they trust that we have to start making inquiries about the real world and the laws of nature (Cherryholmes et al. 2018), "***They might just want to change the subject*"** (King, 1985). Logic therefore opens the way for different techniques, distinctive perspectives and various assumptions for the mixed strategies analyst, as well as extraordinary types of information collection and examination.

Mixed methods research approach which inquires the involvement and collection of both quantitative and qualitative data, and using distinct designs that may involve philosophical assumptions and theoretical frameworks is the selected research approach. As Creswell (2014) puts it, the central presumption of this type of application is that the combination of qualitative and quantitative methodologies gives an increasingly entire comprehending of the study issue than either approach alone.

3.3. Case Study Research Design

A case study research as a contextual investigation of phenomenon answers explicit research questions and which looks for a scope of various types of evidence, proof which is there for the situation setting, and which must be disconnected and collated to find the most ideal solutions to

the question explored. No one is likely to be sufficient or sufficiently substantial by himself (Gillham, 2000). Case study is a research approach that encourages methodical investigation and clarification of situation inside its specific circumstance (Algozzine & Hancock, 2006). It is perfect to de-construct and constructs the concept under scrutiny. According to Baxter & Jack (2008), it is a great idea to assess programs, and develop intervention as a result of its adaptability and flexibility to the local situation. An explanation given by the above scholars will pave impetus and mechanisms as to how SLM, land certification and food security interventions and situations to be studied.

This form of research design is mostly used by various disciplines. It is mainly applied when an in-depth explanation is sought. Yin(2009) defines a case study as an empirical inquiry that investigates a contemporary social phenomenon in-depth within its real-life using multiple sources of evidence. Karlsson et al.(2005) also describe that, a case study design has many advantages: its potential to study the cases in their natural environment, orientation towards understanding, thickness and theory generating capacity are amongst them. In addition, Yin stressed the advantages and disadvantages of using a case study design. First, it helps for an in-depth understanding of the phenomenon in its natural settings. Second, it provides a holistic and in-depth explanation by closely examining the topic in question through individual perspectives. Third, a case study investigation specialist chooses a little land territory for serious examination by asking how and for what good reason questions. Another preferred standpoint of a case study analysis explore configuration is that it consolidates subjective and quantitative techniques for information gathering. For this study, a combination of qualitative in-depth interviews and a quantitative survey were employed to better comprehend the varied perceptions and priorities of the studied households. Using these methods in tandem helps to achieve detailed contextual analysis of the sites. Yin(2009)describes three categories of case studies: exploratory, descriptive and explanatory.

Exploratory case studies explore a phenomenon by asking open-ended questions. This method was helpful in obtaining general information on the study locations and in shaping and reforming the research issues. Descriptive case studies refer to describing the general physical settings which include the study sites characteristics such as the history of food insecurity, demographic attributes, land degradation, tenure security, market points, health posts, temperature, rainfall pattern, and its seasonality, deforestation, and fertility. Explanatory case studies help closely monitor data to provide clarification.

Yin (2009) additionally distinguishes three reactions in utilizing a case study analysis structure. To begin with, it is difficult to make a speculation of the outcomes to a bigger population through sample examining. This investigation intends to make logical speculation instead of measurable speculation from the discoveries. The second analysis is identified with the analyst inclination that may influence the discoveries. In this case using relevant PRA techniques is sought very useful and applicable. These techniques are useful not exclusively to triangulate the outcomes ,but in addition, to build the information validity. The third analysis is that a contextual investigation configuration delivers a lot of data which is hard to oversee. This was somewhat alleviated through arranging the information into various topics. Bearing all these facts in mind, exploratory sequential case study , supported by other case study methods, selected as the design of this research.

Exploratory Sequential Case Study Method: Unlike explanatory case study method, exploratory sequential methodology will start by a qualitative survey and then pursued by a quantitative stage (Creswell,2014). Creswell includes that an exploratory successive mixed strategy is a plan in which the researcher initially explores subjective information and examination and then uses the findings in a second quantitative phase. Like the logical consecutive methodology, the breadth of data expands on the consequences of the underlying qualitative database. The aim of the system is to grow better estimations with explicit examples of the population and to check whether information from a respondent can be summed up to a huge example.

The researcher also intend to use a qualitative approach in this research to collect important information that would help the research as a corner stone . Focus group discussions to be held at different spatial dimensions, planned to explore data on wealth status, seasonal calendar, major livelihood types, livestock situation, market infrastructures and other relevant information that are quite important to be used as an input for the crafting of structured survey questionnaire. Furthermore, in the due process of the research, initially selected qualitative information will be triangulated with the data collected using other quantitative techniques.

This study seeks to explore the existing nexuses among tenure insecurity, land degradation, and food insecurity. In its first phase, it will carry a qualitative exploration to identify data regarding important attributes of the research; land tenure insecurity, land degradation, and food insecurity. Qualitative types of data from primary and secondary source will be collected initially from people residing in six kebeles[4]of the two selected woredas[5]and specific watershed in Beshilo sub-basin

[4] The lowest administrative structure
[5] The second lowest administrative structure

of the Blue Nile basin. At this juncture, the qualitative findings will be used to develop assessment measures that can be administered to a large sample.

3.4. Data Collection Methods

Understanding the complex and dynamic nature of tenure insecurity, land degradation, and food insecurity study requires a mix of both quantitative and qualitative research approaches. Through this approaches, it is expected to generate relevant data which give better insight about the conditions and characteristics of farming communities who are residing in the studied sub basin. The primary data will be collected using focus group discussions (FGD), key informants interviews (KII) and structured household surveys one after the other. Secondary sources will be collected by reviewing various research publications; government policy and strategy documents; and project documents of various organizations and institution working on the above-mentioned subjects. Furthermore, relevant statistical data will be obtained from Central Statistics Authority (CSA) publications, Ethiopian Metrological Survey and concerned zonal and woreda offices archives. In addition, the study will make use of secondary data like satellite images, aerial phots and topographic maps and will complement it with GPS assisted ground truth data collections.

3.4.1. Key Informant Interview

As Patton (2002) describes it, the fieldwork began by speaking with key informants (KII), who knows all about the study topic in question. Diverse group of people with specific knowledge on the three aspects and other domains of policy ranging from the woreda's Agriculture and Rural Development Offices, Food Security Sector, Land administration Bureau, opinion leaders, Development Agents(DAs) Kebele officials to Subject matter Specialists (SMS), progressive farmers, elderly, Farmers Training Centre (FTC) operators, researchers and people working in different subject matter, Community Based Organizations CBOs, Government Organizations (GOs) and None Government Organizations NGOs are among people to be interviewed. This method complements other methods and thus enhances the data quality through triangulation and validation process.

3.4.2. Focus Group Discussion

According to Hancock & Algozzine (2006), FGD is one of the most widely applied data collection methods for qualitative research in a particular and mixed method approach in general. For this research, FGD is found important to gather primary data that might not be collected by other meanness, for instance, interview and questionnaire. Focus group discussant can be selected

based on their education level, age, membership, gender, income, residence, position, participation or non-participation in a given program or intervention.

This method helps the researcher to get into direct contact with participants and generate data not only by recording what they say but also by observing their feelings and the real atmosphere. The inconvenience of this technique is that occasionally it is hard to bring discussants together (Hancock and Algozzine, 2006). This is, for the most part, the case, if the subject under exchange is politically or socially delicate. This is valid in some situations where individuals are reluctant to straight forwardly talk about and scrutinize government supported projects like land formalization. According to the same source, the second disadvantage of FGD is that there is a high probability of limited individuals or groups to influence other participant and divert the idea of other participants.

The method will be applied to understand the differences and commonalities of the informants' experiences and perspectives on the issues of tenure insecurity, land degradation, and food insecurity, the farmers' vulnerability to adverse events and their coping strategies and their role and contribution to SLM activities. FGD will also serve as a medium to establish the wealth status of the community, community resource mapping and Seasonal farming calendar by discussant based on criteria raised from the discussant themselves.

3.4.3. Structured Household Survey Questionnaire

To generate quantitative information at a household level, household survey will be undertaken by developing structured questionnaire. This instrument will be designed in order to generate information on households' socio-economic and demographic characteristics, livelihood, land attributes, land tenure, food security situations and its indicators, SLM related data and other important household attributes. The questionnaire will be designed to efficiently address tenure insecurity, land degradation & food insecurity and the extent and magnitude of the problems and the role of different stakeholders. The structured questionnaire will be designed and coded for Computer Assisted Personal Interviewing (CAPI) format and administered by Open Data Kit (ODK) software then the coded instrument will be uploaded on tablets and will be made ready for data collection. Enumerators will be recruited based on their proficiency in communicating using the local language, educational background and prior exposure to similar works. Training will be given to enumerators on the content of the schedule and the necessary procedure to be followed while conducting the survey. The household questionnaire will be pre-tested with non-sample households to make sure it is adequately prepared with regards of its completeness, clarity and other

related issues and modification will be done based on the feedback collected from the pre-testing operation. The questionnaire will be crafted in such a way that it answers the four sub objectives and the ten corresponding questions of the research.

3.4. 4. Document Analysis

Document investigation is an efficient strategy for inspecting or assessing archives. These archives can be both printed and electronic materials. They have different structures: laws, strategy archives, official and non-official reports, articles, books, papers, manuals, shapes, minutes, review information and so forth.

These records are sources of either row data or interpreted and analysed data. Translated reports can have a nature of experimental information (Bowen, 1997) ;(Strauss & Corbin, 1998) ;(Seddon et al., 2014). Information from archives is utilized to substantiate information created through interview, survey, observation and focus group discussion. The issue with archive investigation, notwithstanding, is that it may be inadequate or even out of date to answer inquiries. Most importantly, it might contain inclination of the individuals who delivered it. This examination adopts an all-encompassing strategy to address the exploration issue.

3.4.5. Observation and Other PRA Techniques

On the due course of the data collection process, the researcher will make an observation of the study area using a village walk or transect walk. This method will help the researcher to observe some environmental, socioeconomic, livelihood conditions and information regarding actors landscape which was over-looked during FGD, KII, and household survey. Information observed while undertaking this process will be recorded and documented using photographing, note taking and voice and video recording techniques and can be used as an input to triangulate with other data collected using other instruments. In addition to overt observation, relevant PRA tools like resource and community mapping, community workshop, pair-wise matrix and seasonal calendar techniques can be implemented.

3.5. Sampling Technique and Sample Size

As the research is intending to see the interdependent variables, it is found difficult to implement known sample size determination techniques because of their nature of reducing size of the sample households to be studied. Based on facts to be contextualized, the one assumed as best fit to this research is the explanation put forward by Yount(2006). According to Yount, It is up to the

researcher to weigh the factors of accuracy, cost, homogeneity of the accessible population, type of sampling and kind of study, and determine the best sample size for his study.

This research will be conducted in Dessie Zuria and Kutaber woredas, which are located in South Wollo Zone, one of the 11 administrative zones of the Amhara National Regional State of Ethiopia. The reasons for selecting these woredas include: the watershed is part of the north-eastern highlands of Ethiopia, which is historically known to be food insecure and highly threatened by severe environmental resource degradation, and no study has been carried out so far regarding food security and the other two aspects parallelly. This may be due to the roughness of the study area's topography.

Six kebeles from two woredas have been selected,3 kebeles from each woreda deliberately selected from three different agroecology; Weinadega (sub-moist cool), Dega (cold) and Wurch (very cold alphine). The agroecological classification and selection have been done based on the works of Hurni(1998). According to Belay et al.(2013), the structure of an agroecosystem is the result of its environment (e.g. climate, soil, topography, different organisms in the area), agricultural technologies and practices and the social environment of farmers (e.g. human values, institutions, and skills). Cognizant to this fact, as the total household heads in two woredas are estimated to be 47,799 and since it is greater than 10,000, the household to be sampled will be one percent or nearly 478 rural households (see yaunt,2006). Thus, the calculated sample size is adjusted to non-response rate of 10%, this will result in the number household to be surveyed to 526. Accordingly, proportional to population size sampling technique will be used to select the 526 households (See table.1).

Table 3.1 ; **Study woredas, kebeles and sample size**

Woreda	**Dessie Zuria**			**Kutaber**			**Total**
Kebele	Kola mote 020	Degamote 021	Atente meseberia	Goro mender	Alansha werkaya	Li-wiche	
Agroecology	Weinadega	Dega	Wurch	Weinadega	Dega	Wurch	-
Population/ Household	868	1340	790	613	998	1755	6364
Sample population/	72	111	65	51	82	145	526

Questionnaire							
KII	7	11	7	5	8	15	52
FGD	2	2	2	2	2	2	12
Community workshop	1	1	1	1	1	1	6

3.6. Data Analysis Method

Data will be interpreted and analysed using different statistical, econometrics, GIS, Remote sensing and food security models and tools. Appropriate qualitative statistical software will be used to interpret different data types and source of data. Data analysis will be done using a pairwise matrix, multiple criteria analysis, exploratory factor analysis, and binary logit models based on the requirements of each specific research question. In addition, the research will make use of map interpretation using ERDAS IMAGIN 10 and ArcGIS 10.2 software and relevant food security tools and measurements like HHFBM, HDDS, and HFIAS. The collected data will be investigated against systematic errors, outliers, and unusual results. Second, the data will be prepared for the econometrical data analysis with coding and decoding based on the feedback from the EDA. Third, the descriptive statistics results of the sample data will be produced using tables and graphs. Some of the descriptive statistics will be used for Spatial data presentation using GIS data presentation techniques. Finally, the econometric analysis and spatial data analysis will be conducted to reveal the situation of SLM, land certification, tenure security and LULC of the study area. Details for data collection, tools, corresponding questions , and analysis for each sub-objectives are explained in the following sections and the research operationalisation matrix (see annex one).

3.7. Methodology by Sub-objectives

3.7.1. Research Sub-objective one

To identify biological and physical soil and water conservation (SWC) practices mainly employed by the households engaged in SLM activities.

Proposed Methodology: the main aim behind this sub-objective is to answer why farmers participating in the SLM program decide to use one or more SWC practices preferably than others. It also seeks to identify major drivers for the adoption and sustainability of these selected technologies. In order to materialize the intent of this sub-objective, sequential exploratory case study

method will be employed and thus data collected through qualitative tools will support to craft and reformulate the quantitative tools (structured questionnaire) which will pave way for further triangulation. According to (Yin, 2003) the case study methodology allows for the use of multiple sources as a quality check. This allows the researcher to move from individual household case to the community stage to address the extent and magnitude of the problem to be studied. As this research follows pragmatism world thinking, it aspires to seek an answer for on-going societal problems. According to (Creswell,2014), pragmatism world view seeks to answer questions which had the nature of consequence of action, pluralistic, real-world practice-oriented and problem centred.

Therefore, this research will make use of different information gathered through qualitative and quantitative techniques from the primary and secondary sources. Using the two approaches, data on economic benefit, social, ecological and other forms in different slope categories will be collected using different tools. The information in this regard further enriched by data to be obtained from Subject matter specialist (SMS), Development agents, experts on the field and selected progressive farmers. It also collects data on major pillars of sustainability based on the opinion of farmers and an idea to be taken from literature and experts opinion. In addition, using the same tool and approach, the adoption and sustainability of these practices will analysed using the five pillars of sustainability.

Method of Data Collection: the case study methodology in general and exploratory case study, in particular, allows the use of various data collection method which paves way for refinement of data through triangulation. Based on this assumption, data will be collected through KII and FGD ,and the information collected through this technique will serve as a spring board to craft and formulate other follow up techniques like structured questionnaire The result of FGD will pave way to determine wealth ranking and seasonal calendar matrixes. The data collection will be further supported by transact walk, and note-taking. It also makes use of government and non-governmental organization reports, policy and strategy documents, community laws and bylaws and other relevant sources, A community workshop at a Keble label will be organized to further maximizes the richness of the data.

Method of Data Analysis: Data will be analysed using Multiple Criteria Analysis (MCA). MCA is a decision-making tool connected to decision issues despite various diverse choices and conflicting criteria (Hajkowicz et al.2000). Thus, a discrete MCA has been created as a basic decision-making instrument when distinctive goals must be fulfilled. MCA is an assessment technique, in light of

feasible advancement monetary hypothesis, that positions or scores the execution of choice alternatives against numerous criteria (Hajkowicz, 2007), guaranteeing the final results have clear importance as far as manageability (Boggia & Cortina, 2010). In any case, as far as assessing SWC technologies, MCA has a point of interest and disadvantages (DeGraaf, 1996; (Prato, 1999), yet offers extraordinary potential in tending to the weaknesses of other SWC assessment techniques. Taking this drawback in to account, pair-wise matrix will be used as an additional tool to complement the drawbacks of MCA. In addition, data will be presented and interpreted using descriptive and narrative methods and other relevant statistical tools.

3.7.2. Research Sub-objective two

To study the contribution of land certification to improve tenure security and agricultural productivity.

Proposed Methodology: It is aiming to study the contribution of successful land certification to tenure security and agricultural productivity. As a prominent concept, it will look into the four interlinked manifestations of successful land certification agricultural productivity, conflict, land rent, and availability of credit. As planned for other sub-objectives, different data collection methods will be utilized. Amongst, KII , FGD, structured questionnaire, transact walk or observation walk, seasonal calendar, wealth ranking are to mention a few. In addition, GO's, NGO's and CBO's reports document will be consulted to further widen the depth of the information. More importantly, household data adapted to local information like plot attributes, household size, consumption, production credits, markets, land, and land-related conflicts and their resolution mechanisms, farm, and non-farm income, investment on land, land rent-outs and rent-ins information will be collected using structured household survey. Samples will be stratified to represent different agroecology, kebeles, woredas, household headship and participation /not participation in SLM activities, In addition demographic, topographic, socio-economic, court cases are among the relevant issue to be addressed in either of the tools.

Methods of Data Collection: data will be collected through KII and FGD, and information collected through this technique will be used to craft and formulate other follow up techniques. Both qualitative and secondary data will be collected from primary and secondary source using data collection tools stipulated in previous two sub-objectives.

Data Analysis and Interpretation: Data will be interpreted using qualitative and quantitative software. Exploratory Factor Analysis (EFA) will be used to analyse data collected in various ways. According to Mac-Callum et al(1999), EFA provides more accurate results when each common factor

is represented by multiple measured variables in the analysis. Methodologist has recommended that at least three to five measured variables representing each common factor be calculated in a study (Veilcer and Fava,1998). In addition, some simple statistical methods, such as percentage, average, and graphic tabulation will also be employed for the analysis and interpretations of the result.

3.7.3. Research Sub-objective three

To investigate major land use land cover (LULC) changes observed as a result of the adoption of SLM activities.

Proposed Methodology: changes in land-use and land cover have occurred at all times in the past, are presently ongoing, and are likely to continue in the future(Lambin et al.2003);(Moser,1996). These changes need to be studied using effective and workable models. Models of land-use and land-cover change are powerful tools that can be used to understand and analyse the important linkage between socio-economic processes associated with land development, agricultural activities, and strategies for managing natural resources and how such changes affect the structure and functioning of ecosystems. Cognizant to this fact, the sub-objective is intending to assess and map LULC change resulting due to SLM in Beshilo sub-basin since 2008. In addition, it also study participatory land use plans made by the community, major changes in land use and the magnitude and adoption of sustainable use of environmental resource ,and major determinants for the observed LULC changes will be studied.

Method of Data Collection: To address its objective, it will use both primary and secondary data collected through qualitative and quantitative methods. Particularly, secondary data like a satellite image, aerial photo, topographic map, metrological data, and population data will be collected. In addition to this, primary data will be collected using Global Positioning System (GPS) to generate primary information regarding the ground truth for image classification and verification. Other methods like FGD, KII, and field survey will be deliberately carried on to increase the validity and reliability of data. This will be achieved by collecting relevant data like the rate of changes in terms of land use land cover, number of farmers engaged in land use planning, percent of adoption rate, degree and magnitude of extension service, number of farmers trained and number participatory land use planning and mapping, and degree and magnitude of adoption and vertical and horizontal scalability of the practices.

Data Analysis: After fieldwork, a supervised classification will be applied to the unsupervised classification signatures to identify the satellite imagery by using the different training sites. The

class assignment will be done using original images, topographic map, and field study knowledge to identify the various classes. Data analysis and processing will be done by digitizing, calculating and classifying the necessary information of each thematic layers using ERDAS IMAGINE 10 and ArcGIS 10.2 software. The procedure of data analysis to be followed will be Image rectification & restoration, image enhancement, image classification, and accuracy assessment. Finally, all parameters will be weighted using MCE(Multiple Criteria Analysis) ;(Carver, 1991) and Analytical Hierarchy Principle (Saaty, 2008). Furthermore, some simple statistical methods, such as percentage, average, and graphic tabulation will also employed for the analysis and interpretations of the result. Finally, LULC map of the studied area and NDVI of Beshelo sub basin will be calculated and mapped for the year 2008 where the SLM has started and for the year 2019 where the study is expected to take place. By collecting agricultural yield data from the district agriculture office and individual farming households, it will further explore how the SLM program has contributed to agricultural productivity and food security. After collecting data on determinants of LULC, the analysis will be made using Factor Analysis, the method which is sought relevant and appropriate for such kind of studies.

3.7.4 Research Sub-objective four

To explore the food security situation of rural households engaged in SLM activities

Proposed Methodology: This objective tries to explore three important possessions; the food security situation of households, major determinants of food security and prominent coping and survival strategies employed by studied rural households during the times of food shortages. As a comparative analysis method, the research looks the above-mentioned attributes by categorizing households in to two main groups; households those engaged in SLM and those who are not engaged. Food security is a concept which includes different layers of pillars that need multiple analysis techniques. Given the multidimensional nature of food security, researchers have long recognized the need for a variety of means of measurement (Kennedy, 2003);(FAO,2013).The "holy grail "of measuring food safety would be a single measure that is valid and reliable, comparable over time and space and captures various elements of food security. In spite of the development of many different indicators in the past decade, no single one meets these criteria (Coates, 2009). Based on this assumption most of the four pillars of food security needed to be measure for better validity and reliability.

Data Collection: Data on household, plot attribute, agroecology, meteorology, agronomy, and consumption will be collected using different tools. Based on the need of the work, these data will be

collected through KII and FGD and this, in turn, allows to rank households based on their wealth status. It also indicates the seasonal distribution of dearth period where seasonal and chronic food insecurities happen. Structured household survey will be made to support questions regarding the three food security measurement pillars (stability, utilization, and availability) are deliberately included in structured household questionnaire. In addition, field observation will be undertaken and various documents will be consulted .A community workshop at a Keble label will be organized to further triangulate the data collection analysis and interpretation process.

Data Analysis: data will be analysed using a different statistical method and different food security tools and models. Most importantly it will use a binary logit model and other descriptive statistical tools. In addition, the research will make use of Household food balance Model (HFBM) to measure food availability, Household Dietary Diversity Scale (HDDS) to measure food utilization ,Household Food Insecurity Access Scale (HFIAS) to measure food stability and reduced Coping Strategy Index (rCSI) to measure major coping strategies employed by households. Result obtained from these model will be analysed using multivariate linear analysis.

In order to study determinants of household food security, different methodological approaches will be followed. First, the list of determinants will be identified during the KII and FGD discussion and further redefined by reviewing the literature and experiment opinion. To avoid multicollinearity effect shortlisted independent variables will be fixed using Variance inflation factor (VIF)

4. OUTCOME AND LIMITATION OF THE RESEARCH

4.1. Validity and Reliability

The criteria this research apply are those of validity and of reliability (which in turn includes accuracy and precision) in a framework that partly overlaps with the one proposed by (A. Jr. Frongillo, 1999). The terms validity and validation have been used with different meanings in different occasions, and general consensus may still not exist (Hamelin et al.1999). The validity of this research will be established based on its careful design and use of a variety of appropriate methods, techniques and tools through triangulation (Patton, 1987) in (Kaulio & Karlsson, 1998). It is expected that results from this study can be a pointer to similar situations in other SLM Interventions with minimal adjustments to reflect the spatiotemporal, socio-economic, political and institutional contexts and peculiarities.

4.2. Expected Outcomes and Outputs

The proposed research aims to study the interplay the three wide spread problems of the place(land degradation, tenure insecurity, and food insecurity) through the lenses of SLM that are predominately affecting the livelihoods of farming communities residing in Beshilo sub-basin of Blue Nile basin specifically in Kutaber and Dessie Zuria woredas. These Woredas are highly heated by the devastating effects of land degradation and food insecurity. Though much studies have been undertaken by different scholars, at various spatial and temporal dimensions, the knowledge we had in this regard is so scanty and limited. Most of the researchers entirely tried to focus on either of the cases rather than showing the interplay among these factors.

Sub-objective one will seek to identify prominent physical and biological SLM technologies mainly practiced by farmers engaged in SLM activities and major drivers for the adoption and sustainability of these technologies. It will look into social, economic, institutional and technological factors that are responsible for the selection and adoption of particular SWC practices. It is well anticipated that the output of this sub-objective will come up with result that can be used as an input in the planning and implementation process of the upcoming planning SLM projects and beyond. These further contribute by and large for sustainable development programs and green economy strategy that the country is intending to implement. The finding of this sub-objective will further linked to the upcoming sub objective and pave way to align with the land certification program, one of the pillars of SLM.

Sub-objective two will study the contribution of land certification for tenure and agricultural productivity. It also looks into prominent factors contributing to successful land certification It is apparent that the finding of the research will be used as an input while crafting the upcoming land certification program and ends with bringing sustainable tenure security in the country. The two sub objective will obviously expected to contribute for LULC change of the place to be studied ,which in turn contributes by and large agricultural productivity ,and thus food security.

The third sub-objective investigates the land cover and land use changes happened as a result of SLM intervention based on before and after scenario. In addition, it also looks the change in terms of NDVI, agricultural productivity and participatory land use maps made and implemented for further and sustainable use of the natural resource base. Finally, major socio-economic, demographic, institutional and technological factors contributing to the change will be identified. The inputs from the finding will be used for the planning of identical projects in the country or beyond. Having appropriate SWC practice capable of arresting water and soil erosion, supported by tenure security and the resultant LULC change will obviously be prominent contributor to household food security in articular and sustainable use and management of natural resource in general.

The fourth objective is a comparative study aiming to study the food security situation of farmers who have participated and not participated in SLM intervention. It also identifies major determinants of food security and prominent coping and survival strategies employed by the studied households.

The innovative aspect of this study is that it is anticipating to study the three core problems which had a back and forth effect on the farmers residing in the sub-basin. Apparently, the problem of food security cannot be addressed unless and otherwise pertinent issues of land degradation and tenure insecurity timely and efficiently addressed. Cognizant to this fact, the result of the research is expected to contribute and inform new knowledge in these three core areas in particular and the academia, development practitioners and policy makers in Ethiopia and beyond in general. Based on the four sub-objective, as indicated in the below table, the study is expected to produce four journal articles.

Expected Publications

Table. 4.1 Publication Schedule

Sub-objective	Journal /Options			Publication title
To identify biological and physical soil and water conservation (SWC) practices mainly employed by the households engaged in SLM activities.	Journal of land use policy	Sustainability	Land degradation and development	Farmer's preference and determinants of selected SWC practices the case of Beshilo basin, Ethiopia
To investigate major land use land cover changes observed as a result of the adoption of SLM practices	Journal of land use policy	Journal of land and rural studies	JAC	Major LULC dynamics resulted due to SLM intervention in two selected woredas
To investigate the contribution of land certification programs to improve tenure security and agricultural productivity	Journal of land use policy	LAND	Journal of land and rural studies	The contribution of land certification to boost tenure security and agricultural productivity in Beshilo basin
Explore the food security situation of rural households engaged in SLM activities.	Global food security journal	Agriculture and food security journal	Land policy journal	Exploring Food security situation and major coping strategies employed by SLM participant and non-participant farming households

4.3. Data Management and Confidentiality

will be asked to sign a consent form and at the same time, they will be informed that their view will be kept out of the reach of the third party. The data will be anonymized and encrypted to protect personal data collected from the studied communities using passwords. Data will be kept in copy using different backup methods, which allow the researcher to get the required data immediately in case of loss of a computer hard wares or other storage devices. Data encryption and anonymity should be carried out both to keep the data secured and confidential. The researcher is also planning to use self-drive accessed from UT and his home institution, Addis Ababa University. In addition, the researcher would benefit from market place portfolio intended to be applied by the EENSAT project which could pave way for a mechanism through which the confidentiality, security, and sharing of data operation can be materialized.

4.4. Anticipated Limitations of the Research

As opposed to anticipated contribution of this research to the academic, policy makers and development practitioners, several factors would be predicted to hurdle the overall process of the research activity. Among other things, the prevailing political unrest in Ethiopia mainly geared by ethnic conflict is now paving way for the absence of peace and stability all over the country could be one of the problems that affects the data collection tasks in places specified. As a result of this unrest, the response of respondent may be influenced or inclined to the prevailing political context or their current sentiments on the issue to be researched.

Secondly, the budget allocated to the work is neither sufficient nor took in to account the economic and political situation of the country at present. Due to the problems specified so far, the living condition in particular and services needed are obtained at the high cost and the scenario is showing a skyrocketing trend. Finally, coupled with the above-mentioned problems, as the researcher is expected to render teaching and supervisory service at home university, it seems difficult for the researcher to undertake the research task parallel with the teaching and supervisory tasks at home university. This calls for a swift and timely discussion and arrangements with the university and minor adjustment on budget allocation or searches for other budget acquisition mechanisms

4.5 Field work Finical Plan

Table 4.2 Field work financial plan

S.no	Activity	Unit	Quantity	Unit price €	Total €
1	Round trip Air ticket (Addis to Kombolecha)	No.	2	200	400
2	Round trip Air ticket (Addis -Bahirdar)	No.	2	250	500
3	Enumerators training	Lump sum	1	200	200
4	Accommodation-researcher	Man days	180	30	5400
5	Accommodation-driver	Man days	180	15	2700
4	Enumerators	Man days	120	10	1200
5	Fuel and lubricants	Lump sum	-	-	1500
6	Community workshop	Lump sum	3	150	450
7	Stationary	Lump um	1	50	50
8	Transportation in NL	No.	6	24	144
9	Data processing	Lump sum	1	300	300
10	Workshop related costs	Lump sum	2	-	2750,00
				Sub-total	12868,00
				Contingency 10 %	1286,80
				Grand total	14154,00

4.6.Tentative Workshop Attendance

Table 4.3 Workshop Attendance Plan

Organizer	Theme	Date	Venue	Cost €
University of London	Food Security	May, 2019	Royal Holloway	To be covered by the organizers
FIG	Land Administration	2020	Utrecht	**250**
World Bank conference	Land	March 2021	Washington DC-USA	**2500**
Total			-	**2750**

5. Research Timetable

Table 5.1 1Reseach Timetable

	Place	2018		2019				2020				2021				2022	
		3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2
Research proposal	NL-UT																
Qualifier	NL-UT																
Prepare for Field	ET-AAU																
Pilot study	ET-BIS																
Field work	ET-BIS																
Data analysis	ET-AAU																
Workshop	TBA																
Writing paper 1 &2	NL-UT																
Attending courses	NL-UT																
Preparing for field work	ET-AAU																
Second field work	ET-BIS																
Data analysis	ET-AAU																
Writing paper 3&4	NL-UT																
Synthesis	NL-UT																
Finalize and submit	NL-UT																
Thesis defence	NL-UT																

NB: NL-UT(Netherland University of Twente), ET-AAU(Ethiopia, Addis Ababa University), ET-BIS(Ethiopia, Beshelo sub basin

6.LIST OF REFERENCES

Abafita, J., & Kim, K. (2013). Determinants of household food security in rural Ethiopia: An Empirical analysis. *Journal of Rural Development*, *37*(2), 129–157.

Adal, Y. (1997). Rural land holding readjustment in west Gojjam, Amhara Region. *Ethiopian Journal of Development Research*, *19*(2), 57–89.

Adal, Y(200). Review of Landholding Systems and Policies in Ethiopia under the Different Regimes: EEA/Economic Policy Research Institute. Working paper No 5/2002.

Africa Development Bank. (2014). Annual report 2014, 1–285. Retrieved from https://www.afdb.org/fileadmin/uploads/afdb/Documents/Generic-Documents/Annual_Report_2014_-Full.pdf

Alden Wily, L. (2018). The Community Land Act in Kenya Opportunities and Challenges for Communities. *Land*, *7*(1), 12. https://doi.org/10.3390/land7010012

Alemu, D. (2006). Comparative performance assessment of various cadastral surveying methodologies: Case-study of the hordofi village cadastral surveying exercise. *Addis Ababa: ARD Inc. in Collaboration with LALU and LAUD*.

Amede, T. (2003). Opportunities and Challenges in Reversing land Degradation: The Regional Experience. *Natural Resource Degradation and Environmental Concerns in the Amhara Nation Regional State: Impact on Food Security. Ethiopian Soils Science Society.*, 173–183.

Aster D. & Yilmaz S. International Water Management Institute. (2009). Characterization and Atlas of the Blue Nile Basin and its Sub basins.

Bao Le, Q., Nkonya, E., & Mirzabaev, A. (2014). *Biomass productivity-based mapping of global land degradation hotspots*. ZEF Discussion Papers on Development Policy.

Bennett, A. (2006). Agricultural Growth for the Poor: An agenda for development . Washington DC: The World Bank (2005), pp. 197, US$35.https://doi.org/10.1017/S0014479705213546

Belay S. et al, (2013). Agro ecosystem analysis of the choke mountain watersheds, Ethiopia. Sustainability (Switzerland), 5(2), 592–616. https://doi.org/10.3390/su5020592

Berry, L. (2003). Land degradation in Ethiopia: Its extent and impact. *Commissioned by the GM with WB Support*, 2–7.

Bewket, W. (2007). Soil and water conservation intervention with conventional technologies in north-western highlands of Ethiopia: Acceptance and adoption by farmers. *Land Use Policy*, *24*(2), 404–416. https://doi.org/10.1016/j.landusepol.2006.05.004

Bhattacharyya, R., Ghosh, B., Mishra, P., Mandal, B., Rao, C., Sarkar, D., … Hati, K. (2015). Soil Degradation in India: Challenges and Potential Solutions, Sustainability, 7, 3528–3570.

Bishaw, B. (2001). Deforestation and Land Degradation in the Ethiopian Highlands: A Strategy for Physical Recovery. *Northeast African Studies*, *8*(1), 7–25. https://doi.org/10.1353/nas.2005.0014

Blaikie, P. (2016). *The political economy of soil erosion in developing countries*. Routledge.

Bob, U. (2010). Land-related conflicts in sub-Saharan Africa. *African Journal on Conflict Resolution*, *10*(2).

Boruff, B. J., & Cutter, S. L. (2007). The environmental vulnerability of Caribbean island nations. *Geographical Review*, *97*(1), 24–45.

Brundtland, G. H. (1987). Our Common Future: Report of the World Commission on Environment and Development. *United Nations Commission*, *4*(1), 300. https://doi.org/10.1080/07488008808408783

CSA (Central Statistical Agency of Ethiopia). 2016. Statistical Abstract of Ethiopia, Central Statistical Agency, Addis Ababa: Ethiopia.

Debebe H., 1995. (1995). FOOD SECURITY: A BRIEF REVIEW OF CONCEPTS AND INDICATORS. Agricultural Economics Society of Ethiopia.

Degefa, T., (1996). Belg Crop Production as a Strategy of Households' Food Security: A Comparative Study of Belg Grower and Non Belg Grower Farmers in Munessa woreda, Arsi Region, M.A Thesis. Addis Ababa University, Addis Ababa

Degefa, T., (2000). Causes of Seasonal Food Insecurity in Oromiya Zone of Amhara Region: Farmers' View, 1–23.

Degefa, T., (2002). Household Seasonal Food Insecurity in Oromiya Zone, Ethiopia: Causes, Social Science Research Report Series, No.26, OSSREA, Ethiopia, Addis Ababa. 5

Degefa T., (2008). Understanding the Realities of Urban Poor and their Food Security Situations: A Case Study at Berta Gibi and Geemchu Safar in Addis Ababa City, Ethiopia. *Vrf Series*, *440*.

Degefa, T. ,(2009). An Assessment of the Role of Local Institutions and Social Capital in Household Food Security : A Case Study at Two Rural Communities in Oromiya Zone , Amhara Region. *Proceedings of the 16th International Conference of Ethiopian Studies*, (2000), 793–807.

Deininger, K., Ali, D. A., & Alemu, T. (2011). Impacts of Land Certification on Tenure Security, Investment, and Land Market Participation: Evidence from Ethiopia. *Land Economics*, *87*(2), 312–334. https://doi.org/10.3368/le.87.2.312

Deininger, K., Ali, D. A., Holden, S., & Zevenbergen, J. (2008). Rural land certification in Ethiopia: Process, initial impact, and implications for other African countries. *World Development*, *36*(10), 1786–1812.

Diagana, B. (2003). Soil Management – Collaborative Research Montana State University Trade-offs Analysis Project in West Africa Land Degradation in Sub Saharan Africa : What Explains the Widespread Adoption of Unsustainable Farming Practices ?, (June).

Diriba, G. (1995). Economy at the cross roads: famine and food security in Rural Ethiopia.

Dula & Degefa (2017). Unemployment and Food Insecurity in Urban Ethiopia. African Development Review, 29(1), 56–68. https://doi.org/10.1111/1467-8268.12238

EDHS. (2006). *Ethiopia Demographic and Health Survey*.

ENHRI.(1968).Food Composition Table for use in Ethiopia.

Eswaran, H., Lal, R., & Reich, P. F. (2001). Land degradation: an overview. *Responses to Land Degradation*, 20–35.

FAO. (2007). Nutritional status and food security. Retrieved from http://www.fao.org/elearning/course/FN/EN/pdf/trainerresources/learnernotes0280.pdf

FAO. (2009). Declaration of the World Summit on Food Security. *World Food Summit*, (November 2009), 16–18. Retrieved from www.fao.org

FAO, 2018. (2017). *the State of Food Security and Nutrition in the World*.

FAO, & ITPS. (2015). *Chapter 6 Global soil status, processes and trends. Status of the world´s soil recourses*. *FAO of the United Nations and Intergovernmental Technical Panel on Soils*.

Federal Democratic Republic of Ethiopia(FDRE, 2011) Ethiopia's Climate-Resilient Green Economy.

Food and Nutrition Technical Assistance(FANTA). (2007). Food and Nutrition Technical Assistance Project (FANTA) Academy for Educational Household Food Insecurity Access Scale (HFIAS) for Measurement of Food Access: Indicator Guide VERSION 3, (August). Retrieved from www.fantaproject.org

Federal Democratic Republic of Ethiopia(FDRE, 2014).Project Implementation Manual for Sustainable Land Management Project-2.

Francis, P., & Si, L. (2015). Sustainable Development Goals - kurz erklärt (englisch).

Gentilini, Ugo, (2002), Sviluppo dell'aiuto alimentare ed aiuto alimentare per losviluppo, Università Degli Studi di Roma Tre, Facoltà di Economia, Rome, 2002

Gebremedhin, B. (2010). *Sustainable land management through market-oriented commodity development: Case studies from Ethiopia* (Vol. 21). ILRI (aka ILCA and ILRAD).

Holden, S. T., Deininger, K., & Ghebru, H. (2009). Impacts of low-cost land certification on investment and productivity. *American Journal of Agricultural Economics*, *91*(2), 359–373.

Holden, S. T., & Ghebru, H. (2013). Welfare impacts of land certification in Tigray, Ethiopia. In *Land Tenure Reform in Asia and Africa* (pp. 137–161). Springer.

Lefroy, R. D. B., Bechstedt, H. D., & Rais, M. (2000). Indicators for sustainable land management based on farmer surveys in Vietnam, Indonesia, and Thailand. *Agriculture, Ecosystems and Environment*, *81*(2), 137–146. https://doi.org/10.1016/S0167-8809(00)00187-0

Lengoiboni, M., Groenendijk, L., & Mukahigiro, A. (2015). Land Tenure Regularization in Rwanda: Registration of Land Rights for Women and Its Impacts on Food Security, 3(2).

Lengoiboni, M., Lemmen, C., & Zevenbergen, J. (2017). Innovative tools for tenure recordation. GIM International, 31(10), 41–43.

Macgregor, C. J., & Warren, C. R. (2006). Adopting sustainable farm management practices within a Nitrate Vulnerable Zone in Scotland: The view from the farm. *Agriculture, Ecosystems and Environment*, *113*(1–4), 108–119. https://doi.org/10.1016/j.agee.2005.09.003

Mafongoya, P. L., Bationo, A., Kihara, J., & Waswa, B. S. (2006). Appropriate technologies to replenish soil fertility in southern Africa. *Nutrient Cycling in Agroecosystems*, *76*(2–3), 137–151. https://doi.org/10.1007/s10705-006-9049-3

Malthus, T.R. (1798). An Essay on the Principles of Population. Wrinley and David Souder (eds). The works of Thomas Robert Malthus, vol. 1. London: William Pickering

Maxwell, D. G. (1996). Measuring food insecurity: The frequency and severity of "coping strategies." *Food Policy*, *21*(3), 291–303. https://doi.org/10.1016/0306-9192(96)00005-X

Maxwell, D., & Wiebe, K. (1999). Land tenure and food security: Exploring dynamic linkages. *Development and Change*, *30*(4), 825–849. https://doi.org/10.1111/1467-7660.00139

McConnell, K. E. (1983). An economic model of soil conservation. *American Journal of Agricultural Economics*, *65*(1), 83–89.

McNeill, J. R., & Winiwarter, V. (2004). Breaking the sod: Humankind, history, and soil. *Science*, *304*(5677), 1627–1629.

Ministry of Environment and Natural Resources(MENR). (2016). Land Degradation Assessment in Kenya: Based on a Study of Land Degradation Assessment (LADA) with Remote Sensing and GIS, for Sustainable Land Management (SLM) in Kenya, (March).

Miranowski, J. A. (1984). Impacts of productivity loss on crop production and management in a dynamic economic model. *American Journal of Agricultural Economics*, *66*(1), 61–71.

Oldeman, L. R. (1992). Global Extent of Soil Degradation. *Soil Resilience and Sustainable Land Use*, 19–36. https://doi.org/10.1016/j.apsoil.2013.10.002

Oldeman, L. R. (1998). Soil degradation: a threat to food security. Report.

Otsuka, K. (2001). Population Pressure , Land Tenure , and Natural Resource Management in Selected Areas of Africa and Asia, (October), 31.

Persha, L., Greif, A., & Huntington, H. (2017). Assessing the Impact of Second-Level Land Certification in Ethiopia. *2017 World Bank Conference on Land and Poverty*, 1–27.

Place, F., Barrett, C. B., Freeman, H. A., Ramisch, J. J., & Vanlauwe, B. (2003). Prospects for integrated soil fertility management using organic and inorganic inputs: Evidence from smallholder African agricultural systems. *Food Policy*, *28*(4), 365–378. https://doi.org/10.1016/j.foodpol.2003.08.009

Place, F. M., Otsuka, K., & Holden, S. T. (2010). Understanding Land Markets: Questions and Hypotheses. In *The Emergence of Land Markets in Africa* (pp. 31–67). Routledge.

Rahmato, D. (1994). *Land tenure and land policy in Ethiopia after the Derg*. Land Tenure Project, Institute of Development Research, Addis Ababa University.

Rigby, D., Woodhouse, P., Young, T., & Burton, M. (2001). *Constructing a farm level indicator of sustainable agricultural practice*. *Ecological Economics* (Vol. 39). Retrieved from www.elsevier.com/locate/ecolecon

Selamyehun K. (2004). Using Eucalyptus for Soil & Water Conservation on the Highlands of Ethiopia.

Sen, A. (1982). *Poverty and famines: an essay on entitlement and deprivation*. Oxford university press.

Shiferaw, B., & Holden, S. T. (2000). Policy instruments for sustainable land management: The case of highland smallholders in Ethiopia. *Agricultural Economics*. https://doi.org/10.1016/S0169-5150(00)00046-3

Sibhatu, K. T., Krishna, V. V, & Qaim, M. (2015). Production diversity and dietary diversity in smallholder farm households. *Proceedings of the National Academy of Sciences*, *112*(34),10657–10662.

Smith, M., Pointing, J., & Maxwell, S. (1993). *Household food security: concepts and definitions:*

an annotated bibliography (Vol. 8). Institute of Development Studies.

Tully, K., Sullivan, C., Weil, R., & Sanchez, P. (2015). The State of Soil Degradation in Sub-Saharan Africa: Baselines, Trajectories, and Solutions, Sustainability, 7, 6523–6552.

Tully, K., Sullivan, C., Weil, R., & Sanchez, P. (2015). The State of soil degradation in sub-Saharan Africa: Baselines, trajectories, and solutions. *Sustainability (Switzerland)*, *7*(6), 6523–6552. https://doi.org/10.3390/su7066523

USAID. (2011). Country Profile: Property Rights and Resource Governance: Ethiopia, 1–28.

Utuk, I. O., & Daniel, E. E. (2015). Land degradation: a threat to food security: a global assessment. *J Environ Earth Sci*, *5*(8), 13–21.

Wairiu, M. (2017). Land degradation and sustainable land management practices in Pacific Island Countries. *Regional Environmental Change*, *17*(4), 1053–1064. https://doi.org/10.1007/s10113-016-1041-0

Webb, P., Braun, J. Von, & Yohannes, Y. (1992). Famine in Ethiopia. Retrieved from http://books.google.com/books?id=4YujWY3vkccC

WHO/FAO. (2002). Food energy – methods of analysis a WHO/FAO. (2002). Food energy – methods of analysis and conversion. Fao Food and Nutrition Paper, 93. http://doi.org/ISSN 0254-4725nd conversion. *FAO, Food and Nutrition Paper*, 93. https://doi.org/ISSN 0254-4725

WRDA, 1993, Ministry of Natural Resources & Environmental Protection, Water Resources Development Authority (WRDA), Prefeasibility Study, Koga

Catchment, Volume 1, Main Report, Feasibility study of the Birr and Koga Irrigation Project, Acres International Limited (Canada) in association with Shawel Consult International (Ethiopia)

Wingeyer, A., Amado, T., Pérez-Bidegain, M., Studdert, G., Varela, C., Garcia, F., & Karlen, D. (2015). Soil quality impacts of current South American agricultural practices. *Sustainability*, *7*(2), 2213–2242.

World Bank, Fernandes, E. C. M., & Burcroff, R. (2006). *Sustainable land management: challenges, opportunities, and trade-offs*. World Bank. https://doi.org/10.4141/cjss95-058

Zeleke, G., Kassie, M., Pender, J., & Yesuf, M. (2006). *SECOND DRAFT Stakeholder Analysis for Sustainable Land Management (SLM) in Ethiopia: Assessment of Opportunities, Strategic Constraints, Information Needs, and Knowledge Gaps*.

Zevenbergen, J.A (2009). Land Administration : To See the Change from Day to Day, (April), 1–23. Retrieved from http://www.itc.nl/library/papers_2009/scie/zevenbergen_lan.pdf

Zevenbergen, J. A. (2014). Systems of land registration : aspects and effects / Systems of Land Registration Aspects and Effects Nederlandse Commissie voor Geodesie Netherlands Geodetic Commission, (May).

Zevenbergen, J.A. & Vries, W. T. D. E. (2018). Dynamics in Responsible Land Administration ; Change at Five Levels (9349) Jaap Zevenbergen (Netherlands), Walter de Vries (Germany) and Rohan Bennett (Australia) FIG Congress 2018 Embracing our smart world where the continents connect : enhancing, (9349).

Annex 1. Research Operationalization Matrix

Sub-objective One: To identify biological and physical soil and water conservation (SWC) practices mainly employed by the households engaged in SLM activities								
Research question	**Concepts**	**Construct**	**Indicators**	**Variables**	**Data required**	**Data source**	**Analysis method**	**Questions**
RQ.1. What are the prominent biological and physical SWC practices mainly applied by the house-holds engaged in SLM activities?	Sustainable Land Management	Physical and biological SWC practices	Economic, social and ecological Benefits	Percent of change in economic, social, and ecological benefits as assumed by household engaged in the activities	Erosion Soil fertility Water retention Crop yield Pasture & bio-mass labour requirement Maintenance cost Convenience for ox ploughing Risk of pest harbouring Dispute and conflict with other users , and Plot label attributes.	FGD KII Structured questioner Pair-wise matrix Observation Document review Community workshop	Qualitative, quantitative,and other statistical software Descriptive statistical methods Multiple Criteria Analysis	1) Is there a problem of land degradation problem in your area? How do you see its extent and severity ? How do you explain the history of land degradation in this locality? 2) Could you tell me the causes of land degradation? 3) How you been informed about these SWC practices? What was your impression at the first glance? 4)How many plots of land do you have? Could you please tell me about the size, fertility, distance from home of your plots ,and the mechanism through which you obtained them? 4)Are there locally available SWC practices? What are they? How widespread are they? 5) Do you find new SWC practices are efficient and adaptable to your farming system condition? On your opinion What were the positive sides of the preferred SWC practice? How is their productivity in terms of yield, pasture and biomass? 6) Have you benefited from the new SWC schemes? How they have contributed to your farm productivity, household income and food security of your households? 7)Why you remain negligent or reluctant to invest in SWC practices introduced by the SLM project? 8) Put in the order of your preference SWC practices introduced by SLM project? 9) What are the draw backs of newly introduced SWC practices?

RQ.2.What are the drivers for the adoption and sustainability of the preferred SWC practices?	Sustainable Land Management	Drivers of sustainability and adoption	Pillars of sustainability; Productivity Viability Acceptability Security ,and Protection	-% of farmers satisfaction based on the pillars of Sustainability.	Yield adoption Crop variability Time requiring to adopt the practice Catastrophic weather trends Degradation trends Length of rotation Extent of fallow government and none-government programs Market objective and infrastructures Availability of service ,and off-farm and non-farm income.	FGD Structured questioner KII Field visit Transact walk Community workshop Document review	Multiple Criteria Analysis Descriptive statistical methods	1)What are the socio-economic, physical and institutional factors, you think that contribute to or/and limited the wide use of these practices? 2)What are major factors , that you think important, you to adopt these practices? How do you rate them? 3)How do you see the role of government and local institutions for the wide spread of these practices? Do you think you are happy and consulted at the initial stages of planning, implementation and monitoring process of all SWC intervention phases? 4) What do you think important to include or eliminate in the upcoming SLM intervention program? Or to be removed from the current project? 5) Do you get sufficient training and awareness about the practices? How often? 6) Are local institution were active in coordinating SWC activities and preventing the schemes from unnecessary use and abuse? Do these institutions have lows and bylaws to protect communal resources? Are government institution and other organization are keen to support the program? 7) Have you also adopted other technologies other than this practice? If yes, what are these practice? 8)Are you often repairing these structures? Is it labour consuming? If yes, do you think this could be one of the reason for less adoption rate of the practice? 9) How many hours/month in average you spent on building and repairing these structures? Are you doing this? If yes, why? 10) How do you see changes in terms of land degradation? Is it increasing or decreasing? 11) Have you faced weather catastrophe since you have implemented these practice? How is its extent and magnitude? How do you managed the problem? 12) Are you practicing fallowing and crop rotation practiced in the area? How often? Do you think these augments yield?

								13)Have you started producing certain goods to supply the market? Since when? What are they? 14) Do you have other off-farm and non-farm incomes other than agriculture? What are they? 15) Is the size and species composition of your livestock number has increased or decreased ?
Sub-objective-Two: To study the contribution of land certification programs to tenure security and agricultural productivity								
Research question	**Concepts**	**Construct**	**Indicators**	**Variables**	**Data required**	**Data source**	**Analysis method**	**Questions**
RQ.1.How has successful land certification contribute to improved tenure security and agricultural productivity?	Tenure security	Successful land certification	Changes in land management and productivity	Degree of change to invest on land with SLM activities Percent of change in agricultural productivity Percent of change in land rental activities Percent of change in land and land related conflicts	Demographic Topographic Institutional, Socio-economic Court cause data and Government non-government organizations Reports, policies, plans and strategies	FGD KII Structured questionnaire Observation Seasonal calendar and Wealth ranking Document review Community work shop	Exploratory factor analysis Descriptive statistical analysis	1)When is the land certification program introduced? When was completed? 2)When does certificate distribution has started? Are you interested with contents of the certificate? If no, what was missing? 3) Was there a land use and land administration committee? Are women well represented in the committee? If not why? 4)Have you felt that you are well informed and represented on and about the program? 5)Have you built new conservation structure on your plot after certification? What type of SWC structures? Do you found them effective? 6)How many plots you rent-out annually? What Size(hectare) ? How many birr or quintal of seed you annually earn from rented plots? 7) How many plots you rent-in annually? What Size(hectare) ? How many birr or quintal of seed you annually pay for rented plot(s)? 8) What type of local land renting mechanisms are common in your locality? Renting or share cropping? 9) Have you changed your house from grass thatched roof to corrugated iron ? If yes, do you think it is because the money you got from rented land or yield increase resulted as a result of investingng on your land? 10) How do you find the trend of land and land related conflicts ? Are they increasing or decreasing?

								11) What are the mechanisms through which you solve and resolve these conflicts? 12) What percent of the total court cases appearing to kebele and woreda courts are land and land related ?or what percent of causes in the local conflict resolving platforms are land related? 13) have you witnessed increase in grain yield ever since you obtained the certificate? If yes, what percent it is ?
RQ.2,What are prominent factors responsible to successful land certification?	Tenure security	Contributing factors to successful land certification	Changes in tenure security	Percent of change in population Type and magnitude of plot characteristics Number and quality of institution Number and effectiveness of policy ,strategy and plans Magnitude and extent of socio-economic factors Number of trainings and awareness creation programs	Demographic Topographic Institutional Socio-economic ;and Court causes Document review	FGD KII Field visit, Transact walk, Seasonal calendar and wealth ranking Structured questioner Document review Community workshop	Exploratory factor analysis Descriptive statistical analysis	1)Are sex and education level of the household affect/effect land certification? If yes, how? 2) Is family size and available labour force determine land certification? If yes specify. 3) Have you received training on land certification? If yes for how long and how often? 4) Is the agricultural extension program is supporting the farming community to participate in land certification? If yes, how do you explain this support? 5)Have you got a credit to upgrade your farming activity from any source? How much ? On what interest rate? Was it feasible? 6)Do you think that, after having land certificate, you will inherit your plots to your children? If no, why? 7)Do you have a fear that land certification will follow land redistribution sometimes in the future? If yes, what is your reason? 8) Do you believe that the core objective of land certification is to answer the felt need of the people or to answer some hidden agendas of the government? If yes/no, why? 9) Is the size and composition of your livestock increased or decreased? If yes/no, what is the reason for the change ? 10) Have you started your individual land use planning to effectively utilize your farm plots? If yes, what type of planning ,since when? 11) Are you planning to commercialize your farming by producing certain commodity to supply to market? If yes, what are the activities on what scale?

				Number of land use and land administration committees organized				12) Have you tried to diversify your income from agricultural, non-farm and off farm activities?
Sub-objective - Three : To investigate major land use land cover (LULC) changes observed as a result of the adoption of SWC practices								
Research question	**Concepts**	**Construct**	**Indicators**	**Variables**	**Data required**	**Data source**	**Analysis method**	**Questions**
RQ.1.What do the LULC dynamics look like?	-Improved and favourable changes	-Sustainable and efficient utilization of natural resource base	-Change in land cover -Change in land use -Agricultural productivity	-Percent of change in NDVI -Percent of change in agricultural productivity -Number of appropriate land use plans performed -Number of farmers trained on participatory land use planing and mapping	-Demographic -Topographic - Institutional -Metrological -Spatial and temporal data -Socio-economic data	FGD KII Observation Structured questionnaire Document review Satellite image Aerial photo Topographic map	ERDAS IMAGINE 10 ArcGIS 10.2 Multiple Criteria Analysis Descriptive statistical analysis	1)Have you witnessed change in terms of LULC after SLM intervention? How do you explain and rate the changes? 2)Is he LULC has brought about change in your yield (crop, pasture and biomass) If yes how ? 3)Have you trained on land use planning and participatory planning? If yes, for how long? 4) Have you witnessed in the quality, water retention and organic contents of your farm soil? How do you explain the change? 5)Does the LULC changes pave for a new livelihood options expressed in terms of off-farm and non-farm activities? 6) Have you informed about the suitability of conducive LULC change to people residing in other kebeles? What was the medium of the information? 7) Do you think, other kebele people are willing enough to practice this intervention? How do you see their eagerness ?
RQ.2.What are the major drivers for the existing LULC changes ?	Improved land use land cover changes	Drivers of changes	Land degradation Population growth Diminishing land size Agricultural intensification	Rate of changes in terms of land use land cover Number of Farmers aware of the problem Percent of the adoption rate	Demographic Topographic Institutional Socio-economic Agronomic	FGD KII Observation Structured questionnaire	Exploratory factor analysis Descriptive statistical analysis	1)How is the extension program look like? Does it organized in such a way that to give efficient and all versed service? 2)Is there a consortium of organizations working to support the program?Who are they? In what areas they provide support? 3)What are the grass root level mechanisms through which these schemes are protected?

			Land tenure status Policies on land use Climate change	Degree and magnitude of Extension service Number of farmers trained Adoption and scaling up of SLM technologies	;and other land related data.	Document review Transact walk Seasonal calendar Wealth ranking Community workshop		4)How was the magnitude and extent of land degradation before the implementation the Land use planning? 5)What percent of the Keble members become willing to participate in the program? What was the reasons for active or passive participation? 6) Is there any sort of conflict between upstream and downstream people on use and abuse of these common resource of resource? 7) How can these problems have been solved? 8)What was the extent of soil erosion ?
Sub-objective -Four : To explore the food security situation of rural households engaged in SLM activities								
Research question	**Concepts**	**Construct**	**Indicators**	**Variables**	**Data required**	**Data source**	**Analysis method**	**Questions**
RQ.1.What does the food security situation of rural household look like?	Food Security	Pillars of food Security: Availability, Accessibility, Utilization; and Stability indicators)	Household food security	Percent of household found food secure, mildly food secure and food insecure. Kcal availability per individual Amount of food available for consumption	Socio-economic Demographic Metrological Environmental ;and Agronomic data	FGD KII Field visit Questioner Government report Seasonal calendar and wealth ranking Transact walk	Binary logit model Descriptive statistics HHFBM HDDS HFIAS	1) What are major crops produced and how is the yield /qt/ha? 2)What are the prominent sources of food entitlements? 3) What are the major reasons for recurrent food shortage? 4)Do you think that you have sufficient food that can feed your family for the whole year? 5) How is the diversity food basket of the household?What are the common diets your community is mostly consumes? 6) Do your household will frequently worry about food shortage very often ?specify the extent and magnitude. 7) Do you often observe under five children stunting and wasting? Hoe the severity of these problems in your locality?

				Number of food items served		Document review Community workshop		8) Do you give or receive grain from/or to others during food shortage times? What amount of grain annually? 9) What are the parameters that your community uses to determine individuals wealth status? How farmers are grouped according to their wealth status? 10) Do you keep seed for the next cropping from your current produce?or improved seed from government stores? If any specify? 11) Is there an opportunity to get meteorological information from the concerned bodies?
RQ.2.What are the determinants of household food security in the study area?	Food Security	Determinants of food security	Household food security	Percent change in agricultural productivity Number plot under SLM Degree and extent of fertilizer and other inputs	Socio-economic Demographic, Metrological Demographic ;and Agronomic data	FGD, KII Structured questioner Document review Seasonal calendar wealth ranking Transact walk Community mapping	Binary logit model and descriptive statistics	1)What are the major factors that determine household food security in this locality? Do you rate the level of significance of each factor? 2) Are there natural calamities that cause food shortage in the area? What are there? What is the frequency of occurrence of these natural calamities? 3) Are there pests and diseases that causing yield reduction? Can you please specify them. What is the extent of the damage? 4)What the average land holding size? Do you think the land holding of individual farmers is enough to support the substance of each household? 5)Have you implemented soil and water arresting structures on your plots? Since when? Do you think it is important to for increased agricultural productivity? 6) Is there market organized in such a way that to efficiently facilitate food transaction process? How and to what extent? 7) Do you think implementation of SWC practices have positive contribution to yield increment? 8)Is post-harvest los common in the area? What is the proportion of post- harvest loss? What are the reasons for the prevailing post-harvest loss? 9) Do you use modern inputs like artificial fertilizer, pesticide ,herbicide and improved seed?How do you access them? How far is the store from your residence?

								10) have you had plot/s cultivated under irrigation? What size and what are the prominent cops or vegetables you are under this scheme? 11) Do you have information access to market, Agricultural extension, health, food preparation ,meteorology and other important events? 12) Have you benefited from safety net programs? How and when?
RQ.3. What are the major coping strategies adopted by households during food shortages?	Food shortages	Coping and survival strategies	Sequential household coping strategies	Change in consumption pattern Seeking money and grain loan of non-productive asset Sale of productive asset Seeking free handout food Destitution and migration	Socio-economic Demographic Institutional Market data	FGD, KII Structured questionare Document review Seasonal calendar wealth ranking Transact walk Community mapping	Binary logit model; and descriptive statistics	1)How land degradation and tenure insecurity affect the household food security? 2)Is the problem of food shortage occurring recurrently ? If yes, in what interval? 3)How do the household manage the effects of food insecurity? 4)Could you tell me any new strategies adopted in production pattern to cope the problem of food shortage? 5)Who are unable to cope and recover when food shocks occurred? Why? 6)Is there culturally established reciprocal claim methods that works during food shortage? If yes, tell me how it works 7)) Do you think the adopted strategies have erosive effects on food security? How? 8) What will be the final option of the household if the problem remains uncontested?