



**ADDIS ABABA UNIVERSITY**

**COLLEGE OF DEVELOPMENT STUDIES**

**CENTER FOR RURAL DEVELOPMENT**

**Determinants of Rural Households' Resilience Capacity to the  
Effect of Land Degradation: The Case of Gubalafto Woreda,  
North Wollo, Amhara National Regional State, Ethiopia.**

**By:-**

**Wasie Tefera**

**Addis Ababa University**

**Addis Ababa, Ethiopia**

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**DEVELOPMENT**

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Degradation; The Case of Gubalafto Woreda, North Wollo Zone of  
Amhara Region, Ethiopia.**

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Rural Livelihood and Development**

**By:-**

**Wasie Tefera**

**Advisor: Negussie Semie (PhD)**

**Co-Advisor: Professor Degefa Tolossa**

**June, 2021**

**Addis Ababa, Ethiopia**

## **Declaration**

I declare that this thesis is my original work. It has not been presented for a degree in any other University, and all sources of materials used in this thesis have been properly acknowledged and a reference list has been appended.

**Declared by:** Wasie Tefera, candidate

Signature: \_\_\_\_\_

Date: - January 21<sup>st</sup>, 2021

**Confirmed by:** \_\_\_\_\_

Date: \_\_\_\_\_

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## LIST OF ACRONYMS

ADB	Africa Development Bank
CSA	Central Statistics Agency
DA	Development Agent
DRRLRP	Disaster Risk Reduction and Livelihood Recovery Program
FGD	Focus Group Discussion
HFIAS	Household Food insecurity Access Scale
HHs	Households
KII	Key Informant Interview
KMO	Kaiser-Meyer-Olkin
OLS	Ordinary Least Squares
RI	Resilience Index
RIMA	Resilience Index Measurement Analysis
NDVI	Normalized difference vegetation index
SPSS	Statistics Package for Social Scientist
SSN	Social Safety Net
TANGO	Technical Assistance to Nongovernmental Organization
TLU	Tropical Livestock Unit

## **ABSTRACT**

*This paper estimates determinants of rural households' resilience capacity to land degradation in Gubalafto Woreda. Cross-sectional data collected through field survey by involving 361 households, key informants interview and FGD was the base of the study. Sequentially, explanatory mixed-method-research strategy was adopted as a research strategy. Stratified, simple random, and systematic sampling methods were employed to draw the sample from the study population. The data was analyzed by using descriptive statistics (dominantly percentage) and Principal Component Analysis (PCA). Socio-economic characteristics of households, perceived effects of land degradation and coping strategies were analyzed using descriptive statistics. Hence, out of the total 361 surveyed households, 293 (81.2%) replied that they were affected by land degradation. Therefore, households employed different coping strategies in response to the effects of land degradation. These coping strategies include; technical coping strategies, consumption based coping strategies and non-consumption based coping strategies, as response to the effects of land degradation. Principal Component Analysis (PCA) was also run to estimate determinants of rural households' resilience capacity. These latent variables (determinants) of resilience capacity were estimated through observed variables. The Kaiser-Meyer-Olkin (KMO) tests of sampling adequacy for all latent variables, except Social Safety Net (SSN) were above 0.5. In addition Bartlett's Tests of Sphericity for each variable (latent) were also significant at different levels, which imply the appropriateness of the model.*

***Key words: Land Degradation, Resilience, Coping Strategy, Gubalafto Woreda, Ethiopia***

# CHAPTER ONE: INTRODUCTION

## 1.1 Background of the Study

Ever since mankind started agriculture, land degradation has been the single largest threat to soil productivity and has remained so till date (Sullivan, 2004). During the 20<sup>th</sup> century, land degradation has been a major global agenda. This problem will also remain high on the international agenda in the 21st century. According to different scholars, this is so because removal of the topsoil by any means has many destructive and disastrous effects on the productive capacity of the soil and ecological wellbeing. For instance Doran and Parkin (1994) in Ime O. Utuk, (2015) captioned the impact of land degradation in their popular maxim that, “the thin layer of soil covering the earth’s surface represents the difference between survival and extinction for most terrestrial life” (Ime, 2015).

Ethiopia is among the poorest of countries and both poverty and land and resource degradation appear to feed off each other. It is known that Ethiopia is a country with high biodiversity and distinctive ecosystems and the natural resource base is critical to the economy and the livelihood of a high percentage of the population. Agriculture accounts for 50 % of GDP, 85 % of foreign exchange earnings and supports, albeit insufficiently, 85 % of the workforce. Direct losses of productivity due to land degradation are minimally 3 % of agriculture GDP which is critically important figure with a population growth rate of 2.3 % (Berry, 2003).

Therefore, the protection, improvement and rehabilitation of mountain or upland watersheds are of critical importance in countries like Ethiopia so as to achieve overall development goals. Recognizing this, many developing countries including Ethiopia, are turning increasing attention to the field of watershed management. Initial efforts have often been "fire-fighting" in nature, i.e. an immediate but isolated response to a perceived problem. However, in many if not most developing countries, the nature and magnitude of the problem of watershed degradation, and the scarce availability of resources mandate a comprehensive long-term approach. The keys to successful implementation of any such effort are accurate and appropriate survey and planning. (Sheng, 1990)

Even if increasing population pressure has made the struggle tougher, Ethiopia has been in continuous struggle to achieve the three objectives of increasing agricultural production, reducing poverty and ensuring sustainable use of the natural resources, especially since the early 1990s. Eicher (1994) lamented that increases in agricultural production need to come primarily from improvements in land productivity since the land frontier are shrinking. This is so because agricultural productivity cannot be attained if the land resource base continues to be degraded. Hence, ensuring sustainable land management is a matter of critical importance for agricultural growth in Ethiopia. (Berhanu Gebremedhin, 2010)

## **1.2 Statement of the Problem**

The land soil and water are the most precious natural resources we have. However, human actions that started 5000 years ago continue to cause an ever decreasing decline in their quality and value. More than 20 years of research has shown that desertification and land degradation can be stopped and large areas restored of their quality. Protecting and restoring the functions and services that have been lost by the land and soil is seen as the key to sustainable development and reversing climate change (Imeson, 2012).

Land degradation has significant costs, particularly in developing countries (Rosegrant and Ringler, 1997). It not only reduces farm productivity affecting livelihood and regional economies, it also leads to reduced biodiversity and stream sedimentation affecting water quality, storage and marine resources. Land degradation in most developing countries is becoming a major constraint to future growth and development (Raina, Joshi and Kolarkar, 1991; Reddy 2003). About 40-75% of the world's agricultural land's productivity is reduced due to land degradation ((IFPRI, 2000); (Maria, 2012))

Ethiopia has mostly complex and fragile landscapes. Land degradation seriously affects and threatens livelihoods and food security of millions in Ethiopia. Mainly land degradation arises from (1) high soil erosion rates as a result of steep slopes, continuous encroachment and cultivation of marginal lands; (2) long history of deforestation, overgrazing, negative coping strategies such as the burning of animal dung, extensive use of charcoal, reduced rotation periods, and others; Recurrent cycles of drought and inadequate infrastructure have further aggravated the problem. Consequently, the farming systems that exist in the country

are progressively impoverished and more vulnerable to shocks. These are serious constraints to sustainable development and a main cause of unstable, over-simplified and drought prone production systems. (Lakew Desta, 2005) Studies have shown that Ethiopia is a country with the highest rates of soil nutrient depletion in sub-Saharan Africa, with soil erosion estimated to average 42 tons per hectare per year on cultivated land (Stoorvogel and Smaling, 1990; Pender, Gebremehedhin, Beninand Ehui, 2001) cited in (Maria, 2012). This impact of land degradation can be seen in various ways. For instance, the direct cost of loss of soil and essential nutrients due to unsustainable land management is estimated to be about three percent of agricultural GDP or \$106 million (1994). Other modeling work suggests that the loss of agricultural value between 2000-2010 was \$7 billion. None of these estimates takes account of the indirect impacts of land degradation in Ethiopia (Berry, 2003).

Although various studies are conducted on resilience to natural disasters and their effects on people's livelihoods in Ethiopia, the majority of them were done on poverty, food insecurity, flooding etc. which for the most part, neglected resilience in line with the impact of land degradation. For instance (Birhan, 2018) studied poverty, vulnerability and resilience in rural Ethiopia: forward-looking empirical analyses for more effective policy interventions. The study by Maxwell *et al.* (2013) was done in Tigray National Regional State, Ethiopia, focused mainly on dynamics of food security and its determinants, and tracking dynamics of livelihood assets accumulation and loss. Households' resilience to seasonal food insecurity was analyzed by the study of (Guyu, 2015). His study identified the building blocks of resilience in the 'green famine belt' in north-western Ethiopia, Benshagul Gumz region (Adane, 2018). Another study made by (Zerihun, 2008) revealed determinants of the livelihood resilience (natural capital, economic capital, human capital, social capital, degree of exposure to flooding and access to infrastructural facilities) of rural households in the face of flood disasters in Ethiopia, a case of Dembia Wereda, North Gondar zone of Amhara National Regional State.

However, none of the aforementioned studies has addressed the focus area of the current study either area wise or in terms of the issues to be addressed. Hence this study agree with the argument of (Adane, 2018) treating resilience as multidimensional concept, which is more appropriate.

Therefore, as to best of the researcher's knowledge research works conducted on the effect of land degradation in relation to rural household's resilience capacity particularly in the study area are still demanding. Accordingly, this research work could fill knowledge gap of resilience from area specific, local context in study area and the region in general. Thus, the aim of this thesis is to systematically assess indicators of rural household's resilience capacity in the context of the effects of land degradation in the case of Gubalafto Woreda, North Wollo, Amhara region, Ethiopia.

### **1.3. Research Objectives**

#### **1.3.1. General Objective**

The major objective of the study is to examine the existing determinants of rural households' resilience capacity to the effect of land degradation in the case of Gubalafto Woreda, North Wollo, Amhara National Regional State, Ethiopia.

#### **1.3.2. Specific Objectives**

- ✚ To identify the main determinants of rural households' resilience capacity to the effects of land degradation in the study area.
- ✚ To identify agro-ecological zones based on their resilience capacity.
- ✚ To identify the effects of land degradation in the study area.
- ✚ To investigate the coping strategies employed by households' in response to the effects of land degradation in the study area and
- ✚ To assess rural households' perceptions towards the effects of land degradation in the study area.

### **1.4. Research Questions**

1. What are the major determinants of rural households' resilience capacity to the effects of land degradation in the study area?
2. Which agro-ecological zone is more resilient or less resilient?
3. What are the main effects of land degradation in the study area?

4. What are the coping strategies taken to encounter the effects of land degradation in the Study area?
5. To what extent rural households are aware of the effect of land degradation?

### **1.5. Significance of the Study**

Besides limited in number, much of the resilience studies are focused on the issue of food security. As to best of my knowledge, research works conducted on the effect of land degradation in relation to rural household's resilience Capacity, particularly in the study area are still limited. Accordingly, this research work could probably fill knowledge gap of determinants of resilience capacity in line with land degradation from area specific, local context in the study area and the region in general. Thus, the aim of this thesis is to systematically assess determinants of household's resilience capacity in the context of land degradation in the case of Gubalafto Woreda, Amhara National Regional State, Ethiopia.

### **1.6. Scope of the Study**

This study focuses mainly on the assessment of determinants of resilience capacity in the face of land degradation in the case of Gubalafto Woreda, North Wollo, Amhara National Regional State, Ethiopia. It was mainly focused on the assessment of land degradation, coping mechanisms to the effect of land degradation and indicators or determinants of resilience capacity across selected households.

### **1.7. Limitation of the Study**

The current study has faced the following limitations: First, assessing factors that determine the resilience of people in the face of land degradation needs to take in to account change in the livelihood conditions of people over time and space. And to accomplish this, data collected by using longitudinal survey design would have been advantageous. However, this study relies on cross-sectional survey design and only shows the factors that determine households' resilience at a time when the data was collected. To overcome this limitation however, the study attempted to obtain data on the previous livelihood conditions, coping strategies, etc. of households by using key informant interviews and Focus Group

Discussions (FGD). In this case for instance, the key informant interview and focus group discussion indicated that households employed consumption based mechanisms like borrow food, rely on help from a friend or relatives, Limit portion size at mealtimes, purchase food on credit etc. But, those coping mechanisms were not significantly captured through cross-sectional household survey. This is due to the data was collected after the time of harvest when rural households usually do not face consumption related problems.

Second, there was shortage of empirical studies related to the issue of resilience capacity in the context of land degradation in the literature. As a result, the study was forced to rely more on other empirical findings done on resilience capacity in the face of food insecurity, drought, flooding, etc. This to some extent might limit the application of some of the lessons drawn from such studies owing to socio-economic and contextual differences.

Third, the study faced financial constraints to hire data collectors. To offset this limitation however, the researcher relied on helps from families and friends.

### **1.8. Ethical Consideration**

Research ethics were properly followed in the process of conducting this study. Formal procedures in the process of data collection were followed; the informed consent of all respondents was obtained before asking for any form of information

### **1.9. Organization of the Thesis**

The rest of this thesis is organized into five sections. Chapter two reviewed the relevant literature that includes definition and concepts, theories and empirical literatures of land degradation and households' resilience. The third part discussed on methodological issues employed and description of study area. Chapter four comprises results and discussions of the study. Conclusions and recommendations made from the study are presented in chapter five.

## CHAPTER TWO: REVIEW OF LITERATURE

This chapter mainly contains (1) concepts of land degradation, causes and consequences of land degradation, farmers' perception about land degradation, coping strategies to land degradation and (2) concepts of resilience, resilience measurement, empirical literature review and conceptual framework of the study.

### 2.1. Definition and Concepts

#### 2.1.1. Definitions of Land Degradation

Land degradation as defined by Abdi, Glover and Luukkanen (2013), is the result of biophysical and socio-economic issues which are highly interrelated. These issues affect many people and their land, especially in the tropics and developing countries. Accordingly, the term land degradation involves both soil and vegetation degradation. Soil degradation refers to undesirable modification in the properties of the soil. On the other hand vegetation degradation is the reduction in the number of species and the vegetational composition. Hence, land degradation is usually described in terms of the loss in natural resources (soil, water, fauna and flora) or in the biophysical process by which it functions. (Ime, 2015)

According to (Yadav, 1996), "**Land**" includes not only the soil resource, but also the water, vegetation, landscape, and microclimatic components of an ecosystem. "**Degradation**" is, by definition, a process of change over time. "**Land degradation**" refers to a reduction in the productive capacity of the land or its potential for environmental management, either temporarily or permanently.

Degradation may also be considered in terms of specific components of the land that are affected. For example, vegetation degradation implies reduction in productivity, declining species diversity, and degeneration in the nutritional value of plant populations for the faunal biota. And soil degradation implies deterioration in soil quality and fertility. Such changes may be brought about by many factors (erosion, pollution, deforestation, and others). Again, land degradation may be considered in respect of its physical aspects, referring to changes in the soil composition, especially loss of soil organic matter, and structure, such as compaction

or crusting and water logging; chemical, pertaining to changes in the soil chemistry's chemical makeup as a result of leaching, salinization, or acidification; and biological degradation referring to reduction of soil biodiversity. (Genesis, 2015)

Land is defined as the “ensemble of the soil constituents, the biotic components in and on it, as well as its landscape setting and climatic attributes” (Vlek et al. 2010). Land degradation is a composite concept that has been defined in many and various ways. Indeed, it is a concept as much as a process, defined in various ways by researchers and institutions in this field. This could partly be as a result of the diversity of processes of land degradation in type, scale, time, and extent; the processes are well known but not always fully understood. According to Warren (2002), land degradation is a very contextual phenomenon and cannot “be judged independently of its spatial, temporal, economic, environmental and cultural context.” This ambiguity makes it hard to establish measurable indicators, remotely sensed or otherwise. (Genesis, 2015)

Stocking and Murnaghan (2000) describe land degradation as a composite term that has no single readily-identifiable feature, but instead describes how one or more of the land resources (soil, water, vegetation, rocks, air, climate, and relief) has negatively changed in to severity. Haigh (2002) offers a more utilitarian definition: the total reduction of the productive potential of the land and its major uses, its farming systems, and its value as an economic resource. This definition highlights deterioration in the biological productive potential of the land, i.e., the entire geo-ecological system that includes soils, climate, biodiversity, topography, and land use. The key message conveyed by this definition is akin to that conveyed by the Millennium Ecosystem Assessment's definition of land degradation, *“the reduction in the capacity of the land to perform ecosystem goods, functions and services that support society and development”*. According to UNEP (2007), land degradation is the long-term destruction of ecosystem function and services, caused by disturbances from which the system cannot recover again. This definition conveys two important messages: the resilient properties of landscapes and their constituent parts and the need for intervention if and when disturbances cause the resilience thresholds to be breached. (Genesis, 2015).

### 2.1.2. Conceptual Framework of Land Degradation

The conceptual framework of land degradation categorizes the causes of land degradation as proximate and underlying causes. These causes interact with each other to result in different levels of land degradation. Those which have a direct effect on the terrestrial ecosystem are the proximate causes of land degradation. The proximate causes are further classified into biophysical proximate causes (natural) and unsustainable land management practices (anthropogenic). The underlying causes of land degradation affect the proximate causes of land degradation, such as institutional, socio-economic and policy factors. For example, poverty could lead to the failure of land users to invest in sustainable land management practices which lead to land degradation (Way 2006; Cleaver and Schreiber 1994; Scherr 2000). Here understanding of the causes of land degradation and their interactions is essential for identifying relevant actions for addressing the problem of land degradation (Ephraim, 2016)

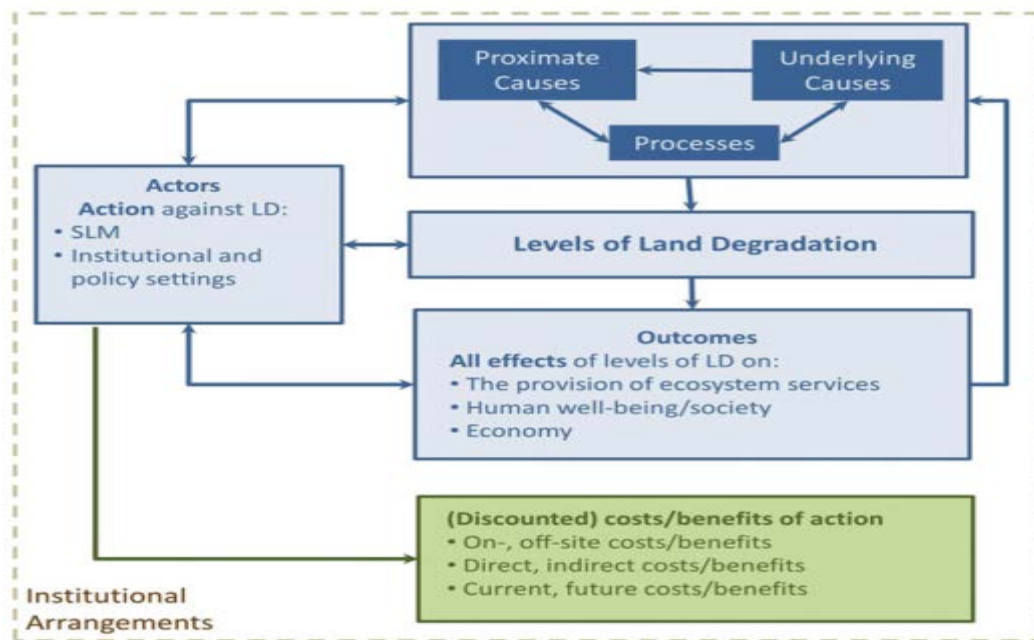


Figure 2.1. The conceptual framework of land degradation; Adapted from (Ephraim, 2016)

## **Causes of land degradation in Ethiopia**

The different causes of land degradation are identified by many scholars. For instance, Berry (2003), classify the causes of land degradation the natural ecosystem and the human social system. WMO(2005) also classified the causes of land degradation into biophysical factors, socioeconomic factors and political factors. In parallel, Mulugeta (2004) argued that land degradation is a biophysical process driven by socioeconomic and political causes in which subsistence agriculture, poverty and illiteracy are important causes of land and environmental degradation in Ethiopia. Gebreyesus and Kirubel (2009) also reported that the heavy dependence of some 85 percent of Ethiopia's growing population on an exploitative kind of subsistence agriculture is a major reason behind the current state of land degradation. Similarly, studies conducted by Temesgenet *al.* (2014a, b) in Dera District, growing population of the area is the major cause of land degradation. Additional study by Fitsumet *al.* (1999) shown that there are a number of interacting forces which have caused and are causing land degradation in Ethiopia. These are the proximate and interacting or root causes. Thus, the above classification indicates that land degradation in Ethiopia is caused by the interaction of multiple forces (Temesge, 2014)

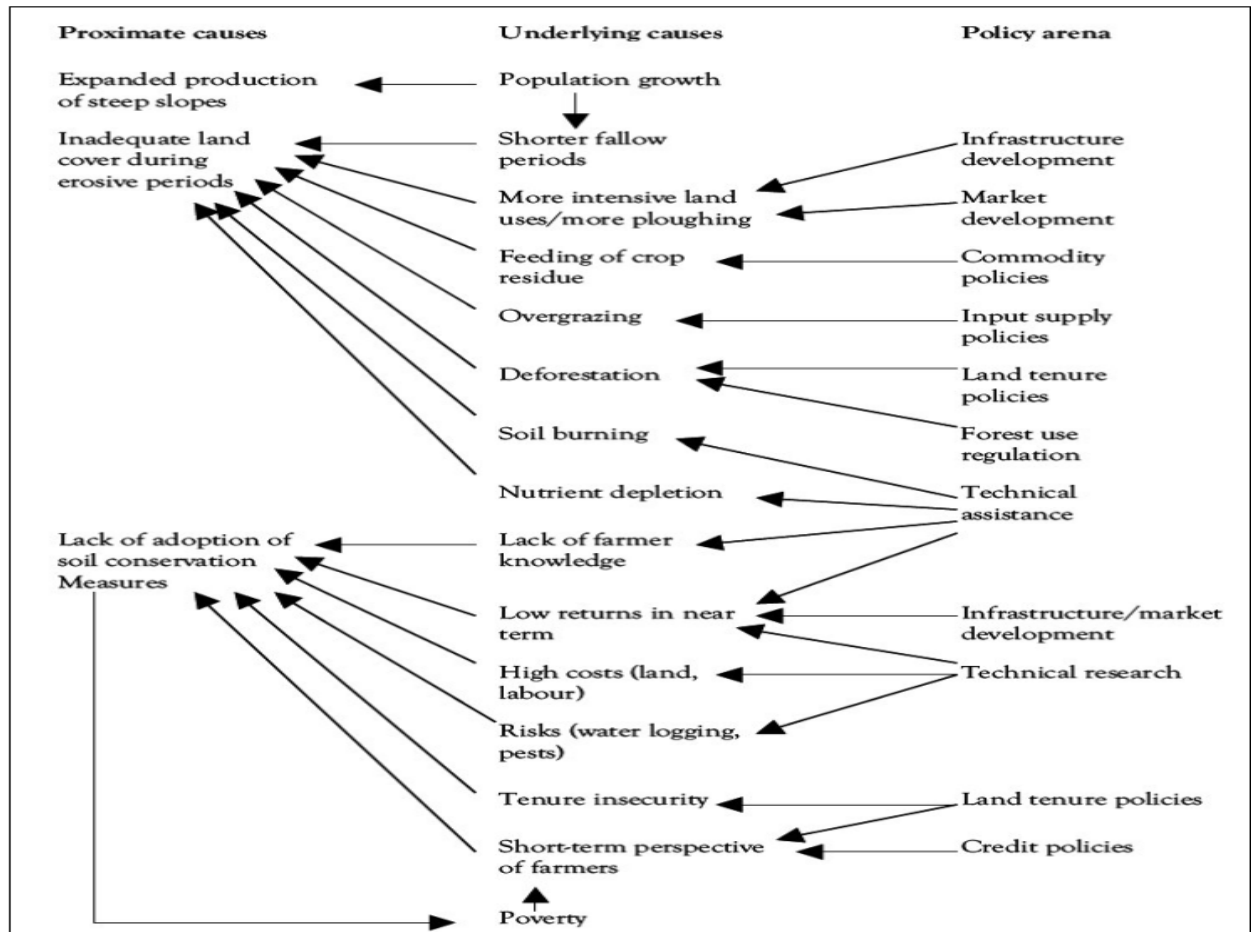


Figure 2.2. Causes of soil erosion (Fitsumet al. 1999), (Temesgenet al, 2014)

### 2.1.3. Impacts of land degradation

Land degradation can be depicted in many different ways: increasingly scarce vegetation, water sources dry up, thorny weeds predominate in once rich pastures, the growing of gullies which were footpaths, and soils become thin and stony. All of these manifestations have potentially adverse impacts on the human environment, for land users and for people who rely for their living on the products from a healthy landscape (Berry, 2003)

#### 2.1.3.1. Socio-economic impact of land degradation

Food security for many of the poorest and most food insecure people living in continents like; Asia, Africa and Latin America is threatening by land and water degradation. Land

degradation contributes to persistent poverty, and results in decreasing ecosystem resilience and provision of environmental services (Bossio *et al.* 2004). It also adversely affects the health, well-being and livelihood opportunities of the individuals (Vivian *et al.* 1994; Scherr and Yadav 1996; Fitsum *et al.* 1999); (Temesge, 2014)

Africa as a whole has become a net food importer since the mid-1980s. This is because of the presence of land degradation. However, due to 65% of the population in Sub-Saharan Africa is rural and the main livelihood of about 90% of the population is agriculture, the economic implications of land degradation are particularly worse. Soil erosion is too the most serious problem of Ethiopia's land resources. Billions of birr in the form of soil, nutrient, water and agro biodiversity losses (Paulos 2001) is being lost every year in Ethiopia. As a result, poverty and food insecurity are concentrated in rural areas (MoARD 2010). Deforestation and land degradation are the major problems of the Ethiopian highlands. These processes have eroded the resource base and aggravated the repeated food shortages caused by drought. Even if estimates vary considerably, direct losses of productivity from land degradation in Ethiopia are minimally 3 percent of agriculture GDP (Berry 2003). Hence land degradation is one of the major causes of low and declining agricultural productivity and continuing food insecurity and rural poverty in Ethiopia (IFPRI 2005), (Tilahun, 2003)

Because of land degradation, increased runoff and reduced infiltration contributes to flooding problem (Desta *et al.* 2000; Bezuayehu *et al.* 2002). Land degradation minimizes livestock productivity as a result of reduced grazing resources, loss of nutritious plants and grass species (Fitsum *et al.* 1999). Deforestation combined with desertification adversely affect agricultural productivity, the health of humans as well as of livestock, and economic activities such as ecotourism (UNCCD, 2004).

### **2.1.3.2. Ecological impact of land degradation**

Land degradation has diverse and complex impacts on the global environment through a range of direct and indirect processes (GEF 2006). The principal environmental impacts of land degradation include a rapid loss of biodiversity and habitat, modifications of water flows, and sedimentation of reservoirs and coastal zones (Project Development Facility 2007). According to (Berry 2003) the resultant ecological impacts of land degradation in

Ethiopia include loss in the chemical, physical and/or biological properties of soil which directly affects the type of plant that are grown on the area, declined availability of potable water, minimized volumes of surface water, depletion of aquifers due to lack of recharge, and biodiversity loss. Mulugeta (2004) also described that land degradation is being threaten biological resources and agricultural productivity. In addition land degradation also interrupts the regulating and provisioning services of ecosystems, in particular nutrient cycling, the global carbon cycle and the hydrological cycle (GEF 2006). Generally, land degradation has multiple environmental impacts on regional and global level. First, degradation of forests and woodlands has impacts on global biodiversity. Second, the flow of major rivers has been affected due to changes in forest cover and wetlands. Third, global climate change is the current threat due to changes in the albedo and air circulation patterns. This is mainly because of large scale loss of forest cover. Fourth, soil erosion may cause excessive siltation in rivers and inland lakes, causing reduced water storage capacity in lakes, as well as eutrophication and water quality problems (Project Development Facility 2007); (Temesge, 2014).

#### **2.1.4. Farmers' perception about land degradation**

The responses, commitments and responsibilities required for the success of formulation of appropriate resource management policies depend on perception of the problem by smallholder farmers (Ayalneh, 2002). Farmers' decisions to conserve natural resources are largely determined by their knowledge of the problems and perceived benefits of conservation. Farmers are aware of the problems of land degradation in its different forms indifferent ways. In this manner, Tesfaye (2003) reported farmers' view of land degradation problems in his case mainly in terms of soil erosion and soil fertility problem as follows: For farmers, soil movement is not that apparent unless rills and gullies are created. Their concern with soil is fertility that they measure using different indicators i.e its color (dark or light), compare the trend of crop stand and yield, and they see its physical characteristics such as weight on the plough shear and plough depth, stoniness and the like. Farmers tend to give soil erosion a lower priority than soil fertility when ranking the different forms of land degradation; however, this view does not mean that farmers are not concerned with soil

erosion and he concluded in their view, soil fertility takes precedence over erosion and the entrance point to their minds and hem1s is through soil fertility (Ephrem, 2008)

### **2.1.5. Linkage between Land degradation and Livelihood Resilience**

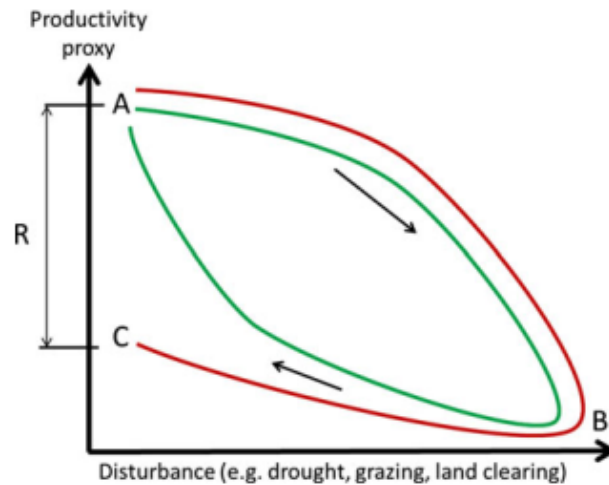
No less than land degradation, resilience is an ambiguous term (Thorén and Persson2014) subject to scientific and political debates (Walker et al. 2004 ). In his seminal paper in 1973, Holling writes: *Resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb change of state variable, driving variables, and parameters, and still persist* (Holling1973). Perrings ( 1998 ) offered a more open definition: *in its broadest sense, resilience is a measure of the ability of a system to withstand stresses and shocks—its ability to persist in an uncertain world, and interdisciplinary scientists interested in coupled social and ecological systems (SESs) have incorporated the idea into their thinking, as expressed by Adger: The ability of human communities to withstand external shocks or perturbations to their infrastructure, such as environmental variability or social, economic or political upheaval, and to recover from such perturbations* (Adger 2000 ); (Genesis, 2015).

Ecosystem service trade-offs can thus lead to declines in human well-being and increased vulnerability for people dependent on these services. Generally speaking, ecosystems can tolerate a great deal of abuse before they reach a ‘tipping point’, and are therefore considered ‘stable’. Within a certain stability ‘domain’, the system can rebound from degradation because its internal regulatory systems enable this quality. If, however, it reaches the tipping point, these internal regulatory mechanisms collapse, and the system’s basic characteristics differ considerably from its previous condition and may have little human utility. The latter outcome is particularly true where land degradation causes the system to tip. Such degraded systems are themselves stable, and hence the system can have multiple states, so to speak. Once a system has tipped, restoring it to its previous condition is both difficult and costly, and generally requires heavy application of external resources, such as nutrients and energy subsidies. When an ecosystem reaches a tipping point, and switches from one state to another, it is understood to have undergone a regime shift. Such shifts often come as a surprise.

It is in systems where the potential for regime shifts exists that multiple ‘stability domains’ are said to exist. In a study from Peru, Antle *et al.* (2006) demonstrate how certain soil conservation technologies may induce agricultural systems to exhibit two equilibria, characterized by low and high levels of soil degradation. They are separated by threshold level of soil degradation, beyond which a conservation investment will not yield a positive return. At this point, it is not economically viable to attempt to return the soil to its previous state, even though it may be technically reversible. Thus, this particular threshold or tipping point is not defined by the state of the ecosystem but by economic (societal) conditions. This also implies that once farmers have degraded soils to the point that the system is operating in the low productivity domain, a subsidy to encourage the adoption of soil conservation practices will have to be maintained long enough for soil productivity to be restored to the point that the system returns to a high-productivity domain (Enfors)

Renschler *et al.* (2010) have argued that environmental and ecosystem resources might be used as indicators of ability of the ecological system to return to or near pre-shock or pre-event states. The strong correlation of NDVI with aboveground NPP makes it a useful indicator of ecosystem resilience. In a study exploring the concepts and application of theories of general resilience, Walker *et al.* (2014) identified twelve components of general resilience in five catchments in south eastern Australia. These components include diversity (which may be identified and measured by processes including vegetation clearing, forest fires, floods, and drought), and connectivity, modularity, and reserves in ecological systems (Walker *et al.* 2014 ) which can be identified and measured by earth observation methods, including land use and land-cover change assessments. In the context of monitoring land degradation using remotely sensed data, we would prefer a more precise definition of resilience that can be operationalized by something measurable. A central concept in ecological resilience is a system’s ability to absorb and recover from disturbance or stress; this may be depicted by a hysteresis curve (Kinzig *et al.* 2006 ); (Genesis, 2015) A resilient system subject to stress, such as drought, may reduce its productivity as long as the stress persists but, then, return to its pre-stress productivity. If the system is not sufficiently resilient, it will not regain its pre-stress productivity.

The Sahel is an example of resilience at a grand scale. Since the 1980s, long time series of NDVI data have been used extensively in the study of land degradation in the Sahel (Fensholt et al. 2013 ; Anyamba and Tucker 2005 ; Hickler et al. 2005 ; Prince et al. 1998 ), confirming a general pattern of recovering vegetation (Genesis, 2015)



**Figure 2.3. The principle of hysteresis**

Source; (Genesis, 2015)

At point A, before the stress, productivity is high. As the stress increases, productivity declines to a point B. As the stress is reduced, productivity increases. A fully resilient system (*green curve*) will spring back to its original state (A).

A less-resilient system (*red curve*) will only recover to point C. The resilience of the system, R, is related to the distance between A and C; the lower the value, the higher the resilience

### 2.1.6. Definition of Resilience

According to (Boka, 2017), there is no shortage of literature on resilience, nor any shortage of conceptual issues to discuss. The purpose is to identify the key dimensions of resilience that are generally common across different interpretations, by way of an exploration of why resilience is so attractive to current thinking about risk reduction. Stein (2013) compiled a list of resilience definitions, and more recent compilations of definitions can be found in Winder

(2014). Within the arena of community resilience to disaster risk alone, Norris et al. (2008) listed more than 20 representative definitions of “resilience”— each of which shares features with the others, yet is distinct.

The concept of resilience is at the center of the current debate amongst development and humanitarian actors. Resilience has been defined in various ways by combining keywords such as ability, mitigation, adaptation, recovery, shocks, stresses, address risks, vulnerability, but most of the elements have been identified and are comparable (Sandrine, 2013). Here under are selected definitions of resilience.

Resilience is the ability to cope with adverse shocks and stresses, and to adapt and learn to live with changes and uncertainty. The review of the literature notes that it is the ‘ability to resist, recover from, or adapt to the effects of a shocks or a change’. Resilience is a long-term approach, not only focused on the ability to bounce back but also integrating adaptation and transformation while undergoing change (Sandrine, 2013)

The United States Agency for International Development (USAID) viewed resilience in the face of recurrent crisis as: the ability of people, households, communities, countries, and systems to mitigate, adapt to, and recover from shocks and stresses in a manner that reduces chronic vulnerability and facilitates inclusive growth (USAID 2012). In a relatively similar way, the UK’s Department for International Development (DFID) put forth the working definition of “Disaster Resilience as the ability of countries, communities and households to manage change, by maintaining or transforming living standards in the face of shocks or stresses—such as earthquakes, drought or violent conflict—without compromising their long-term prospects” (DFID 2011: 6); (Boka, 2017).

According to (Neil Adger, November 2013) human / social resilience refers to the (i) absorptive, (ii) adaptive, and (iii) transformative capacities that individuals, households, groups, communities and societies develop to reduce the risk of long-term detrimental impacts induced by specific adverse events (shock/stress) (Bénéet al. 2012). In essence this conceptualization of resilience<sup>1</sup> means that building resilience requires interventions that strengthen the three components (absorptive, adaptive, and transformative resilience) together. It also means that in their response to adverse events, people don’t simply try to

reduce the detrimental impact of these shocks; they also try to (a) minimize the costs it takes to respond and (b) to recover from these events. Resilience outcomes therefore result from trade-offs and combinations between three different dynamics: (i) intensity of shock, (ii) costs of impact, and (iii) costs of response.

According to (Boka, 2017) the basic notion of resilience comprises the capacity to anticipate, mitigate, adapt to, react to and recover from shocks and stress. Hence, measurement of the resilience level in a community should then include all characteristics that can be factored into these dimensions.

**Table 2.1. Selected definitions of resilience by different institutions and scholars**

<b>Institution</b>	<b>Definition of resilience</b>
United Nations Development Programme (UNDP)	A transformative process of strengthening the capacity of women and men, communities, institutions, and countries to anticipate, prevent, recover, adapt, and/or transform from shocks, stressors, and change (UNDP, 2013).
European Union (EU)	Resilience is the ability of an individual, a household, a community, a country or a region to withstand, to adapt, and to quickly recover from stressors and shocks (EU, 2016).
United States Agency for International Development (USAID)	Ability of people, households, communities, countries, and systems to mitigate, adapt to, and recover from shocks and stressors in a manner that reduces chronic vulnerability and facilitates inclusive growth (USAID, 2013a).
Department for International Development (DFID)	Resilience is the ability of countries, communities, and households to manage change, by maintaining or transforming living standards in the face of shocks or stressors— such as earthquakes, drought or violent conflict—without compromising their long-term prospects (DFID, 2011).
Food Agriculture Organization (FAO)	The ability to prevent disasters and crises as well as to anticipate, absorb, accommodate or recover from them in a timely, efficient and sustainable manner. This includes protecting, restoring and improving food and agricultural systems under threats that impact food and nutrition security, agriculture, and food safety/public health (FAO,2013).
Resilience Measurement Technical Working Group (RM TWG)	The capacity that ensures stressors and shocks do not have long-lasting adverse development consequences (FSIN, 2014a).
Lutheran World Relief (LWR)	The capacity of a system (e.g., a community) to absorb the impacts of shocks and stressors, to adapt to change and to potentially transform, in a manner that enables the achievement of development results (e.g., sustainable livelihoods, well-being, poverty alleviation) (LWR, 2016).
Barrett and Costas	Barrett and Constat (2013) defined development resilience as the capacity over time of a person, household, or other aggregate unit to avoid poverty in the face of various stressors and in the wake of myriad shocks. If and only if that capacity is and remains high, then the unit is resilient.
Mercy Corps	The ability of communities in complex socio-ecological systems to learn, cope, adapt, and transform in the face of shocks and stressors (Petryniak et al., 2015).
Oxfam	The ability of women and men to realize their rights and improve their well-being despite shocks, stressors, and uncertainty (Oxfam, 2015).
Rockefeller Foundation	Resilience is the capacity of individuals, communities, and systems to survive, adapt, and grow in the face of stress and shocks, and even transform when conditions require it. (Rockefeller Foundation, 2017).
Tulane University	Resilience is the capacity of the affected community to self-organize, learn from, and vigorously recover from adverse situations stronger than it was before (Tulane University, 2012).
OECD	Resilience is the ability of households, communities, and nations to absorb and recover from shocks, whilst positively adapting and transforming their structures and mean

**Source;**(Ramnath)

## Indicators and Measurements of Resilience

### Indicators of Resilience

**Table 2.2. Resilience Index Measurement Analysis (RIMA) indicators**

Pillar	Variable
Access to Basic Services (ABS)	Service closeness (education, health, security)
	Service satisfaction (transports, water, health)
	Daily water supply
	Stable access to water
	Public water
Assets (AST)	Wealth index
	Residential buildings for household use
	Animal index
	Land lots
	Tools and equipments for production
Social Safety Nets (SSN)	Subsidies from National Aid Fund (NAF)
	Public transfers (value)
	Private transfers (value)
Adaptive Capacity (AC)	Average years of education
	Education level of the Household Head
	Dependency Ratio (inverse)
	Participation index
Food Security Indicators (FS)	Food consumption (pc)
	Food Consumption Score (FCS)

Source; (Stefania Di Giuseppe and Marco Letta, 2013)

#### 2.1.7. Measuring Resilience

Resilience measurement has soared to the top of the development agenda (Frankenberger et al., 2014). As a result, researchers have proposed a large number of frameworks and methods to quantify the resilience of different social systems – whether at a household, community or national level (Constas and Barrett, 2013; Elasha et al., 2005; D’Errico and Di Giuseppe, 2014; Nguyen and James, 2013; Twigg, 2009; USAID, 2009). To date, the vast majority of these methods have focused on objective indicators and approaches, often centered on

observing key socioeconomic variables and other types of capital that support people's livelihoods (Bahadur et al., 2015). More recently, the advantages of subjective approaches to measuring social systems have been advocated (Jones and Tanner, 2015; Lockwood et al., 2015; Marshall, 2010; Maxwell et al., 2015). These methods may offer opportunities to address many of the weakness that beset traditional objective approaches, such as lack of attention to context specificity, difficulties with indicator selection and an inability to take people's own knowledge of their resilience into account. However, few quantitative assessments of subjective resilience have taken place to date (Marshall, 2010). As such, little is known about the feasibility of subjective approaches as a resilience measurement tool and how they compare with traditional objective methods. (Samman, nd)

The idea of resilience, particularly as a programming tool in response to disaster and climate-change phenomena, has become increasingly prevalent in international development. Given the widespread use of the terminology in various fields and by various technical and non-technical actors, it is important to present a synthesized view of resilience and create a common language to advance core terms. It is particularly important to translate high-level concepts of resilience into actionable measurement metrics in order to implement, monitor, and evaluate resilience programs (Ramnath, nd).

Empirically, available resilience assessment differ, depending on their orientation toward the outcome (end result) or process-driven (leading to the desired outcomes) approach (Ahsan and Takeuchi, 2015); (Birhan, 2018). The former approach deals with resilience in terms of end results, while the latter approach treats resilience as a sequence of dynamic reformations to regain the original state. There are many frameworks in explaining resilience in the literature.

The resilience assessment by DFID (2011) proposes four possible reactions (i.e., outcomes) to a shock. The first best case is 'bounce back better,' which indicates that a household demonstrates a stronger capability to deal with future perturbations than it did in the past. The second best case is 'bounce back,' indicating a household's capability of reinstating the pre-disaster status. The third best case, 'recover, but worse than before,' refers to less capacity, compared with the pre-disaster condition; and finally, 'collapse' indicates

the worst case where a household suffers substantial deterioration in its capacity to cope with future perturbations (DFID, 2011); (Birhan, 2018).

Likewise, FAO, 2013, 2016 portraits resilience as outcome through a number of socioeconomic variables namely access to basic services, adaptive capacity, assets and social safety-nets. By assigning weights to these factors, a composite weighted index is obtained which provides a resilience capacity for a specific households and the model called Resilience Index Measurement and Analysis (RIMA). Following this, FAO compares the resilience capacities among different household and socio-economic characteristics (Birhan, 2018).

As it is stated earlier there are many empirical resilience assessment models. Thus, this study adopted the FAO RIMA model, introduced first by (Alinovi et al., 2008) and further developed by FAO, 2013, 2016 since it accommodates a wider spectrum of resilience dynamics.

#### **2.1.8. Household's Coping Strategies to the Effects of Land Degradation**

In the face of shocks, rural households use a variety of strategies to maintain their level of consumption. In this case, a coping action is defined as an explicit and active undertaking to counteract the negative shock effects as reported by the households. On the other hand, households are categorized as “do not cope” if they did nothing explicitly and directly to deal with any of the shocks due to various reasons or if they responded in a passive way such as slightly reducing consumption (Birhan, 2018)

According to (Ellis, 2000) rural households employed different strategies to shocks/risks. These strategies are grouped into *ex-ante* and *ex-post*, depending on whether they are put in place before or after the occurrence of a shock, respectively.

*Ex-ante* risk management is defined as consisting of “forward planning to spread risk across a diverse set of activities, in the context of subjective evaluations about the degree of risk attached to each source of risk”. These strategies are proactive in nature and undertaken before the occurrence of a shock, to prevent the risk from happening, or if prevention is not

possible, to mitigate the impacts of such shocks (Dercon, 2002; Heitzmann et al., 2002). The common *ex-ante* prevention strategies include sound macro-economic policies, public health and education investments ((Heitzmann et al., 2002) while the common *ex-ante* risk mitigation strategies include income diversification (Dercon, 2002) livelihood diversification (Dercon, 2002; Hoddinott and Quisumbing, 2003).

*Ex-post* coping strategies are defined as “*the methods used by households to survive when faced with unanticipated livelihood failure*” in either a gradual or a sudden sense(Ellis, 2000). These strategies can smooth households’ consumption and deal with the impacts of shocks that have not been managed *ex-ante*. What poor people are concerned about is not so much that their levels of income, consumption, or capabilities are low, but that they are likely to experience highly stressful declines in these levels, to the point of premature death (Shepherd, 2003).

## **2.2. Related Empirical Literature Reviews**

### **2.2.1. Empirical Review of Resilience**

In Ethiopia, there are some recent empirical studies on household resilience, specifically focused on food and livelihood security. The study of Mulat and Nigussie (2013) showed that cultivated land, ownership of livestock, use of improved technologies and household membership in traditional saving groups are positively and significantly correlated with dynamics of building sustainable resilience for food security (Birhan, 2018). They studied resilience for food security and livelihood dynamics based on the ERHS panel data using principal component analysis (PCA) and dynamic probit random effect model.

A study was undertaken by (Adane, 2018) on resilience capacity of rural households to food insecurity and examined three interrelated questions: (1) sources of rural household’s resilience to food insecurity, (2) food security status, and (3) household’s coping mechanisms. His study was based on cross-sectional field survey in line with key informant’s interview. He adapted sequentially explanatory mixed-method-research strategy. Stratified sampling, simple random and systematic sampling methods were used to draw a sample. In order to analyze the data, he employed PCA, ANOVA, descriptive statistics, and Chi-square

test. The result of PCA revealed that while all turned to be significant, income and food access, agricultural assets, and agricultural technology adoption are the three resilience dimensions. According to the study the household's resilience vary based on the livelihood systems. Thus, the result of ANOVA shows significant effect, i.e., F-ratio is significant at  $F(2, 417) = 4.991, p < 0.001$ . With regards to food security, the analysis of HFIAS revealed that 62.4% of the served households have food insecurity situation that runs from 'moderate' to 'severe'. On the other hand, the analysis of FCS showed that 42.4% of the surveyed households have food security situation of below 'acceptable' threshold.

The ANOVA, which was designed to see if food security situation was the same across livelihood zones, consistently indicated existence of statistically significant differences in mean food security scores both in the case of HFIAS for  $F(2, 417) = 15.046, p < 0.001$  and FCS for  $F(2, 417) = 6.626, p < 0.01$ . His study's finding also indicated that households used a multitude of consumption based coping strategies that run from compromising quality of food by eating less preferred foods to food rationing.

Another recent study was done by (Birhan, 2018) on determinants of poverty, vulnerability and resilience in rural Ethiopia during 2012-2016 using the Ethiopian Socioeconomic Survey data. For analysis, the study employed fixed effect model, feasible generalized least square model, factor analysis, structural equation modeling and multivariate probit model to assess the determinants of poverty, vulnerability, resilience capacity dimensions, resilience capacity and coping strategies respectively. The result indicated that poverty and vulnerability are dynamic and prevalent. The vulnerability rate also follows in an increasing pattern. While education of members, income diversification and distance to market centers are the determinants of both poverty and vulnerability; age, sex and education of head, working household members, social capital, distance to main roads and midland agro ecological location are factors symptomatic to vulnerability only. The study also indicated a difference in resilience capacity & its dimensions over time. Adaptive capacity and assets are very important dimensions of resilience capacity. Moreover, the study revealed savings; livestock sales; and spiritual help as major coping strategies as well as the type of shocks households faced, literacy, oxen ownership and regional locations as determining factors for households' choice a particular coping strategy.

**Table 2.3: Empirical works on household's resilience**

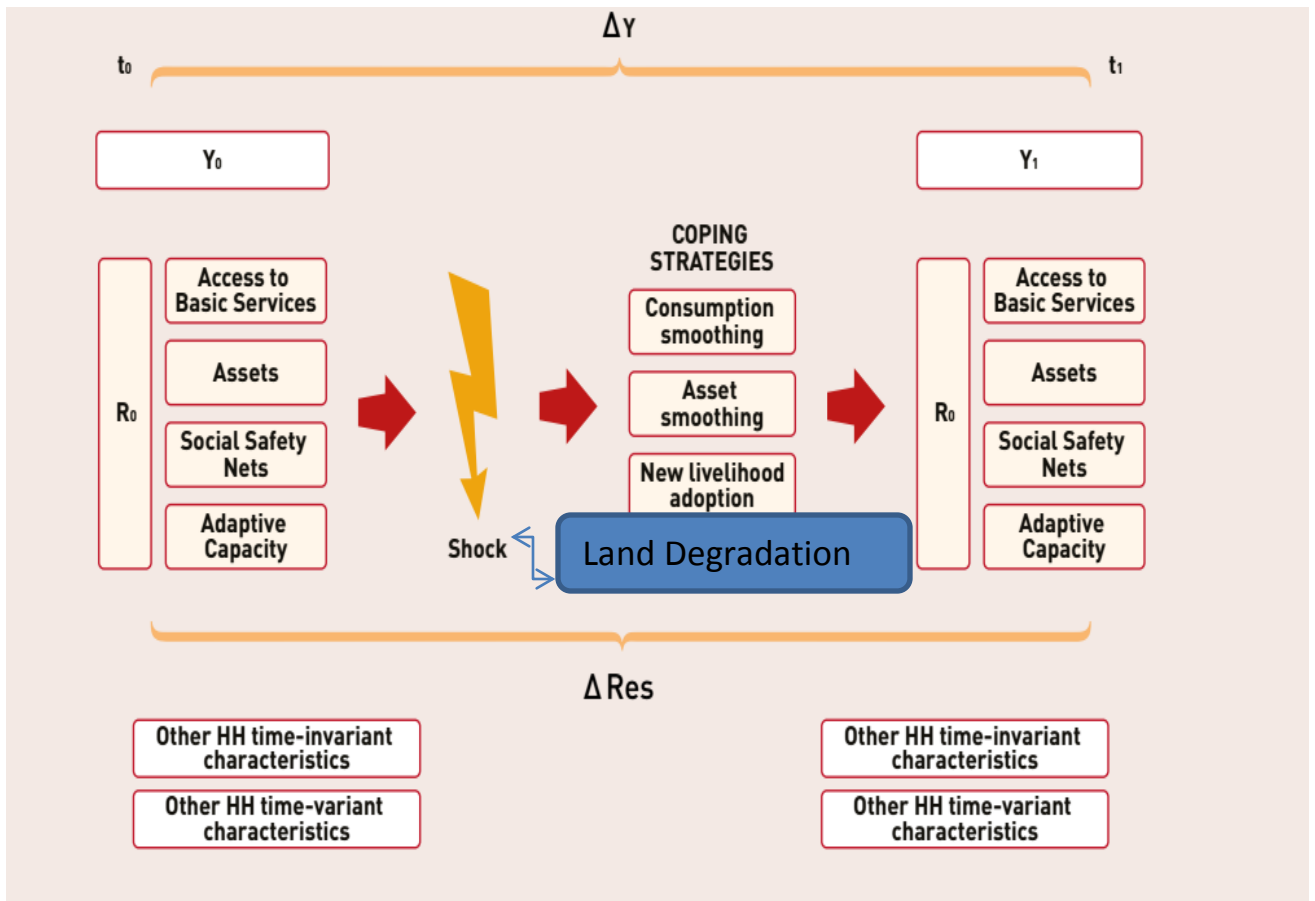
Author	Objectives	Methodology	Findings
Alinovi <i>et al.</i> (2010) in Kenya	- Measuring empirically the outcomes of different livelihoods strategies in terms of household resilience to food insecurity	- Two stage factor analysis for resilience measurement, treating it as latent variable	- Large-holder farmers' livelihood cluster is the most resilient one while the pastoralist group being the least resilient. That is, pastoral livelihood strategy based group is found to be the least resilient one in terms of food security
Ciani and Romano (2013) in Nicaragua	- Developing a methodology for resilience measurement and testing its with household level data	- Two stage factor analysis for resilience measurement, treating resilience as latent variable and -Weighted least square model for testing predictive power of the resilience index	- They found positive relationship between pre-shock resilience index and post shock food security status of households - Small land owners and agricultural wage livelihood groups are found less resilient livelihood groups
Maxwell <i>et al.</i> (2013) in Ethiopia	- Tracking household food security status overtime, as well as changes in livelihoods (in particular the dynamics of asset accumulation or loss).	-Resilience has not been measured directly	- They observed steady improvement in households' food security indicators over time without a corresponding improvement in the level of assets at the household level
Mulat and Negussie (2013) in Ethiopia	-Identifying determinants of sustainable resilience for food and nutrition security	-Employed principal component analysis for measuring resilience and -Used dynamic probit random effect model to find determinants of dynamics of household's resilience.	-They observed positive and significant correlation between sustainable resilience to food in security and land under cultivation; ownership of oxen, milking cows and transport animals, use of improved technologies, and membership in traditional saving groups (iqub).
Mulugeta (2014) in Ethiopia	-Identifying impacts of droughts on HH food security -identifying resilience capacities for recovery from shocks	-frequency analysis models (mainly percentage) & paired sample test to analyze pre and post drought asset level differences	- Herd mobility, literacy, sanitation, and social networks have been identified as factors strongly linked with shock absorption capacity
Guyu and Mulneh (2015) in Ethiopia	- Analyzing household's resilience to seasonal food insecurity and -Comparing resilience status of indigenous and no indigenous ethno culture groups.	-Two stage factor analysis for resilience measurement, treating it as latent variable -Regressing the estimated resilience index on its components (resilience dimensions) to detect their relative importance - Examining frequency distribution to compare resilience of the two groups (no statistical test was run)	-The resilience capacity of households in the study area is very weak - Households in the indigenous ethno culture group were much less resilient than the non-indigenous ones.

Source:- (Debessa, 2018)

### **2.3. Conceptual Framework of the Study**

Resilience is an intrinsically dynamic concept that exhibits complex and far-from-equilibrium dynamics (Levin et al., 1998) and as such requires a dynamic analytical framework. Small perturbations in a non-linear system can be magnified and lead to qualitatively unexpected behaviors at more macroscopic levels (Levin et al., 1998). Barrett et al. (2014) presented a good representation of non-linear expected well-being dynamics with multiple stable states. Households are affected by both positive and negative shocks. A high food price shock could have a negative effect on some households but could translate into a positive effect for producers and sellers. Ideally both effects should be captured in order to analyze the long-term effect of shocks and related coping strategies. In the case of consumption or asset smoothing strategies, reducing short-term consumption could become a positive coping strategy if it fits into the long-term perspective of investments. (FAO, 2016)

All possible pathways to well-being in the face of shocks must be captured by conceptual framework for resilience measurement. Figure 2.4 describes what happens to a household well-being when a shock occurs and resilience mechanisms are activated. This analytical framework is based on classic psychometric theories (Crocker and Algina, 1986; Cronbach and Meehl, 1955; Nunnally and Bernstein, 1994) as well as on more modern measurement references (Preacher et al., 2013); it is also the natural evolution of the conceptual framework elaborated by Alinovi et al. (2008). (FAO, 2016)



**Figure 2.4. Conceptual Framework of the study**

Source; (FAO, 2016) with own modification

## **CHAPTER THREE: RESEARCH METHODOLOGY**

### **3.1. Description of the study area**

#### **Overview of North Wollo Zone**

According to Gubalafto Woreda Environmental Protection, Land Administration and Use Office, most of the land is mountainous and characterized by steep slopes, unsuitable for agricultural purpose thus; the cultivated land is limited only to 36.59% of total land area, which is followed by 21.3% of degraded area out of 98,687.5 ha of the total land size. The average land holding size for a household is 0.78 hectare, which is ranging from 0.4 hectare in the highland areas to the 1.93 hectare in the lowland areas of the Woreda (Wolde, 2013).

The major crops cultivated in the study area included teff, sorghum, wheat, barley, bean, chickpeas, lentil, maize, onions and garlic. The study area is highly prone to frequent shortage of rainfall and receives an annual rainfall ranging between 300-400 mm on average. Due to both man-made and natural calamities, the rural community in the woreda had not been able to produce sufficient amount of output to feed its population throughout the year. The production system is mainly mixed agriculture including crop and livestock farming. Crops are mainly produced for home consumption and household unable to meet their annual consumption from their own farm production. Households subsidize their consumption expenses by selling animals, which means that livestock ownership is an important for livelihood in the study area. Oxen are the main source of plowing power supply. In addition, there are about 104,439 cattle, 121,780 goats and sheep, 18,714 donkeys, horses and camels based on 2009 local livestock enumeration by the Woreda Agricultural Office Mohammed (2010) cited in (Wolde, 2013).

## Topography and Agro-ecological zones

The study was conducted in Gubalafto worda, which is found in North Wollo Administrative Zone of the Amhara National Regional State (ANRS). Gubalafto Woreda has three agro ecological zones, lowland (*kolla*) that ranges from 1500-1800, mid-altitude (*Weynadega*) ranges from 1900-2200 and highland (*Dega*) ranges 2300-3300masl Woreda Agricultural Office (2012). Agro ecological distribution of the study area accounts 17% of *Kolla*, 37% of *Dega* and 46% of *Weynadega* (Wolde, 2013).

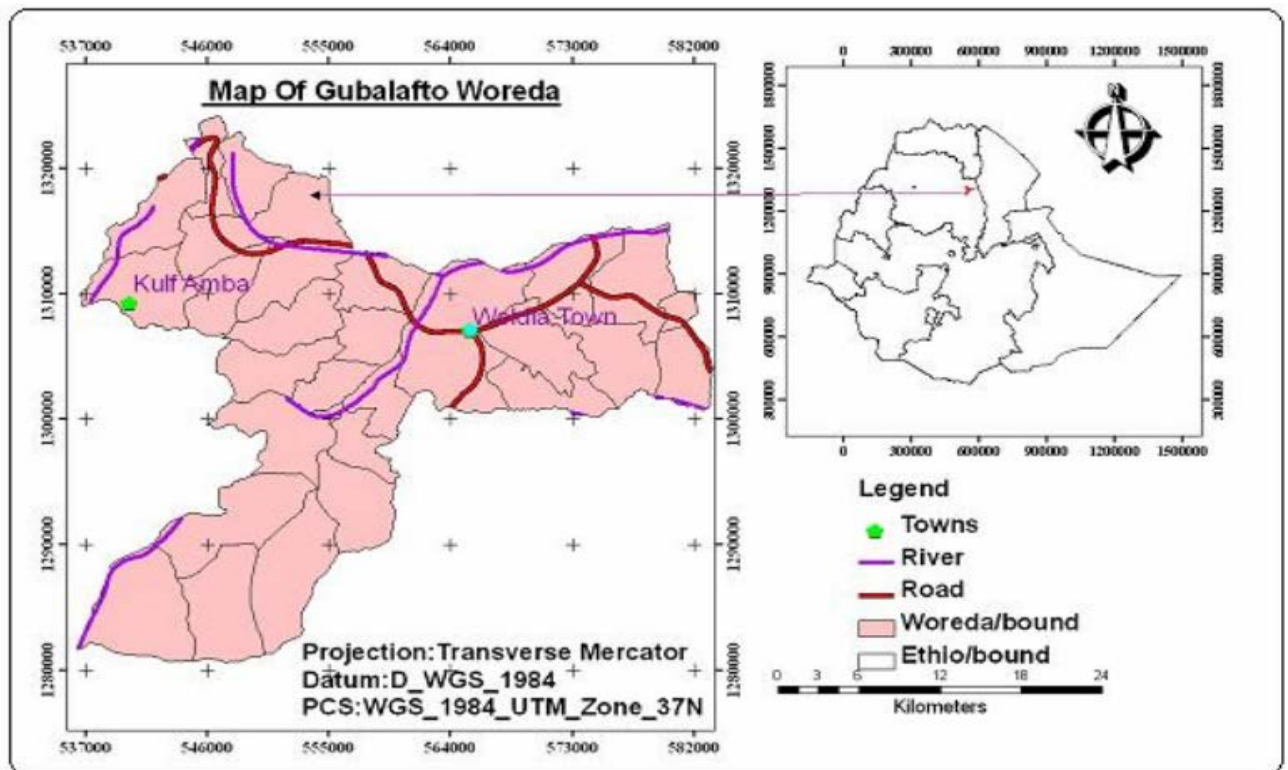


Figure3.1.Location map of the study area

Source; (Lemma, 2012)

### 3.2. Research Design

This study employed household survey as its research strategy and mainly it used quantitative approach with qualitative triangulation when it comes to research choice. That is, the study adapted mixed research design. The resilience of the rural households was defined in function of access to basic services, asset, agricultural technology adoption, social safety nets and adaptive capacity.

### 3.3. Sampling Technique

A multistage sampling procedure was used so as to select the sample households for the household survey. Accordingly, the study used the combination of stratified, simple random, and systematic sampling, i.e. the study area was categorized into three agro ecological strata or zones (*kola*, *dega* and *woynadega*). Sample kebeles from each agro ecological zone were chosen through simple random sampling proportionally. Then sample households were chosen from each kebele through systematic sampling by using the lists available at *kebele* administration office as sample frame. The number of kebeles found in each agro ecological zone was a criterion to decide the number of sample kebeles. Hence two kebeles from *woynadega* strata were chosen and another two kebeles from *dega* & *kola* strata were chosen. This is because out of 34 kebeles 19 kebeles are *woynadega*, 8 kebeles are *dega* and the remain 7 kebeles are *kola* kebeles.

### 3.4. Sample Size

The statistically representative size of sample households was determined based on recommendations given by (Yamane 1967); (Mayan, 2018) to calculate sample sizes which has 95% confidence level and  $P = 0.5$ . This formula was chosen due to its simplification while determining sample size (Glenn, 2003).

$$n = \frac{N}{(1 + N (e^2))}$$
$$= \frac{3663}{1 + 3663 (0.05)^2} = 361 \dots\dots\dots \text{Equ.1}$$

Where, n= sample size, N= population size, and e= level of precision.

Simple mathematical formula was used to determine the number of sample households. Accordingly 361 rural households were determined as sample households for all kebeles. As it is indicated in table 3.1, the number of sample households for each agro ecological zone was determined based on the number of kebles found in each agro ecological zone. In this case total number of households in each kebeles was only used to determine sample size of the study.

Table 3.1. Sample size of the study

<b>Ecological Zones (stratums)</b>	<b>Number of Kebeles in each stratum</b>	<b>Sample kebeles</b>	<b>Total number of HHs in each Kebele</b>	<b>Sample HHs</b>
<i>1. Dega</i>	8	<i>1.Woket</i>	855	85
<i>1. Woynadega</i>	19	<i>2.Gesho Ber&amp;</i>	971	115
		<i>3.Zewor Gotera</i>	732	87
<i>2. Kolla</i>	7	<i>4.Laste Gerado</i>	1105	74
<b>Total= 3</b>	Total= 34	Total= 4	Total HHs= 3663	Total= 361

### **3.5. Data Types, Sources and Collection Methods**

The study used both primary and secondary data to analyze indicators of resilience of respondents in the study area. The primary data for this study was gathered from households, as represented by an individual, the head of the household. Thus, households in the study area were unit of analysis for the study. In addition, information pertaining to the research

questions raised in this study was also gathered from MoA, local administrators, wereda level agricultural experts and agricultural and extension workers.

The secondary data for the study was obtained from published documents including policy manuals, annual and periodic reports, academic journals, books, thesis, and newspapers which provided basic information pertaining to the purpose of the study. Generally the study used the following tools and tools to collect data:

### **3.5.1. Primary Data Collection Methods and Tools**

**Household Survey:** In order to generate information at household level, household survey was undertake using semi structured questionnaires. Before conducting survey, questionnaire revision was made and finalized, and then enumerators were assigned to collect data. The semi structured questionnaire survey was used to collect information of land degradation, coping strategies, level and factors influence households' resilience through basic services, asset, agricultural technology, social safety nets and adaptive capacity.

**Focus Group Discussion:** Focus group discussion (contained 14 discussants) on the selected discussions such as land degradation and its' effects, coping strategies and resilience indicators (basic services, asset, agricultural technology, social safety nets and adaptive capacity) was conducted. The focus group discussions was also employed to collect information on land degradation, factors that make a given household to become non-resilient or resilient, existing opportunities and resources, and coping strategies in the study area.

**Key Informants' Interviews:** To supplement the quality and reliability of the data collected through the questionnaire, interviews were conducted. It was flexible and allowed open-ended discussion. These techniques were used to collect primary data from woreda and kebele level experts who have rich knowledge about the issue. Thus two key informant interviewees, from woreda agricultural office and kebele extension office were interviewed.

### 3.5.2. Secondary Data Collection

Secondary data were obtained from *woreda* Agricultural and Rural Development Office and Ministry of Agriculture and Rural Development Office documentary files. Moreover, documents, reports and research journals from internet and different institutions were reviewed.

### 3.6. Methods of Data Analysis

Data analysis was done by using Statistical Package for Social Scientists (SPSS) Version 22. Then, the data was analyzed using qualitative and quantitative methods. The FAO RIMA model, introduced first by (Alinovi et al., 2008) and further developed by (FAO, 2016) was used to examine determinants of resilience through latent variable modeling (i.e. factor analysis). The RIMA approach used a Factor Analysis (FA). The current study utilized factor analysis, specifically its family/variant i.e. Principal Component Analysis (PCA) to identify the resilience latent indicators. These factors or determinants are: Access to Basic Services (ABS), Assets (A), Agricultural Technology Adoption (ATA), Social Safety Net (SSN) and Adaptive Capacity (AC). Besides, qualitative information from interview questions were narrated to assess perceived effects of land degradation on livelihood and households' coping strategies to the effect of land degradation. In this case the major effects of land degradation include food insecurity, costs of forest removal, loss of livestock productivity, loss of environmental service & water resource and costs of nutrient loss. Following (Adane, 2018) cited from, (FAO 2014) and (Alinovi *et al.* 2010) the current study modeled household's resilience to the effect of land degradation as the function of its components.

Accordingly,  $R = f(\text{ABS}, A, \text{ATA}, \text{SSN}, \text{AC},)$

Where:-

R= resilience of household, Access to Basic Services (ABS), Assets (A), Agricultural Technology Adoption (ATA), Social Safety Net (SSN) and Adaptive Capacity (AC).

### **3.6.1. Descriptive Analysis**

For qualitative data, the researcher analyzed as the research progresses, continually refining and reorganizing in light of the emerging results. To make the analysis of qualitative data easy, an interview summary form or a focus group summary form was prepared. This includes practical details about the time and place, the participants, the duration of the interview or focus group, and details about the content and emerging themes. It was useful to complete these forms as soon as possible after the interview and attach them to the transcripts. The forms helped the researcher to remind about the content and were useful when the researcher come to analyze the data. Finally, descriptive statistic mainly percentage was used to analyze qualitative information.

### **3.6.2. Quantitative or Inferential Analysis**

For quantitative data, the analysis was left until the end of the data collection process, and statistical software was the easiest and most efficient method to use. For this type of analysis time had to be put aside for the data input process which was long and laborious. The quantitative data was analyzed using Resilience Index Measurement Analysis (RIMA) to examine resilience indicators or determinants through latent variable modeling (i.e. principal component analysis).

#### ***3.6.2.1. Data analysis method for factors or determinants of households' resilience capacity to land degradation***

Using the Principal Component Analysis (PCA), the estimation of observed variables that determine the major determinants of resilience was done by estimating each of the observed variables. This is because to estimate determinants of resilience capacity. However, the specification presented hereunder is not for the estimation of resilience capacity; rather it is only for the estimation of each of the indicators or determinants of resilience. One thing to be noted is that with PCA in use in the current study's context, the size of the factor loadings indicates the substantive importance or relative contribution of a given variable to household's resilience to the effect of land degradation.

The factor loadings in a given analysis can be either correlation coefficients or regression coefficients. However, this depends on the factor rotation undertaken. When orthogonal rotation is used, any underlying factors or components are assumed to be uncorrelated and the factor or component loading is the correlation between the factor or component and the variable as well as the regression coefficient. That is, the values of correlation coefficients are the same as regression coefficient. But, in the situation where oblique rotation is used, the underlying factors or components are assumed to be correlated and the resulting Pearson correlations between variables and factors will differ from the corresponding regression coefficients (Field, 2005); (Adane, 2018)

There seems having lack of consensus in the statistical significance determination rule of a factor or component loadings. While understanding the common practice of taking loadings of an absolute value of more than 0.3 to be significant by researchers, (Field, 2005) argues sample size determines the significance of factor loading. In this regard, Stevens (1992) cited in Field (2005) recommends the critical values against which the factor loadings can be compared. Accordingly, for the sample size of 50 a loading of 0.722 can be considered significant, for 100 the loading should be greater than 0.512, for 200 it should be greater than 0.364, for 300 it should be greater than 0.298, for 600 it should be greater than 0.21, and for 1000 it should be greater than 0.162. According to Field (2005), these values are based on an alpha level of 0.01 (two tailed), which allows for the fact that several factor or component loadings shall need to be tested. One thing that can be learned from these critical values is that, even the small loadings can be statistically meaningful when sample size gets larger and larger (Adane, 2018). Thus, the current study has employed Principal Component Analysis.

### **3.7. Research Explanatory Variables**

The explanatory variables determining the households' resilience are perquisites to address the research questions and thereby the objectives stated. A many of socioeconomic, environmental, political and demographic explanatory variable and other household characteristics were expected to affect indicators of household resilience capacity in the study area. The major explanatory variables that are expected to influence positively or negatively on the household resilience capacities are: Access to Basic Services (ABS), Assets (A),

Agricultural Technology Adoption (ATA), Social Safety Net (SSN) and Adaptive Capacity (AC).

**Access to Basic Service:** refers to both access to services and the quality of access and services. Consequently, there are two categories of indicators to proxy ABS. In terms of access, services to be considered are schools, hospitals and other health services, markets, stores, paved roads, safe houses and water and waste disposal systems. On the other hand, a proxy for the quality of access can be the monetary cost of access to services. According to Adger et al. (2004), the increase in health and education costs is an important process that positively affects household vulnerability. Subjective indicators can also be employed, such as public perception of the quality of services and security in the community where the household is located (FAO, 2016). To account for Access to Basic Services, household heads were asked seven questions. To estimate Access to Basic Services (ABS) latent variable, Principal Component Analysis (PCA) was used.

**Assets:** These are the key elements of a livelihood. In both rural and urban contexts, assets give a household the opportunity to have something tradable; something to build an activity upon; and assets to employ. Examples of indicators include land, livestock and durables (FAO, 2016). Assets are important aspect of household resilience since the more a household have assets, the more he/she copes with a shock and become more resilient. The assumption is that the households whose assets are not depleted by food security shocks are more resilient than their counterparts. This variable is count variable and factor analysis was used to analyze it. Principal Component Analysis (PCA) was used.

**Agricultural Technology Adoption:** Four variables were used to estimate Agricultural Technology Adoption: number of time received development agents' service, number of times pesticide usage, amount of fertilizer/kg used and amount of improved seeds/kg used.

**Social Safety Net:** Access to transfers, whether cash or in-kind, represents a major source of poverty alleviation in many developing countries. Public and private transfers make up a substantial portion of poor households' annual income, providing important cash to generate additional income. The SSN pillar includes both formal and informal transfers. While the former category is easily observed, informal social networks flowing through unrecorded

channels are not easy to capture as they are not easily detected and quantified because they involve various forms of exchange that by definition take place outside formally institutionalized channels (Ligon, 2001; Mordoch, 1999). Formal transfers are one of the principal areas of intervention intended to provide social protection and poverty alleviation for the poor through improved access to credit and subsidization of credit. The informal financial sector is also a key source of social protection, especially in areas with limited access to the formal financial sector. In many countries, such transfers are much larger than those handled by the formal sector. Freund and Spatafora (2005) showed that informal transfers amount to about 35 to 75 percent of formal ones in developing countries (FAO, 2016).

**Adaptive Capacity:** Adaptive capacity can be defined as the level of access to and exploits benefit therein from resources in order to deal with shocks. It refers to the ability to react to shocks, which ranges from institutional framework that enables to learn, generate experience and store knowledge to create power structure to solve *ex ante* and *ex post* problems through learning processes (Alinovi L., Mane E., and Romano, 2009). All of the variables are based on a count measurement scale. Factor analysis was run using Principal Component Analysis (PCA) method in order to estimate the AC latent variables.

## **CHAPTER FOUR: RESULTS AND DISCUSSIONS**

### **4.1. Households' Characteristics, Land Degradation Situation, and Coping Mechanisms**

#### **4.1.1. Demographic and Socioeconomic Characteristics of Households**

##### **4.1.1.1. Demographic Characteristics**

According to the survey result, out of the total 361 respondent household heads, 79.8% (288) are male and 20.2%(73) female. The study shows that the majority 74.5% (269) of the total respondents are married, 18.3% (66) divorced 6.1% (22) widow and 1.1% (4) single. The study also revealed that 95 years is the maximum age of the household head, while 26 years is the minimum age of the household head with an average age of 50.84 years. In addition to this the maximum and minimum number of household members is 9 and 2 respectively with an average value of at about 5 household members. In relation to educational status 76.7% (277) of the respondents are unschooled, 15.2% (55) grades 1 to 6, 6.6% (24) 7 to 8 and 1.4% (5) 9 to 10.

Table4.1. Household heads' sex, marital status & educational status

<u>Sex</u>	<b>Frequency</b>	<b>Percent</b>
Male	288	79.8
Female	73	20.2
Total	361	100.0
<u>Marital Status</u>		
Married	269	74.5
Single	4	1.1
Divorced	66	18.3
Widow	22	6.1
Total	361	100.0
<u>Educational Status</u>		
Unschoolled	277	76.7
1-6 Grades	55	15.2
7-8 Grades	24	6.6
9-10 Grades	5	1.4
Total	361	100.0

Source: Own survey result, May 2021

#### ***4.1.1.2. Socioeconomic Characteristics***

Majority of the respondents 292 (80.9%) are farmers, 31 (8.6%) farmers and merchants, 27 (7.5%) merchants, 9 (2.5%) farmers and employed & 2 (0.6 %) employed. The major crops cultivated in the study area are teff, sorghum, wheat and barley.

Table 4.2. Household Head's Occupation

<b>Household Occupation</b>	<b>Frequency</b>	<b>Percent</b>
Agriculture	292	80.9
Trade	27	7.5
Employed	2	.6
Agriculture & Trade	31	8.6
Agriculture & Employed	9	2.5
Total	361	100.0

Source: Own survey result, May 2020.

Among the total respondents, 198 (54.8%) cultivate teff & sorghum, 83 (23%) wheat and barley, 28 (7.8%) teff and wheat & 22 (6.1%) teff, wheat and barley. Out of the total respondents i.e. 30 (8.3%) were not engaged in any type of crop cultivation. As it is indicated in the following table, most of the respondents 305 (84.5%) are living in houses made of grass or straw, while 56 (15.5%) are living in houses made of corrugated iron sheet.

Table4.3. Types of Crops Cultivated& Households’ housing Condition

	Frequency	Percent
<u>Types of Crops Cultivated</u>		
Teff & Sorghum	198	54.8
Teff & Wheat	28	7.8
Wheat & Barley	83	23.0
Teff, Wheat & Barley	22	6.1
No	30	8.3
Total	361	100.0
<u>Households’ housing Condition</u>		
Grass/ Straw roof	305	84.5
Corrugated Iron Sheet roof	56	15.5
Total	361	100.0

Source: Own survey result, May 2020.

#### **4.1.2. Perceived Effects of land degradation on livelihood**

Land degradation has many effects. It has both on-site and off-site effects. A decline in both the current and potential crop and livestock yields which translate into income losses is the most critical and urgent on-site impacts of land degradation particularly of soil erosion. The consequences of soil erosion may also be viewed as the need to use more inputs to maintain soil productivity so as to attain the same level of yield Wagayehu, 2003. is the off-site effect of soil erosion is mainly the effect of land use change (such as the expansion of the agricultural land and the migration of households and communities towards pastoral land, fragile ecosystem).Kirui and Mirzabaev 2014; cited in (Debrie, 2018)

Table 4.4. Households affected by Land Degradation?

Affected?	Frequency	Percent
Yes	293	81.2
No	68	18.8
Total	361	100.0

Source: Own survey result, May 2020.

The effect of land degradation on food security, costs of forest removal, loss of livestock productivity, loss of environmental service, water resource and costs of nutrient loss are the anticipators for the seriousness of its effect in the study area. Accordingly, the FGD indicated that land degradation has noticeable effects mainly exhibited in decline in pasture lands and reduced agricultural productivity. As indicated in table 4.4, from the total respondents, about 293 (81.2%) of the respondent replied that land degradation affects their livelihood, and only 68 (18.8%) of the respondent replied that land degradation does not affect their livelihood.

Table 4.5. Types of perceived effects of land degradation perceived by households

Effects	Yes/361	No/361
Food insecurity	161 (44.6%)	200 (55.4%)
Loss of livestock carrying capacity	165 (45.7%)	196 (54.3%)
Cost of forest removal	141 (39.1%)	220 (60.9%)
Loss of environmental service	60 (16.6%)	301 (85.9%)
Reduced water source and irregularity	51 (14.1%)	310 (85.9%)
Cost of nutrient loss	157 (43.5%)	204 (56.5%)

#### 4.1.3. Households' coping strategies

Land degradation puts a negative effect on the resilience capacity of a farming community. So to overcome these problems rural households employ different ways of coping strategies. These coping strategies are the results of years of experiences of living with hazards and involve the use of local resource's and skills in different combinations and levels. According to (Wood, 2003) coping strategies are often used sequentially depending mainly on the nature of the hazard and availability of resources which in turn determine the type and effectiveness of the strategies. The rural community in the study area employs different types of strategies to overcome the problem. Thus, coping Strategies of households in this study are generally grouped as (a) technical coping strategies, (b) consumption based coping strategies& (c) non-consumption based coping strategies.

### 4.1.3.1. Technical Coping Strategies

#### 4.1.3.1.1. Watershed Management

Watershed management is simultaneously a technical, social and economic undertaking. From a technical perspective, it involves reducing soil erosion, promoting vegetative cover, and harnessing rainwater resources. From a socio-economic perspective, it involves coordinating the actions of numerous land users in the watershed who may have multiple and possibly conflicting objectives (Cai, 2007). In the study area, households undertake watershed management practice at a community level not at a household level. Thus this study tried to assess the number of households engaged in watershed management practice at a community level. As a result, few numbers of household heads responded that they are not engaging in watershed management practice. This is because household heads who are above 60 years old and those with sickness problems are not forced to engage in watershed management practice

Table 4.6. Engaged in Watershed Management Practices?

Engaged?	Frequency	Percent
Yes	306	84.8
No	55	15.2
Total	361	100.0

Source: Own survey result, May 2020.

Effective and sustainable watershed management depends upon educating and fully engaging beneficiary communities, their representatives, and government agencies, in planning, implementation, monitoring and evaluation. Engagement must therefore ensure community acceptance and adoption of management decisions from the outset. Capacity and skills building can begin before project implementation and can be incorporated into the early planning phases of the project (GIZ Ethiopia, 2015). In Ethiopia a Community-Based

Participatory Watershed Development Guideline (CBPWDG) was issued by the Ministry of Agriculture (MoA) in 2005. Likewise, in the study area, specifically areas where land degradation is more serious watershed management practice is common. As it is shown in the above table, out of the total respondents, 306 (84.8%) households engaged in a community level watershed management practice.



**Figure 4.1. Watershed comparison in Laste Gerado Kebele**

Source; photo taken by the researcher

As we can see from Figure 4.2 land degradation even varies within the same. The land area found in the left side (A) is well protected watershed, while the right side (B) is not well protected. According to the key informant interviewee (KII) working at Gubalafto Woreda Agricultural Office, the woreda is working on management practices strongly. The KII responded that different watersheds in the woreda are being protected and remarkable changes are also seen. For this, I the researcher tried to prove the change. I knew the area indicated in figure 4.2 (A) which was nearly devoid of plant cover, but now surprisingly covered with vegetation and grass. The KII responded to the question of measures taken in the study area.

He said:-

*“Gubalafto Woreda Agricultural Office is working thoroughly so as to reverse land degradation. All stakeholders, starting from farmers in different kebeles up to Ministry of Agriculture are working harmoniously. In this case the farmers are major actors and they are given the mandate to protect their environment from degradation. That’s why remarkable changes are being observed in the woreda. These changes can be seen easily and recognized by the one who knew some areas before which were bare lands, but now already covered with grasses and vegetation”.*

### **1. Contour Ploughing**

Contour farming is the practice of tillage, planting and other farming operation performed on the contour of the field slope. This method is effective on moderate slope. Tillage and planting operations follow the contour line to promote positive row drainage and reduce ponding. Also, by increasing the soil surface roughness, contour ridging results in rainwater ponding in the furrow area, which reduces runoff velocity, increases infiltration, and reduces soil erosion (Liu et al., 2014). In addition, nutrients (e.g., nitrogen and phosphorus) in runoff are retained better in contour ridge tillage compared with up and down slope tillage (Ma et al., 2010; Liu et al., 2014). In dried areas, contour farming increases crop yield by increasing infiltration and retaining water. (Farshad Soheili Fard, 2016)

Farming on the contour creates small ridges that slow runoff water, and it maximizes the rate of water infiltration, reduces the hazard of erosion, and redirects runoff from a path directly down slope to a path around the hill slope. Farming on the contour rather than up and down the slope minimizes fuel consumption and is easier on equipment. Contour ploughing mitigates the impacts of floods, storms and landslides on the crops by reducing soil erosion up to 50 percent, controlling runoff water, increasing moisture infiltration and retention and thus enhancing soil quality and composition (FAO, 2008). The measure aims at reducing the speed of water runoff, thus reducing the risk of soil erosion on parcels of land where water runoff can gain considerable speed due to high slopes. However, the measure concerning ploughing along contour lines on steep parcels (slopes over 10 %) is not widely adopted or

respected. The fact is that on certain parcels ploughing along contours is dangerous and farmers adopt a more convenient ploughing pattern that does not support soil conservation from erosion (Nick Barbayiannis, 2008). In the study area 83.1% (300) households practice contour ploughing.

Table 4.7. Contour Ploughing?

	Frequency	Percent
Yes	300	83.1
No	61	16.9
Total	361	100.0

Source: Own survey result, May 2020.

## 2. Farm Land Soil & Stone Terracing

Terracing is an agricultural technique for collecting surface runoff water thus increasing infiltration and controlling water erosion known from an ancient history and used to transform landscape to steeped agro systems in many hilly or mountainous regions of the world (Zuazo et al., 2005). Terracing is commonly used in agriculture in Northern and Southern America, Asia (e.g. Chinese Loess Plateau, Thailand, India etc.) and in developing countries in arid environment in Africa, i.e. Ethiopia, Rwanda, Tanzania and others (e.g. Dabney et al., 1999; Fu et al., 2003; Nyssen et al., 2000; Ramos et al., 2007; Sang-Arun et al., 2006; Tenge et al. 2005). The main purpose of terracing application was to improve the usefulness of steep slope and to increase its agricultural potential. This function is realized by creating the level surfaces according to contour lines of transformed slope (Cots-Folch et al., 2006). The level, bench platform allows to spread the surface runoff water, decreases its speed and thus allows more time for water infiltration into soil profile. Terraces are usually reported as a successful soil erosion control manner in regions endangered by soil erosion by combinations of steep slopes, climatic conditions and erodible soils. But in some cases this effectiveness is limited, especially with combination of sparse vegetation (Zuazo et al.,

2005). They are also, in some cases, found to be expensive to construct and maintain (Ramos et al., 2007), (Widomski, 2011). Stone terraces are a significant element of the rural landscape in the mountainous locations or dega kebeles of the study area. Thus, 283 (74.4%) households apply farmland soil & stone terracing.

Table4.8.Farm Land Soil & Stone Terracing

	Frequency	Percent
Yes	283	78.4
No	78	21.6
Total	361	100.0

Source: Own survey result, May 2020.

### 3. Changing Cropping Pattern

When a household is exposed to a recurrent loss of food production as a result of climatic-hazards, change of crop patterns is a frequently observed coping strategy with the view of fending-off food insecurity (Salih, 2001; Desalegen, 1987) cited in (Zerihun, 2008). Even if changing cropping pattern is taken as coping strategy in literature, it is less significant in the study area which is applied by very few numbers of households, i.e. 15%(54).

Table4.9.Changing Cropping Pattern

	Frequency	Percent
Yes	54	15.0
No	307	85.0
Total	361	100.0

Source: Own survey result, May 2020.

#### **4.1.3.2. Consumption Based Coping Strategies**

Consumption based coping mechanisms constitute short term change of consumption patterns by households. Watts (1983), Corbett (1988), and Devereux (1993) in Maxwell and Caldwell (2008) take them as easily reversible strategies that do not jeopardize long term prospects. They mainly do not require commitment of domestic resources. They could be chosen by those households: whose food insecurity situation is not worsening enough to force them to commit other resources at their disposal, who decide to take the brunt of the current food insecurity for the interest of future food security, or by those who don't have other assets to dispose for food acquisition (Adane, 2018).

Households in the study area use different types of consumption based coping strategies as a response to the effects of land degradation. Based on questions raised for households whether they employed each of the strategies within the last seven days prior to the date of survey, 57.9% (209) of the households relied on less preferred and less expensive foods. About 11.1% (40) of the respondents borrowed food and relayed on help and 3.6% (13) of the respondents limit portion size at meal as coping mechanisms. Most of the consumption based coping mechanisms, except relied on less preferred and less expensive foods were insignificant due to the survey was conducted after the time of harvest. However, the study attempted to obtain data on the previous consumption based coping mechanisms of households by using key informant interviews and Focus Group Discussions (FGD). Accordingly, coping mechanisms like borrow food, rely on help from a friend or relatives, Limit portion size at mealtimes & purchase food on credit, etc. were most commonly used types of coping mechanisms before the time of survey.

Table4.10: Consumption based coping strategies

In the past 7 days, was there a time your households use the following coping method as a response to food shortage	Count/total respondents	Percent (%)
Rely on less preferred or less expensive foods?	209	57.9
Borrow food or rely on help from a friend or relative?	40	11.1
Purchase food on credit?	6	1.7
Harvest immature crops?	9	2.5
Consume seed stock held for next season?	3	0.8
Limit portion size at mealtimes?	13	3.6
Restrict consumption by adults in order for small children to eat?	6	1.7
Reduce number of meals eaten in a day?	3	0.8

Source: Own survey result, May 2020.

#### 4.1.3.3. Other coping (non- consumption)strategies

In addition to consumption based coping strategies, households may also use non-consumption based coping mechanisms such as disposing the resources at their disposal so as to get food or taking other related actions that they think appropriate. For instance, Christaensen and Boisvert (2000) in Maxwell and Caldwell (2008);(Adane, 2018) argue that people start to change their consumption habits when they anticipate a problem and don't wait until food is completely lost. Changing consumption habits is generally referring to limiting short term effects of not having enough food to eat. However, in the situation where a particular community lives under long standing food stress, such adjustments could go long as a normal habit even in the situation where non-consumption based strategies too are activated.

That is to mean that even if other strategies are employed, foods obtained through such methods could be subject to consumption based coping such as rationing. The point of argument here is that the two set of coping strategies, consumption and non-consumption based, should not be perceived as entirely detached and mutually exclusive. As it is indicated in table 10 households in the study area employed other coping strategies. But few coping strategies are employed significantly. According to the survey, 40.7% (147) households divert loan from microfinance institutions, 39.9% (144) households appeal for food aid from the government, 28.3%(102) households rent out their land as major coping strategies during the time of shocks (Adane, 2018).

Table4.11. Other Coping Strategies

Were there times your household used the following coping strategies over the past two years' period as a response to problems/shocks/ facing your household such as food shortage?	Count	Percent (%)
Desperate migration	28	7.8
Sold reproductive animals	85	23.5
Sold Oxen used for farming	44	12.2
Sold land	11	3
Rented out land	102	28.3
Remove children from school	7	1.9
Borrowed money at high interest rate	52	14.4
Consumed seed stock held for next season	7	1.9
Reduced number of meals	87	24.1
Migration to nearer areas for wage labor	28	7.8
Drawing on savings	71	19.7
Selling firewood	44	12.2
Selling nonproductive assets	41	11.4
Diverting loan from microfinance institutions	147	40.7
Appeal for food aid	144	39.9

Source: Own survey result, May 2020.

## **4.2. Estimation of Determinants of Households' Resilience Capacity to Land Degradation: Analysis and Discussion**

According to (Birhan, 2018), since 2008, in the context of food security, many researchers and institutions have tried to measure resilience and assess the impacts of their resilience programs at the household or community levels. Applying two stage factor analysis techniques, Alinovi et al. (2008) studied the resilience of Palestinian households to food security. The authors used six dimensions of resilience capacity, namely, asset, income and food access, access to basic service, social safety nets, adaptive capacity and stability. The study revealed that the dimensions of the resilient model showed a significant difference in terms of location that richest and more stable area (East Jerusalem) are most resilient and its resilience is depending on income and food access capacity, while in Gaza Strip mostly dependent on social safety nets.

Conceptualization of the components or indicators of resilience has become a significant part of the “new” thinking about resilience, which is linked to promoting resilience as a development agenda, whereas, the ability and methods to measure resilience are contested (Boka, 2017). Consequently, for the purpose of this paper, the FAO RIMA model was used while defining indicators (Access to Basic Services (ABS), Assets (A), Agricultural Technology Adoption (ATA), Social Safety Net (SSN) and Adaptive Capacity (AC)) of resilience.

### **1. Access to Basic Services (ABS)**

This shows the capacity of a household to rely on a valid infrastructural setting. Examples of indicators include access to school, markets, health facilities and other minimum requirements (e.g. toilets, water and electricity). According to (FAO, 2016) having ABS, such as schools, health centers, water, electricity and nearby markets, is a fundamental aspect of resilience for three main reasons. First, the capacity of generating income from assets, a key dimension of resilience, is constrained by access to market institutions, as well as non-market ones, public service provision and public policy (Dercon et al., 2004). For example, crop sales at the farm-gate or district market can result in very different revenues for farmer

households. Furthermore, the density of the road network influences not only access to markets, but also the efficacy of aid distribution in response to disasters (Adger et al., 2004). Recent evidence supports the association between access to basic services before a disaster and the rate of recovery after a disaster (Khan, 2014). Second, ABS plays a key role in determining the risk exposure of households and communities. For example, “risk of illness is often closely related to particular environmental risks, linked to inadequate waste disposal, water supplies, and sanitation” (Dercon et al., 2004). These risks are also very relevant in urban areas (Moser,1998). Third, the relationships between state and civil society assume a relevant role in adaptation. Inefficient state institutions are likely to neglect adequate healthcare, housing and sanitation, leading to inefficient responses to shocks. In contrast, democracy and accountability push governments to manage risks and shocks adequately in order to be re-elected (Adger et al., 2004), (FAO, 2016).

For the current variable, components were extracted using Principal Component Analysis method applying Eigen value of greater than 1. In addition, Bartlett Test of Sphericity was found to be significant with Approx. Chi-Square (541.564), df (21), Sig. (p<.000) see the following table. The sample size is also more than sufficient for principal axis factoring, KMO (Kaiser Meyer-Olkin Measure of Sampling Adequacy) was used to test sufficiency of overall sample. According to (Field, 2005), the KMO measure of sampling adequacy value should be 0.5 and above in a good model. For the current variable, i.e., access to basic service the overall KMO (Kaiser-Meyer-Olkin) measure of sampling adequacy is 0.573 which is above 0.5.

Kaiser-Meyer-Olkin (KMO) and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.573
Bartlett's Test of Sphericity	Approx. Chi-Square	541.564
	Df	21
	Sig.	.000

Table4.12.Component loadings for the observed variables used to estimate Access to Basic Service (ABS).

	Component		
	1	2	3
Distance from Market center/km	.878		
Distance from Main/All Weathered/ Road/km	.823	.313	-.133
Distance from Secondary School in Km	.715	-.324	
Distance from Health Center in Km	.253	.832	-.161
Distance from Water Source in Km	.432	-.517	-.272
Distance from Primary School in Km	.183	-.316	.699
Amount Saved in Micro Finance Institutions		.402	.688

Extraction Method: Principal Component Analysis.

Source:- Field Survey, 2020

As it is indicated in Table4.15, three components were extracted using the eigen value of greater than 1 as a criterion. The three components together accounted for about 68% of total variances in the data (component 1 accounted 32.144%, component 2 accounted 20.338%, and component 3 accounted 13.512%). According to Table 4.15, the first three variables, distance from market center, distance from all weathered road and distance from secondary school are grouped together and have their maximum loadings on the first component and the other two, distance from health center and amount saved in micro-finance institutions, on the second component. Distance from primary school and amount saved micro-finance institutions have also their higher loadings on the third component. Overall, all the seven variables' loadings are significant (each has loadings greater than 0.298) to their respective component, implying the variables' meaningful contribution to Access to Basic Services (ABS). In the context of correlation coefficients interpretation, most of the variables are meaningfully correlated with latent variable- ABS. However, distance from market center, distance from all weathered road and distance from secondary school are the three variables

that come up front in terms of relative contribution. Distance from market center was estimated as a component score to be used in the resilience estimation.

## **2. Assets (A)**

Rural farmers possess agricultural assets like land, livestock and non-agricultural assets like nonfarm income earned. Land holding and livestock ownership are real assets that improve quality of life by supporting and enabling to generate diversified sources of income, encourage productions of both crop and livestock, improves mechanism to access nutritious food, and enhances resilience of rural farmers (Bachuch, 2018). Therefore, in this study two observable variables were used to estimate the assets. These variables are:- Agricultural and Non-Agricultural Assets.

- (a) **Agricultural Assets** To estimate agricultural assets, land holding size, cash crops like coffee and chat, trees ready for cut and sell and livestock ownership were used as components of asset.
- (b) **Non Agricultural Assets** This is a continuous variable that refers to amount of non-agricultural assets (gold, car, bajaj, motor bike, etc.) in monetary value. This is also directly related to asset and resilience.

All indicators of the Asset component were estimated by factor analysis using principal component analysis method. The KMO test was 0.602, Bartlett's test was significant with Approx. Chi-Square (156.026), df (10), Sig. ( $p < .000$ ). The first component generated is meaningful and can be used to represent a latent variable. This factor alone accounted for about 35.443% of the variance while both of the factors constituted about 57.267%. All variables except income from non-agricultural assets are positively correlated with Asset (A) in different degree and are good indicators of households' resilience capacity.

### Kaiser-Meyer-Olkin KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.602
Bartlett's Test of Sphericity	Approx. Chi-Square	156.026
	Df	10
	Sig.	.000

As can be seen in Table 4.16, except income from non-agricultural activities, all four variables have significant loadings on the first component extracted. This implies that they all are important to agricultural assets (A) of households. According to (Field, 2005), factor/component loadings of size 0.298 and above are considered statistically significant for the sample size of 300. In this study, the sample size is 361 which is quite above 300. Field (2005) cited in (Adane, 2018) maintains that factor/component loadings can be taken as both correlation as well as regression coefficients if the factor/component rotation method applied is orthogonal though the two varies under oblique rotation. In the context of correlation coefficients interpretation, except income from non-agricultural activities, all four variables are meaningfully correlated with latent variable- agricultural asset (A). In this study however, land holding size and tropical livestock unit are the two variables that weights more in terms of relative contribution. For the selection of statistically meaningful components, landholding size/ha was taken as a component score to be used in the resilience estimation.

$$A = 0.35443 \times \text{comp 1 score } i + 0.21824 \times \text{comp 2 score } i \text{ ----- (equation 2)}$$

Where:

$A_i$  = Asset score for *i*th household

Comp1 score *i* = component 1 score for *i*th household

Comp 2 score *i* = component 2 score for *i*th household

Table4.13.Component loadings of the observed variables used to estimate Asset

	Component	
	1	2
Landholding Size/ha	.770	
Tropical Livestock Unit	.656	.469
Income from Cash Crops	.435	
Income from Non Agricultural Assets	-.139	.899

Extraction Method: Principal Component Analysis.

Source: Field Survey, 2020

### 3. Agricultural Technology Adoption (ATA)

Agricultural technology adoption is one of the latent variables that are believed to contribute to household's resilience to the effect of land degradation in rural household. In order to estimate this variable, four variables were used: adoption of chemical fertilizers, improved seeds, farmers' utilization of pesticides, and utilization of services of Agricultural Development Agents.

Kaiser-Meyer-Olkin (KMO) and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.705
Bartlett's Test of	Approx. Chi-Square	376.268
Sphericity	Df	6
	Sig.	.000

Table4.14.Component loadings for the observed variables used to estimate Agricultural Technology Adoption (ATA).

	Component
	1
Number of Times Received DAS	.860
Number of Times Pesticide Usage	.799
Amount of Fertilizer Used/kg	.694
Amount of Improved Seeds Used/kg	.673

Extraction Method: Principal Component Analysis.

Source:- Field Survey, 2020

#### 4. Social Safety Nets (SSN)

Social safety nets are a crucial aspect of mitigating crisis. They include assistance from international agencies, charities and non-governmental organizations, as well as help received from friends and relatives. According to (Adane, 2018), literatures take social safety nets as one of the important source of household's resilience. For instance, Alinovie *al.* (2008) and Guyu and Muluneh (2015) consider it as a capacity of the system to mitigate shocks and Alinovie *al.*(2010) underlines its importance especially to poor households resilience. Total benefits received from productive social safety net program (PSNP) and other supports received in the form of aid from government and non-governmental sources were used as indicator of this variable.

The analysis was done by using principal component analysis method. The KMO test was 0.433, Bartlett's test was significant ( $p=0.000$ ), approximate chi-square 141.906 and df. 6. The first component generated through this procedure was quite suitable which can be used to represent the SSN. This first factor accounts about 39.584% of the variation. In this regard, consideration of component 2 in estimating SSN is evident as it explained more than 65% of the total variance. As result, SSN is suitable indicator of household's resilience capacity. The following equation is used to estimate overall resilience index.

$$SSN = 0.39584 \times \text{comp1 score } i + 0.25582 \times \text{comp 2 score } i \text{ ----- (equation 3)}$$

Where:

SSNi = Social Safety Net score for *i*th household

Comp1 score *i* = component 1 score for *i*th household

Comp 2 score *i* = component 2 score for *i*th household

Kaiser-Meyer-Olkin (KMO) and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.433
Bartlett's Test of Sphericity	Approx. Chi-Square	141.906
	df	6
	Sig.	.000

Table4.15.Component loadings for the observed variables used to estimate Social Safety Net (SSN)

Variables	Component	
	1	2
Aid Received During Last 12 Months	.865	-.150
Informal Transfer/Birr	.638	.474
Credit Received During Last 12 Months	.621	-.512

Extraction Method: Principal Component Analysis.

Source:- Field Survey, 2020

## 5. Adaptive Capacity (AC)

Measuring household's ability to adapt and react to shocks is a crucial dimension of resilience (Alinovie et al, 2010). It represents the household's capacity to absorb shocks (Alinovi et al, 2009). Having more coping strategies implies more probability of mitigating food insecurity (Bachuch, 2018). Adaptive capacity represents household ability to adapt to the changing environment in which it operates. This is a multidimensional concept, being determined by complex inter-relationships among a number of factors at different scales (Vincent, 2007). A household can become more adapted by improving its conditions in its own environment (Gallopín, 2006). One of the consequences of loss of adaptive capacity is the loss of opportunity, constraining options during periods of reorganization and renewal (Resilience Alliance, 2002); (FAO, 2016).

Since KMO test is 0.534 the component generated using Bartlett's scoring method was suitable to represent the AC. It indicates that the adequacy of sample size for running principal component analysis, and it fits well the criteria that KMO statistics should be  $>0.5$ . The Bartlett's test of Sphericity was significant ( $p$ -value = 0.000, Chi-square = 888.847). Here under is the formula to estimate resilience capacity.

$$AC = 0.37744 \times \text{comp 1 score } i + 0.22877 \times \text{comp 2 score } i + 0.16960 \times \text{comp 3 score } i \dots$$

-- (equation 4)

Where:

AC  $i$  = Adaptive Capacity score for  $i$ th household

Comp1 score  $i$  = component 1 score for  $i$ th household

Comp 2 score  $i$  = component 2 score for  $i$ th household

Comp 3 score  $i$  = component 3 score for  $i$ th household

Kaiser-Meyer-Olkin (KMO) and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.523
Bartlett's Test of Sphericity	Approx. Chi-Square	916.616
	df	21
	Sig.	.000

Table 4.16. Component loadings for the observed variables used to estimate Adaptive Capacity (AC)

	Component		
	1	2	3
Total Cash Saved at Present	.913	.112	.328
Money Can Be Saved/month	.908	.218	.279
Household's Present Health Situation	-.591	.466	.378
No. Time Visited Health Center	-.258	.803	.298
Number of Disability		.595	-.614
No. of Income Source	.428	.312	-.473

Extraction Method: Principal Component Analysis.

Source: - Field Survey, 2020

### 4.3. Estimating an Overall Resilience Index

The estimation of the components of resilience was done separately prior to resilience estimation. The approach was adapted as it makes the model more flexible allowing the inclusion of prior information and thus reducing parameter identification problems as argued

in (Alinovi *et al.*, 2008); (Adane, 2018). Each of the five latent variables separately estimated above, in stage one, were used to estimate resilience, in stage two, using Principal Component Analysis. To estimate resilience (R), PCA was run on the five latent variables and their component loadings are presented in Table 4.17.

All statistical requirements for the goodness-of-fit of the PCA model were checked and all passed the tests. Bartlett’s test of Sphericity was significant at (Approx. Chi-Square = 43.607, df =4, p<.001) implying the existence of sufficient correlation among variables for running PCA. KMO test of sampling adequacy and determinant of R-matrix stood at 0.627 and 0.804, respectively. Both statistics are well above the required minimum indicating that sample size insufficiency and multicollinearity are not issues of concern. Using *Kaiser’s rule*, only one component was extracted and the component scores obtained through Bartlett scoring method was used to estimate household’s resilience to the impacts of land degradation.

Table: 4.17 Component loadings for the variables used to estimate the household’s resilience to food insecurity

	Component
	1
Access to basic services	.889
Asset	.821
Agricultural Technology Adoption	.702
Net Adaptive Capacity	.451
Social Safety	-.441

Extraction Method: Principal Component Analysis.

Source: - Field Survey, 2020

The overall resilience index (RI) for each household was estimated by applying factor analysis using principal component analysis method (PCA). The five building blocks (latent factors) were analyzed using Bartlett’s method for factor scores saved in the SPSS active data set in order to calculate the overall index.

Most of the extant frameworks for resilience analysis fail to suggest cutoff points for decision regarding who is resilient and who is not. However, using some antecedents as a base, the current study has also ventured on this issue as well. In their study titled determinants of sustainable resilience to food and nutritional security, Mulat and Negussie (2013) use the mean resilience index (RI) as cutoff point for household’s resilience status determination. They treat households whose resilience index falls below the mean as non-resilient and those whose index falls above the mean as resilient. On the other hand, in their study of household’s resilience to food insecurity, Guyu and Muluneh (2015) cited in (Adane, 2018), classify households into four resilience categories: vulnerable (with  $RI < 0.100$ ), moderately resilient ( $0.100 \leq RI < 0.250$ ), resilient ( $0.250 \leq RI < 0.500$ ) and highly-resilient (with  $RI \geq 0.500$ ). The current study adapted the approach of Guyu and Muluneh (2015) for household’s resilience status determination. Accordingly, as presented in table 4.18, significant proportion of the surveyed households (59%) are not resilient and only 41% are resilient at different level.

Table: 4.18 Level of resilience by ecological strata

Name of strata	Measurement	Level of resilience by ecological strata				Total
		Non resilient	Moderately resilient	Resilient	Highly resilient	
Kolla	Count	75	24	11	9	119
	Percent	20.77	6.64	3.04	2.49	32.94
Woyna	Count	62	39	26	22	149
Dega	Percent	17.77	10.08	7.2	6.09	41.12
Dega	Count	76	7	4	6	93
	Percent	21.05	1.93	1.1	1.66	25.74
Total	Count	213	70	41	37	361
	Percent	59.00	19.39	11.35	10.24	100

Source: - Field Survey, 2020

## **CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS**

### **5.1. Summary and Conclusion**

Giving emphasis mainly on land degradation and indicators of resilience capacity of rural households in Gubalafto Woreda, this study attempted to show effects of land degradation, coping strategies & determinants of rural households' resilience capacity in the face of land degradation. Micro-level analysis should be done on the linkage between resilience capacity and land degradation so as to ensure food security at household level in Ethiopia. Thus, the current chapter presents what has been learned from the study as summary, conclusion and forwards possible implications for various stakeholders and development agents to address these problems.

According to the data obtained through household survey, land degradation has effects on food security, natural vegetation, livestock carrying capacity, environmental services, water resources and major soil nutrients. Accordingly, in the study area 293 (81.2%) households replied that land degradation affect their lives in one or more ways. The FGD results indicated that land degradation has brought several effects on the livelihood of rural households. The effect of land degradation was seen as a gradual process mainly exhibited by decline in the productivity of the land. This lead to lack of food availability and increased in the price of food stuff which forced rural households to use irreversible coping mechanisms to food insecurity by selling their assets such as poultry, goats, sheep, ox and cows, and fire wood.

The study identified a range of coping strategies employed by households in the study area. These strategies categorized as; technical coping strategies, consumption based coping strategies and non-consumption coping strategies. The study has identified positive coping mechanisms; especially technical coping mechanisms are essential types of coping mechanisms in the study area.

Examination of loadings of PCA shows that all hypothesized variables appear to be significant contributors for the resilience of households to food insecurity shocks. To

estimate indicators of household's resilience capacity, building block or variables that determine resilience were estimated separately. These variables themselves are latent variables because they cannot be directly observed in a given survey. These variables include; Access to Basic Services (ABS), Assets (A), Agricultural Technology Adoption (ATA), and Adaptive Capacity (AC). Thus, as indicated above, Principal Component Analysis (PCA) was run to examine determinants of household resilience capacity. The PCA examined loadings of variables for each resilience block and those variables are found to be significant. The applicability of the model was also seen using all statistical requirements for good PCA model. The KMO tests of sampling adequacy for all latent variables, except Social Safety Net (SSN) were above 0.5 implying the appropriateness of the model. In addition, Bartlett's Tests of Sphericity for each variable (latent) were also significant. Hence, from the appropriateness of all statistical requirements, this study has concluded that the aforementioned latent variables are major determinants of rural households' resilience capacity.

## **5.2. Recommendations**

As it is defined by (FAO, 2016) resilience is the ability to prevent disasters and crises as well as to anticipate, absorb, accommodate or recover from them in a timely, efficient and sustainable manner. This includes protecting, restoring and improving food and agricultural systems under threats that effect food and nutrition security, agriculture, and food safety/public health. Therefore, to enhance resilience capacity of rural households it is important to focus on (1) preventing or minimizing natural hazards and (2) creating awareness among the rural households on employing effective coping strategies.

In this regard Experts in the field of economics, geography, soil science and agricultural development, as well as environmental management must draw the attention of policy makers to soil degradation concerns and work with them to set priorities for public investment in land degradation problems. This is necessary because soil is virtually a non-renewable resource. The society has an obligation to protect soil, conserve it, or even enhance its quality for future generations. This section therefore, presents a framework for actions to tackle the problem of land degradation at the local, national, regional &

international levels. These actions should be taken by the Ethiopian government, Non-governmental Organizations (NGOs) and the farmers themselves.

It has also been learned and understood that a combination of various coping strategies was employed by the surveyed households. i.e. technical coping strategies, consumption based coping strategies and non-consumption based coping strategies, as response to the effect of land degradation problems. Technical coping strategies range from engaging in watershed management practice (84.8%), to contour ploughing (83.1%), farmland soil and stone terracing (74.4%) and less significantly used changing cropping pattern (15%). On the other hand, consumption based coping strategies utilized by households include: relay on less preferred & less expensive food (57.9%) and borrow food or relay on help from a friend or relative (11.1%). Households responded to food insecurity shocks by utilizing a range of non-consumption based coping mechanisms over the last two years period. These coping mechanisms include: diverting loan from microfinance institutions (40.7%), appeal for food aid (39.9%) and rent out land (28.3%). Even if they were less significant some non-consumption coping strategies (sold reproductive animals (23.5%), drawing on savings (19.7%), borrowed money at high interest rate (14.4%) and selling fire wood (12.2%) were employed. These findings have the implication that such coping mechanisms can lead households to the poverty trap and degrade their capacity to cope with similar problems in the future. Therefore, based on observations from the survey and key informants interview, the following measures are recommended by this study.

- ❖ Experts in the field of economics, geography, soil science and agricultural development, as well as environmental management must draw the attention of policy makers to soil degradation concerns and work with them to set priorities for public investment in land degradation problems.
- ❖ There is a need for introduction of energy saving technology and alternative energy source for rural households. This is due to deforestation for fuel wood, utilization of crop residue for animal feed and energy source coupled with animal dung as fuel to the household interrupt the nutrient cycle and result in further deterioration of the land. The key informant interview with Gubalafto Woreda agricultural expert indicated that land degradation has been aggravated the collection of fire wood.

- ❖ There is a need to develop an integrated watershed management plan in Gubalafto woreda in order to conserve the natural resource base of the area. Specifically, activities like soil conservation, afforestation and terracing should be given attention with the view of reducing environmental degradation.
- ❖ There is a need for proper land use policy. Currently lands that shouldn't be cultivated are being tilled. Proper types of conservation practices are not implemented. Therefore, government should design and implement appropriate land use policy, regulations and directives.
- ❖ There is a need for the implementation of proper and locally friendly coping strategies. Besides it is also important to improve the awareness of the farmers through training and scale up the literacy level of the society.
- ❖ There is a need for strengthening the resilience of rural households through the provision of improved access to basic services, opening access to acquire asset, application of proper agricultural technology, strengthening the adaptive capacities of farmers, etc.
- ❖ Further study on the relationship of land degradation and rural households' resilience capacity should be carried out for better understanding of the relationship between land degradation& resilience capacity of households and the types of coping strategies employed by rural households.

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## Appendices

### 1. Survey Instrument

#### Structured Questionnaire

**Rrural household’s resilience capacity to land degradation; a case of Gubalafto Woreda,**

**Amhara region.**

Good morning /afternoon. My name is \_\_\_\_\_. I am a student of Addis Ababa University College of Development studies.I am doing a research to develop an academic study about the analysis of rural household’s resilience capacity to land degradation. I would like to account on your cooperation to understand resiliencestatus through examining your asset, consumption and human capital, etc.

#### I. Basic Information of Household Head

1) Please, fill out the following table with appropriate response.

No.	Information	Answer
1	Date of interview	
2	Respondent’s identification code (ID)	
3	Name of Kebele	
4	Sex	1. Male 0. Female
5	Age (in years)	No. ____
6	Marital status	1. Single 2. Married 3. Divorced 4. Widow 5. Polygamy
7	Education	Grade completed-----
8	Number of Permanent members	1. Male= 2. Female=
	Condition of House	1. Grass/straw 2. Corrugated iron sheet
10	Occupation	1. Farmer 2. Trade 3. Employed 4.1&2 5. 1&3 6. 3&2 7. Other (specify)-- -----
10.1	If farming is part of your occupation, in what activity have you been involving	1.Crop production 2.Animal rearing 3.Both
10.2	If you cultivate crop, which crops are you mainly cultivate?	1. Teff 2. Wheat 3. Barley 4. Sorghum 6. Maize
10	No. of conomicallydependent household members	No. ____

## Appendix 2:

### Resilience Related Questions

#### A. Access to Basic Services (ABS)

1. Is the main source of drinking water for members of the household piped? [1 = yes 0 = no]  
Is electricity the main source of energy used in the household for cooking or lighting?  
[1 = yes 0 = no]
2. How far (one way) is the household dwelling from the closest accessible/ functioning [SERVICE] in minutes? [kilometers or minutes]
  - Water source -----
  - Primary school,-----
  - secondary school &-----
  - preparatory school-----
  - Clinic or Public hospital / health facility -----
  - Local market -----
  - All weather road-----
3. Are you the user of microfinance institutions' (MFIs) services? 1.Yes----0.No-----
  - 3.1. If yes, how much savings do you have in MFIs at present? 1. Money -----
4. Does any member of your household own mobile telephone? 1.Yes----0.No-----

#### B. Assets (AST)

1. Do you own land? 1.Yes 2.No
  - 1.1. If yes, what is your land holding size in hectare? -----he
2. Do you own/keep/ livestock? 1. Yes---- 2.No-----
  - 2.1. If yes, how many of each of the following do you have?
    - Cows-----
    - Heifer-----
    - Calves-----
    - Bull-----
    - Plough oxen-----
    - Donkeys-----
    - Sheep-----
    - Goats-----
    - Hens-----
    - Bee Hives-----

3. Do you have cash crops (coffee, avocado, papaya, apple, chat etc.)? 1. Yes 2. No
  - 3.1. If yes, How much cash income do you expect from the upcoming harvest?  
Birr-----
4. Do you have eucalyptus, tid or other trees ready for cut and sell? 1. Yes 2. No
  - 4.1. If yes, how much do you expect the market (buyers) would offer to you if you put all of them for sale? Birr-----
5. Do you have nonagricultural assets? (car, bajaj, motor bicycle, gold etc.) 1. Yes 2.no
  - 5.1. If yes, please put their monetary value in birr-----

### C. Agricultural Technology Adoption:

Over the past 12 months (1 year period), did your household:

		Yes	No	If yes:
1.	Use chemical fertilizer			Amount in KG _____
2.	Use improved seeds			Amount in Kg _____
3.	Utilize pesticides			How many times? _____
4.	Receive development agents (DA)services			Number of times visited by DAs _____

#### **D. Social Safety Nets (SSN)**

1. What is the total amount of loan(s) received in the last 12 months by the

Members of the household? [monetary value in birr]-----

2. What is the total amount of formal transfers (relief food, cash assistance, livestock, safety net programs, pension schemes, etc.) received in the last 12 months by the members of the household? [monetary value in birr]-----

3. What is the total amount of informal transfers (cash, remittances, food or grain gift, seed gift, free use of animals, etc.) received in the last 12 months by the members of the household? [monetary value in birr]-----

4. How many networks can the members of the household rely on in case of need?

[number]-----

- Associations (farmers groups, women support groups, youth groups, Business associations, unions ,etc.)-----
- Relatives/friends/family members\_\_\_\_\_

### E. Adaptive Capacity (AC)

1.	How much is your household able to save per month?	in birr-----		
2.	How much total cash savings does your household have at present?	in birr-----		
3.	Over the past 1 year time, have you visited clinics /health centers due to illness (health problem)?	1.Yes 2. No		
3.1	If yes, indicate number of time you visited clinics	-----		
4.	What is your present health situation? (Encircle one that applies from options)	1.Excellent	2.V. Good	3.Good
		4.Poor	5.V. Poor	
5.	Is there a household member with worrisome health problem?	1.Yes----- 0. No-----		
6.	Is there a household member with disability problem?	1.Yes----- 0. No-----		
6.1	If yes please indicate their number	Number-----		
7	How many salaried household members do you have? (who have not formed their own family)			
8	In the past 12 months, was [SOURCE] a source of household income?	1 = Yes	0 = No	
	• Agriculture, animal breeding, trade			
	• Family business (other than agriculture)			
	• Government wage and salary			
	• Private sector wage and salary			
	• Transfers and social assistance			
	• Other			
	9	What is considered as the main income source of the household?	open answer-----	
10	Indicate the number of income sources available to your household.	Number		

## F. Other resilience related questions

1. To what extent do you think the following events, if they occur in the next year, will affect your household's food security?

Event	Extent of effect will be:				
	Sever	Large	Moderate	Small	No effect
Household members illness					
Household members death					
Drought					
Livestock death					
Food items price rise					
Crop failure due to land disasters					

2. If drought occurs in the upcoming year, do you think that your household will be able to feed its members to the extent that it can do at present? 1. Yes \_\_\_\_\_ 2. No \_\_\_\_\_

## Coping Strategies (CS)

### 1. Technical Coping Strategies

- Indicate the Coping Strategies your household used to reverse land degradation.

Coping Strategies	1. Yes	2. No
Engaging in Watershed Management practices		
Changing cropping patterns		
Farm land soil and stone terracing		
contour ploughing		

### 2. Consumption based coping strategies

In the past 7 days, was there a time your households use the following coping method as a response to food shortage	Yes	No
Rely on less preferred and less expensive foods?		
Borrow food, or rely on help from a friend or relative?		
Purchase food on credit?		
Harvest immature crops?		
Consume seed stock held for next season?		
Send household members to eat elsewhere?		
Send household members to beg?		
Limit portion size at mealtimes?		
Restrict consumption by adults in order for small children to eat?		
Feed working members of HH at the expense of non-working members?		
Reduce number of meals eaten in a day?		
Skip entire days without eating?		

## 2.1. Other coping strategies

Were there times your household used the following coping strategies over the past <b>two</b> years' period as a response to problems/shocks/ facing your household such as food shortage?	Yes	No
Desperate migration		
Sold reproductive animals		
Sold Oxen used for farming		
Sold land		
Rented out land		
Remove children from school		
Borrowed money at high interest rate		
Consumed seed stock held for next season		
Reduced number of meals		
Migration to nearer areas for wage labor		
Drawing on savings		
Selling firewood		
Selling nonproductive assets		
Diverting loan from microfinance institutions		
Appeal for food aid		

### Effect of Land Degradation on Livelihood of the Household

1. Have you been affected by land degradation in the last 12 months? 1. Yes---- 2. No----

1.1 If yes, how you were affected by the land degradation.

Effects of Land Degradation	1.Yes	2. No
• Food insecurity		
• Costs of forest removal		
• Loss of livestock carrying capacity		
• Loss of environmental services		
• Increasing irregularity of stream and rivers and reduced groundwater Capacity		
▪ Costs of nutrients lost with top soil erosion (or the replacement costs of these nutrients)		

**Annex 3:**  
**Focus Group Discussion guide**

**Discussion topics**

**1) Land Degradation as a livelihood Shock or Problem**

*Discuss the effects of land degradation in line with its severity and frequency, how it affects household's livelihood and the most affected group of people by the problem.*

- A. what types of hardships have your community faced over the past five years or recent past?
- B. How does land degradation have affected the livelihoods of families in your communities?
- C. How often does agricultural production decline due to land degradation related problems in the area?
- D. How long do land degradation related problems last in?
- E. How severe the effects have become?
- F. Who are the most affected people by these hardships (e.g. those who have no assets, access to basic services or women headed households, etc.)

**2. Land and Its Resources**

- i.** Trends in the conditions of natural resources of the district?
- ii.** Trends in forest cover, condition of water bodies,
- iii.** Local land tenure, distribution, access, fertility issues,
- iv.** Major problems of agricultural (crop and livestock) production?

### **3. Resilience**

Discuss the concept and determinants of resilience

- i. What does having "livelihood resilience" mean to you? And/or what does a family that is "livelihood resilient" look like in your communities? And/or describe the characteristics of livelihood resilient households. Identify the local characteristics of resilience.
- ii. What are the factors that determine the resilience capacity of the people in the face of land degradation?

### **4. Shocks and Coping strategies**

Discuss the main Coping strategies employed by communities or households used in the area.

- A. What are the most severe shocks faced by the community in the last 12 months?
- B. What are the main Coping strategies employed by communities or households before production decline due to land degradation?
- C. What are the main Coping strategies employed by communities or households after production decline due to land degradation?
- D. Did you or any members of your community ever do any livelihood activity in the past that you or they do not any more now? What was/were the livelihood activity/ies? Why did you or your community stop doing it (them)?

## APPENDIX 4:

### CHECKLIST TO CONDUCT KEY INFORMANT INTERVIEWS (KII)

#### 1. Guiding Questions to Agricultural Experts (woreda/Kebele)

- A. What is the level of land degradation in the woreda?
- B. What is the accessibility aspect? How do you characterize your *woreda* households in terms of access/entitlement: sufficiency of resource to produce food, sufficiency of income to purchase food, access to common resources or public transfers?
- C. Which areas of the *kebele* are most vulnerable to land degradation? Would you tell me areas with severe, moderate, or less vulnerable based on agro climatic zones? What are the household's coping mechanisms?
- D. Would you tell me your feelings about the effectiveness of the rural policy and institutions to alleviate land degradation problems? What do you suggest as a way out to this problem?
- E. How often the effects of land degradation occur in the community?
- F. What kinds of coping mechanisms do Gubalafto woreda and households commonly employ to overcome the effects of land degradation?
- G. How did the effect of land degradation affect the household's resilience capacity?
- H. Are the effects the same for all households?
- I. Which type of households manages to remain resilient irrespective of the occurrence of the effect of land degradation? Quickly recovered from the effects? Gradually recovered? Couldn't recover at all?