



ADDIS ABABA UNIVERSITY
COLLEGE OF DEVELOPMENT STUDIES
CENTER FOR FOOD SECURITY STUDIES

**RURAL HOUSEHOLDS' RESILIENCE TO FOOD INSECURITY IN LARE DISTRICT,
GAMBELLA REGION, SOUTHWEST ETHIOPIA**

BY

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DISTRICT, GAMBELLA REGION, SOUTHWEST ETHIOPIA**

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This thesis is my original work and has not been presented for a degree in any other University, and all sources of materials used for the thesis have been properly acknowledged.

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LIST OF ACRONYMS/ABBREVIATIONS

AC	Adaptive Capacity
ADB	Africa Development Bank
APS	Access to Public Services
CSA	Central Statistics Agency
DRRLRP	Disaster Risk Reduction and Livelihood Recovery Program
EFSOR	Ethiopia Food Security Outlook Report
FA	Factory Analysis
FAO	Food and Agricultural Organization of United Nations
FGD	Focus Group Discussion
GDP	Gross Domestic Product
HFIAP	Household Food insecurity Access Prevalence
HFIAS	Household Food insecurity Access Scale
HHs	Households
IFA	Income and Food Access
KII	Key Informant Interview
KMO	Kaiser-Meyer-Olkin
NGOs	Non-Governmental Organizations
OLS	Ordinary Least Squares
RI	Resilience Index
RIMA	Resilience Index Measurement Analysis
SPSS	Statistics Package for Social Scientist
SSN	Social Safety Net
UNDP	United Nations Development Programme
UNICEF	United Nations International Children's Emergency Fund
WFP	World Food Programme

ABSTRACT

Food insecurity is one of the critical challenges faced by Ethiopia's rural poor, and it ultimately affects rural households by depleting its assets which are essential for their food access. The objective of the study is to analyze the rural households' resilience to food insecurity in Lare district of Gambella region southwest Ethiopia. Two kebele (Mallow and Palbol) were selected purposively due to their susceptibility to food insecurity. The analysis was based on 171 respondent households from Lare District. Out of 171 respondents, 91 were from Malow kebele and 80 were from Palbol kebele, and were interviewed to identify their resilient capacity to food insecurity. The resilience was analyzed as a function of income and food access, assets, access to public services, social safety net, adaptive capacity and stability. The estimation of each bloc was done separately using factor analysis, logit model and ordinary least square model, and statistics package for social scientist version 20 was used for analyzing the data. The results of household food insecurity access scale showed that 12.83 and 87.13% of households were food secure and food insecure respectively. Out of 87.13% food insecure households, 2.34% were mildly food insecure, 1.75% moderately food insecure and 83.04% were severely food insecure. The resilience index results also show that 67% and 33% of households were non-resilient and resilient respectively. Based on the proportion of level of non-resilient households by Kebele, the Malow Kebele (38.5%) had greater non-resilient households than that of the Palbol Kebele (27.5%). This is because of inaccessibility to public services and damage of crops by flood. As indicated by the Beta coefficients, income and food access ($B=0.471$), access to public services ($B=0.67$), stability ($B=-0.329$) and adaptive capacity ($B=0.200$) were the most important dimensions of household resilience to food insecurity with significance level at (0.000). These are followed by social safety net ($B=0.151$) and asset ($B=0.138$) which played an intermediate role and would play important role in long-term in enhancing household's resilience capacity. Therefore, interventions are needed to target non resilient rural households in study area by addressing resilience dimensions based on importance of each bloc of the resilience.

Keywords: Households, Resilience, Food Insecurity, Lare District

CHAPTER ONE: INTRODUCTION

1.1 Background of Study

Food insecurity is an enduring critical challenge in Ethiopia. Over 80 percent of Ethiopian population live in rural areas and are heavily dependent on rain-fed agriculture. This makes them extremely vulnerable to changes in weather conditions (Andersson *et al.*, 2009). The 2008 global food crises due to increase in global cereals prices and global rainfall variability show the most recent trend in food security challenges. For Ethiopia, there exists strong relationship between the overall Gross Domestic Product (GDP), agriculture and the rainfall pattern, showing how plentiful rain events associated with surplus food availability. During a growing rainfall season speaks to a bountiful agricultural production, while a poor or limited rains in amount and/or extent-meaning a poor agriculture harvest for most (Temesgen *et al.*, 2016).

Temesgen *et al.* (2016) estimated that an average of 4.5 million Ethiopians were left to emergency food handout from 2011 through 2015 due to climate related calamities. Due to the continued *El Nino* from June 2015 onwards; Ethiopia is facing one of the worst crises, with an estimated 10.2 million people dipping in need of food aid. Several reports have also presented similar arguments to justify that progress out of poverty was greatly challenged in Ethiopia during 2015, due to successive seasons of drought. Smallholders and pastoralists report rising levels of indebtedness, forced sale of livestock, reduced food intake both in numbers of meals and dietary diversity and in some areas, the consumption of seeds significantly increased. These trends have culminated in rapidly worsening poverty levels in general and household food security in particular that was expected to deepen through to the main *meher* harvest of October and November 2016 (Chemonics, 2015).

Specifically, food insecurity is driven by the complex interplay of economic, natural, health, and social factors. Economic factors impacting food insecurity act through price inflation, limited access to markets, high unemployment rate, and limited livelihood opportunities, and agricultural production loss has ranged from 44 percent to 99 percent in some of the areas in the country (Okidi *et al.*, 2015).

The natural factors contributing to the crises include inadequate and/or irregular rainfall, drought, crop failures, livestock mortality, natural resource degradation, and small plot sizes.

While health factors include sudden illness, poor hygiene and sanitation practices, lack of access to health services, and poor understanding of maternal and child health and nutrition needs; and the social factors contributing to poverty include low literacy levels, social marginalization especially for women, insecure land tenure rights, and the prevalence of harmful traditional practices (Anderson and Farmer, 2015). These numerous factors highlight the complex and sensitive nature of food insecurity alleviation. The impacts of these factors have been exacerbated by the 2015–16 El Niño weather events in Ethiopia, which have resulted in the most severe drought and subsequent food emergency in decades. As of September 2015, the number of highly affected districts had increased by 46.3 percent since May 2015. The number of severe acute malnutrition cases in July 2015 was 73 percent higher than those reported in January 2015 in the country.

The Gambella Regional Survey that was conducted in (2009) reported that the food insecure account for more than half of the population. Zeid *et.al* (2016) also estimated that more than half (59.5%) of the households in region were food insecure. Of these households, 20%, 23.6% and 15.8% were experiencing mild, moderate and severe food insecurity, respectively. Bum (2013) estimated that 81% of rural populations in Lare district of Gambella Region were seasonally food insecure due to climate related factors such as flooding and erratic rainfall which result in crops destruction, failure and serious disruption of economic activity. Hence, people in the district dependent on relief/aid for their livelihoods. Of the total 37,100 food aid beneficiaries of Gambella Region identified for 2011 due to flooding, 6,307 (17%) of them are from the Lare the study district of the region (MoA, 2010). This demand for the shift in attention from the crises management to the risk management, which again needs the shift in mental model construct of the society itself and the key actors for building households resilience to such a food insecurity (Temesgen *et al.*, 2016).

The resilience measure the capability of systems (households) to absorb the negative consequences of unpredictable shocks while a similar does not (Alinovi *et al.*, 2008). Theoretically, resilience refers to the capacity of economic agents to sustain conscious from myriad shocks, avoid shocks and exploit benefits from it (Constas and Barrett, 2013).

However, it is a complex process more often than not requiring people to adapt completely new orientation of life and to transform existing social and institutional structures. In such cases, well established and institutionalized patterns of social agency will have to be discarded and new organizational settings beyond the framework of familiar strategies will have to be developed and put in place. Two basic facts according to Alinovi *et al* (2009) can be pointed out. The first reason is related to the fact that resilience has multidimensional nature and the second reason is associated with unpredictable nature of shocks households to which they are exposed makes a strong case for measuring extent of households' resilience in terms of food security.

The study conducted by Temesgen *et.al* (2016) in West Shoa zone of Ethiopia measured household level resilience through asset based resilience indicators and evaluates their resilience status. Asset-based index was the underlying unobserved variable that can be determined through indicator variables associated with a household's relative wealth position and which needs to select and attach appropriate weight from the vexing problem. In this study, resilience was defined according to seven building blocks. These building blocks are income and food access, asset, access to public services, social safety nets, adaptive capacity and stability.

1.2 Statement of the Problem

Ethiopia is one of the most foods insecure and famine affected country. A large portion of the country's population has been affected by food insecurity. The situation of food insecure people is becoming more and more severe. Therefore, food security situation in the country is linked to recurring of food shortage and famine, which are associated to recurrent drought (ADB, 2014). According to UNDP (2018), more than 23 percent of the Ethiopian population lives below the poverty line and above 20 million people are undernourished.

However, Ethiopia's economy has been growing on average by a double digit rate since 2004. Perhaps following this fast economic growth, food security status at national level has shown improvements over the last two and half decades. Food insecurity at national level had declined from approximately 52% in 1980s to 43% in 1995/96 (Devereux, 2000a), but stayed almost the same at about 44% in 2003 (USAID, 2004). From this status, it had declined to about 39% in 2004/05 and further to about 36% in 2005/06. Then, it came down to about 33% in 2006/07, 28%

in 2009/10 and 23.5% in 2018 (MoFED, 2008 and UNDP, 2018). The most recent information show that the proportion of undernourished population has remained at about 35% (WFP, 2014).

Despite these reports of fast economic growth and declining trend in food insecurity status at national level, empirical research shows that food insecurity at household level has remained considerably high in many parts of the country. A surprising feature of food insecurity in Ethiopia is its situation in the Green Famine Belt; the area that generally represents the western half of Ethiopia is characterized by adequate rainfall, green cover, non-drought occurrence, low population pressure, and better land resource endowments, but it showed that the majority of households (72%) were food insecure. Moreover, the analysis of resilience vulnerability continuum in the same region revealed that about 65% of households were vulnerable while only about 35% of them were resilient to food insecurity at different levels (Guyu and Muluneh, 2015). This shows that food insecurity has remained as one of the most considerable challenges of the region despite the relative suitability of conditions for agricultural production.

Beside, the study conducted on household food security situation in Central Oromia Ethiopia reported that 37.93% of the investigated households were food insecure; and the major factors constraining their food production are high fertilizer price, shortage of farm land, erratic rainfall pattern, water logging, crop disease and insect pests, lack of improved seed supply, and lack of improved farm machineries (Degefa and Furgasa, 2016). UNICEF (2014) reported also that the causes of food insecurity in Ethiopia were interlinked factors but vary from one region to another. The major causes of food insecurity in rural part of the country were natural disasters such as drought and climate change, population growth, lack of secured land tenure, lack of infrastructure, less purchasing power of households, and lack of off-farm income opportunity.

Ethiopia Food Security Outlook reports(EFSOR) on (Oct, 2011- march 2012) showed that the *Meher* harvest in Akobo, Wanthoa and Jekow districts of Gambella Region was not promising due to repeated dry spell and moisture stress; maize crop in Lare district was damaged by flash flood. While, maize was harvested in Agnuak and Mejenger zones of the region while sesame and sorghum were at flowering stage. The poor and very poor households in districts like Akobo, Wanthoa, Lare and Jekow in Gambella were faced food insecurity; while the remaining districts in the regions was reported not to have acute food insecurity. Therefore, poor households in

districts with expected below normal harvest (Akobo, Wanthoa, Lare and Jekow of the region) were to remain at stress food insecurity level and the food insecurity is likely to deteriorate in those districts of Gambella. The other parts of the region were reported not to have an acute food insecurity problem throughout the outlook period.

Bum (2013) stated that alertness was carrying out on the seriousness of food insecurity and its impact on the long term livelihood of households in Lare district. However, there are rarely studies that empirically analyze rural household resilience to food insecurity in Lare district because the approach is not yet established in the study area. It therefore, needs to harmonize life with the food insecurity impact by designing different resilience mechanisms to address such a food security shocks (Temesgen *et al*, 2016). Having this statement of the problem, the theme of this study is to investigate rural household's resilience to food insecurity in Lare District in Nuer Zone of Gambella Region, Southwest Ethiopia.

1.3 Objective of the Study

1.3.1 General Objective

The major objective of this study was to investigate rural households' resilience to food insecurity in Lare District, Gambella Region Southwest Ethiopia.

1.3.2 Specific Objectives

More specifically, the study aimed to:

- Examine food insecurity status and coping strategies of rural households in Lare district;
- Analyze the level of resilience of rural households in the study areas;
- Analyze the indicators of the rural households' resilience in study area.

1.4 Research Questions

1. What is level food insecurity status of rural households in Lare district?
2. What are food insecurity coping strategies of rural households in Lare district?
3. What is level of households' resilience in study area?
4. What are the indicators of the households' resilience in study area?

1.5 Significance of the Study

This study assesses the rural households' resilience to food insecurity in Lare District of Gambella region, and is expected to contribute to knowledge of resilience from area specific, local context in study area and the region in general. Furthermore, it will possibly play a role in policy and practices that are dedicated in alleviating food insecurity via resilience and improving the overall living standard of rural households.

1.6 Scope and Limitation of the Study

The study was conducted in Lare district in Gambella people's National Regional State of Southwest Ethiopia, to investigate the resilience to food insecurity at household level; and also to assess the severity of the problem of food shortage. However, owing to time and resource constraints, the study covered only two selected *Kebele* of the 28 *Kebele* of the study area. Household was a unit of analysis in this study. Even if the problems of resilience are multi-dimensional and dynamic, this study emphasized mostly on issues and analysis at level of rural households by taking 'Snap-shot' at a particular period of time bases on cross-sectional data. Notwithstanding useful, the study does not capture the complex and dynamic nature of rural households' resilience.

While the researcher has tried to implement it with up to date information on the non-resilience indicators and food insecurity factors affecting the study communities; the original data of household survey were collected in April 2018. Meanwhile, in order to avoid major gaps in the data, the researcher put efforts capturing the new development in the study *kebele* through field observation, key informant interviews, focus groups discussions as well as review of recent secondary data sources. During data analysis, the researcher omitted some unclear answers not to draw wrong conclusion.

1.7 Organization of the Paper

The study was organized into five chapters. The first chapter dealt with the introduction, background of study, statement of problem, objectives, research questions, significance, scope and limitations of the study. The second part of the paper was about the theoretical and empirical literatures including basic conceptual and measurement issues related to the subject of study available in Ethiopia and other countries. The third part discussed on description of study area and methodological issues employed. The interpretations of findings and analysis are presented under fourth chapter. The final section draws conclusion and possible policy and program implications.

CHAPTER TWO: RELATED LITERATURE REVIEW

2.1 Resilience Concept and Theoretical Literature Review

The concept of resilience is familiar in ecology but new in social sciences (Ciani, 2012). It officially began in 1970s mainly by the influential work of Holling in ecology. Resilience in ecology is regarded as the persistence of relationships within a system and the measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters (Holling, 1973). Understanding of the concept of resilience becomes complete when the worldviews associated with it are understood. Accordingly, two broad aspects of resilience that can be considered as worldviews are identified as “engineering resilience” and “ecological resilience” (Sakurai *et al*, 2012). Both deal with aspects of stability of equilibrium providing alternative measures of a system’s ability to maintain its functions following disturbance (Alinovi *et al*, 2009). Their definitions reflect which of the two aspects of stability of a system should be emphasized. In order to understand the essence of the first two views, you can relate them to the engineers’ desires when designing, for example a building as ‘*fail-safe* or *safe-fail*’ design, the former being equated with engineering resilience while the later with ecological resilience (Holling, 1996).

The engineering resilience can be defined as the speed of return to the steady state following a perturbation perceiving a system as existing close to a stable state (Sakurai *et al*, 2012). In this definition, resilience focuses on efficiency and assumes constancy and predictability of a system’s properties. All of these attributes are at the core of engineers’ desires for *fail-safe* design (Holling, 1996). It perceives a system to exist close to a known stable equilibrium steady state and its functions should be maintained to this state after a perturbation (Holling, 1996). Thus, an increased resilience implies the system’s ability to bounce back faster after stress, enduring greater stress, and being disturbed less by a given amount of a stress (Martin-Breen and Anderies, 2011).

Engineering resilience is therefore grounded more within the theory of positivist tradition, both epistemologically and ontologically (King, 2008). The epistemology and ontology of a positivist scientist aims at developing an objective understanding about a reality (a system) assuming that a system can be known and a truth exists suggesting there is one best management option for this system. In this tradition, people are also assumed to be separated from nature. A researcher

adopting engineering resilience approach therefore searches for variables that contribute to the existence of a single stable state. A system's resilience is measured as a resistance to disturbance and the speed of return to this steady state or recovery from a shock following a perturbation. In reality, however, a system has multiple states of equilibrium for which ecological resilience approach that assumes dynamism in the properties of a system is appropriate for analyzing and understanding a system (King, 2008).

Ecological resilience refers to the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist (Holling, 1973). It is simply the potential of the system to remain in a particular configuration and to maintain its feedbacks and functions, and involves the ability of the system to reorganize following disturbance-driven changes (Walker *et al*, 2002). In other words, ecological resilience model focuses on persistence despite changes in, and unpredictability of a system's properties (King, 2008). It assumes multiple stability domains and is measured by the magnitude of disturbance that can be absorbed before instabilities shift/flip into another regime of behavior (Alinovi *et al*, 2009). Ecological resilience is dynamic model, rather than static, that captures properties of complex dynamic systems. It conceives conditions far from any single stable steady state, where instabilities can flip a system into another regime of behavior and domain of stability (Holling, 1996). In general, three defining characteristics of ecological resilience are listed as: the amount of change a system can undergo (and the amount stress it can sustain) and still retain the same controls on function and structure (still be in the same configuration-within the same domain of attraction); the degree to which a system is capable of self-organization; and the degree to which a system expresses capacity for learning and adaptation (Walker *et al*, 2002).

The ecological resilience model is grounded in constructivist tradition epistemologically and ontologically. In this philosophical stance, knowledge or understanding of the property of a system is obtained through a social construction while reality/truth is ultimately subjective. Moreover, unlike positivism in which man is assumed to be separated from nature, constructivism assumes that people cannot be separated from nature, but are part of nature. Accordingly, researchers search for alternative stable states, the properties of the boundaries between states, and the conditions that cause a system move from one stability domain to

another. Resilience, according to this approach is therefore measured in terms of the magnitude of disturbance absorbed before the system is restructured with different controlling variables maintaining the existence of functions (King, 2008).

In summary, the choice between the two approaches for practical application in a field of research depends on the objective and methodological underpinnings of the study as well as the characteristics of the system under investigation. In this regard, ecological resilience approach is therefore applied in this study assuming that different equilibriums exist, at least, among different households (a household is defined in this study as a system, or sub-system of food system). Thus, rural household resilience to food insecurity is analyzed considering the existence of different levels of resilience among households.

2.2 The Concept of Resilience to Food Insecurity

Food security, as quoted from Food and Agricultural Organization, FAO (1996), is defined as “all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs food preferences for an active and a healthy life”. Failure to achieve this as a result of food deficit is what is termed as food insecurity.

Food insecurity is defined as a temporary, complete lack of and/or decline in access to productive resources, deterioration of the household assets position over time, declining resource productivity as a result of environmental degradation and lack of alternative technologies (Maxwell, 1996). WFP (2004) also define food insecurity as a situation that exists when people lack secure access to sufficient amounts of safe and nutritious food required for normal growth and development and an active and healthy life.

In Ethiopian context, Degefa (2005) defined food insecurity as “when a household is not capable of sufficiently feeding its members from either its own production or purchase on the market, in return to own cash that might be earned from the exchange of self endowment”.

Resilience thought is a systemic thought; and food systems are complex systems that involves household as a component (Alinovi *et al*, 2009). Food systems encompass a set of activities and outcomes ranging from production to consumption which involve both human and environmental dimensions, and whose primary policy objective is achieving food security. Such

activities include production, distribution, processing, preparation and consumption of food, whereas their outcomes include food availability, affordability, preference, food use, value, and safety (Ciani, 2012). They are made up of the interacting social and ecological components that affect the food security of a given group of people (Alinovi *et al*, 2009).

Households are therefore not only subsystem of a food system but also are adaptive complex systems that can make a choice among available alternatives because they are decision making units that play a leading role in reorganizing the function of the food system when they face food crisis (Alinovi *et al*, 2009). The source of resilience therefore lies in the diversity and flexibility of the system's functional groups (Ciani, 2012). The sources of such diversity and flexibility for a household to reorganize better in the face of food insecurity depends on economic factors (diversification of income sources and accumulation of income, asset, access to market, credit etc.), social (education and health), infrastructural (road, energy and electronic communication) (Alinovi *et al*, 2009).

In general, resilience systems (including household) have plenty of buffering capacity and can absorb disturbances, where diversity is a key factor for such buffering capacity; they can also take action (including restructuring and reorganizing) to respond to feedbacks, which depends on how well managers understand these feedbacks; and they can learn. A household's resilience can be enhanced if it shows the characteristics that decrease its sensitivity/vulnerability to shocks and increase stability (Ciani, 2012).

Recently, Alinovi *et al* (2008) defined resilience as the capacity of a household to keep a certain level of wellbeing (food security), notwithstanding shocks and stresses, and reorganize while undergoing change so as to still retain essentially the same function, structure and identity. More recently, DFID (2011) defined 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. The individual at Technical Working Group on Resilience Measurement (FSIN) also defined resilience as the capacity that ensures adverse stressors and shocks do not have long-lasting adverse development consequences (Errico *et al*, 2013). Building resilience requires helping people to cope with change, adapt to new and changing circumstances, and facilitate governance and institutional changes that promote good policies, plans and programs to

support wider development at sufficient scale and over a long enough time period to have lasting benefits (Frankenberger and Nelson, 2013). These definitions imply that (i) resilience is an outcome-based concept, being the outcome of food security or any other indicator of well-being; and (ii) resilience emphasizes long-lasting effects on the outcome variable at hand as well as agency that is the agent's capacity to absorb and adapt negative impacts of shock.

2.3 Empirical Review of Resilience to Food Insecurity

Resilience to food insecurity is a system's (household) ability to maintain a certain level of well being (food security) in the face of risks; and it depends on the options available to that household to make a living and on its ability to handle risks (Alinovi *et al.*, 2008). They also termed a household resilience as therefore to ex-ante actions aimed at reducing or mitigating risks, and ex-post actions of coping with those risks. It also covers both short-term actions (coping) and actions that have longer-term impacts (adaptation to structural changes to ensure household functioning). The options that were available to responds to food security related chocks are: income and food access, assets, access to public services, social safety nets, adaptive capacity and stability.

Temesgen *et.al* (2016) reported that income and food access are directly related to households capacity to absorb shocks. Food access is the economic capacity of a household to afford food, which requires a household to have income for food consumption expenditure; therefore, the per capita income, coping strategies and dietary diversity were indicators of the household's resilience. Moreover, land, livestock and non agricultural assets like estimated amount of non-farm income earned, house structure 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 households.

According to FAO (2016), access to public services (APS) such as schools, health centers, water, electricity, mobility/transportation, phone networks and nearby markets were the main indicators of resilience for three main reasons. First, the capacity of generating income from assets is constrained by access to market institutions, as well as non-market ones, public service provision and public policy. 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 effectiveness of aid distribution in response to disasters. Second, APS 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. 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. Besides, social safety nets are crucial aspect for the poor to make life simple and lessen the impact of food security shocks to them. Social safety nets as social protection, in the form of relief that consists of given to households affected with food security related shocks. The indicators of household's resilience via SSN were drink-coffee ceremony, borrowing grain/Cash and job assistance (Temesgen *et al*, 2016).

Frankenberger *et al* (2012) reported that adaptive capacity is the level of access to and exploits benefit therein from resources in order to deal with shocks. The authors also reported that education, income diversity, and labor disposal diversity, diversity of asset-disposal as coping strategies and diversity of wild edible foods were the adaptive capacity indicators of resilience to food security related shocks. Therefore, the household's options and capacity to withstand as a whole to external shocks and stressors during shock prevalence time is stability. It is one bloc of resilience responds to perturbation, confronts food security related shocks and recovering quickly; also is an important dimension of household's resilience. The bedeviled nature of notoriously unpredictable food insecurity causes instability. It progressively worsens resilience of rural households' and severely hamstrung their life and livelihoods. The indicators of households' instability were livestock diseases, crop failure, water shortages and Income instability. Moreover, human related disturbances like chronic illness (Temesgen *et al*, 2016).

In Ethiopia context, survey households done in western Ethiopia reported that more than 65% households were less resilient to the food insecurity shocks. Therefore, the resilience capacity of households in the country is very weak and they may remain vulnerable in the future unless sound intervention measures are taken (Guyu and Muluneh, 2015). The main hazards and chocks faced by the community comprised droughts and associated food shortages, malnutrition and famine, with the 2010-2012 droughts being one of the most destructive (ACDRM, 2015). Moreover, the agro-pastoralists were observed to have gained more resilience than pastoralists

this is due to some resilience interventions. Residents of high intervention areas reported to have gained resilience whereas resilience of those in middle-and low-intervention areas was perceived to be same and decreased, respectively. Most beneficial interventions for improving resilience were those related to water, education, health, productive farming and access to credits.

The studied conducted by African Centre for Disaster Risk Management (ACDRM) (2015) in Oromia Region also found that ownership livestock and access to veterinary services, engaging in off-farm activities, and having access to credit and saving services were good indicators of households' resilience to shocks in Ethiopia. Moreover, resilience in households is typically characterized by the amount of assets and degree of accessibility to different goods and services. Mulat (2010) also reported that food access, liquid assets, education, and social network were good indicators resilience food security shocks in the country.

Fekadu (2010) done an empirical analysis on determinant of rural households food security in central Ethiopia and indicated that the size of land cultivated, as a basic input in farming, is significantly associated with food security status of a household. It also revealed that land play important role as means of coping mechanism during serious food shortage and guarantee to receive credit service. This means households with large cultivated land produce more for household consumption and for sale and have better chance to be food secure than those having relatively small size of cultivated land. Author showed that household assets and income diversification contributed to household food security which in turn results in resilience. The contribution of different forms of capital (financial and physical) to attaining food security indirect and direct because farmers in the area engaged in share cropping and land renting where part of their cultivated land is operated by other families who did have the capacity to invest on the land. Therefore, access to land alone increases the chance to attain food security through getting involved in other forms of economic transactions. In that sense, informal institutions that facilitate crop-sharing arrangements and engagement in informal land lease contracts played a crucial role. Moreover, the results also implied that scaling-up of the supply of chemical fertilizer immensely contributed to enhancing food security. Policies and strategies that involved regulation of the trend of increases in the prices of agricultural products vis-à-vis chemical fertilizer and introducing necessary adjustments were essential to sustain this positive effect.

Absence of this might cause a disproportional increase in input prices that would in turn create disincentives for farmers to purchase such inputs (Fekadu, 2010).

Beatrice (2012) showed that the coping strategies used among households in Tharaka Central Division Kenya during food shortages were reduction in size of meals, consumption of immature crops; restriction of consumption of adult to allow more for children, and wild foods gathering. Bum (2013) conducted study in south western Ethiopia and found that household the study area sold their livestock as a mean of food insecurity coping mechanism; and also stated that some of households used milk and milk products, cash/grain borrowing, fire wood collection, fishing, wild fruits products as coping strategies to shocks. Since the resilience is new approaches in study area, the research aims is to alleviate food insecurity of rural households via resilience indicators.

2.4 Livelihood and Food In/security Situation in the Gambella Region

The Gambella Region has total area of 34,063 square kilometer size, being flat and humid, is also rich in major perennial navigable as well as irrigable rivers. The annual population growth rate of region is exceptionally highest in the country with 4.1 while the national average is 2.6. Meanwhile, the region has three livelihoods zones such as mixed agriculture livelihood zone, coffee, honey and cereal livelihood zone and agro-pastoral livelihood zone. These livelihood zones comprises farming and livestock rearing, fishing, beekeeping, or a combination of farming mixed with livestock, or with fishing or beekeeping and/or livestock mixed with farming or fishing. Hunting and gathering are also practiced as means of living (Tsegahun, 2007).

In 2007, the region has 63,692 housing units where 44,612 belong to rural residents. Of the total rural housing units, 97.8 % reported to be made up with wood and mud thatched with grass or wood only; 10 % with corrugated sheet, 59 % with having single room; and 82 % of the units do not have toilet facility. Fuel wood use for cooking comprises 83 % while over 66 % of the rural housing unit uses unprotected water sources and rivers. According to the 2005 Demographic and Health Survey, around 44 % of the rural population falls under the lowest wealth quintile in terms of household assets such as Television and radios and characteristics of the household including access to water and sanitation facilities. On the contrary, women malnutrition is among

highest category. From 2002/03 to 2004/05 cereal production decreased by 58 %, which is a sharp decline as compared to the three consecutive years of 1998-2001 whereas 11% increment was observed. The increment of population in need of food aid from year to year, coupled with reduction in agricultural productivity and production, indicates the severity and widespread rural poverty in the region (Abeba and Degefa, 2011)

Meanwhile, annual report of the region showed that some of the basic non-income poverty indicators such as literacy, health, water services show improvement at least in terms of coverage. The same source reported that the primary school education and health services coverage for region were 106% and 73.16 %, respectively in 2004 though the quality of data can be questioned. Again the quality and equitable distribution of the services at regional level needs further investigation as these indicators of welfare does not necessary substantiate improvement in poverty reduction at household levels (GNRS, 2016).

2.5 Analytical Framework

There are very few studies that have tried to quantitatively assess household's resilience to food insecurity. The main problem with a quantitative approach to resilience measurement is that resilience is not directly observable. But there are two possible strategies to overcome this problem. First, modeling resilience as a latent variable (Alinovi *et al.*, 2008 and 2010; Mulat, 2010), and second, using an observable variable as a proxy of resilience (Carter *et al.*, 2006; Keil *et al.*, 2008). Mulat (2010) estimated household's resilience to food insecurity in a dynamic context by using micro-panel data from the Ethiopian rural households' survey. The author considered resilience as a latent variable and it is estimated through a Factor Analysis (FA) run on four variables: food access, liquid assets, education, and social network. Carter et al (2006) applied their approach to the assessment of the impact of the 1998-1999 droughts in Ethiopia as well as to the impact of the Mitch hurricane in Honduras in 1998. Their approach is based on the idea that resilient households have the ability and the possibility to smooth their consumption by depleting their asset stock or by implementing other coping strategies. Conversely, non-resilient households tend to cope by reducing their consumption in order to maintain their assets. Moreover, the authors emphasize the existence of poverty traps if household's asset basket falls under a given threshold; the household is likely to not be able to recover from the shock

Achieving resilience at a significant scale require the ability to measure resilience outcomes at an individual, household, and community levels. However, measuring resilience is not simply about measuring outcomes (food security), but rather measuring changes in outcomes over time. It covered both short-term actions (coping) and actions that have longer-term impacts (adaptation to structural changes to ensure household functioning) (Mukungu, 2016). The resilience is determined by various components such as income and food access, assets, etc. These components are in turn not directly measurable and are considered as latent variables themselves. This paper assesses the rural households' resilience, and the observed variables are used to estimate a first set of latent variables through a factor analysis. These latent variables are, in turn, used to compute a resilience index (Alinovi *et al.*, 2008 and 2010). The figure below is study analytical framework adapted from Alinov *et al* and Guyu (2008:10; 2015).

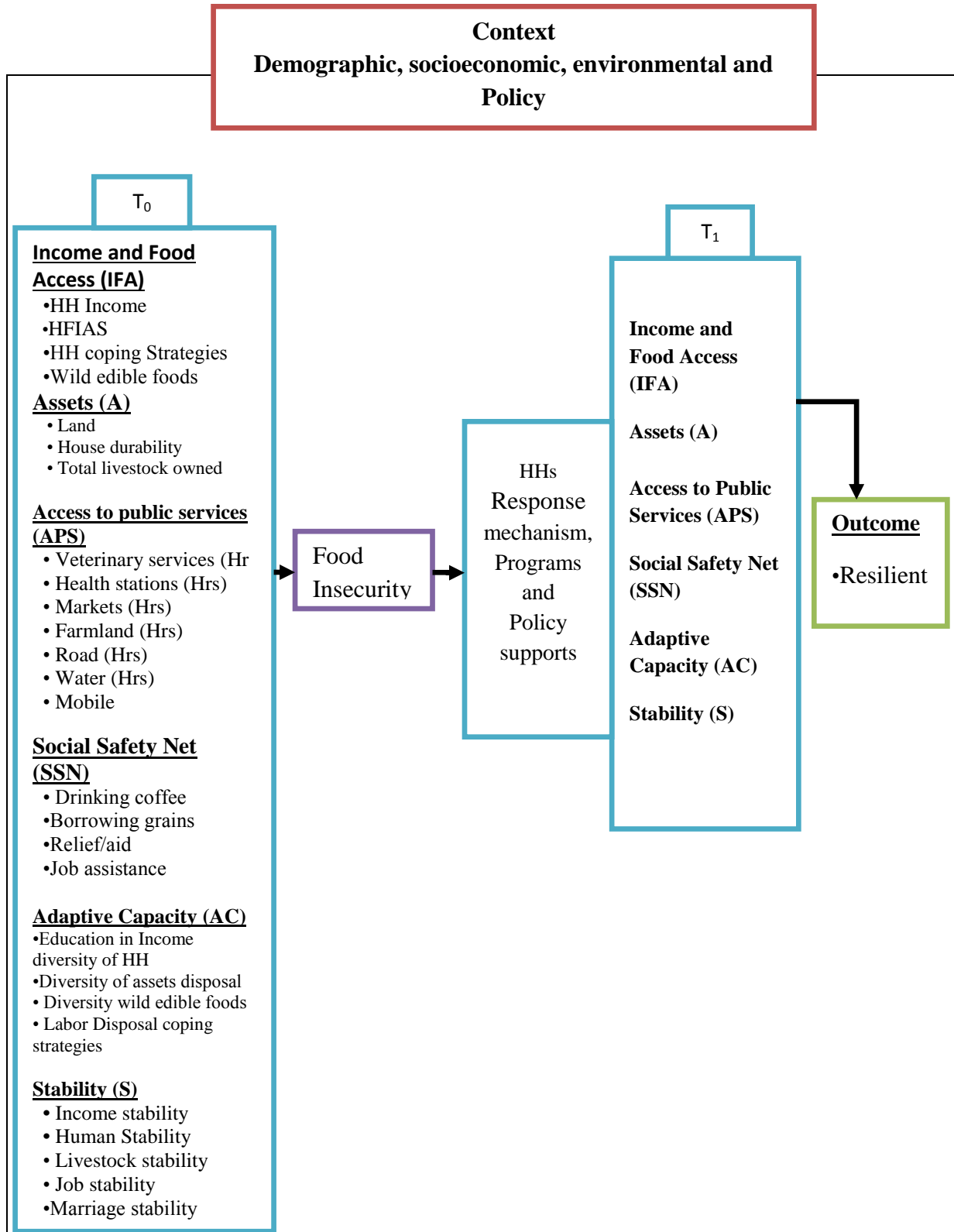


Figure 1: Analytical framework, adapted from Alinovi *et al* (2008:10); Guyu and Muluneh (2015)

CHAPTER THREE: DESCRIPTION OF THE STUDY AREA AND RESEARCH METHODS

3.1 Physical Location and Demographics

Gambella People's National Regional State (GPNRS) is located at Southwest Ethiopia between the geographical coordinates of 6°28'38" to 8°34' North Latitude and 33° to 35°11'11" East Longitude, which covers an area of about 29,782.82 km², about 3% of the nation. The region is bounded to the North, North East and East by Oromia National Regional State, to the South and South east by the Southern Nations and Nationalities People's Regional State and to the Southwest, West and Northwest by the Republic of South Sudan. The regional capital town is Gambella which is about 766km from Addis Ababa, the capital city of Ethiopia (CSA, 2017).

The region is divided into three ethnic zones (i.e. Nuer Zone, Anuak Zone and Mejeng Zone); and 13 administrative Districts that include one special district. It is inhabited by five indigenous ethnic groups (e.g. Nuer, Anuak, Mejeng, Opo and Komo) and many highlanders. Based on the 2017 Population and Housing Census of the region, it has an estimated total population of 435,999. Of which, 227,000 were males and 208,000 were females), whereas Nuer constitutes 143189 (46.65%) followed by Anuak with 64,959 population (21.17 %), Mejeng with 12,277 (4 %), Opo with 990 (0.32 %) and Komo with a population of only 224 (0.07 %). An estimated 75 % of the population of the region lives in rural areas which below the national proportion (nearly 84 %).

In 2017, the region has 65,445 households out of which the 45,855 are rural residents with an average family size of 4.6. 90.3% of the population belongs to Christianity of all denominations while 4.9 and 3.8 % belong to Islam and traditional belief, respectively (CSA, 2017). According to CSA (2017), among the population aged of 10 years and above, 34.4% are economically inactive and 64.4% were economically active. Based on the distribution of the age, among the male, 73.3% were economically active, while in case of female it is 55.1%. In all zones, the percent economically active males were higher than females. This is true mainly because housewives are mostly engaged in activities that are not considered economic (CSA, 2017). As observed from the census data in rural areas of Gambella Region, more active persons were

recorded as compared to urban. Specifically in the age group 10-14 years, the difference was much wider, where the activity rate was 5.9% for urban areas while it is 37.7% for rural areas (CSA, 2017). The major reasons for such variation was that in the rural areas young children rather than going to school at an early stage, get usually engaged in farm activities such as herding cattle and helping parents in weeding and harvesting.

Lare district is one of the 13 districts of Gambella Region of Ethiopia. It is located in the western part of the region and is 85 km from Gambella Town, Eastern part of Nuer Zone and Jekow District, Southeast and Southern part of Itang Special district, and at its north is the Republic of South Sudan. The district is divided into 28 *kebeles*. Based on figures published by the Central Statistical Agency in 2007, the District has an estimated total population of 31,406, of whom 16,145 were males and 15,261 females and with an area of 685.17 square kilometers (CSA, 2007).

According to estimation made in 2017 by the Central Statistical Agency, the district has the total population of 38,985, which shows the rapid growth of population in the district. Lare District is found in the Agro-pastoral livelihood zone (APLZ) and dependent on livestock and crops production as well as fishing, hunting and wild food collection. The terrain in Lare district consists of marshes and grasslands; elevations range from 300 to 400 meters above sea level. The figure two below shows the physical location of the Gambella region and the study district.

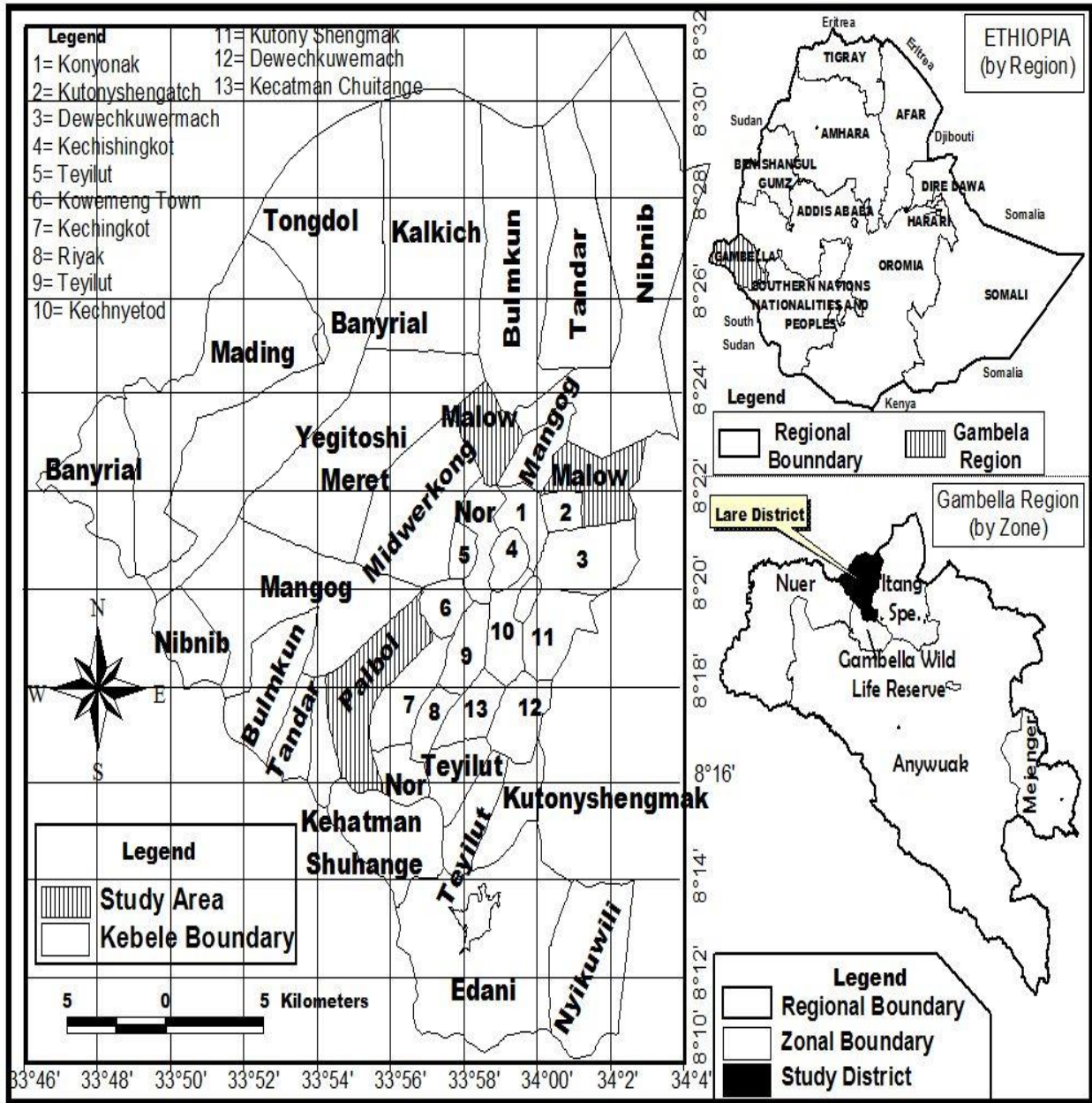


Figure : Map of Gambella Region and Location of Study District; source: CSA (2012)

3.2 Natural Resources Base

The region is endowed with a vast flat land which is suitable for agriculture and other economic activities. The existing land cover types of the region are identified as cultivated land, forest land, wood land, bush land, shrub land, grass land, bamboo, wet (marsh land), etc.

The major rivers within Gambella region are the Baro, Alwero, Gilo and Akobo with their tributaries originating from the highlands which have immense potential for diversified seas. The

eastern foothills that lie below the main escarpment are between 1,300 and 600masl and the plains to the west of the foothills between 450 to 600masl. Rainfall generally increases with altitude, from 850 mm in the west to over 2,000 mm at the highest parts of the escarpment. Temperature is inversely related to altitude, with mean annual temperatures of 22⁰C to 27⁰C (Bum, 2013).

Four major soil types are found in the region. Fertile but poorly drained Vertisols covering 47 percent of the Region are found on the low-lying alluvial plains. On the interfluvies between the plains are relatively infertile well-drained orthic Acrisols on 14 percent of the area. On the gently sloping foothills below the escarpment are relatively fertile eutric Fluvisols, occasionally with high water tables, with 27 percent of the area. On the escarpment with 11 percent of the area are deep well drained dystric Nitisols of moderate fertility. The natural (i.e. undisturbed) vegetation patterns are closely related to patterns of rainfall and temperature, with local variations due to soil and drainage factors. In the upper parts of the foothills a mixed broadleaf montane forest occurs, with increasing species diversity to the west. Between 600 and 450masl a lowland forest occurs which has affinities with the Guinea-Congo plant realm. Between about 1,300 and 600 masl a transitional type of forest occurs with species of both the highland and lowland forest types. The woodlands can be divided into the Acacia-Commiphora woodlands in the drier southern lowlands and broadleaf Combretum-Terminalia woodland found in the wetter areas of the western lowlands. The western part of the Region is covered by vast areas of permanent and seasonal swamps (CSA, 2017).

3.3 Pattern of Local Climate in the Region

The agro climate of Gambella falls under Arid, Semi-arid and humid conditions. This region is divided into two distinct climatic zones including mid altitude and low land areas. The minimum temperature of the low land area is about 15.5⁰c where as in the eastern highlands is 10⁰ c and the extreme maximum temperature in the low land area is about 44.5⁰ c whereas in the mid altitude is 23⁰c. the mean annual temperature of the low Land area is about 27⁰c and the annual temperature in the high land areas is about 21⁰c. The rainfall is also very variable and is becoming increasingly unpredictable and this trained affect the livelihoods of traditional farmers and agro

pastoralists. The occurrence of rainfall was highly erratic and uneven in its distribution in time and space. The total amount of rain varies greatly from year to year resulting droughts in some years and change of cropping seasons. Moreover, temperatures are high throughout the region and in most of the months in the year. Rainfall of the region ranges from 800mm-1200mm in low land area. The annual total rain fall recorded about 1200mm-1800mm at mid altitude. Near the equator, location and the altitude varying from 390m to more than 2500 meters above sea level influence a rich variety of local climates, ranging from tropical climate along the Republic of South Sudan boarder to warm temperate and high plateaus on the mountain peaks from the Eastern part of the region (BoARD, 2009).

3.4 Research Methods

In this study, a cross-sectional survey was applied to undertake the study in investigating rural households' resilience to food insecurity in Lare District of Gambella Peoples' National Regional State of Ethiopia. The resilience of the rural households was defined in function of income and food, assets, access to public services, social safety nets, adaptive capacity and stability. These variables are rural households' response mechanisms to a given food security chocks. Mixed research method was employed in this study because resilience is a multi-faceted concept and is not directly observable (Alinovi *et al.*, 2008).

3.4.1 Data Sources

The study used both primary and secondary data to analyze resilience of respondents in the study area. The primary data were collected from a sample population of rural households through closed and open-ended questionnaires. Information pertaining to the respondents' households such as demographic, socio-economic and institutional variables was assessed during the study.

Secondary data were extracted from publication journals, seasonal and annual periodical reports of the district disaster prevention and food security agency, district agricultural office and Gambella people's national regional state disaster prevention and food security agency and Regional Disaster Risk Reduction and Livelihood Recovery Program (DRR/LR) coordination office, and regional finance and economic development bureau and World Food Program (WFP).

3.4.2 Sampling Methods and Sample Size

Lare District has twenty eight *kebeles*. Of the total twenty eight *kebeles*, two *kebeles* were selected purposively due to their susceptibility to food insecurity since Malow *kebele* is nearer to bank of Baro river which overflow during rainy seasonal and result always in crops damage and livestock deaths while Palbol *kebele* is water stress area which make it vulnerable food insecurity (BoARD, 2009). The information obtained from Lare administration district indicated that Malow *kebele* has 159 and Palbol *kebele* has 141 rural households, which make a total of 300 rural households in the two *kebeles*; and the rural households were stratified to identify the food insecure households. The statistically representative size of sample households were determined based on recommendations given by Yamane (1967) to calculate sample sizes which has 95% confidence level and $P = 0.05$.

$$n = \frac{N}{1 + N(e)^2} = \frac{300}{1 + 300(.05)^2} = 171 \dots\dots\dots \text{equ.2}$$

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

The total 171 rural households were determined as sample households for both *kebele*; and the proportional quota sampling techniques were used to assign 171 rural households' respondents to Malow *Kebele* and Palbol *kebele* based on their proportional to total population (159 and 141) as 91 and 80 respectively.

The selection of the respondents both male and female within *kebele* stratum was done through simple random sampling from the list of *kebele* inhabitants. In this technique, the numbers were assigned to cards which represent households and then mix the cards. After mixing, the cards were picked and then the interviewed households were obtained and interviewed by using both structured and unstructured questionnaire.

3.4.3 Methods of Data Collection and Tools

The study employed both qualitative and quantitative methods of data collection. In addition, it utilized both primary and secondary data. The study used the following tools to collect data:

Household Survey: In order to generate information at household level, household survey was undertaken using structured questionnaires. Before conducting survey, questionnaire revision was made and finalized, and then four enumerators were employed to collect data. The structure questionnaire survey was used to collect information of food insecurity status, coping strategies, level and factors influence households' resilience.

Focus Group Discussion: Focus group discussion on the selected discussions theme such as general welfare conditions, vulnerabilities to food insecurity, coping strategies and resilience indicators of study households was conducted. Three FGD were conducted and communities' members, representing both men and women of the community and various ages and who are active participants in the socioeconomic and development affairs of the study area were the major targets of the focus group discussions. The FGD in particular consists of a group of eight people comprises of four women and men drawn from all lifestyles were selected from each economic groups and meeting held for half day per a group.

The focus group discussions were employed to collect information on food insecure and food secure households. The other questions that were posed to both categories of households were factors that make a given household to become non-resilient or resilient, existing opportunities and resources, demographic, food in/security, coping strategies, and food diversity perception in the study district.

Key Informants' Interviews: A key informant interview was carried out with the intention of capturing diverse welfare status; and was selected in all proposed study *kebele* with the support of *kebele* and opinion leaders and development agents. A thorough interview was made with both Development Agents and experts of the Agriculture and Rural Development Office. The checklist was prepared to guide and facilitate the interview, and the KII used semi-structured checklists so as to generate relevant data from sample households. Semi-structured questionnaires were directed to key officials of relevant government offices at all levels of study

area. Besides, informants interview meeting were carried out with district officials to discuss efforts made so far in resilience to food insecurity at local level.

3.4.4 Methods of Data Analysis

The collected data were edited to detect errors and omitted unnecessary data; and thereafter analysis was done by using Statistical Package for Social Scientist (SPSS) Version 20. Then, the data were analyzed using qualitative and quantitative methods. Qualitative information from interview questions was narrated. The quantitative data were analyzed using Household Food Insecurity Access Scale (HFIAS), Logit Model and Coping Strategy Index (CSI) that quantitatively assesses household food insecurity status and its coping strategies. Moreover, Resilience Index Measurement Analysis (RIMA) was used to examine resilience indicators through latent variable modeling (i.e. factor analysis). The RIMA approach used a Factor Analysis (FA). Factor analysis was used to identify the resilience latent indicators. These indicators are: Income and food access (IFA), Assets (A), Access to public services (APS), Social safety nets (SSN), Adaptive capacity (AC) and Stability (S). After analyzing of each resilience bloc, resilience index was estimated in function of all resilience latent variables. Finally, Ordinary Least Square (OLS) was used to identify factors that influenced rural households' resilience, and also to find out which factors are important in resilience of the households.

A. Households Food Insecurity Status Analysis using HFIAS

HFIAS was used to analyze food insecurity status of households. The study used HFIAS nine items of food insecurity scale that was developed by the FANTA project which measures anxiety about food supply, followed by questions about food quality, questions on food quantity, and, lastly, questions on going to sleep hungry or going all day and night without eating (Deitchler *et al.*, 2010). The HFIAS score is then calculated as a continuous measure of the degree of food insecurity (access) in the household in the past four weeks (30 days).

Using HIFIAS, households have been categorized as food secure, moderately food insecure, mildly food insecure, and severely food insecure. The response variable has four values as:

$$y = \begin{cases} 1 = \text{if food secured} \\ 2 = \text{if moderately food insecure} \\ 3 = \text{if mildly food insecure} \\ 4 = \text{if severely food insecure} \end{cases}$$

B. Household Food Insecurity Determinants Analysis using Logit Model

The statistical model was used to establish the relationship between the household characteristics and food insecurity. Typically, linear regression analysis is widely used in most economic and social investigation because of availability of simple computer packages, as well as the ease of interpreting the results. This data analysis was used to identify the determinants of food insecurity status of households. According to Gujarati (1995), the functional form of the logistic model is presented as follows:

$$P_i = F (Z_i) = \frac{1}{1+e^{-(a+\sum b_i x_i)}} \dots \dots \dots \text{Equ. (3)}$$

Where: P_i = is the probability that household is being food insecure given X_i

X_i = represents the i th explanatory variables,

a & b_i = are regression parameters to be estimated,

e = is the base of the natural logarithm.

C. Household Food insecurity Coping Strategy Analysis using Coping Strategy Index

Coping Strategy Index (CSI) is often used as an alternate indicator of household food insecurity. CSI is based on a list of behaviors (coping strategies), and it is a particularly powerful tool for assessing households food insecurity coping strategies (Maxwell, 2008). To conduct an analysis of the CSI, two procedures are needed. The first is a scoring of the relative frequency and the other is a scoring of the severity weights. The frequency is a measure of how many days in the past week a household had applied on the various coping strategies, range from “never” (0) to “every day” (7). That frequency score is then multiplied by the severity weight. The simplest method of weighting the strategies is by grouping (ranking) severity weighting as least severe

weighted=1, moderately severe=2, severe=3 and more severe=4. The average weights were calculated by summing up weights score of all households. According to Maxwell (2008), the values for both the frequency and the severity influence the CSI score in the same way. That is the higher the frequency, the higher the score; and the greater the severity, the higher the severity weighting. And then, households were asked 10 coping strategies and assign weights on them, see table1.

Table : Coping strategy index

No.	Coping Strategies	Frequency score (0-7) days	Universal Severity Weight	Weighted Score = Frequency X severity weight
			(1). least severe (2).moderate severe (3).Severe (4). More severe	
1	Less expensive food		1	
2	Borrow Grain		2	
3	Depend on WEFs		4	
4	Harvest on Immature Crops		4	
5	Send HH members elsewhere		3	
6	Reduce number of meals		2	
7	Reduce Adult consumption		2	
8	Feed working members		2	
9	Reduce portion size		1	
10	Skip the whole day		4	
	Total HH scores	Average for each individual strategy		

Source: Maxwell (2008).

D. Indicators of Households' Resilience using Factor Analysis (FA)

Factor analysis was used to estimate and construct unobserved variables (resilience blocs) and reduce a set of observed variables that are used as proxy indicators (food security outcomes) for the latent variable into a single variable. The data reduction mechanism relies on cross correlations between the observed variables, identifying the number of (unobservable) factors reflected in the correlations, and predicting the latent outcome as a linear combination of underlying factors. If all the variables defining the latent variable are closely correlated, they may be represented by a single factor. When variables cluster into a few groups of closely related variables, they can be represented by more than one factor (Bollen, 2002). The basic idea of a latent variable approach for resilience measurement is that there are one or more latent variables

that create the association between unobserved variables (Bollen, 2002, 609). The assumption is that Y variables are related to a number of functions operating linearly. A formal expression of this idea is as follows:

$$Y_1 = \alpha_{11}F_1 + \alpha_{12}F_2 + \dots + \alpha_{1m}F_m \dots \dots \dots \text{Equ (4)}$$

$$Y_2 = \alpha_{21}F_1 + \alpha_{22}F_2 + \dots + \alpha_{2m}F_m$$

$$Y_3 = \alpha_{31}F_1 + \alpha_{32}F_2 + \dots + \alpha_{3m}F_m$$

$$Y_n = \alpha_{n1}F_1 + \alpha_{n2}F_2 + \dots + \alpha_{nm}F_m$$

Where, Y = variable with known data, which are food security indicators,

α = a constant, and

F = factors of some unknown variables which are resilience latent variable.

This algebraic perspective, is an application of the known data on the Y variables (food security indicators), and factor analysis defines the unknown factors. The loadings emerging from a factor analysis are the constants. The size of each loading for each factor measures how much that specific function is related to Y. For any of the Y variables of equation 4 it can be rewritten as:

$$Y = \alpha_{11}F_1 + \alpha_{12}F_2 + \alpha_{13}F_3 + \dots + \alpha_{1m}F_m \dots \dots \dots \text{Equ(5)}$$

Where, Fs= representing factors and their loadings, and some of the F functions are common to several variables. These are called group factors and their delineation is often the goal of factor analysis.

To estimate resilience (R), it is therefore necessary to estimate separately the resilience attributes (IFA, A, APS, SSN, AC and S) which are themselves latent variables because they cannot be directly observed in a given survey (FAO, 2016), and it is mathematically represented as:

$$R_i = f(\text{IFA, A, ABS, SSN, AC and S}) \dots \dots \dots \text{Equ (6)}$$

E. Importance of Latent Dimensions of Household Resilience using Ordinary Least Square

Linear regression models, especially Ordinary Least Square (OLS) have several uses in real life problems. It is widely used method to estimate the parameters of a linear regression model. Ordinary Least Square (OLS) estimators minimize the sum of the square errors (a difference between observed values and predicted values). In this paper, OLS is used to identify factors that can influence rural households’ resilience, and also to find out which factors are important in resilience of the households. This gives the impacts in terms of standardized (B) coefficient. The household resilience score was used as dependent variable and six of the latent variables as explanatory variables. Hutcheson (2011), present the equation used to predict household resilience (RI) as:

$$Y = \partial + \beta_1X_1 + \beta_2X_2 + \dots + \beta_nX_n + \varepsilon \dots \dots \dots \text{Equ. 7}$$

Where, Y = dependent variable; ∂ = constant; X_{1-n} = independent variables; β_{1-n} = coefficient of each variable; ε = an error term. This can be rewritten as:

$$RI = \partial + \beta_1 \text{ IFA} + \beta_2 \text{ A} + \beta_3 \text{ APS} + \beta_4 \text{ SSN} + \beta_5 \text{ AC} + \beta_6 \text{ S} \dots \dots \dots \text{Equ. 8}$$

Where, RI = household resilience; ∂ = constant; β_{1-6} = coefficient of each variable, e = an error term representing the negligible information of the variables used to estimate resilience, but excluded from the model above.

3.3 Research Explanatory Variables and Expected Outcomes

The explanatory variables affecting the households’ resilience as well as dimensions are perquisites to address the research questions and thereby the objectives stated above.

A many of socioeconomic, environmental, political and demographic explanatory variable and other household characteristics are supposed to affect household resilience in the study area. The major explanatory variables expected to influence positively or negatively on the household opportunities, capabilities and vulnerabilities are: Income and Food Access (IFA), Assets (A),

Access to Public Services (APS), Social Safety Net (SSN), Adaptive Capacity (AC) and Stability (S).

In order to find reasonable responses for the aforementioned research questions, a set of appropriate working assumption is required. From general nature of these research questions and in most other natural science as well as resilience to food insecurity related studies, the following research hypothesis are chosen for this research:

Income and Food Access (IFA): Income and food access are directly related to households capacity to absorb shocks. Food access is the economic capacity of a household to afford food, which requires a household to have income for food purchase. Therefore, it needs to calculate it as the total income of the household obtained from all sources productions. To account for perception of food access, household heads were asked nine generic questions of the Household Food Insecurity Access Scale (HFIAS) developed by Food and Nutrition Technical Assistance (FANTA) in 2007. To estimate income and food access latent variable, factor analysis was used.

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. 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.

Access to public Services (APS): Access to public services encompassed key responses provided by the public that is expected to enhance household's resilience. The provisions of public services are exogenous to households, but it remains fundamental to manage risk and respond accordingly and enhancing household's resilience. Proximity to various social services like education, health and veterinary centers, roads, extension credit facilities etc. create direct and indirect effect on welfare of households. Observed variables to estimate the latent variable of access to public services included access to health centers, veterinary clinic, drinking water, market, dry weather roads, mobile possession, and distance to nearest farmland. These are

measured in term of distance (hr) to households' homestead and they are continuous variables. Factor analysis was used for analyze

Social Safety Nets (SSN): Social safety nets are crucial aspect for the poor to make life simple and lessen the impact of food security related chocks to them. The social safety nets are social protection in form of relief/aid that consists of (grain and oil, assistances in cash and in kind), borrowing grains/oil, remittances and drinking coffee.

Adaptive Capacity (AC): Adaptive capacity refers to the level of access to and exploits benefit therein from resources in order to deal with shocks. Adaptive capacity is 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 (Alinov *et al*, 2009). The variables included to estimate this latent variable is the role of education in diversifying source of income. It was based on the premises that a diversified sources of income leads to a greater adaptive capacity. Other variable are diversity of wild edible foods, diversity of asset disposal as coping strategies and diversity labor disposal enhances household's adaptive capacity.

Stability (S): Stability refers to household's options and capacity to withstand as a whole to external shocks and stressors during shock prevalence time. It is one bloc of resilience responds to perturbation; confront related shocks and recovering quickly. Household's survival depends on the interaction components that enable them to react to such external stimuli and continue their life and livelihoods operations indifferently. Stability is an important dimension of household's resilience. The bedeviled nature of notoriously unpredictable food security chocks causes instability. It progressively worsens resilience of smallholder farmers' and severely hamstrung their life and livelihood. Even smaller external event can bring nefarious outcome like catastrophe destruction. Households with high stability are likely to illustrate high resilience to food insecurity, while those showing low stability will have low resilience. Socio-economic and ecological variables were captured to estimate this latent variable like perceptions to livestock diseases, marriage instability, income instability and job instability. Moreover, human related disturbances like chronic illness, violence, death were also taken into account. To estimate stability, observed variables are, indeed, an indicator of stability.

CHAPTER FOUR: RESULTS AND DISCUSSION

This chapter presents the results of the descriptive analysis. A summary of the explanatory variables that potentially influence households' resilient to food insecurity was computed. The household food insecurity and its determinants were assessed through Households Food Insecurity Access Scale (HFIAS) and Logit Model respectively. And then Coping Strategy Index (CSI) was used to investigate households' food insecurity coping options. Finally, Factorial Analysis (FA) and Regression Model were used to analyzed level and factors that influence households' resilient.

4.1 Demographic and Socio-economic Characteristics of the Respondents

According to the study result, 62% of the sample households were males and the reminding 38% were females. Out of the total 171 respondents, the majority (80.1%) of the respondents are married while the rest of them are widowed, divorced and polygamies. The study shows that 82.5% of total 171 respondents are illiterates and the others 17.5% were literates. The study also showed that 97.7% out of the 171 respondents were farmer and other 2.3% were both farmers and government servants. The demographic characteristics of the study revealed that the average age of the respondents was 40.36 with a minimum of 25 and 99 maximum age range. The average family size of the respondents was 6.02 family sizes with a minimum and maximum of 3 and 12.

Table 2: Demographic and Socioeconomic characteristics of the respondents

Descriptions		No. of respondents	%	
Sex of HH Head (Male=1& 0=Female)	Male	106	62	
	Female	65	38	
	Total	171	100	
Marital Status of the HH Head	Married	137	80.1	
	Widowed	9	5.3	
	Divorced	10	5.8	
	Polygamous	15	8.8	
	Total	171	100	
Education of the HH Head (illiterate=1)	Illiterate	141	82.5	
	Read and write	30	17.5	
	Total	171	100	
Occupation (Farmer=1 & 2=Both)	Farmer	167	97.7	
	Both	4	2.3	
	Total	171	100	
Variable	Mean	Std. Dev.	Min	Max
Age of the HH Head (yr)	40.36	9.06	25	99
HH Family Size	6.02	1.81	3	12

Source: Own survey result, April 2018.

As shown in table 3, the variables which are associated with determinants of food insecurity status are characterized and examined using t-test and chi-square. Demographic and socioeconomic variables such as age, family size, farmland size, household income livestock ownership were analyzed using t-test; and the dummy variables such as sex of the household head, marital status of the household head, education of household head, occupation of household head and extension contacts were examined using chi-square.

The dummy variables such as a sex of household head, marital status of the household head, education and occupation of the household head were examined using chi-square. As indicated in table3, the marital status and occupation of both food in/secure household head was statistically different at 1% level of significance. The result shows that 6.04% and 6.71% of the widowed and divorced head households were food insecure while 63.64% married households head were food secure. And the result of occupation showed that 86.36% and 99.33% rural farmer households were food secure and food insecure respectively while those who are both farmers and government employee households have 13.64% and 0.67% food secure and food insecure respectively. The result implied that farmer household heads are more vulnerable to food insecurity than those who are both farmers and government employee. This is because those who both farmer and government employee have diverse sources of income than those who depend on farming only.

The results of the t-test indicated that there is a statistical difference in the average value of the area of total cultivated land (ha) at 10% significance level, respectively. As it is shown in table , the average size of the cultivation land of food secure households is 1.00 while the cultivation land of the food insecure households is 1.10. The result implies that households which have smaller cultivated farmlands are food insecure than those who have larger farms. Most of the farming households have own farmland for the cultivation of crops. The average cultivation land size of the sampled farming households in the study areas is above the national figure of 0.15 hectares (CSA, 2012).

Table 3: Descriptive of continuous and dummy of demographic and socioeconomic variables

Variables	Description	Food Secure	Food Insecure	P-value
Sex of the HH head	Male	58 (38.93%)	91 (61.07%)	0.521
	Female	7(31.82%)	15 (68.18%)	
Marital status of the HH Head	Married	14(63.64%)	123(82.55%)	0.000***
	Widowed	0.00	9(6.04%)	
	Divorced	0.00	10(6.71%)	
	Polygamy	8(36.36%)	7(4.70%)	
Education of the HH Head	Illiterate	18(81.825)	123(82.55%)	0.933
	Literate	4(18.18%)	26(17.45%)	
Occupation(1)	Famer	19(86.36%)	148(99.33%)	0.000***
	Both	3(13.64%)	1(0.67%)	
Variables		Mean Value of Food secure HH	Mean Value of Food insecure HH	P-Value
Age of the HH Head (yr)		41.32	40.22	0.701
HH Family Size		6.54	5.87	0.99
Total Cultivated Farmland		1.00	1.10	0.076*
HH Income		11.38	44.10	0.1
Livestock Ownership		7.92	24.43	0.92

Source: Survey result, April 2018. *** Significant at 1% level, ** significant at 5% level,* significant at 10% level.

4.2 Households Food Insecurity Status

HFIAS was used to investigate households' food insecurity status. It measured food insecurity occurrence based on the response of households about their access to food. It is a continuous measure of how households' access to food and was used to indicate the level and depth of severity of exposure to food insecurity as 'rarely', 'sometimes' and 'often' (Maxwell, 2008).

Household Food Insecurity Access Scale (HFIAS) results of analysis were investigated using access-related, condition, and prevalence. The analysis of the Access-related condition based on the 9 generic questions Table4 indicated that 81.81% of the surveyed households faced problems of both economic and physical access to food while 18.19% of them had never faced it. With regards to the average severity level, 39.18% of households faced access problems were 'rarely', 25.08% 'sometimes' and 18.13% 'often' during that year. This finding is similar with Guyu and Muluneh, 2015) which indicated that 71.8 of households were food insecure.

Table 4: Household food insecurity status

No.	HFIAC	Number and Percent of Households by Frequency					HH Experienced a condition	
		Never	Rarely	Sometime	Often	Total		
1	Worry about food	No.	25	128	13	5	171	146
		%	14.6	74.9	7.6	2.9	100	11.51
2	Unable to eat preferred Food	No.	26	74	51	20	171	145
		%	15.2	43.3	29.8	11.7	100	11.44
3	Eat just a few kinds of foods	No.	27	49	66	29	171	144
		%	15.8	28.7	38.6	17.0	100	11.35
4	Eat foods they really do not want to eat	No.	26	49	51	45	171	145
		%	15.2	28.7	29.9	26.3	100	11.44
5	Eat a smaller meal	No.	28	56	46	41	171	143
		%	26.4	32.7	26.9	24.0	100	11.28
6	Eat fewer meals in a day	No.	26	70	50	25	171	145
		%	15.2	40.9	29.2	14.6	100	11.44
7	No food of any kind in the household	No.	30	49	52	40	171	141
		%	17.5	28.7	30.4	23.4	100	11.12
8	Go to sleep hungry	No.	37	52	36	46	171	134
		%	21.61	30.4	21.1	26.9	100	10.57
9	Go a whole day and night without eating	No.	46	76	21	28	171	125
		%	26.9	44.4	12.3	16.4	100	9.86
Total Score is 171*9=1539		No.	271	603	386	279	1539	1268 (100)
		%	17.61	39.18	25.08	18.13	100	82.39

Source: Own survey result, April 2018.

The 9 generic questions of households' food insecurity access were also designed to represent varying levels of food insecurity and reflect three domains. These domains are *anxiety and uncertainty*, *insufficient quality* and *insufficient quantity* and its consequences.

In the first domain (anxiety and uncertainty) match to the proportion of households answered "yes" to the first question only. The result indicated that almost all (85.4%) of surveyed households were uncertain and anxiety about their access to enough food at any severity levels while only 14.6% of them were sure of adequate access to food. Out of this, 74.9%, 7.6% and 2.9% of surveyed households was anxious and uncertain for access to food is rarely, sometimes and often respectively table 4. Considering the most severity levels of condition as (sometimes and often), significant proportion (10.5%) was anxious and uncertain about their access to enough food.

The second domain that shows food quality in term of variety preference was measured based on the three next questions (2, 3 and 4). The percent of households that affirmatively responded to each of these questions give the perception about the quality of food accessed by a household. The result revealed that 84.8% of households reported that they could not eat the food they prefer, 84.3% ate just limited variety of meal and 84.9 of them depended on the food type they really did not want to eat because of lack resource to get food, see in table 4.

The last domain representing the access to sufficient quantity and its consequences was also investigated based on the last five questions (5, 6, 7, 8 and 9) that indicate the most severe behaviors as reflected by households. As shown in table 4, about 83.6% of surveyed households *ate less than what they felt*. The next severe condition under this domain is whether a household *ate smaller meals per day*, which is reported by 84.7%. The third and fourth severe condition that households reported were *having absolute no food and sleeping hungry at night*, which were reported 82.5% and 78.4% of households respectively. Finally, 73.1% reported that they *went hungry the whole day without eating any food* indicating that there was no food at all for that particular day.

The Household food Insecurity Access Prevalence (HFIAP) is a categorical indicator of households' exposure to food insecurity that shows its depth. It categorized households into four severity levels by using formula given by Coates *et al* (2007) as: "food secure", "mildly food insecure", "moderately food insecure" and "severely food insecure". Households are categorized as increasingly food insecure as they responded affirmatively to more severe conditions frequency. Among the severity levels indicated on (Table4), only the whole columns of "never," was the affirmative respond to the first condition for "never," indicated that households are food secure. In other words, households are food secure if their affirmative response is "never" for all the 9 generic questions; and "rarely" indicate food insecurity condition of any severity level.

The analysis of the HFIAP (Table 5) shows that 87.13% of households were food insecure. Of this, 2.34% were mildly food insecure, 1.75% moderately food insecure and 83.04% were severely food insecure. This shows that access factors are important determinant of food insecurity. To compare severity level of food insecurity between two *Kebele*, Malow is more severe than Palbol *Kebele* due to its proximately to the bank of Baro River which overflow during crops plantation and harvesting season, and always results in crops damage and livestock

death (BoARD, 2009). This Finding was nearly similar to Bum (2013) which reported that 97% were food insecure in Lare district. This shows a significance decrease of food insecurity level by 14%.

Table 5: Household food insecurity status by kebele

Household Food Insecurity Status	Malow kebele (N= 132)		Palbol kebele (N=154)		Total		P-value
	No. of resp.	%	No. of resp.	%	No. of resp.	%	
Food Secure	7	7.7	15	18.8	22	12.87	0.001***
Mildly Food Insecure	2	2.2	2	2.5	4	2.34	
Moderately food Insecure	1	1.1	2	2.5	3	1.75	
Severely Food Insecure	81	89	61	76.3	142	83.04	
Total	91	100	80	100	171	100	

Source: Own survey result, April 2018, *** significant at 1% level

4.3 Estimating Determinants of Household Food Insecurity Status

In the study, the analysis of determinants food insecurity status using logit model was used to check the food insecurity status of sample rural households. The logit analysis was made using socioeconomic and demographic factors that could affect the food security status of the rural households. A logit model of estimation used to figure out factors having a certain sort of relationship to the food insecurity status of study households. As (table 6) shows, the logit model of $\text{Prob} > \chi^2$ is a good fit since it is below < 0.05 (i.e. 0.001). As showed, the p-value of these four variables is below 0.05 or above Z score of 1.96. The output for the logit equation shows that four variables significantly influenced and determined the probability of the food insecurity status in the study area. These variables are household marital status, household family size, household occupation and household contact with development agents. The result indicated that window households were food insecure due to shortage of labor force with significant level at 1%; and the households who main occupations are farming only are more food insecure than those who are both government workers and farmers with the significant level at 5%.

Family size and food insecurity are positively related. The result showed that the households who have large family size are food insecure than those who have small family size and it is significant at 10%; and households who have lack of contacts with development agents are food insecure than their counterpart with significant level at 10%.

Table 6: Determinants of household food insecurity status

HFIAS	Coef.	Robust Std.Error	z	P> z
Sex of the HH Head	.8512109	.6694847	1.27	0.204
Age of the HH head	-.0329225	.0554334	-0.59	0.553
Marital Status of the HH Head	.6554046	.228244	2.87	0.004**
Education of the HH Head	-.2106979	.8125488	-0.26	0.795
Family Size	.2577029	.1561629	1.65	0.099*
Occupation of the HH head	2.067093	.7428964	2.78	0.005*
Total Cultivated Farmland of HH	-.8347045	.5691609	-1.47	0.142
HH Livestock Ownership	.0000936	.0000721	1.30	0.194
HH Income	-.0000499	.0000553	-0.90	0.367
Extension contacts	-1.219399	.6953017	-1.75	0.079*
Log likelihood = -42.658743				
Number Obs.=171				
Prob > chi ² =0.001				
R ² = 0.3500				

Source: Own survey result, April 2018

** Significant at less than 5% probability level; * Significant at 10% probability level

4.4 Households' Food Insecurity Coping Strategies

Coping Strategies Index (CSI) is one of the tools used to know about households' response mechanism to food insecurity. The index is good measure of possible exposure to food insecurity. The index was calculated based on the frequency of (0-7 days) to a one question (Maxwell, 2008). "What do you do when you do not have enough food, and do not have enough money to buy food?"

Table 7: Household food insecurity coping strategy index

No	Coping Strategies	Frequency score	Severity Weight	Weighted Score = Frequency X weight
			1. least severe 2. Moderate severe 3. Severe 4. More severe	
1	Less expensive food	5	1	5
2	Borrow Grain	7	2	14
3	Depend on WEFs	4	4	16
4	Harvest on Immature Crops	3	4	12
5	Send HH members elsewhere	0	3	0
6	Reduce number of meals	6	2	12
7	Reduce Adult consumption	5	2	10
8	Feed working members	0	2	0
9	Reduce portion size	1	1	1
10	Skip the whole day	2	4	8
Total HH score		Average for each individual strategy		7.8

Source: Own survey result, April 2018.

The basic idea of CSI is to multiple the frequency and severity of coping strategies. As indicate in Table 7, four severity weights were identified based on households survey conducted in the study area. The average weights were calculated by summing up weights score of all households. The households were asked 10 coping strategies and assign weights on them. The least severity weight = 1, moderately severe=2, severe=3, and more severe=4.

The CSI was therefore calculated as the result of the frequency of occurrence (0-7days) and respective weight of each coping strategy. The sum of weighted frequency of ten coping strategies gave the overall CSI of each household.

Table 8: Household coping strategy index by kebele

Name of Kebele	Coping Strategy Index by Kebele					
	Mean	Minimum	Median	Maximum	Percentile 25	Percentile 75
Malow	55	0	53	162	38	73
Palbol	45	0	49	105	27	60
Both Kebele	50.58	0	50	162	37	63
HH score <CSI Mean	50.29%					
HH score ≥CSI Mean	49.71%					
Total	100%					

Source: Own survey result, April 2018.

The result in Table8 indicated that the mean CSI was 50.58% for the whole surveyed households with minimum and maximum score of 0 and 162 for Malow and Palbol *Kebele* respectively. In principle, the higher the score, the more a household becomes food insecure. To compare between the two *Kebele* that shows food insecurity condition was more severe among households in Malow *Kebele* with mean score of 55% than the households in Palbol *Kebele* with the mean score of 45% as expected to before.

The CSI by itself tells about the food insecurity strategies the given households employed during food shortfalls. Moreover, CSI can also indicate that the households with index of 162 is more food insecure than that of 0. The result also showed that that about 50.29% surveyed households scored CSI less than the mean score for Palbol *Kebele* while about 49.71% of them scored greater than the mean for Malow *Kebele*. The finding goes with assumption that the mallow are more exposed to food insecurity due to it's nearer to bank of Baro River than Palbol *Kebele*.

4.5 Estimation of Latent Indicators of Household Resilience

As it already stated in literature, resilience is the positive capacity of households to bounce back from the negative effects of adverse shocks. To estimate resilience, it is therefore, necessary to estimate separately each building block which are themselves latent variables because they cannot be directly observed in a given survey, but it is possible to estimate them through factor analysis) (Alinovi *et al.*, 2008). For this purpose, analysis was undertaken using factor analysis for all latent variables separately. After that, essential variables were selected based on the factor loading and other statistical criteria like Kaiser-Meyer-Olkin (KMO) statistics of sampling adequacy, Bartlett's test of sphericity, communalities and variance explained by the factor generated. The variables were used to estimate the respective latent dimensions that were later used to estimate the overall resilience index. Based on these, the following observable variables were identified to estimate their respective latent variables.

4.5.1 Income and Food Access (IFA)

IFA is an essential latent dimension of household resilience. It is directly related to the capacity of households to access a food through different ways (Alinovi *et al.*, 2009). In rural areas of Ethiopia, economic access to food is a critical problem. Identified main indicators that constitute IFA were essential as each indicator should be focused when designing programs that aim at building resilience. The traditional indicator of IFA that measure food access capacity is the household income, household food insecurity access scale, coping strategies index and wild edible foods.

- Household Income: It is average income (birr) generated from all sources of income generated from agriculture and non agriculture that might be expended for purchasing food by a household.
- Household Food Insecurity Access Scale (HFIAS): This indicator was computed based on the 9 generic questions developed by Food and Nutrition technical Assistance (FANTA) 2007, a Project based on the answer to what happened over the past 30 days. This indicator is inversely related to household resilience.
- Coping Strategies Index: Coping refers to what people have to do when they do not have enough to eat, thus the more people have to cope, the less they are food secure. This implies that CSI is directly related to resilience.

- Wild Edible Foods: This is the sum of wild food gathered and/or hunted measured in Kg. The amount of WEFs is assumed to positively contribute to IFA. As a result, the larger amount of WEFs accessed, the more a household becomes resilient.

As all of these variables have continuous scales, factor analysis was run to estimate IFA (a latent indicator) using the principal axis factoring method and the scoring method suggested by Bartlett (1937) using SPSS version 20. The first factor generated is quite meaningful and can be considered as the underlying latent variable (IFA) as it meets all statistical requirements. Although it satisfies the requirements, the remaining 2 factors were also used in estimating IFA as they accounted for significant variance, the three factors accounting for more than 91% of the variance. The KMO measure of sampling adequacy is 0.647 indicating that the sample size was adequate for running factor analysis and indicating a reliable first principal component representing IFA. This well fits the suggestion that KMO statistics should be >0.5 if sample size and the proportion of variance in variables that might be caused by underlying factors are adequate for running factor analysis. This result goes in line with the finding of Guyu (2015) where the KMO measure of sampling adequacy was 0.631 indicating relatively compact pattern of correlations so that factor analysis yielded distinct and reliable factors. Moreover, Bartlett's test of sphericity is also evaluated for testing the null hypothesis that the original correlation matrix is an identity matrix. Accordingly, smaller values (<0.05) of significance level indicate that it is insignificant and generally suggest nearly an identity matrix. The result of this study shows that the test was significant at ($p = 0.000$) and Chi-square =133.782), and suggesting that the factor analysis was appropriate with the data available for the study. The entire variables have larger extraction communalities. The factor loadings of each observed variable is greater than ± 0.3 (table 9) meeting the suggestion of Peterson (2000) that factor loadings of ± 0.3 are considered as the minimum level accepted especially in social and behavioral sciences although different researchers set different thresholds.

These indicators play important role in estimating the IFA dimension although they differ in their correlation coefficients. As expected, the factor loadings and correlation coefficients of all variables except household income and HFIAS are negatively correlated to IFA. This seems against the study hypothesis that the more household income, the less it becomes food insecure. The relative size of factor loading of each variable has therefore important policy implication

(i.e. the higher the loading, the more important it is, and the more policy attention should be placed on it). In general, as suggested by the statistical criteria mentioned above, the factor scores can be used to estimate the IFA variable. As a result, three of the factors were used to estimate IFA as their contribution is adequate. It is estimated as follows:

$$\text{IFA} = (0.5178 \cdot \text{FAC1} + 0.2264 \cdot \text{FAC2} + 0.1645 \cdot \text{FAC3}) \dots \text{equ.9}$$

Table 9: Communalities, factor loadings, and correlation of variables with IFA

Indicators of IFA	Communalities		Factors and their load			Corr. with IFA
	Initial	Extraction	1	2	3	
HH Income	0.16	0.306	-0.439	-0.295	0.161	-0.391
HFIAS	0.425	0.687	0.799	0.203	-0.086	-0.651
Coping Strategies Index	0.424	0.687	0.799	-0.203	0.087	0.751
Wild Edible Foods	0.153	0.299	-0.427	0.303	0.158	0.918
Eigen value	Total		2.071	0.906	0.658	
	Variance		0.5178	0.2264	0.1645	
	Cumulative		0.5178	0.7442	0.9087	
KMO Test of Sample Adequacy=.647						
Bartlett's Test of Sphericity is significance at p=.000; Chi ² =133.782						
Extraction method: Principal Axis factoring						

Source: Own survey result, April 2018.

4.5.2 Asset (A)

This bloc is an important aspect of household resilience since the more a household have assets, the more he/she copes with a chock and become more resilient. Four observable variables were used to estimate the assets (A) components as they were very essential for a farm household.

- *Non-agriculture assets:* This is a continuous variable that refers to amount of non agriculture assets in monetary value. This is also directly related to A and resilience.
- *Total farmland cultivated last year:* This is a continuous variable that refers to the total amount of farmland cultivated last year

- *Livestock owned*: This is a continuous variable that refers to the number of livestock owned by a household. This variable is directly related to A and resilience
- *House durability*: it related to household durability of its house

All indicators of the Asset component were estimated by factor analysis using principal factor axis method. The KMO test was 0.497, Bartlett’s test was significant (p=0.005).The first factor generated is suitable and can be used to represent A latent indicator. This factor alone accounted for about 30.06% of the variance while both of the factors constituted about 79.99%. All variables are positively correlated with A in different degree and are good indicators of households resilient.

$$A = (0.3006 * FAC1 + 0.2644 * FAC2 + 0.2346 * FAC3) / 3 \dots \dots \dots \text{equ.10}$$

Table 10: Communalities, factor loadings, and correlation of variables with A

Indicators of A	Communalities		Factors and their load			Corr. with A
	Initial	Extraction	1	2	3	
Non-agriculture assets	.019	.153	.256	.292	-.054	.551
Total Farmland Cultivated last Year (ha)	.004	.058	-.030	.182	.159	.214
Total Livestock	.025	.171	.319	-.259	.052	.405
House Durability	.040	.238	.487	.027	.004	.816
Eigen value	Total		1.202	1.058	.939	
	Variance		.3006	.2644	.2346	
	Cumulative		.3006	.5650	.7997	
KMO Test of Sample Adequacy=.497						
Bartlett’s Test of Sphericity is significance at p=.005; Chi-square=97.459						
Extraction method: Principal Axis factoring						

Source: Own survey result, April 2018.

4.5.3 Access to Public Services

It is a key factor for enhancing households’ resilience by improving their access to public services although it is beyond their control (Alinovi et al, 2009). It is true that better access to public services affects the capacity of households to manage food insecurity. The average

distance to reach the nearest available services is taken as a proxy for representing APS. Despite their poor quality, other services such as school are available in every village while electricity is totally absent in all villages of Lare district except Kuergeng town. As a result, the APS latent variable was constructed as a composite of the following observable indicators.

- *Distance to farmland*: This is a continuous variable measured in hours. This is directly related to APS latent variable, and the more resilient a household is. It was assumed that households whose farmland nearer to homes are more resilient than those farther from homes.
- *Distance to health center*: This is a continuous variable measured in hours. It is directly correlated to APS latent variable.
- *Distance to veterinary clinic*: It is a continuous variable measured in hours. This is directly correlated to APS latent variable.
- *Distance to fetch water*: This is a continuous variable measured in hours. This is directly correlated to APS latent variable.
- *Distance to market*: This is a continuous variable measured in hours. It is directly correlated to APS latent variable.
- *Members of households having mobile*: It is a continuous variable measures of how many members in households possessing mobiles; and it is directly related to APS latent variable. The assume is that households which have mobile are easy to adapt new technology than those who have do not have.
- *Access to dry weather road*: This is a continuous variable measured in hours. It is directly correlated to APS latent variable.

All of these variables are continuous and factor analysis using principal factor axis method is appropriate to estimate the APS. The result shows that the first factor was suitable to represent the APS as examination of statistical outputs shows. The KMO statistics was sufficient (0.513) while Bartlett's measure was significant (p = 0.000). The three factors generated together accounted for more than 44% of the variance. As a result, they were used to estimate APS as follows:

$$APS = (0.1845 * FAC1 + 0.1392 * FAC2 + 0.1188 * FAC3) / 3 \dots \dots \dots \text{equ.11}$$

The factor loadings and correlation between the variables and APS are positive. It should be noted that almost all factors have the positive relationship in the factor loadings except distance to farmland at factor2, distance to health center at factor1 and distance to market at factor3. This is because the poor households have no access to public service comparison to better off counterpart.

Table 11: Communalities, factor loadings, and correlation of variables with APS

Indicators of APS	Communalities		Factors and their load			Corr. with APS
	Initial	Extraction	1	2	3	
Distance to farmland(Hrs)	.138	.492	.155	-.405	.151	.108
Distance to Health center(Hrs)	.187	.573	-.258	.355	.417	.049
Distance to Vet clinic (Hrs)	.113	.306	.019	.304	.243	.171
Distance to clean water (Hrs)	.143	.335	.160	-.356	.244	.451
Distance to market (Hrs)	.233	.430	.184	.378	-.461	.303
Member of HH having (phone)	.701	.922	.832	.063	.243	.223
Access to dry weather road(Hrs)	.113	.519	.129	.145	-.141	.352
Eigen value	Total		2.214	1.670	1.425	
	Variance		.1845	.1392	.1188	
	Cumulative		.1845	.3237	.5361	
KMO Test of Sample Adequacy=.513						
Bartlett's Test of Sphericity is significance at p=.000; Chi-square=346.804						
Extraction method: Principal Axis factoring						

Source: Own survey result, April 2018.

4.5.4 Social Safety Net (SSN)

SSN is important component of household resilience in almost all communities. In Ciani (2012), SSNs are regarded as dependence for assistance on national and international agencies, charities, and NGOs. In the present study, these are totally absent. As a result, traditionally existing SSNs that are inherent to this particular community are employed. Whatever the source, SSNs can be considered as a system's capacity to mitigate shocks (in this case, food insecurity). The idea is that the more households practice these indicators, the stronger they are socially integrated, and the more resilient they become. Accordingly, the following indicators of SSN are identified in the present study area.

- *Relief/Aid*: It is a direct help from NGOs and governments during food short falls. It is directly related to SSN latent variable.
- *Borrowing grains/oil*: It refers to way households borrowed grain or cash during food shortages. This is directly related with SSN and increases households' resilience.
- *Remittances*: It relates to the money send abroad to family in time of food shortage.
- *Drinking coffee*: This is variable refers to whether a household had been engaged in such a social co-existence. It is expected to enhance the cooperation of villagers. This directly related to the social bond and an overall resilience to food insecurity.

All of these variables are estimating the SSN latent variable. And then the analysis was done by factor analysis using principal factor axis method. The KMO test was 0.551, Bartlett's test was significant ($p=0.000$). The first factor generated through this procedure was quite suitable and can be used to represent the SSN. This first factor alone explained about 51.04% of the variation. In this regard, consideration of factor2 and factor3 in estimating SSN is evident as both explained more than 97% of the total variance. As result, SSN is suitable indicator of households' resilient. The bellow equation of SSN was used to estimate overall resilience index.

$$SSN = (0.5104 * FAC1 + 0.3424 * FAC2 + 0.1140 * FAC3) / 3 \dots \dots \dots \text{equ.12}$$

Table 12: Communalities, factor loadings, and correlation of variables with SSN

Indicators of SSN	Communalities		Factors and their load			Corr. with SSN
	Initial	Extraction	1	2	3	
Relief/aid	.753	.904	.910	-.248	-.125	.288
Borrowing grains/Oil	.749	.890	.896	-.263	.135	.836
Remittances	.303	.560	.315	.669	.116	.449
Drinking coffee			.385	.650	-.113	.556
Eigen value	Total		2.041	1.370	.456	
	Variance		.5104	.3424	.1140	
	Cumulative		.5104	.8528	.9667	
KMO Test of Sample Adequacy=.511						
Bartlett's Test of Sphericity is significance at p=.000; Chi ² =297.783						
Extraction method: Principal Axis factoring						

Source: Own survey result, April 2018.

4.5.5 Adaptive Capacity (AC)

It is a crucial dimension of resilience that measures the household's ability to adapt and react to shocks (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. The following observed variables were selected as determinants of AC of households to food insecurity in the study area.

- *Education in income diversity*: This is a count variable that represents the number (diversity) of income sources of a household. The assumption behind this variable is that the more literate of the household heads, the more diversified the sources of income and also the higher ability of a household to adapt to a given shock (in this case food insecurity).
- *Diversity of wild-edible foods*: This is a count variable that refers to the total number of wild foods gathered and/or hunted during the year. The idea is that the more the number of wild foods a household gathered/hunted, the more he/she adapts to the food insecurity.

- *Diversity of asset disposal as coping strategies*: This is a count variable that refers to the number of coping strategies that involve asset disposal during a shock.
- *Labor disposal diversity*: This is a count variable that refers to the number of household members engaged in labor as a means of making a livelihood during food shortages. This variable is directly related to the adaptive capacity of a household.

All of the variables are based on a count measurement scale and factor analysis was run using principal axis factoring method in order to estimate the AC latent variables. The result obtained through this equation was further used as one of the latent indicators in constructing an overall RI for each household.

$$AC = (0.3937 * FAC1 + 0.2714 * FAC2 + 0.1988 * FAC3) / 3 \dots \dots \dots \text{equ.13}$$

Table 13: Communalities, factor loadings, and correlation of variables with AC

Indicators of AC	Communalities		Factors and their load			Corr. With AC
	Initial	Extraction	1	2	3	
Education in Income Diversity	.220	.489	.686	-.107	.077	.503
Diversify of Wild edible foods	.207	.450	-.644	.156	.106	-.481
Asset Disposal Coping Strategies	.033	.188	-.137	-.396	.115	-.109
Labor Disposal coping strategies	.068	.252	.318	.376	.099	.145
Eigen value	Total		1.575	1.085	.795	
	Variance		.3937	.2714	.1988	
	Cumulative		.3937	.6650	.8638	
KMO Test of Sample Adequacy=.545						
Bartlett's Test of Sphericity is significance at p=.007; Chi-square=11.377						
Extraction method: Principal Axis factoring						

Source: Own Survey result, April 2018.

The first factor generated using Bartlett's scoring method was suitable to represent the AC latent dimension since KMO test is 0.545. It indicates that the sample size was adequacy for running factor analysis, and it fits well the criteria that KMO statistics should be >0.5. The Bartlett;s test of Sphericity was significant (p-value = 0.007, Chi-square = 11.377); the factor has eigenvalue of

1.575 that accounted for about 39.4% of the variation, and all observed variables have factor loadings of >0.3 and can be used for further analysis. All variables are also positively correlated to the AC as expected with the exception of the coping strategies diversity and wild edible foods which are negatively correlated with AC. This was in contrast to the original assumption that this variable has positive relationship with AC, thus the alternative assumption is accepted. The negative correlation indicates that increased asset disposal in long run it gradually leads to a decreased AC of households as the asset might be exhausted.

4.5.6 Stability (S)

In most food security literature, stability is used to describe the stability of food supply. Since the novel contribution of Alino et al (2009), it has become an across-sectional dimension of resilience. In the study area, stability is seen in relation to human health, livestock diseases and income stability etc.

- *Human health stability*: It is a count variable that refers to the number of sick household members during the survey year.
- *Job stability*: This is variable refers to number of household that loss their job during survey period. Job stability means working stability in rural households.
- *Income stability*: This is variable refers to the perception of households about whether they have stable sources of income or not.
- *Livestock diseases*: This is variable refers to whether a household had reported a death of a livestock.
- *Marriage stability*: It is variable refers to stability household in their marriage.

As a result, factor analysis method was employed to estimate the stability (S) latent variable. The KMO test is 0.507; the Bartlett's test of Sphericity was significant (p-value = 0.000, Chi-square = 61.595); the factor has eigenvalue of 1.584 is accounted for about 32% of the variation. The result shows that the first factor generated was suitable explaining about 32% of the total variance. But, the contributions of the second and the third factors were also significant as they altogether accounted for about 74% of the total variance. Therefore, finally all of them were used to estimate S as follows:

$$S = (0.3168 \cdot \text{FAC1} + 0.2281 \cdot \text{FAC2} + 0.1972 \cdot \text{FAC3}) / 3 \dots \dots \dots \text{equ.14}$$

Table 14: Communalities, factor loadings, and correlation of variables with S

Indicators of S	Communalities		Factors and their load			Corr. with S
	Initial	Extraction	1	2	3	
Human Heath Stability	.019	.148	.030	.246	.294	.214
Job Stability	.051	.207	.161	.423	.051	.362
Income Stability	.280	.586	-.764	-.045	-.006	-.864
Livestock Diseases	.246	.502	.655	-.260	.069	.629
Marriage Stability	.049	.206	.231	.262	-.289	.408
Eigen value	Total		1.584	1.140	.986	
	Variance		.3168	.2281	.1972	
	Cumulative		.3168	.5449	.7421	
KMO Test of Sample Adequacy=.507						
Bartlett's Test of Sphericity is significance at p=.000; Chi-square=61.595						
Extraction method: Principal Axis factoring						

Source: Own survey result, April 2018.

4.6 Estimating an Overall Resilience Index

The overall resilience index (RI) for each household is estimated by applying factor analysis using principal axis factoring method and taking the latent variables estimated earlier, which are in fact normalized through factor analysis (mean = 0 and variance = 1). 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. The household RI was, therefore, constructed by calculating the weighted sum of the 5 factors (the weights = proportion of variance explained by each factor) as suggested by Distefano et al (2009). The result indicates that all factors had heavy loadings at least from one variable. Five of them had loadings of ± 0.3 . The model shows that five factors together accounted for about 83% of the total variance, and all latent indicators except stability(S) are positively correlated with RI in different degree. The KMO statistics for

the model was 0.540 and Bartlett's test of sphericity was significant (p-value = 0.000 with Chi-square =95.757).

Table 15: Factor loadings and correlation of Latent variables with RI

Latent Variables	Factors and their load					Corr. with RI
	1	2	3	4	5	
IFA	.56	-.238	.202	-.043	-.034	.759**
A	.308	.343	.222	-.112	.160	.359**
APS	.456	.360	.152	.194	-.034	.626**
SSN	.044	.069	-.165	.295	.101	.194
AC	.155	.426	-.285	-.070	-.040	.310**
S	-.536	.400	.270	-.023	-.044	-.593**
Eigen value	1.78	1.27	1.08	.97	.74	
Variance (%)	.2546	.1818	.1540	.1385	.1059	
Cumulative	.2546	.4364	.5904	.7288	.8348	
KMO Test of Sample Adequacy=.540						
Bartlett's Test of Sphericity is significance at p=.000; Chi ² =95.757						
Extraction method: Principal Axis factoring						

Source: Own survey result, April 2018.

As defined in the theoretical framework, resilience is a flip side of susceptibility on a resilience-vulnerability continuum. That is, the gradual decline in the resilience status of households is accompanied by an increasing level of susceptibility and vice-versa. The extreme negative value on the spectrum shows the most vulnerable households whereas that of positive shows the most resilient ones. In between these values are the intermediate ones and can be categorized into relatively different levels of resilience. Like all composite indices, RI is a relative measure of the level of household resilience.

So far, resilience is unlike the static measures of food security status that divides households into food secure and food insecure; no universally accepted cut-off point has been established for delineating resilient from non-resilient households (Guyu and Muluneh, 2015). The RI is a composite index that simply shows the relative decrease or increase in the level of resilience among the studied subjects. An own cut-off points to categorize households into different

resilience levels was used. The objective of this study is examine the significant building blocks and determinants of household resilience and resilience levels of households belonging to the two Kebele as these have profound policy implications. The paper uses the following ranges of RI scores by using percentile, which are randomly proposed and used as grouping methods of three levels of resilience: Less-resilient ($RI < 33\%$), moderately Resilient ($33\% \leq RI < 66\%$), Resilient ($RI \geq 66\%$).

The result (Table16) shows that 67% of surveyed households were non-resilient while only 33% were resilient. The proportion of non-resilient households in the Malow Kebele (38.5%) was much greater than that of the Palbol Kebele (27.5%). This is because of inaccessibility to public services and damaged of crops by flood in Malow kebel. This finding is relatively consistent with Guyu and Muluneh (2015) in which 72% of households were found susceptible to food insecurity.

Table 16: Level of resilient by kebele

Name of Kebele	Level of Resilient by kebele					
	Non resilient		Moderately resilient		Resilient	
	Count	%	Count	%	Count	%
Malow	35	38.5%	30	33.0%	26	28.6%
Palbol	22	27.5%	27	33.8%	31	38.8%

Source: Own survey result, April 2018.

4.7 Importance of Latent Dimensions of Household Resilience

All latent dimensions do not equally contribute to households' resilience. Some have more significant impact than others although the role of each is still crucial in estimating resilience. To identify the impacts of each latent variables on household resilience, simple regression analysis was run using ordinary least squares (OLS) algorithm. This gives the impacts in terms of standardized (B) coefficient. The household resilience score was used as dependent variable and six of the latent variables as explanatory variables.

SPSS recommends examination of the Beta Coefficient for the relative importance of each variable in determining a household resilience to food insecurity. Accordingly, (Table17) shows

that irrespective of the negative signs, income and food access (IFA) was the most important dimension which actually contributed more ($B = 0.471$) to the regression model followed by access to public service (APS) ($B = 0.367$), stability (S) ($B = -0.329$), and adaptive capacity (AC). The importance of social safety net (SSN) ($B=0.151$) and asset (A) ($B= 0.138$) seem less as compared to others. For example, a 0.471 unit increase in households' income and food access (IFA) to change increases their resilience by 1 standard deviation. In contrast, a 0.329 unit decrease in households' stability increases their resilience by 1 standard deviation. The logic behind negative impacts of stability is that households' data were collected against the presence of instability, which decreases household resilience.

Table 17: Important of latent variables in household resilience

Latent variables	Un-standardize coefficient		Stdzd coef. Beta	t-value	Sig.	Co-linearity Statistics	
	B	Std Error				Tolerance	VIF
Constant	-.022	.000	-	-22000	.000	-	-
IFA	.184	.000	.471	184000	.000	.701	1.426
A	.112	.000	.138	112000	.000	.890	1.123
APS	.685	.000	.367	685000	.000	.840	1.191
SSN	.179	.000	.151	179000	.000	.983	1.017
AC	.200	.000	.200	200000	.000	.907	1.102
S	-.182	.000	-.329	-182000	.000	.767	1.304

Source: Own survey result, April 2018.

The results of the FGD indicated that rural households were vulnerable to food insecurity due to crops damage and livestock death by flood every year. This lead to lack of food access and inaccessibility of public services such as health centers, safe drinking water, market and schools which are the life saving institutions, and also showed that rural households used irreversible coping mechanisms to food insecurity by selling their assets such as hoe, poultry, goats, sheep, ox and cows, and fire wood, charcoal and local wine.

While the KII showed that lack farm inputs, tradition farming practices, lack of credits, social safety nets (i.e. Aid), and instability of livestock were the indicators of food insecurity of rural household and also make them non resilient.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The objective of this study was to investigate rural households' resilience to food insecurity. The results of food insecurity analysis using HFIAS food insecurity techniques indicated that about 12.87% and 87.13% of households were food secure and food insecure respectively. Out of total 87.13% food insecure households, 2.34% were mildly food insecure, 1.75% moderately food insecure and 83.04% were severely food insecure with significant level at of 1 and 5; and the analysis Logit Model indicated that the explanatory variables such as household marital status, household family size, household occupation and household's contact with development agents were statistically associated with food insecurity at a significant level of 1%, 5% and 10%. As indicated by CSI analysis, food insecurity condition was more severe among households in Malow *Kebele* with mean score of 55% than the households in Palbol *Kebele* with the mean score of 45%. This is because Malow *Kebele* is more exposed to food insecurity due to it is nearer to bank of Baro River which is flood prone area than Palbol *Kebele*.

The Resilience Index analysis indicated that 67% and 33% of households was non-resilient and resilient respectively. The proportion of level of non resilient households by *Kebele*, the Malow *Kebele* (38.5%) was much greater than that of the Palbol *Kebele* (27.5%). Moreover, as indicated by Beta coefficients, income and food access, access to public services, stability and adaptive capacity were the most important dimensions of household resilience to food insecurity. These are followed by social safety net and asset which played an intermediate role, and then by access to agriculture technologies, which also played considerable role and would play important role in long-term in enhancing household's resilience capacity.

Therefore, the research concludes that the resilience capacity of households in the study area is very weak due to lack of income and food access, access to public services, stability and adaptive capacity which are the major households' response mechanisms to food insecurity shocks, and they may remain susceptible to food insecurity in the future unless sound intervention measures are taken. In this regard, a clear and sound policy that aims at building household resilience capacity should be included in the existing food security programs in the Gambella region, particularly the study area. Moreover, a short and long term programs is needed rather than

merely focusing on strategies that improve agricultural productivity, but also strengthening their capacities that could help the people to bounce back and recover from food insecurity.

5.2 Recommendations

To improve food insecurity situation in the study area and country, it is suggested that the government of Ethiopia through Ministry of Agriculture and Rural development, and Food Security Agency plus other institutions should incorporate different research outputs and design a policy that aims at building household resilience capacity in line with the existing food security strategies and programs. The local government and other stakeholders should create awareness among the people so as to enable them understand the importance of self-dependency so that they can struggle themselves to solve their problems of food insecurity, instead of depending on the central government. A short and long term interventions should be emphasized rather than merely focusing on strategies that improve agricultural productivity, but also strengthening their capacities that help people to bounce back and recover from food insecurity shocks.

Therefore, the following measures are recommended:

- ❖ As family size and food insecurity are positively related and serious attention has to be given to limit the increasing population in the study area. This can be achieved by creating sufficient awareness about family planning in the rural households by Lare district of health centers. Even though every individual has a natural right to multiply himself with his willing partner, this right should be exercise with the ability to provide his descendents with all the necessary or basic needs. So, along with creation of effective family planning, effective extension services methods of incentive, such as material reward for those households accepting a given number of children by the end of productive age.
- ❖ The district Agriculture and Rural Development office should providing the small farming households with access to training, expertise support, agriculture inputs for cultivation to improved their food security status and also enhance their resilience to chocks.
- ❖ Sustainable food insecurity interventions must be done by Agriculture and Rural Development offices to improve households' food insecurity coping strategy.

- ❖ The households in study are vulnerable to food security shocks. Therefore, there is need for regional government, especially Agriculture and Rural Development Bureau to improve their access to public services, maintain stability and enhance adaptive capacity so that households can come out of food insecurity and also boost up their resilient.
- ❖ Since the resilience capacity of households in the study area is very weak, Gambella Urban/Rural Job Creation and Food Security Agency should adapted sound interventions in according to the importance of the resilience blocks. Failure to do so, the study households may remain vulnerable in the future unless sound intervention measures are taken. An intervention that aims at building household resilience capacity should be included in the existing food security programs in the region. A short and long term intervention should be done to improve agricultural productivity and also strengthening their resilient capacities.

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Appendix 1: Households Survey Questionnaires

Dear Respondents, I am Yien Bachuch Mayian, a Master of Science student at Addis Ababa University in the Center for Food Security Studies. Currently I am conducting a research that aims at investigating “**Rural Households’ Resilience to Food Insecurity in Lare District, Gambella Region south western Ethiopia**”. You are one of the randomly selected household heads from this Kebele to respond to the questions in this questionnaire. The study is expected to help understand the current level of rural household resilience to food insecurity. Such understanding is expected to help the government and concerned bodies when planning to work to build households’ resilience in the district in particular and in the region in general. Thus, your responses are highly valuable, will be held in utmost confidentiality, and will be used only for the analysis of this research. For this purpose, you will not be identified by name. Your participation in responding is considered voluntarily and there will not be any monetary return. However, copies of the findings of the study may be sent to you upon your request. So, be free to respond to all questions in the questionnaire. This may take about one 1to 2 hours to respond and the researcher would like to thank you for devoting your precious time to this common goal.

Thank you in advance for your cooperation!

APPENDIX A: QUESTIONNAIRES SURVEY

Code of Enumerator: _____

I. Basic Information of Household Head

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

S/n	Information	Answer
1	Date of interview	
2	Respondent's identification code (ID)	
3	Name of Kebele	
4	Sex	1. Male 2. Female
5	Age (in years)	
6	Marriage	1. Single 2. Married 3. Divorced 4. Widow 5. Polygamy
7	Residential status	1. In-migrant (new comer) 2. Resident
8	Place of origin if you are in-migrant	
9	Duration of stay at currently residence (in years)	
10	Reason for migration if in-migrant	1. Marriage 2. Join-relative
11	Education	1. Illiterate 2. Read & write 3. Grades ____
12	Number of Permanent members	1. Male= 2. Female=
13	Roof of House	1. Grass/straw 2. Corrugated iron sheet
14	Main occupation	1. Farmer 2. Daily laborer 3. Both 4. Other (specify)----

II. Demographic and Socioeconomic Characteristics of Household Members

1) Please, give appropriate information including head of the household in the table:

S/n	Name of Family members	R/n with HH head	Age (yrs)	Sex M/F	Marital status	Educational Level	Economically Active/inactive	Current occupation
1								
2								
3								
4								
5								
6								

7								
8								
9								

- **Economically inactive**, if permanently sick, disabled, aged, etc and cannot involve in economic activities for much of his time over the past cultivation year.

2) How many children are currently at school? _____.

3) If there is “economically inactive” member, what is the reason

1. Sick repeatedly
2. Permanently sick
3. Permanently disabled
4. Aged or too old
5. Too young (less than 10 years)
6. Others (specify) _____

III. Access to Agricultural Assets, Production, and Food Security

3.1. Access to Farmland

1) Do you have an access to farmland for practicing agriculture? 1. Yes 2. No

2) Indicate your ownership type on land and its amount:

S/n	Ownership Type	Amount	
		(In hectare)	(In time)
1	Own land		
2	Got on share cropping basis		
3	Rented for one or more years		
4	Freely got from a relative for year or more		
5	Others Types (Specify)____		

3) How long do walk on foot to arrive the nearest farm plot? _____min/hours.

4) How do you perceive the quality of soil of your farmland currently?

1. Fertile
2. Medium
3. Poor
4. Other (Specify) _____

5) Total amount of farmland you cultivated during the 2016/2017 crop year? ____ (in ha).

3.2. Information Regarding Crop Production

1) Give the type and amount of crop obtained from your land in or out during 2016/2017 crop year; and indicate the type and amount of crop production in the following table for crop year:

Types of crop	Cultivated land (ha)	Production (Kg)	Seed Reserved (Kg)	Sold (kg)	Income from sale(Birr)	Reason for sale
Cereal (Tot)						
Maize						
Sorghum						
Millet						
Teff						
Oilseed (tot)						
Sesame						
Nug						
Groundnut						
Legume (tot)						
Soya bean						
Cheek pea						
Root-crop (tot)						
potato						
Sweet potato						
Vegetable (Tot)						
Pumpkin						
Pumpkin leaf						
Tomato						
Cabbage						
Onion						
Fruits						
Mango						
Orange						
Lemon						
Banana						
Other specify						

3.3. Access to Small-Scale Irrigation and Amount of Crop Produced from it

1) Do you have irrigable land in addition to other plots? 1. Yes 2. No

2) If “Yes” to No.1, have you cultivated crops on it? 1. Yes 2. No

3) If “Yes” to Q1&2, indicate the type of crop produced, amount and income from its sale (if any).

s/n	Types of Crop	Mark “√” if grown	Amount produced	
			In quintal	In birr (if sold)
1	Maize			
2	Banana			
3	Cabbage			
4	Onion			
5	Tomato			
6	Other (specify)			

4) If you have irrigable land but have not cultivated it, indicate your reasons

1. Lack of Awareness about its benefits
2. Lack of skill and Knowledge
3. The Produce from non-irrigable plots is sufficient
4. I have alternative activity so that I ignored it at it is time wasting
5. Others (specify)—

5) Indicate the amount of grain under each of the following conditions during 2016/2017

Type of Crops	Source, Produce, Seed Reserved (SR), purchase, borrowed, Sold and lost (In Qtls)						
	Own production	Purchased	Borrowed	Aid	Sold	Lost	SR
Maize							
Sorghum							
Millet							
Ground nut							
bean							
Sesame							
Egg							
Milk (liter)							
Butter							
Wild fruits							
Wild vegetables							

3.4. Access to Farm Inputs and Technology

1) Did you use modern inputs (selected seed, fertilizer, herbicides, chemicals, etc)?

A. Yes B. No

2) If “No” to No.1, state your reason(s). (Multiple answers are possible):

1. Land is fertile
2. Too expensive & not profitable

	Shortage of rainfall			Inadequate facilities	
	Too much rainfall			Failure to use irrigation	
	Off-set delay & early off-set in rain			Dependence on rain-fed farming	
	Water logging			Backward farm technologies	
	Erratic rain		4	Biological Constraints	
	Windy rains (destructive)			Pest infestation	
	Flooding			Plant disease	
5	Others (specify)			Weed infestation	
				Bird attack on crops	
				Insect infestation	
				Rate plaque	

2) Estimate the number of days you devote to working in your farm fields and other activities per week:

3.6. Livestock Production:

1) Indicate the following information about your livestock production

s/n	Type of Assets	Owned (produced) (Ha, no)	Monetary value(birr)	Sold (No.)	Income from sale (birr)	Reason for sale
1	Farmland(ha)					
2	Mango, Banana, papaya					
3	Livestock (No.)					
	Oxen					
	Bull					
	Cows					
	calves					
	Goat					
	Donkey					
	Poultry					
4	Bee Hives					
	Honey					
	Wax					
	Other					
5	Agricultural capitals					
	Plough					
	Hoe					
	Axe					
	Spade					
	Other (specify)-----					

3.7. Constraints to Livestock

1) Please, indicate the type, number, monetary value of animal lost and reasons for loss if any (including chicken):

_____.

2) Indicate which of the following constraints of livestock are common in your area and you faced during 2016/2017: (show your choice using “√” mark and their rank order as: 1st, 2nd, 3rd, etc) according to their seriousness.

s/n	Constraints	Choice“√”	Rank order
1	Livestock diseases		
2	Traditional means of livestock management		
3	Lack market for livestock & its products		
4	Lack veterinary services		
5	Lack access to better breeds		
6	Shortage of grazing land		
7	Shortage of water		
8	Wild animal attack (e.g hyena & lion)		
9	Marsh area		
	Thief		
	Lack modern podder supply		
	Tick infestation		
	Long distance of market		
	Other (specify)-----		

3.8. Food Security Information

1) Did you worry whether your farm production feeds your family until the next harvest?

1. Yes 2. No

2) If “Yes” to No.1, for how long can it feed your family? _____ Months

3) How do you perceive your current food security status?

1. Food secure; 2. Food insecure

4) Who assisted you during the time of food shortage?

1. Government food aid 2. Relatives

3. Neighbors other than relatives 4. Others (specify) ---

5) Indicate the amount of food you got from any source of assistance _____ Kg.

6) What was the type of assistance?

1. Grain ____kg 2. Food oil _____ liters 3. Cash money ____ birr 4. Others (specify) ____

7) How do you perceive the number of food items in your daily meal?

1. Very low /insufficient 2. Medium/enough 3. Sufficient 4. Very high

8) Information on Household Food Insecurity Access Score (HFIAS) and Hunger scale (HHS)

8.1. Put “0” if you “Never” experience the events under each question; otherwise respective number of your choice (1, 2, or 3) if your answer is “yes” to the occurrence. Write a number of your choice under “response column”.

0. Never (No) 1. Rarely (once or twice in past 30 days) 2. Sometimes (3 to 10 times in the past 30 days) 3. Often (more than 10 times in the past 30 days)

s/n	To each of the following, What has happened in the past 30 days?	Response
1	Did you worry that your household would not have enough food?	
1.1	If 'yes' how many days within the month?	
2	Were you or any household member not able to eat the food kinds you/s/he preferred because of a lack of resources?	
2.1	If 'yes' how many days within the month?	
3	Did you or any household member have to eat a limited variety of foods due to lack of resources?	
3.1	If 'yes' how many days within the month?	
4	Did you or any household member have to eat some foods that you/s/he did not want to eat because of lack of resources to obtain other types of food?	
4.1	If 'yes' how many days within the month?	
5	Did you or any household member have to eat a smaller meal because there was not enough food?	
5.1	If 'yes' how many days within the month?	
6	Did you or any household member have to eat fewer meals/day because there was no food?	
6.1	If 'yes' how many days within the month?	
7	Was there ever no food to eat in your household because of lack of resources to get food?	
7.1	If 'yes' how many days within the month?	
8	Did you or any household member go to sleep at night hungry because there was not enough food?	
8.1	If 'yes' how many days within the month?	
9	Did you or any household member go without eating anything a whole day and night?	
9.1	If 'yes' how many days within the last month?	

9) Indicate the Coping Strategies your household used

9.1 Indicate the type of behavioral coping strategies and number of days your household members depended on the following Coping Strategies.

How many days you employed the following Coping Strategies employed over the past week (7 days)?	Frequency (0-7 days)
a) Rely on less preferred and less expensive foods	
b) Borrow grain from a friend or relative	
c) Depend on wild foods (Gathering & hunting)	
d) Harvest immature crops (maize, haricot bean, etc)	
e) Send household members (children) to eat elsewhere	
f) Reduce number of meals eaten per day	
g) Limit adult consumption for feeding small children	
h) Feed working members & abandoning non-working	
i) Limit portion size at mealtimes	
j) Skip entire day (s) without eating	

10.2. Asset Disposal Based Coping Strategies

a) Sell domestic assets for buying grain		
b) Sell farmland to buy food grain		
c) Lease land in exchange of grain or cash to buy food grain		
d) Sell farm ox or milk cow to buy grain		
e) Sell other a livestock-bull, heifer, calf, donkey, etc to buy food grain		
f) Sell small animals (goat, sheep, chicken, etc) to buy grain		

10.3. Labor Disposal Coping Strategies Based

a) feed on early maturing crops during food shortage		
b) Sell labor for buying food or in exchange of food grain		
c) Sell charcoal to buy food grain		
d) Sell firewood to buy food grain		
e) Migration to nearby towns for wage labor to remit to family		
f) Working on others' farm as a wage laborer to buy food grain		

IV. Information on Vulnerability to Shocks/Stresses

1) To which of the following types of shocks/stresses you were vulnerable to? Indicate the frequency of occurrence of each shocks.

Types of Chocks/stress		Response
Climate related shocks	Delayed-onset-&-early-offset (yes/no)	
	Water-lodging (yes/no)	
	Heavy wind (yes/no)	
	Weed infestation (yes/no)	
	Plant pests (e.g. Fungus) (yes/no)	

Biophysical induced shocks	Rat Plague (yes/no)	
	Wild animal Attacks (yes/no)	
	Erosion stress (yes/no)	
	Deforestation stress (yes/no)	
	Bird attacks (yes/no)	
	Soil infertility (yes/no)	
Economic related shocks/stress	Animal diseases & death (yes/no)	
	Poverty stress (yes/no)	
	Backward technology (yes/no)	
	Price fluctuations	
Social related shocks/stress	Human diseases (yes/no)	
	Conflict (yes/no)	
	Literacy of Household head (number of years	
Demographic stresses	In-migration (yes/no)	
	Child-dependency (Child<15 years)(number)	
Food Insecurity	Perceive occurrence of food insecurity (yes/no)	

V. Off-farm Practices:

1) Indicate the Off-farm Activities and income generate from them:

Activities	Income (birr)	Who are engaged in? Husband/wife/one/daughter
Daily Wage laborer in Agriculture		
Traditional beekeeping		
Sale of Arake		
Sale of Pottery products		
Daily wage laborer in Non-farm activities		
Others-----		
Sale of Firewood		
Sale of charcoal		
Sale of Construction materials		
Other-----		
Aid (in cash or kind) from Gov't/NGOs		
Income from Remittances		
Others (specify)--		

2) What do you do with the income earned from off-farm sources?

1. Buy food grains
2. Buy Non-food items (soap, cloths, etc)
3. Buy spices (including food oil, salt, red pepper
4. Pay tax

5. Buy beverages 6. Buy Farm implements 7. Buy Fertilizers

8. Others (specify) ----

3) If you have not been engaged in off-farm activities, indicate the constraints for either lack of sufficient and viable income from off-farm activities in your household. (Indicate their Rank in order of seriousness as: 1st, 2nd, 3rd, etc)

s/n	Constraints	Yes/No	Rank
1	Lack of access to Off-farm job opportunities		
2	Lack of access to credit services		
3	Shortage of start-up capital		
4	Inability to work (disabled, illness, old-aged)		
5	Limited knowledge and Skill		
6	Lack of Raw materials for available activities		
7	Lack of Market for products		
8	Poor infrastructure to support activities		
9	Lack of forests for forest-based products		
10	Others----		

4) How do you rate the role of education in diversifying income and ensuring food security?

1. Very high 2. High 3. Moderate 4. Very low

5) Do you have access to formal credit services? 1. Yes 2. No

6) If “No”, what are the reasons? (Multiple Answers are possible):

1. I have sufficient money 3. Because of High Interest rates

2. The Service is not available 4. Do not know what to do with it

5. Others (specify) _____

7) If “yes”, where did you get it? From: _____

8) What was the type of credit you got? 1. Cash 2. Fertilizer

3. Others (specify) _____

VI. Information on Resilience:

6.1. Social Institution as a Safety Net

1) Indicate a Social Organization in which you have participated in?

s/n	Type of Social organization	Yes/ No	Who Participate in? (H, W, S, D)
1	Iqub		
2	Village Drinking Coffee ceremonies		
3	Oxen cooperation		
4	Oxen renting in exchange of labor		
5	Oxen renting in exchange of grain		
6	Oxen help to ox less HHs		
7	Others (specify)		

H = Husband, W = Wife, S = Sons, D = Daughter

2) Indicate other safety nets from which food grain or cash you get and its monetary value: Rank them in order of their frequency as 1st, 2nd, 3rd, etc

s/n	Type & Sources of Assistance	Grain (Kg)	Cash (birr)	Rank Order
1	Remittances elsewhere			
2	Government Relief aid			
3	NGOs aid			
4	Assistance from Relatives			
5	Job Assistance each other			
6	Assistance from Neighbors			
7	Borrowing Grain or Money			
8	Sharing food and beverage with neighbors			
9	Borrowing Grain or Money			
10	Sharing grain stocks to hungry households			
11	Others (specify)-----			

6.2. Gathering and Hunting Wild foods for Consumption

1) Please tell me whether your family has been engaged in collecting and/or gathering wild foods during 2016/17 crop year? 1) Yes 2) No

2) Identify the type of wild foods and estimate the amount that your family has collected over the past crop year (2016/17).

s/n	Source of wild food	Yes		No	Type
		Estimated (Kg)	Who engaged in? (H,W,S,D)	Reason	
1					
2	Wild Fruits				
3	Wild meat				
4	Wild Honey				
5	Honey				
6	Wild leafs				

6.3. Information on Household Expenditure

1) Indicate the amount of food grain requirement covered by purchasing over the past year. ___kg

2) Indicate average **expenditure** for your household food and non-food items during 2016/17

Source of Expenditure	Type of Items	Expenditure Total (Birr)
Purchasing food Items	Grains (Cereals & Legumes)	
	Meat	
	Drink (soft/alcohol)	
	Coffee/spices	
	Food oil	
	Others----	
	Purchase	Clothing for household members
Soap, hair oil, gas, etc		
Non-food Items	Renting land	
	Buying land	
	Buying ox(en)	
	Buying other livestock	
	Farm inputs (fertilizer, seed, pesticide, veterinary drug, etc)	
	Farm implements (Axe, hoe, plough, etc)	
	Others--	
Expense for social Ceremonies	Wedding	
	Holidays	
Government related expense	In Support of Millennium Dam	
	In support of development organizations	
	In Support of Other development activities	
Paying for daily laborers for farm activities (weeding, harvesting, etc)		
Education of Children		
Health Related Expenditure		
Others (specify)---		

3) Who decides on the type of items purchased above?

1. Husband 2. Wife 3. Sons 4. Daughters

6.4. Household Physical Access to Public Services

1. Indicate whether your household has access to the following public services.

Type of Public Service Accessed	“√” if agree	Characterization of Service	Fig.
Health Post		Distance travelled to nearest Health Post (km/ hours)	
Clinic		Distance travelled to nearest Clinic (km/ hours)	
Hospital		Distance travelled to nearest Hospital (km/ hours)	
Veterinary clinic		Distance traveled to nearest center (km/hours)	
School (Grade1-8)		Distance travelled to the nearest school (km/hours)	
School (Grade 9-12)		Distance travelled to nearest school (km/hours)	

Clean water		Distance traveled to fetch it (km/hours)	
Tele (mobile)		Member of household that have mobile (number)	
TV/radio		Whether a household owns TV/Radio or not	
Dry-weather Road		Distance traveled to the nearest DW road (km/hour)	
All-weather Road		Distance traveled to the nearest AW road (km/hour)	
Mode of transport for humans		1. On-foot 2. Animal back 3. Animal-dragged four-wheeled cart 4. vehicular	
Mode of transport for Non-human		1. Animal back 2. Human-power 3. Animal-dragged four-wheeled cart 4. vehicular	
Market		Distance travelled to the nearest market area (km/hours)	

2) How many times you or your household members were sick during 2016/17 and for how many days you were asleep? Sick _____ times and slept _____ times in the year.

6.5. Stability of households

s/n	Indicators	Response
1	Skill Training (Hh head & members)	1. Yes 2. No
2	Educational level (Grade level)	Grade _____
3	Employment status of household head	
4	Number of household members lost their job/unemployed	Number__
5	Income Stability	1. Increased 2. Same 3. Decreased
6	Income from Safety Net or Assistance (amount in birr)	
7	Assistance Stability	1. Increased 2. Same 3. Decreased
8	Marriage stability	1. Unstable if married/not ever divorced, widowed, etc 2. Stable otherwise
9	Shocks to Livestock	
10	Shocks to Crops	

APPENDIX 2: CHECKLIST FOR FOCUS GROUP DISCUSSION (FGD):

I. Historical of the Study Area

1) Overall history of Lare: Administrative, Population size, density, migration, land resource, forest, animals, development infrastructures, etc

II. Land and Its Resources

1) Trends in the conditions of natural resources of the district?

- 2) Trends in forest cover, condition of water bodies,
- 3) Local land tenure, distribution, access, fertility issues,
- 4) Major problems of agricultural (crop and livestock) production?

III. Poverty and Food Security:

- 1) Do you expect poverty and food insecurity?
- 2) What are the major indicators of food security/ insecurity?
- 3) Perception towards poverty and food insecurity? Causes of poverty and food security?
- 4) What determines sustainable supply of food?
- 5) Crop cultivation, livestock and food security
- 6.) How do people cope with food shortage?
- 7) Who do you think are the most resilient to food insecurity shocks?
- 8) How do neighbors help each other to minimize food insecurity problems?
- 9) In which months are people vulnerable to food insecurity? Why?
- 10) Socio-economic infrastructure?

IV. Social Institutions and household food security and resilience

- 1) Kin relationships and food security?
- 3) Social institutions: Iqub, coffee drink ceremonies, etc
- 4) How these affect food security and households' resilience to food insecurity?

VII. Coping Strategies Score

Consumption-based coping strategies. Indicate the Severity Level of each coping strategy:

1, if Least severe 2, if Moderately severe 3, if Severe & 4, if Very Severe

VIII. Food Diversity Perception

- 1) How many meal types you eat per day on average?
- 2) How do you perceive your current meal diversity?

Thank you!!

APPENDIX 3: CHECKLIST TO CONDUCT KEY INFORMANT INTERVIEWS (KII)

Current Organization in which you are working in _____,

Responsibility _____

Line of work and Expertise _____

I. Guiding Questions to Administrators & Experts at Different Level

- 1) How do you perceive your accountability to the people you are serving for?
- 2) How do you respond to the questions of the people in the district?
- 3) Do you think there is a prevalence of food insecurity in the district? If “yes” tell me the nature (Transitory, Seasonal, or Chronic).
- 4) What do you think are the challenges to meet food requirements of the people in the district?
- 5) Please, tell me the specific factors that affect household food supply and access?
- 6) What are the basic principles of resilience to food insecurity? Or, what does resilient food system look like? Or, what type of households are said to be resilient?
- 7) Please, tell me in detail the overall trend in crop productivity, its challenges, opportunities and prospects .

II. Guiding Questions to Agricultural Experts (District/Kebele)

A) Guiding Questions to Experts of Crop Production

- 1) What does the overall trend in crop productivity, its main challenges, opportunities and Prospects look like? What should be done to mitigate the challenges/constraints?

- 2) Do you think low productivity of crops is the cause of food insecurity in the district?
- 3) How do you perceive the role of agricultural extension services in ensuring food security?
- 4) What technical assistance did you provide to improve agricultural production?
- 5) How do people cope with food shortage when crop produced from their own is insufficient?
- 6) What assistance did you provide to the farmers to enhance the productivity of agriculture?
- 7) Are there any problems related to crop production such as soil degradation, deforestation?

Scarcity of farmlands, weather conditions, etc?

B) Guiding Questions to Livestock Experts and Veterinary Service Providers

- 1) What do you know the history of livestock production in Gambella Region and in particular in the district?
- 2) Please, tell me in detail the overall trend in livestock productivity, its challenges, opportunities and prospects.
- 3) What are the main challenges to livestock production?
- 4) Is there any problems related to livestock production such as death of farm animals, cows, etc and scarcity of pasture land, etc?
- 5) What major animal diseases affect the livestock sector in this area? How do you describe its seriousness?
- 6) Has any attempt been made to mitigate these problems? If 'yes' please tell me in detail by citing specific example(s).
- 7) Do you think that there are sufficient and efficient veterinary services in your area?
- 8) Explain problems related to pasture and water for livestock consumption.
- 9) Add more ...

III. Guiding Questions to Economic Growth and Food Security Officials

- 1) What do you know about the economy and food situation in the district?
- 2) Have you or your office evaluated the current socio-economic status of households in the district? If 'yes', what was the finding of the evaluation? Tell me in detail? What problems were identified during the evaluation processes?

- 3) Are there NGOs or any international humanitarian aid providers involved in food security?
- 4) Has the national food security program been implemented in the district?

IV) Guiding Questions to Credit Service Providers (District)

- 1) How do you perceive the credit service provision in the district?
- 2) Do you think all households are accessible to the service?
- 3) What are the main challenges to provision of credit services?
- 4) What short-run and long-run measures have you ever attempted to address the problems of food shortage in the district?

V) Guiding Questions to Health Service Providers (District/Kebele)

- 1) What are the major problems affecting human health? Please tell me in detail their seriousness?
- 2) Where do people get treatment?
- 3) To what extent is the health extension package has been effective? Tell me in detail?
- 4) What are the main challenges to health service provision?
- 5) What short-run and long-run measures have you ever attempted to address the problems of food shortage in the district?

VI) Key Informant Guide: For Village Elderly,

- 1) Your Name, age, Marital status, Household Size: Male__ Female__
- 2) How do you perceive food security and hunger in the district?
- 3) The major type of staple foods and foodstuffs, cash crops of the district and your kebele
- 4) Who do you think are most resilient to food insecurity? The destitute, poor, rich, medium? Or Female-headed, male-headed?
- 5) Tell me in detail the resilience history of your and other households in the district.

Thank you!!

Appendix 4: Robust and Model Goof Fit of Logit

```
. logit foodsec AGE SEX familysize EDN HHIncome MARR TFLAND ATLU MAINO STHH, vce(robust)
```

```
Iteration 0: log pseudolikelihood = -65.633535
Iteration 1: log pseudolikelihood = -46.313747
Iteration 2: log pseudolikelihood = -45.064888
Iteration 3: log pseudolikelihood = -42.697505
Iteration 4: log pseudolikelihood = -42.659064
Iteration 5: log pseudolikelihood = -42.658743
Iteration 6: log pseudolikelihood = -42.658743
```

```
Logistic regression                               Number of obs   =       171
                                                    Wald chi2(10)  =       27.91
                                                    Prob > chi2    =       0.0019
Log pseudolikelihood = -42.658743                Pseudo R2      =       0.3500
```

foodsec	Robust		z	P> z	[95% Conf. Interval]	
	Coef.	Std. Err.				
AGE	-.0329225	.0554334	-0.59	0.553	-.14157	.0757249
SEX	.8512109	.6694847	1.27	0.204	-.460955	2.163377
familysize	.2577029	.1561629	1.65	0.099	-.0483707	.5637766
EDN	-.2106979	.8125488	-0.26	0.795	-1.803264	1.381869
HHIncome	-.0000499	.0000553	-0.90	0.367	-.0001583	.0000585
MARR	.6554046	.228244	2.87	0.004	.2080546	1.102755
TFLAND	-.8347045	.5691609	-1.47	0.142	-1.950239	.2808303
ATLU	.0000936	.0000721	1.30	0.194	-.0000477	.0002349
MAINO	2.067093	.7428964	2.78	0.005	.6110425	3.523143
STHH	-1.219399	.6953017	-1.75	0.079	-2.582165	.1433672
_cons	-4.722012	3.348211	-1.41	0.158	-11.28439	1.840362

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Appendix 5: Important of Latent Variables in Household Resilience

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	1.000 ^a	1.000	1.000	0E-8

a. Predictors: (Constant), SSN, A, S, AC, AAT, APS, IFA

Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	-.022	.000		.	.		
A	.112	.000	.138	.	.	.890	1.123
APS	.685	.000	.367	.	.	.840	1.191
AAT	.029	.000	.186	.	.	.910	1.099
S	-.182	.000	-.329	.	.	.767	1.304
IFA	.184	.000	.471	.	.	.701	1.426
AC	.200	.000	.200	.	.	.907	1.102
SSN	.179	.000	.151	.	.	.983	1.017

a. Dependent Variable: RI