DETERMINANTS OF FOOD SECURITY IN THE RURAL HOUSEHOLDS OF SILITI WOREDA, SILITE ZONE, SNNPR, ETHIOPIA

BY

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A THESIS SUBMITTED TO THE DEPARTMENT OF ECONOMICS, COLLEGE OF BUSINESS AND ECONOMICS, SCHOOL OF GRADUATE STUDIES WOLKITE UNIVERSITY IN PARTIALS FULFILLMENT OF THE REQUIREMENTS FOR MASTER OF DEGREE IN DEVELOPMENT ECONOMICS

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Declaration

I, Mifta Abdella, declare that this thesis entitled: **"**DETERMINANTS OF FOOD SECURITY IN THE RURAL HOUSEHOLDS OF SILITI WOREDA, SILITE ZONE, and SNNPR, ETHIOPIA**"** is outcome of my own effort and study and that all sources of materials used for the study have been duly acknowledged.

To the best of my knowledge, this study has not been submitted for any degree in this University or any other University. It is offered for the partial fulfillment of the degree of Masters of Development Economics.

By: (MiftaAbdella)

Signature----------

Date----------

ADVISORS' APPROVAL SHEET

This is to certify that the thesis entitled **"**DETERMINANTS OF FOOD SECURITY IN THE RURAL HOUSEHOLDS OF SILITI WOREDA, SILITE ZONE, and SNNPR, ETHIOPIA**"** submitted in partial fulfillment of the requirements for the degree of Master's with specialization in Developmental economics, the Graduate Program of the Department/School of Economics, and has been carried out by Mifta Abdella, under my/our supervision. To the best of my knowledge, is an original work and not submitted earlier for any degree either at this University or any other University.

Therefore I recommend that the student has fulfilled the requirements and hence here by can submit the thesis to the department.

Name of major advisor----------

Signature----------

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Name of CO- advisor ----------

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Date----------

EXAMINERS' APPROVAL SHEET

We, the undersigned, members of the Board of Examiners of the final open defense by Mifta Abdella have read and evaluated his/her thesis entitled **"**DETERMINANTS OF FOOD SECURITY IN THE RURAL HOUSEHOLDS OF SILITI WOREDA, SILITE ZONE, AND SNNPR, ETHIOPIA**"**, and examined the candidate. This is, therefore, to certify that the thesis has been accepted in partial fulfillment of the requirements for the degree .of Master in Developmental Economics.

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Final approval and acceptance of the thesis is contingent upon the submission of the final copy of the thesis to the School of Graduate Studies (SGS) through the Department/School Graduate Committee (DGC/SGC) of the candidate's department.

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ABSTRACT

Household food security issues have become the concern of national governments as well as the international communities during the last few decades. Despite some improvements in recent years, poverty and food insecurity remain widespread and the main challenges in Ethiopia. The vast majority of extraordinarily poor households live in rural areas that are heavily reliant on rain fed agriculture. In Ethiopia, the Snnpr *region in particular, has been prone to much suffering in the past, and was one of the hardest hit areas. An understanding of the major determinants of food security is important for interventions aiming at minimizing food insecurity. Therefore the objectives of this study were identified determinants of food security among rural households Siliti district of Silite Zone and were collected Sample from 256 households drawn from 7 randomly selected sample kebeles through interview schedule. Descriptive statistics and Econometric analysis were used. Logit model were employed of data analysis. The survey results indicate that 34.38 % of the respondents were food secure, while 65.63% were food insecure. Results also indicate that there was a significant mean difference between the food secure and food insecure households. The study reveals that reducing numbers and quantity of meals, sales of livestock, purchase food on cash, borrowing grain/ cash from others and eating less preferred food were some of frequently practiced coping mechanisms in study area. The Logit result shows that marital status household head, marital status of household head, use of chemical fertilizer, and size of cultivated land, total income of household, credit access and Social capital were found to be significant in determining household food security. Generally, the study recommends that proactive policy which facilities the family planning techniques, expansion of infrastructure services, as well as awareness creation on better utilization of credit with expansion of credit access should be integrated as food security efforts.*

Keywords*: Food security, coping strategies, Siliti woreda, logistic regression Ethiopia*

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LIST OF ACRONOMS AND ABBREVATIONS

ADLI---------- Agriculture Development Led Industrialization AE- Adult Equivalence

AE---------- Adult Equivalent

AFSH---------- Africa Food Security and Hunger

CARE---------- Cooperation for Aid and Relief Everywhere

CC---------- Contingency Coefficient

CSA---------- Central Statistical Agency

DAP---------- Dominium Phosphate

DFID- ----------Department for International Development

DPPC----------Disaster Prevention and Preparedness Commission

EFSS----------Ethiopian Food Security Strategy

FAO- ----------Food and Agricultural Organization

FDRE---------- Federal Democratic Republic of Ethiopia

GDP---------- Growth Domestic Product

FAO---------- Food and Agricultural Organization of the United Nations

FSCB---------- Food Security Coordination Bureau

FSHA----------Food Security of Horn of Africa

FSS---------- Food Security Status

HH---------- Household

HHHs---------- Household Heads

HRD---------- Humanitarian Requirements Document

IFAD---------- - International Fund for Agricultural Development Kcal- Kilocalorie

IFPRI---------- International Food Policy Research Institute

Kcal---------- Kilocalorie

M.a.s. ----- --------Meter above Sea Level

MDG----------Millennium Development Goal

OECD---------- Organization for Economic Co-operation and Development

PSNP----------Productive Safety Net Program

SPSS---------- Statistical Package for Social Science

SNNPR---------- Southern Nations Nationalities and People's Region

SSA---------- Sub Saharan Africa

TLU---------- Tropical Livestock Unit

UN---------- United Nations

UNDP---------- United Nations Development Program

UNICEF---------- United Nations International Children's Emergency Fund

USAID---------- United States Agency for International Development

VIF---------- Variance Inflation Factor

WB---------- World Bank

WFS----------World Food Submit

(SWFEDD, 2018) --------- Siliti Woreda Finance and economics Development Statically report of 2018

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CHAPTER ONE

INTRODUCTION

1.1. Background of the study

Food insecurity and poverty are serious and persistent problems facing the world. The number of people who are food insecure and malnourished globally has been an escalation since 2014, reaching an estimated 815 million in 2016 from 777 million during 2015 affecting 11 percent of the global population (FAO, 2017). Besides, FAO (2017) report argued that food insecurity situation visibly worsened in parts of Sub Saharan Africa, south Eastern and Western Asia as the food insecurity prevalence was much compounded by droughts, floods (caused by El Nino phenomenon and climate change) and economic slowdown in the regions.

As part of Sub Saharan Africa, Ethiopia is facing with the problems of poverty and food insecurity. A recent study figured out that about 23 million Ethiopian live under poverty line and food insecurity remains a major challenge (Wondifraw et al., 2016). Furthermore, UNDP (2016) showed that around 44.2% of children under five were malnourished and stunned mainly caused by climate change, drought and the spread of diseases. Moreover, different scholars depicted that the food insecurity and poverty incidence were higher in rural areas constituting around 30.4% of the total population live under poverty line, while merely 25.7% for the urban dwellers consuming below the minimum recommended daily intake of 2,200 kcal/AE/day (FAO 2017).

Ethiopia is the second populous nation in Africa, has also out of the total population of the country, 81 percent of the population was lived in rural areas (CSA, 2017). The foundation of its economic growth is agriculture which plays an important role in the national economy (Adugna and Wagayehu, 2012). It accounts about 43 percent of the total GDP, employing and supporting about 85 percent of the total population and accounts for about 90 percent of the exports but its productivity and performance in terms of feeding the country's population which is growing at 2.6 percent per annum is dismal (UNDP, 2017). The per capita gross national income is among the lowest worldwide and estimated to be USD 410 in 2012 (WB, 2017). About 23 million Ethiopians live in conditions

substantially below the basic poverty line and food insecurity remains a major challenge. Ethiopia is amongst the poorest countries in the world, with a very low human-development ranking, or 174th out of 188 countries (UNDP, 2015).

Consequently, chronic and acute food insecurity is prevalent, especially among rural populations and smallholder farmers (Birara *et al.,* 2015). Food insecurity has become one of the defining features of rural poverty in Ethiopia particularly, in drought prone areas. The problem of food insecurity is undermining people's health, productivity, and often their very survival. Efforts to overcome the development challenges posed by food insecurity necessarily begin with identifying the causes at household level (Smith *et al*., 2006).

The effect of climate change risks is short-term, resulting from frequent and intense extreme events which include drought, floods, heavy precipitation and snow events and long-term changes in temperatures and precipitation patterns (Bals et al. 2008; FAO 2008, 2016a). Yet, farmers 'vulnerability to changes is a function of the magnitude, duration, and frequency of shocks as well as their ability to respond to them (Frankenberger et al.2013).

To reverse the terrible food insecurity situation of small-scale rural farmers, the Ethiopian government formulated a long-term strategy the growth and transformation program which takes agriculture transforms to industrialization as its point of departure and as the growth engine (GTPII, 2015).

According to the 2010 Disaster Prevention and Preparedness Commission (DPPC) half year report on SNNPR food security situation, the Southern Nations, Nationalities and People's Regional State (SNNPR) was an area the study area was delivered in one of the food insecure regions in Ethiopia. The report also revealed that the food insecure in rural areas of the region includes the following vulnerable groups: landless and the poor without assets, very small and fragmented land holders, female- headed households, families with large size, dislocated pastoral members, drought and pest affected households are vulnerable for food in security households.

According to Siliti Woreda Agricultural Office of 2018, Siliti Woreda is believed to be one of the chronically and seasonally food insecure areas of the SNNP Region. In Siliti Woreda, 22 food insecure kebeles are by now using Productive Safety Net Program. This study is aimed to identify determinants of food security and copping strategy from food insecurity in Silti Woreda.

1.2 Statement of the problem

Food is a basic necessity of life. It is regarded as the basic means of sustenance, and an adequate food intake in terms of quantity and quality, is a key for healthy and productive life (FAO, 2005). The need for food is top most in the hierarchy of needs as it is essential for a healthy living. Thus, achievement of food security is important in any given country.

Hence, to reverse the prevalence of food insecurity situation, the government of Ethiopia planned and implemented various long term strategies (Such as Agricultural Development Led Industrialization, Sustainable Development & Poverty Reduction Program, Poverty Alleviation & Sustainable Development Program, Growth & Transformation Plan I & II) to ensure food security and eliminate poverty through main- streaming the Sustainable Development Goals into the Plan (UNDP (United Nations Development Program, 2016) and (CIDA Canadian Hunger Foundation and Reach Consult Ltd, 2013). However, to bring improvement in the food security situation in the country, (Van der Veen, A. and Tagel, G. 2011) recommended that location specific empirical evidences should support the improvement programs. However, agricultural production has deteriorated over time due to the high increasing population and diminishing of landholding (Tewodros and Subaro, 2013). This has been manifested on the prevailing pressure on land, resource degradation, farm holdings fragmentation, declining of soil fertility and food per capita. Hence, the slow agricultural production growth and its low productivity is a reason to earn low income as well as to be food insecure (FSCB, 2004).

The Government of Ethiopia, WFP and development partners work together to increase families' long term resilience to food shortages. For instance, in 2005 Productive Safety Net Program (PSNP) was established and aimed at enabling the rural poor facing chronic food insecurity to resist shocks, create assets and become food self-sufficient. In this year the program commenced by covering four regions

of the country (Tigray, Amhara, Oromiya and SNNPR) aiming to reach more than 1.6 million households (5 million people) in 263 districts identified as chronically food insecure areas (Legovini, 2006; Gilligan *et al*., 2009; Siyoum, 2012).

By the end of 2010, the number of peoples whose PSNP beneficiaries had reached over 7.8 million spanning over 300 districts in eight regions across the country (Kwadwo *et al*., 2013). Even thought, Food is a basic necessity of life and many development partners works for eradicating the problem of food insecurity, Ethiopia has not managed to solve the problem of food insecurity.

Various organizations and researchers identified determinants of food security status of the households. But, there are significant variations among regions and among districts of a single region in the extent, cause, vulnerability and coping strategies against food insecurity. This can be attributed to variations in climatic and natural resource endowments, land availability and fertility as well as due to variations in cultural and socio-economic conditions. As a result, in order to combat threats of food insecurity and poverty by ensuring food security, detailed understanding of the socioeconomic condition of the group affected by it, the determinant factors and how households cope with the problem of food insecurity is critical (NEPAD, 2013).

Despite the effort made by the Government of Ethiopia, World Food Program and development partners' food insecurity problem remains a challenge in Ethiopia in several and particular in Siliti district. In line to this Siliti district is one of the food insecure districts which government is taken as a pilot district for the implementation of PSNP in 22 *Kebeles* by having 33975 numbers of beneficiaries starting from 2006 up to 2015. But now, in 22 *Kebeles* by having 23833 numbers of beneficiaries' and also here is high problem of food insecurity in the district. In each year, Siliti district is identified among food insecure districts of the Silite zone. There is high level of rural urban migration in search of employment (Siliti District Agricultural Administration Office, 2018).

Hence, this study was aimed at assessing households' food security, identifying factors responsible for households' food security and examining coping strategy of households towards food security in this small geographical area of the country. This study therefore, aims to fill this gap as it would contribute to already existing literature on food security from such area and it would provide

baseline information to policy makers, non- governmental agency, researchers, and other development partners who normally provide support for such households at micro level and it would help any concerned body to adjust additional remedies to problem and it helps those who interested to study on similar issues in the study area.

1.3. Research Questions

This research was tried to answer the following questions.

What is the status of food security in the study area?

What are the major factors of food security among the rural household?

What coping strategies households were employed to food insecurity?

1.4. Objectives of the study

1.4.1. General Objective of the study

The general objective of the study is to identify determinants of rural households' food security and copping strategies of Siliti Woreda, in Silite Zone, and SNNPR in Ethiopia.

1.4.2. The specific objectives of the study are:

To assess the status of households food security in the study area

To analyze determinants of food security among the rural household in the study area and

To identify coping strategies/mechanisms employed by households to cope with food insecurity in study area.

1.5. Significance of the study

Identify and understand major factors that cause and/ or influence the problem as well as its copping strategies at house hold level. It is imperative to describe and diagnose the existing farming systems to provide policy related information that helps to prioritize among the many possibilities depending on the relative extent of influences of its determinants for silite zone siliti woreda agricultural and natural resource office. More specifically, the results of the study will help

concerned bodies formulate policies and develop intervention mechanisms that are tailored to the specific need of the study area. In the end, the study will contribute to further research, extension and development schemes. It is expected that this study will be of help to the policy makers, government, Non -governmental organizations, investors as well as other researchers to play a sustainable and significant role to ensure the food security to the rural households. The study will also contribute to the existing body of knowledge in the area of study and provide a basis for further research in related fields. This research study will aim to increase the general understanding of food security in order to improve the targeting of interventions to food insecure populations.

1.6 Scope and Limitation of the study

The study is focused to identifying major factors that are expected to influence household food security and the copping strategies with limited number of households in the rural parts of Siliti Woreda because most of woredas population live and drought prone area are the rural part of Siliti Woreda. The study covered only seven Kebeles namely Kertef , Dobo badeno , Dacha gisila , Tuto zogere , Aratber mukere , Elose and Anshebeso.. Out of the seven kebele of Siliti Woreda, selected 256 households. logit model which only identifies determinants food security without measuring the extent of food security was used. The major challenges the researcher faced were lack of financial support and willingness of the respondents to give the appropriate responses to the questions during data collection. Despite all these challenges, the researcher did his level best to capture reliable information explaining the purpose of the study and the benefits it contributes to their well-being.

1.7 Organization of the thesis

Relevant literatures related to the study were reviewed in chapter two. Chapter three focused on description of the study area, methods of sampling, methods of data collection and methods data analysis. In chapter four, the results obtained from the descriptive statistics and econometric models were clearly presented and discussed. Finally, chapter five presents the conclusion and recommendation of the study.

1.8. Definition of Key Terms

Food security: is a situation that exist when all people at all times have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life(Clay, 2002).

Food insecurity: is a situation in which individuals have neither physical nor economical access to the nourishment they need (FAO, 2012).

Coping strategies: are short term responses made by households to improve the declining situation of households' food (Thomas *et al*., 2007)

Household: a person or a group of people living in the same compound (fenced or unfenced), answerable to the same household head and sharing a common source of food and/or income (Mbidha, 2011).

CHAPTER TWO

2. LITERATURE REVIEW

In this chapter, literature that is relevant and available on the subject of the study is reviewed. Various concepts and approaches to food security and factors that could influence food security are discussed in detail. Different views on food security are discussed briefly. Problems faced by communities in developing countries are highlighted. For the purpose of the study, it was necessary to obtain an overview regarding these three contexts and how food security manifests itself on the three levels, finally, conceptual framework of the study.

2.1. Concepts and Definitions of Food Security

Food security concept emerged at the United Nations Food and Agriculture Organization World Food Conference in 1974. It centered based on two sub-concepts; food availability and food entitlement. The first refers to the supply of food available at local, national or international levels and also in other food availability means enough, safe and nutritious food either domestically produced or imported from the international market. Food availability does not ensure food accessibility. For food to be accessible individuals or families must have sufficient purchasing power or ability to acquire quality food at all times (Omonona *et al*., 2007).

The concept of food security in particular is a more recent development and the bulk of the literature dates from the 1980s. When we look into the evolution of food security, the initial concerns in the 1970s focused on the global, regional and national food supply or stocks. Such view favored macro-level food production and supply- oriented variables that overlooked the micro-level food access. Household food security can be loosely defined as the ability of all individuals to access an adequate supply of food, on stable basis and in sustainable way and also another aspect of household food security concept is the issue of vulnerability. This show how household cope in terms of their ability to cope with times of shock like when there are droughts or floods (Peggy, 2004).

Food security is a concept that defined in different ways over time and there are many literatures on the potential to household food security dimensions. According to Hoddinott (1999) approximately there are 200 definitions of food security and 450 indicators of food security. But in today the most widely used definition of food security is the one adopted from 1996 world food summit (WFS). According to this definition "Food security exists when all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life". This definition has been identified with the four dimensions of food security: availability, access, stability, and utilization (FAO, 2012).

Generally there are numerous definitions of household food security. Different institution and organization defined food security differently but, the basic concept is not change. According to the World Bank (2009) food security means a situation when all people at all times to sufficient food for an active, healthy life. Food security takes into consideration the physiological needs of individuals, the complementary and trade-offs among food and other basic necessities that households make, the dynamic nature of household food security over time and the levels of vulnerability and response to risk (TANGO, 2002).

According to USAID (1992) defines food security as: "when all people at all times have both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life." Here food security includes at a minimum the availability of nutritionally adequate and safe food, and assured ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, etc).

According to FAO (1992) food security is defined not only in terms of access and availability of food, but also in terms of resource distribution to produce food and purchasing power to buy food, where it is produced. This is one of the most influential definitions of food security that encompasses many issues. It deals with production in relation to food availability; it addresses distribution in that the produce should be accessed by all; it covers consumption in the sense that individual food needs are met in order for that individual to be active and healthy. The availability and accessibility of food to meet individual food needs should also be sustainable. This implies that early warning systems of

food insecurity should monitor indicators related to food production, distribution, and consumption.

According to Mohammed (2003) food secure households are households whose food intake above their minimum calorie (energy) requirements. The assessment of food security extends to consider the health of those eating the food as the objective is to obtain a healthy and active life. In contrast to food security, the term food insecurity is defined as lack of access to enough food both in quantity and quality on sustainable bases. Food insecurity cans also articulate, limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways (Bickel *et al.*, 2000).

2.2 Theoretical Review

2.2.1. Food Security

Under this sub-title food security reviewing three things. Those are: food security situation in global, in Africa and in Ethiopia.

2.2.2. Global food security

According to FAO (2013) estimates indicate that, 842 million people of the global population were unable to meet their dietary energy requirements in 2011–13 or around one in eight people in the world are likely to have suffered from chronic hunger, not having enough food for an active and healthy life. Food security is a universal issue. It is not the problems of developing nations only. This means developed countries also face food insecurity. Number of prevalence undernourished people was 9 million, in industrialized country (FAO, 2006). According to Thompson (2008) 10.9% of U.S households were food insecure in 2003. In the same year 4.0 % of all U.S. households had very low food security; meaning that the food intake of one or more adults was reduced and their eating patterns were disrupted at times during the year because the household lacked money and other resources for food. According to a survey made in 27 largest cities of the U.S in 2004 it was found that there was a 17% increase in people requesting emergency food assistance from shelters and food stores and also in2006 the number of food insecure peoples in Americans increased to 40 million.

2.2.3. Food security in the context of Africa

Agricultural growth in sub-Saharan African countries averaged nearly 3% over the past 25 years (Malik *et al.,* 2009). This slow growth is partly attributed to low investment in agriculture, poor infrastructure and downsizing of public agricultural institutions for research, extension, credit and marketing of sate role. Recently, emerging issues like climate change and population growth along with decline scale of agricultural investment in developing countries, inappropriate rules for trade and investment between rich and poor countries and extreme global inequality of food resources have direct and negative influence on food security status (PANE, 2010).

Africa is the only region in which levels of hunger increased in recent decades (Sanchez, 2005). Chronic food insecurity now affects about 200 million people who are suffering from malnutrition. Acute food insecurity in 2003 affected 38 million people in Africa. Out of the 39 countries worldwide that faced food emergencies at the beginning of 2003, 25 are found in Africa (Clover, 2003).

The number of prevalence of undernourished people was 206 million in Sub-Saharan Africa (FAO, 2006). Between 1990–92 and 2012–14, the prevalence of undernourishment has fallen from 23.4 percent to 13.5 percent in developing countries. This means that the Millennium Development Goal hunger target of halving the proportion of undernourished people by 2015 is within reach. If the current trend of a reduction of about 0.5% per year since 1990–92 continues, the prevalence of undernourishment in developing regions would reach 12.8% in 2015 to 1.1 percentage points above the MDG target of 11.7% (FAO, 2014). Despite of the progress in developing regions as a whole, large differences remain across regions. In general, in Africa, there has been insufficient progress towards international hunger targets, especially in the sub-Saharan region (AFSH, 2014).

2.2.4. Food security trends in Ethiopia

Despite the rapid economic growth Ethiopia has experienced in the last decade that malnutrition and hunger continue to present key policy challenges (Paul and Shahidur, 2013). Ethiopia is one of the poorest countries in the world with human development index ranking 157 out of 169 countries reported (UNDP, 2010). With US$ 350, the country's per capital income is much lower than Sub-Saharan Africa average of US$ 1077 in year 2009 (WB, 2011). It's continually affected by chronic

and transitory food insecurity especially majority of the peoples who live in rural area and defendant on subsistence agriculture. According to ministry of agriculture (2012) about 38.7% of households were food insecure.

In Ethiopia, according to food security program (2003) document explained the combinations of factors such as adverse changes in climate, poor technology, soil degradation and policy induced as well as program implementation problems have resulted in serious and growing problems of food insecurity. Food security in Ethiopia shift between chronic and acute expressed by broad and deep crisis, which often is the characteristic of drought prone areas with low and variable rainfall, high population density and low natural resource endowments. Since the country is dependent on agriculture, crop failure usually leads to household food deficit. The absence of off-farm income opportunities, and delayed food aid assistance, leads to asset depletion and increasing levels of destitution at household level. Over the last fifteen years this situation has resulted in importing an average of 700-thousand metric tons of food aid per annual to meet food needs (FSPO, 2003).Generally, According to humanitarian requirements document reports in different year the number of people need of emergency food assistance is increasing from year to year, in 2014 it were 2.7 million people, in 2015 2.9 million people and in 2016, 10.2 million people (HRD, 2016).

2.2.5. Food security trends in SNNPR

The SNNPR, the region where the current study area is located, has also been implicated in the report of WFP and CSA (2014). Accordingly, in the region, about 22% of the total households live below food poverty line. Similarly, the report of MDG (2014), which was released in 2015 by National Planning Commission and the United Nations in Ethiopia, reported the region's food consumption poverty as 25.9%. silte Zone is one of the 13 zones in the region and is located towards the west.

Currently, it is divided into 8 *woredas* and 1 self-administered towns. siliti *woreda* is among 08 *woredas* of Silite Zone in southern Ethiopia. It is one of the chronically food insecure *woredas* in the Silite zone (Zeleke *et al.,* 2016) and is known for repeatedly occurring food insecurity shocks.

2.2.5. Dimensions of food security

Generally there are four dimensions of food security. Those are access, availability, utilization and stability.

Availability: Refers to the amount of food that is present in a country or area through all forms of domestic production, imports, food stocks and food aid" (WFP, 2009).

Accessibility: It refers to physical, economic and social access. Although, the concept of access to food was first presented by Amartya Sen. In the early 1980's, it is not yet necessarily common to refer to it as an important element of food security. Moreover, since the Niger food crisis in 2005 and the World food prices crisis in 2008, many are tempted to limit the access dimension of food security to its economical or financial dimension. WFP defines the food access as "a household's ability to acquire adequate amount of food regularly through a combination of purchases, barter, borrowings, food assistance or gifts" (WFP, 2009). It is the ability of the nation, region, household or individual to gain access to the available food. The factors that determine this access could be economic in nature or not. In the economic aspect it is the purchasing power of the household to acquire the food needed for its nutritional need. It is clear that the sources of food for a household are different, households typically whether: grow it and consume from their own stocks, purchase it in the marketplace, receive it as a transfer from relatives, members of the community, the government, or foreign donors; or gather it in the wild (Bassie, 2014).

Utilization: The third dimension of food security is food utilization. In the WFS definition it refers to "safe and nutritious food which meets their dietary needs". It is not sufficient that food be available and accessible to households to ensure that people will have a "safe and nutritious" diet. A number of elements intervene here such as: the selection of food commodities, their Conservation and preparation as well as the absorption of nutrients. Food has to be of good quality and safe. According to USAID (1992) described food utilization has two aspects which includes socio-economic and biological aspect. Adequate food utilization is realized when food is properly used, proper food processing and storage techniques are employed, adequate knowledge of nutrition, health and sanitation services exist.

Stability*:* The fourth dimension of food security is stability. In the WFS definition it refers to: "at all times". This stability applies in the first instance to the previously mentioned three dimensions of food security. Food security is "a situation" that does not have to occur a moment, a day or a season only but on a permanent basis with sustainability. Based on the stability dimension of food security, one speaks about chronic and transitory food insecurity. Chronic food insecurity is a long term or persistent inability to meet minimum food requirements and transitory food insecurity is a short term or temporary food deficit. There is also cyclical food insecurity such seasonality (Devereux, 2006).

2.2.6. Measurement and Indicators of Food Security

Measuring the required food for an active and healthy life and the degree of food security attained is a question to be addressed in a food security study. According to Hoddinott (1999) there are four ways of measuring household and individual food security: individual intakes (either directly measured or 24-hour recall), household caloric acquisition, dietary diversity, and indie of household coping strategies.

Income and consumption has been traditionally used as a measure of food security. But measurement method based on income has three further limitations those are: they cannot be used for determining the location of food insecurity, it has limited use for understanding the cause of food insecurity, it focuses only on the diet quantity to the exclusion of other important aspect of food security such as diet quality and vulnerability (Smith *et al.*, 2006). Thus, consumption is a better measure of longer-term household welfare as it is subject to less temporal variation than income. In addition, households are likely to under report their income level more than they do with their consumption (MoFED, 2008). Comparison of different outcome measures of household food security made as the following by Hoddinot (2001).

Individual food intake data: This is a measure of the amount of calories or nutrients consumed by an individual in a given time period, usually 24 hours. To generate these data, there are two basic approaches used. The first is observational. An enumerator resides in the household throughout the entire day, measuring the amount of food served to each person, and the amount of food prepared

but not consumed ("plate waste") is also measured. In addition, the enumerator notes the type and quantity of food eaten as snacks between meals as well as food consumed outside the household. The second method is recall. The enumerator interviews each household member regarding the food they consumed in the previous 24-hour period. This covers the type of food consumed, the amount consumed, food eaten as snacks and meals outside the household. Data collected on quantities of food are expressed in terms of their caloric content, using factors that convert quantities of edible portions into calories. These intake data are compared with minimum calorie requirement. Despite its advantages in terms of accuracy, it is unlikely to be an indicator that can be feasible collected as part of many development projects.

Household caloric acquisition: This is the number of calories, or nutrients, available for consumption by household members over a defined period of time. The principal person responsible for preparing meals is asked how much food she prepared over a period of time. After accounting for processing, this is turned into a measure of the calories available for consumption by the household. To generate these data, a set of questions regarding food prepared for meals over a specified period of time, usually either 7 or 14 days, is asked to the person in the household most knowledgeable about this activity. This measure produces a crude estimate of the number of calories available for consumption in the household. Because the questions are retrospective, rather than prospective, the possibility that individuals will change their behavior as a consequence of being observed is lessened. The level of skill required by enumerators is less than that needed to obtain information on individual intakes. On average, it took around 30 minutes per household to obtain these data, an amount of time considerably less than that required to obtain information on individual intakes.

Dietary diversity: This is the sum of the number of different foods consumed by an individual over a specified time period. To generate these data, one or more persons within the household are asked about different items that they have consumed in a specified period. These questions can be asked to different household members where it is suspected that there may be differences in food consumption among household members. Even though it is simple to use, the simple form of this measure does not record quantities. If it is not possible to ask about frequency of consumption of particular quantities, it is not possible to estimate the extent to which diets are inadequate in terms of caloric availability.

Indices of household coping strategies: This is an index based on how households adapt to the presence or threat of food shortages. The person within the household who has primary responsibility for preparing and serving meals is asked a series of questions regarding how households are responding to food shortages. After these data are collected, the number of different coping strategies used by the household will be counted and categorized as number of strategies that the household used often, from time to time, or rarely. The higher the sum, the more food-insecure the household will be. As it is subjective comparison among household would be difficult. In addition, it is highly susceptible to misreporting of the household's circumstances. To sum up, among the four types of food security measurement discussed above, in this study household calorie consumptions/acquisition was utilized.

Indicators at individual and household level can be grouped as generic indicators and location specific indicators. Generic indicators are those indicators that can be collected in a number of different settings and are derived from a well-defined conceptual framework of food security whereas location specific indicators are those indicators typically carried only within a particular study area because of unique agro climatic, cultural, or socioeconomic factors. Location-specific indicators can be identified only from a detailed understanding of local condition by using qualitative data collection methods, while the generic indicators are drawn from the food security literature and tested using statistical methods (Chung *et al*., 1997).

However, there are two types of food security indicators. Those are process indicators and outcomes indicators. Process indicators provide an estimate of food supply and food access situation whereas outcome indicators serve as proxies for food consumption (Frankenberger, 1992).

2.2.7 Household Coping Strategies

In describing the concept of coping strategy/mechanism common terms or phrases like coping techniques or survival methods are often used interchangeably by writers and researchers. In this context, coping strategy means coping mechanism or coping technique is implying mainly at a household and individual levels. The term response is also used for individual actions aiming at survival in the face of disaster-induced food crisis, famine or food shortages. Coping strategy could

be defined as a mechanism by which households or community members meet their relief and recovery needs and adjust to future disaster-related risks by themselves without outside support (Dagnew, 1993; as cited in Tesfaye, 2005).

Households typically adjust their consumption patterns and reallocate their resources to activities which are more insulated from the influence of those risks. In drought periods, for example, households may shift their labor resources from crop production to non-farm wage employment or sell-off small assets to ensure continued income. They may also adjust their consumption patterns, reducing their dietary intake to conserve food and relying more on loans or transfers and less on current crop production and market purchases to meet their immediate food needs. Over time, as crisis deepens, household responses become increasingly costly, leading to the loss of productive assets which can ultimately undermine future livelihoods and their long-term food security status (Riely *et al.,* 1999*).*

Coping mechanism used by peoples in Ethiopia include; livestock sales, agriculture employment, certain type of off-farm employment and migration to other area, requesting grain loans, sales of wood or charcoal, small scale trading, selling dung and crop residues, rising of food consumption of wild plants, reliance on relief assistance, relying on remittances from relatives, and dismantling of parts of their houses for sale (Yared, 2001). According Maxwell (1995) noted six main short-term and food-based coping strategies; Eating foods that are less preferred, Limiting portion size, Borrowing food or money to buy food, Maternal buffering, Skipping meals and Skipping eating for whole days.

Patterns of coping strategies can show the sequence of responses that farm households typically employ when faced with food crises. These sequences of responses are most frequently divided into three distinct stages. In the earliest stages of crises (stage one), household employ the types of risk-minimization and loss-management strategies. These typically involve a low commitment of domestic resources, enabling speedy recovery once the crisis has eased. As the crisis persists, household are increasing forced into a greater commitment of resource just to meet substantial needs (stage two). There may be a gradual disposal of key productive assets, making it harder to return to a pre-crises

stage. At this stage, a household vulnerability to food insecurity is extremely high. Stage three strategies are signs of failure to cope with the food crisis and usually involve destitution and distress migration (Corbett, 1988; as cited in Timothy, 1999).

2.3. Empirical Literature Review on Determinants food security and Copping Strategies

Empirical studies conducted by various authors identified various factors influencing household food security and also household food security/ insecurity status is measure by various ways such as individual intake, household calorie acquisition, dietary diversity and indices of household coping strategies in terms of time requirement. But most of them use the same methods. According to a study done by Tewodros and Fikadu (2014) in Mareko District, Guraghe Zone Southern Ethiopia, a binary logit model was used to identify the determinants of food security. A total of 17 explanatory variables were included in the model Out of those variables, 11 were statistically significant at less than 10% of probability level. The significant variables were; age of household head, level of education, household size, size of cultivated land, use of improved seed, number of contact with development agents, size of credit received, size of livestock owned, and off-farm income per adult equivalent and also household calorie acquisition were used to measure household food security status, about 38% of the households were food secure and acquire 2100 kilo calorie and above per adult equivalent, while majority 62% are never escape transitory food insecurity.

According to a study done by Tilksew and Fekadu (2012) in Babile District, a binary logit model identified five out of ten variables included in the model as significant factors of rural household food insecurity.

The significant variables were; size of cultivated land, farm income, and use of improved variety, educational status of household head and insect and pest infection problem and also they using 2200 kcal per AE per day as a benchmark to classify food insecure and food secured HHs, 85 sample HHs were found to be unable to meet the minimum subsistence requirement and 65 sample HHs met the minimum subsistence requirement. In other words, 57% and 43 % of the sample HHs were food insecure and food secure, respectively.

According to James et-al. (2013) in his study identified the major determinants of food security in the study area by using the logistic regression model. Out of the total 10 explanatory variables household size, farm size, off-farm income, credit access, and marital status were significantly influence household food security area positively. According to Genene (2006) in his study identified the major determinants of food security in the study area by using the binary logit model. The model output clearly indicated the influence of hypothesized variable on the dependent variable. It also indicated the appropriate measure to be taken for improving the food security status. Out of the total 12 explanatory variables hypothesized sex, family size, dependency ratio, education, soil conservation measures, livestock owned, farm income and perception index were significant determinants of household food security status.

Guled (2006) in his study on food insecurity and copping strategies of agro-pastoral households in Awbare District, identified among 11 explanatory variables included in then logistic model, 6 of them were significant at less than 10 percent probability levels. These were age of the household head, sex of the household head, household size in AE, total cropping land in hectare, oxen ownership and remittances income in Birr. Among 14 explanatory variables included in the logistic model, 9 of them were significant at less than 10% probability level. These were family size, number of oxen owned, use of chemical fertilizer, size of cultivated land, farm credit use, total annual income per adult equivalent, food consumption expenditure, livestock owned, and off farm income per adult equivalent (Tesfaye, 2005).

According to Amsalu and Beyene (2012) in their study entitled in Empirical analysis of the determinants of rural households food security in Southern Ethiopia in Shashemene District has shown that the major factors affecting food security of rural households were family size, total cultivated land, size of household head, annual farm income, total off-farm income and livestock holding. Study also indicates that annual farm income; off farm income have a significant and positive influence on the state of household food security while family size and food security were negatively related.

The binary logit model identified six significant variables as determinants of the food security status of male-headed households, i.e. age of head of household, market distance, participation in ox fattening, off-farm/non-farm income, total livestock holding and crop income. The model also identified three significant variables as determinants of the food security status of female-headed households, i.e. crop income, market distance and farm implements and other productive household items (Dereje, 2006).

Several studies revealed that different factors affect both household food security and insecurity in Ethiopia because of difference in resources availability, topography, time dimension and other factors; on the other hand, farm land size, small ruminant holding in TLU and oxen holding in TLU affect household food security positively; whereas, family size has negative effect on it (Tilaye, 2004).

In the study done by Sisay (2012) households' food or calorie acquisition/consumption per adult per day is used to identify the food secure and food insecure households by using 2100 kcal per AE per day as a benchmark to classify food insecure and food secured HHs, 84 sample HHs were found to be unable to meet the minimum subsistence requirement and 36 sample HHs met the minimum subsistence requirement. It means that (70%) of the respondent households were food insecure and (30%) of them were food security.

The level of food shortage problem varies from household to household. A household uses different Copping Strategies at different level of food insecurity situation in their area. According to the study done by Tewodros and Fikedu (2014) About 10 copping strategies were practiced by the households at early stage of food shortfall. Accordingly at initial stage of food insecurity 60% and 73.5% of food secure and food insecure households were reducing the number of meals. Reducing size of meal also was employed as coping strategy by 60% and 72.5% of food secure and food insecure households.

Borrowing grain and cash was used as third coping mechanism was employed by 42% of food secure and 62.5% of food insecure households. About 38% and 45% of food secure and food insecure households receiving food aid as the fourth coping mechanism. Sale of small livestock was used as fifth coping mechanism by 36% and 42.5% of food secure and insecure households. Participation in food for work programs, which is ranked sixth, was practiced by 38% and 37.5% of food secure and

insecure households.

Wage from daily paid laborer was equally used as coping mechanism by 26% of food secure and insecure households. Renting out and mortgaging of land was the eighth and ninth coping mechanism. Renting out land was practiced by 10% and 16.25% of food secure and insecure households whereas mortgaging land by 4% and 11.25% of food secure and insecure households. Pity trade was used as the tenth coping mechanism by 10% and 3.7% of food secure and insecure households.

According to the study by Abdurrahman (2015) noted that in this study area households use alternative coping mechanisms such as: sale of more livestock than usual, borrowing of food, reduce number of meal, reduce size of meal, sale firewood and charcoal, seasonal migration, seeking alternative or additional job, rely on less preferred and less expensive food, seeking relief assistance, becoming temporary trade, household splitting, consume wild food, remittance, participating in cash basis project works.

2.4. Conceptual framework

Achievement of food security is important in any given country. So, it is important to differentiate which functional variables determine for a household food secure. Based on empirical analysis, for this particular research different factor that affects status of the households to be food secure have been discussed. These are demographic factors which including (age of the household head, sex of the household head, educational level of the household head, family size dependency ratio), institutional factors which including (use of chemical fertilizers**,** use of improved seeds, access to credit service, distance to nearest market, participation in productive safety net program and contact with development agent) and socio-economic factors which including (size of cultivated, land livestock ownership, number of oxen owned, cash crop production, off /non-farm income) will fall in any of the three dimensions of food availability, access, and utilization which were shown below (figure 1)

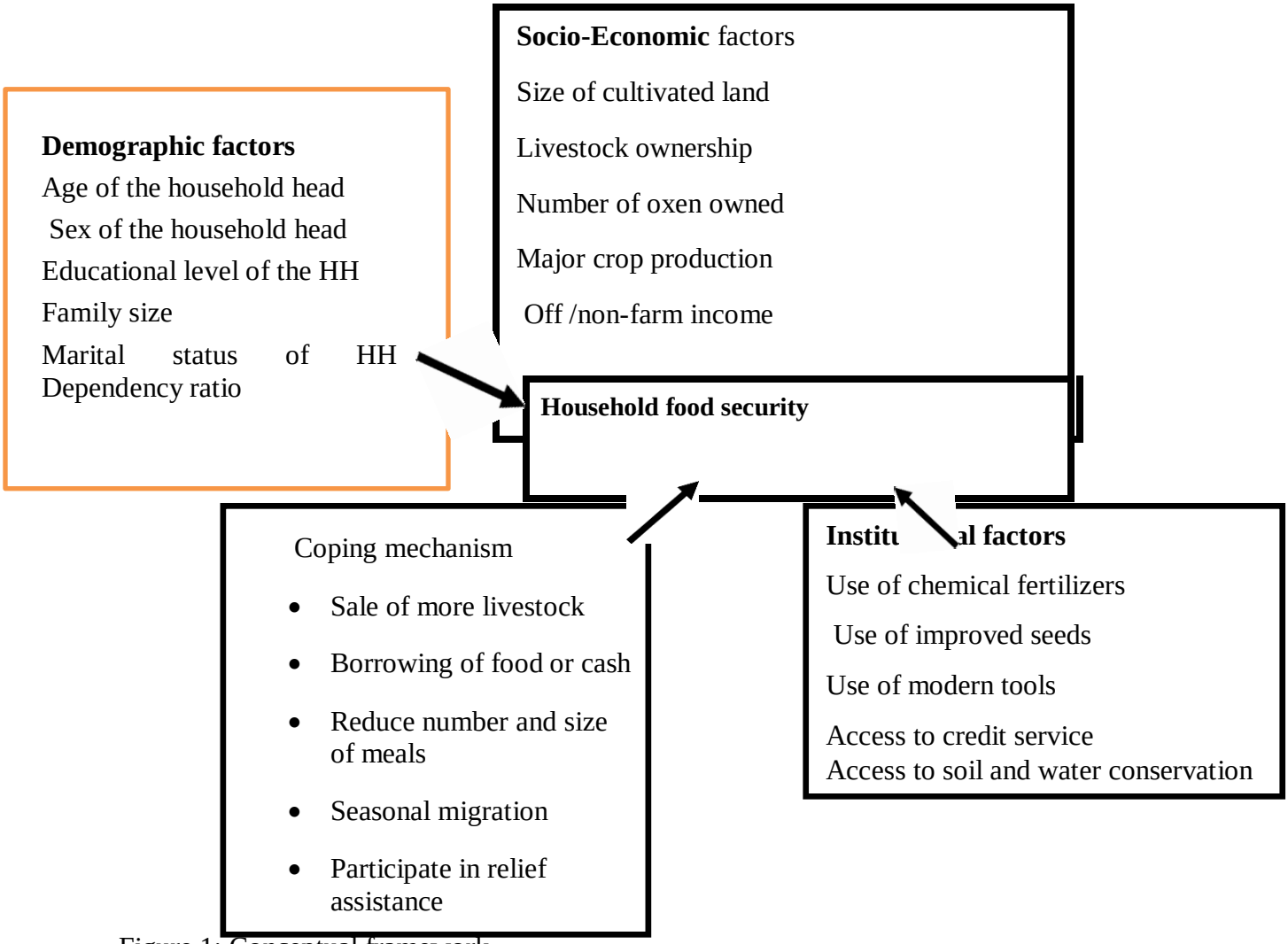

Figure 1: Conceptual framework
Adapted from Food Security Information for Action: Food Security Concepts and Frameworks. FAO (2008), with minor modification

2.5. Concluding remarks

Much of the reviewed literature on household food security concentrated on describing qualitatively and quantitatively, the extent of household food security; identifying the factors and examining their implications. In almost all studies reviewed, there were no statistical explanations on determining sample size and also they didn't include social capital as determinants of food security for determinants of food security in the study area.

CHAPTER THREE

3. METHDOLOGY

3.1. Description of the study area

Siliti woreda is one of the 8 *woredas* in silite Zone, SNNPRS. According to siliti *Woreda* Finance and Economic Development office (SWFEDO, 2018), the *woreda* specifically lies between 7.993515^0- 8.278101^0 latitude and 38.263131^0-38.5786^0 longitude. It is bordered by Alicho wuriro woreda in the West, Worabe administrative city in the South, Lanfuro in the East and *M*eskan woreda in the north direction as well as the woreda Fars 147 kilometer apart from Addis Ababa in the south west direction.

Among the five climate zones of Ethiopia as *Bereha* (Desert), *Kolla* (Semi-desert), *Woinadega* (moderate temperature), *Dega* (cold) and *Wurch* (extremely cold); about 79.7% of the *woreda* lies under *Woinadega* and the remaining 20.3 % has *Dega* climates with 1501m-3500m elevation above sea level (SWFEDD, 2018). The average annual temperature of the *woreda* ranges from 12- 25^0C and its average annual rainfall ranges from 875-1215 mm (SWFEDD, 2018).

Mixed farming system (crop-livestock integration) prevails as a dominant economic activity in the district. Depending on the agro-ecological location, households in the study area produce varying degree of mix of cereals, pulses, oil seeds, and livestock some households also grow and vegetables to a lesser extent with almost all households producing chat. Land has been cultivated 22,123 hectare and grows Wheat, Barley, maize; sorghum, teff, enset and vegetables are grown in woreda. The woreda soil types clay 55%, loamy soil 10% and sandy soil 35%. In 2018 production year 7974 hectare maize, sorghum 684 hectare, teff 3310.5, Wheat 6413 hectare and Barley 881.5. (SWFEDD, 2018)

Livestock which were found in the woreda cattle 157304, sheep 64654, goat 48,882, poultry 154,638, horse 4,297, donkey 27,464 and mule 875. (siliti woreda finance statistical abstract, 2018). Crops and cropping activities are essentially determined by rainfall pattern and distribution. The bimodal rainfall distribution results into two cropping seasons, locally named as '*belg*' and '*meher*' cropping seasons. The *belg* rain (short rains) is useful for short duration crops; and for the land preparation and germination of long season '*meher*' crops. (SWFEDD, 2018)

According to Siliti District Agricultural and Rural Development Office (2018), there are 36 rural *kebeles* that are found in the district in mid-highland and highland agro-ecological zones. From the total of 36 rural *kebeles*; 22 kebeles that are found in the district depends on food aid obtained from both governmental and nongovernmental organizations.

In general, the district is designated as famine prone area due to the erratic rainfall pattern and frequent crop failure is a common problem usually leading to food shortage and also the district is mostly cited as food insecure district in the zone. Drought induced food insecurity has been a common recurrent phenomena exacerbating the vulnerability of resource poor farm households in the area to be food insecure (MARDO, 2013).

3.2. Sampling Technique

The study employed multi-stage sampling techniques to select the representative samples. First, the rural *kebeles* of Siliti district are stratified into two based on agro-ecology (highland, and midland). Secondly, from each agro-ecological zone five kebele from mid land agro-ecology rural *kebele and two rural kebele from high land* agro ecology were selected by using simple random sampling. This was because of from 36 rural kebele of siliti woreda 22 of kebles under mid land agro ecology and they are under safety net program from them selected five kebeles and the remained 14 kebeles from high land and they were not safety net program list of kebele of siliti woreda and selected two kebele.

Finally, from the selected *kebeles* the required representative sampled households were randomly selected based on proportional to size of populations. The desire number of sample household is determined by using a formula developed by Yamane (1967). To determine the required sample size at 95% confidence level, with a 0.5 degree of variability and 6% level of precision.

The desired margin of error (also called confidence) was set equal to 5%. The error in sampling is calculated to check whether the sample taken is representative. This margin of error ensures representativeness from the selected population (it is important to decide how many questionnaires need to be completed to be representative of the overall population using or benefiting from the water service), because the general accepted margin of error for representative samples is 10% or less (Hosking and Preez, 2003; Andualem, 2011, Tesfaye, 2017

$$n = \frac{N}{1 + N(e)^2} = 34983/1+34983(0.06)^2 \approx 256$$

Where n= (n1+n2+n3+n_4+n_5+n_6+n_7) number of sampled households and n_1, n_2, n_3, n4, n5, n6, and n_7 are the number of households proportionally selected from each of the seven selected *kebeles*. N= Total number households of the seven selected *kebeles* and e = level of precision. When calculated by Yamane formula n= 256. Then according to the Yamane (1967) formula the sample size of 256 rural households were selected randomly from the selected seven (7) rural *kebeles, namely* Kertef , Dobo badeno , Dacha gisila , Tuto zogere , Aratber mukere , Elose and Anshebeso.

Table 3.1: Total number of households by kebeles and their respective sample size

Summary of Sample size & Sample Respondents

Sample Kebele	**Total Household Number(ni)**	**Sample Respondents**
Kertef	365	27
Dobo badeno	451	33
Dacha gisila	823	60
Tuto zogere	625	46
Aratber mukere	665	49
Elose	372	27
Anshebeso	192	14
Total	3493	256

Source: Own computation from district data, 2018

3.2. Method of Data Collection

Both quantitative and qualitative types of data were used to this study which was collected from both primary and secondary sources. The primary data were gathered using structural interview schedule, key informant interview and focus groups discussion. To collect the primary data first, the enumerators for the data collection was selected on the basis of their educational back ground and their ability to speak the local language. Two days training was given to the enumerators about method of data collection about how the approach to be delivered to household heads and the contents of the interview schedule. Data collection process was started after pretest conducted and modifications were made based on the feedback from the pretest. The pretest was conducted on randomly selected 7 respondents.

By using structural interview schedule different quantitative type of information was gathered from the households such as information on demographic characteristics, total cultivated land holding, off-farm/non-farm income, and livestock ownership excluding oxen, oxen ownership, types and amount of food consumed by a household in a specific period (seven days recall). Additional data on institutional factors such as access to credit and nearest to market, use of external farm inputs (improved seed and fertilizer) were gathered.

In order to capture the socio-economic context of households in the area focus group discussion and key informant interview was conducted in each *kebele* consisting 6 members. The total focus group members for the discussion were 42 (constitutes 1 households from male headed and female headed HH's, 2 elderly and 2 religious leaders) in each *kebele* considering the time and budget limitation. The focus group discussion were used to generate in-depth information regarding household access to livelihood resources and socio cultural information of the households on the area, participation in non-farm activity and identification of primary coping strategies and community perceptions of the importance of each strategy.

Key informant interview were used to obtain important information on the livelihood of the population, the non-farm activity in the area, the vulnerability of the population, food security situation and determinants of food security in the area and each *kebeles* have seven (7) total key informant interviews (1 administrator of district, in each *kebeles* with 1 DAs, 1 *kebele* administrators).

To complement the primary data, secondary data were collected from different journal, articles, non-government organization report, and agricultural development offices of the district.

3.3. Methods of Data Analysis

In order to achieve the stated objectives of the study, the survey data was edited, coded, organized and analyzed using descriptive, econometric analysis and logit model using stata 13. Logit model was used to identify the determinants of the rural household food security and also the study used the direct survey of household consumption to measure the household food security status. Narration and conceptual explanation were employee to analyze data having qualitative nature such as coping strategies employed by sample households during food shortages and other supplementary information for quantitative data which was collected using focus group discussions and key informant interviews. Descriptive summaries of coping strategies data were expressed in percentages and frequency distributions.

3.3.1. Measuring food security status of the household

Food security at household level is best measured by direct survey of the household consumption. The person responsible for preparing meals was asked how much food was prepared and consumed from purchase, stock and/or gift/loan/wage over a period of seven days. In this study, a seven day recall method was used since such a measure gives more reliable information than other method. According to Gulled (2006), the seven days recall period was selected due to the fact that it is appropriate for exact recall of the food items served for the household within that week. If the time exceeds a week, for instance 14 days, the respondent may not recall properly what she has been served before two weeks.

The food items consumed by sample households' calorie content were calculated using calorie conversion factor and the household members were also converted to their adult equivalent. Then, in order to calculate the household‘s daily food consumption, the total household‘s caloric food consumption for seven days was divided by seven day. The household‘s daily caloric food consumption per adult equivalent was calculated by dividing the household‘s daily food consumption by the family size after adjusting for adult equivalent using the consumption factor for age-sex categories. Then the result was compared with the minimum subsistence requirement per AE

per day of 2,200 Kcal which is set by the Ethiopian Government (MoFED, 2008). Accordingly, this value of minimum subsistence requirement was used as a cut-off point between food secure and insecure households in which case the household is said to be food secure if it meets this minimum and if not insecure.

3.3.2. Econometric model specification

In order to identify the determinants of the food security situation of the households a Logit model was used. In this study, the dependent variable Y (household food security) is dichotomous variable taking value 1 if the household is food secure and 0 otherwise. In the case where the dependent variable is dichotomous, probability regression models are the most fitting to study the relationship between dependent and independent variables. In the case where the response variable is qualitative, it is the probability of the dependent variable given independent variable that is determined. One the most common qualitative regression model is logit model (Gujarati, 2004).

Linear probability model like a typical linear regression model, determine the conditional expectation of the dependent variable given independent variable. Beside this, the model is encountered with many problems like non-normality and heteroscedastic variances of the disturbance Ui and the probability fails to fall in between 0 and 1 values. For this reason, linear probability model is not attractive model and it is fallen out of use in many practical applications. These problems could be easily solved by using probit and logit models. In these two models the probability will fall in between 0 and 1. In most applications these two models are quite similar. The main difference being the logistic distribution has slightly fatter tails, that is to say, the conditional probability Pi approaches zero or one at a slower rate in logit than in probit. Therefore, there is no compelling reason to choose one over the other.

In practice many researchers choose the logit model because of its comparative mathematical simplicity (Gujarati, 2004). Therefore, in this study also logit model was used. Then, following Gujarati (2004) logit model is specified as follows:

Π (×) =E(Y=1/x) =1

$$\pi(x) = E(Y = 1/x) = 1/(1 + e^{-(\beta_0 + \beta_1 X_1)}) \quad \text{---------- (1)}$$

For ease of exposition, we write (1) as:-

$$\pi(x) = \frac{1}{1+e^{-zi}} \quad \text{---------- (2)}$$

Where Π(X) = is a probability of being food secure ranges from 0 to 1

Z_i = is a function of n-explanatory variables (X) which is also expressed as:

$$Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots\ldots + \beta_n X_n$$

Where X_i, is the summations of explanatory variables this means;

$$Xi = \sum_{i=1}^{x} xi$$

B_0 = intercept β_1, β_2..... β_n = are slopes of the equation in model

The probability that a given household is food secure is expressed by (2) while, the Probability for food insecure:-

$$1 - \pi(x) = \frac{1}{1+e^{-zi}} \quad \text{---------- (3)}$$

Therefore we can write:-

$$\frac{\pi(x)}{1-\pi(x)} = \frac{1+e^{zi}}{1+e^{-zi}} = e^{zi} \quad \text{---------- (4)}$$

Now $(\pi(x)/1-\pi(x))$ is simply the odds ratio in favor of food security. It is the ratio of the probability that a household will be food secure or food insecure.

$$Li = \left(\frac{\pi(x)}{1-\pi(x)}\right) = zi \quad \text{……----------} \quad \text{(5)}$$

$Z_i = \beta_0 + \beta_1 X1 + \beta_2 X_2 + \ldots\ldots\ldots\ldots + \beta_n X_n$

If the disturbance term, (Ui) is introduced the logit model becomes

$Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots\ldots + \beta_n X_n + U_i$…… (6)

L_i = log of the odds ratio, which is not only linear in Xi but also linear in the parameters.

X_i = Vector of relevant explanatory variables.

But, before estimating the logit model, existence of multi-collinearity among the continuous variables and discrete variables were checked by using Variance Inflation Factors (VIF) and coefficients of contingency (CC) technique.

3.4. Definition of Variables and Working Hypothesis

3.4.1. Dependent variable

Food security status (**fstat**), which is dependent variable for the logit analysis, is a dichotomous variable representing 1 for food secure and 0 for food insecure. Thus, those households who consume above the minimum requirement of 2200 Kca were categorized as food secure and those households who consume below the threshold were considered as food insecure.

3.4.2. Independent variables

In this study the independent variables are the potential explanatory variables that can influence state of household food security in the study area. Based on the review of literature and the past research findings the following sets of variables were selected to identify the potential determinants of household food insecurity in the study area. Thus, taking state of household food insecurity as dependent variable, the following explanatory variables were hypothesized.

Age of the household head (Age): Age is a continuous explanatory variable measured in years. As the age of household head increases, it is assumed that farmers could acquire more knowledge and experience and also they are more risk prevents and the chances of a household to become less food insecure decreases along an increase in age (Mulugeta, 2002). endowment for both agricultural and nonagricultural operations. Thus, it is hypothesized that the effect of the variable is negative or positive association with food security.

Dependency ratio (depratio): Dependency ratio is continuous explanatory variable which is measured by the number of members in non-working age group supported by those in the working age group. It obtained by dividing inactive labor force (age less than 15 and above 60) by the active

labor force (age between 15 and 60) (Aschalew and Guled, 2006). A household with more inactive productive labor force compared to the active age shows a high dependency ratio and it is less likely to be food secure or more likely to be food insecure. Therefore, in this study it was hypothesized that dependency ratio and food security are negatively correlated.

Total Income (totinc): this is a count variable that accounts for the number of the household sources of income to the household (types of crop + sale of livestock+ sale of livestock by-products + type's non-farm+ types of off farm). The ability of a household to adapt to a given shock is high with diversified income sources (Gutu Tesso, *et al*., 2012). It is positively related.

Size of cultivated land (lhold): Cultivated land is a continuous variable representing the total cultivated land owned by the household is important resource for food production and has positive influence on the probability of rural household's food security. Farmers who cultivate larger farmland would be less food insecure than those with smaller land size. Increase in size of cultivated land has positive relationship with the amount of production to be harvested. Therefore, those farmers who cultivated more become in a better position than those who cultivated less (Tamene, 2014). Consequently, in this study it was expected that size of cultivated land will have positive association with household food security.

Livestock ownership excluding (livst): It is a continuous variable and measured in TLU. Unlike urban dwellers, the rural households accumulate their wealth in terms of livestock. They are prominent sources of wealth to farm households. Households with large livestock size are expected to be less vulnerable to food insecurity. It hypothesized that possession of large size of livestock (higher value of TLU) increases the likelihood of the household to be food secure (Guled, 2006). Therefore, in this study it is hypothesized that livestock ownership was positively associated with household food security.

Sex of the household head (sex): Household head is a person who economically supports or manages the household or for some reason of age or respect is considered as head by other members of the household. It could be male or female. Male-headed households have more access to agricultural technologies, more labor power and farmland as compared to female headed households.

Women farmers may need a long adjustment period to diversify their income sources fully and become food secure (Christina et al., 2001).

As most female headed households lack labor, they often rent out their land on a share cropping basis. Hence, male headed households are in a better position to pull labor force than the female-headed ones. Moreover, with regard to farming experience and access to technology, males are better than female farmers. So sex of household head is an important determinant of food security and it is represented in the model by dummy variable (i.e. 1 if the household head is male and 0 otherwise).

Sex of the household head looks at the role played by the individuals in providing households needs including acquisition of food. Female headed households have higher dependency ratios which hinder household capacity to allocate labor to on-farm or other income generating activities. Also female headed households tend to be older and have fewer years of education than male heads of household (FAO, 2012). Therefore, it is hypothesized male headed households are more likely to be food secure than female headed households.

Education level of the household head (educ): It refers to the educational level of the household head which is continuous variable measured in grade of formal schooling. Education is an important variable determining of household food security in such a way that educated households have a better chance of practicing soil and water conservation measures which in turn increases crop production. As the level of education increases, the percentage of food secure households increases. This is expected because with increase in the level of education, individuals will be able to adopt more modern farm technologies on their farms thus improving their productivity and again have access to better job opportunities in the labor market (Million and Belay, 2004). Therefore, in this study Education was expected to have positive influence on household food security.

Chemical fertilizer uses (usech): It is a dummy variable taking value of 1, if a farmer uses chemical fertilizers and 0 otherwise. Fertilizer use improves productivity per unit of cultivated area. Households using fertilizer are expected to have better food production capacity than the non-users (Yilma, 2005; Adugna and Wogayehu, 2012). Therefore, it is hypothesized that, the households who use chemical fertilizer were expected to be more food secure than the non-users.

Use of improved seed (useis): It is a dummy variable taking value of 1, if the farmers used improved seeds and 0 otherwise. Seed is the essential agricultural inputs, which affects production. Improved seeds; particularly moisture stress resistant varieties can withstand drought and erratic rain distribution. It increases agricultural productivity by boosting overall production, which in turn contributes to attaining food security at the household level. Use of improved seed has positive impact on the probability of being food secure among the farm households. But this is farm households who use improved seed but not adaptable in the community leve have negative effect to be food secure than those who do not use (Fikadu and Tewodros, 2014). Therefore, in this study it is hypothesized that using improved seeds have negative association with household food security.

Access to credit (cred): It is a dummy variable taking the value 1, if the household takes credit 0 otherwise. Credit serves as a means to boost production and expand income generating activities (Devereux, 2001). Thus, a household which has access to credit does initiate investment in farm and non-farm activities and achieve food security and also it's a means to boost production and expand income generating activities. Household who have access to credit does initiate investment in farm and non-farm activities and enhance sustainable food security (Aschalew, 2006). Therefore, in this study it is hypothesized that a household which has access to credit is more likely to be food secure than household which has not access to credit.

Households practiced soil and water conservation (useswct): It is represented by a dummy variable taking value 1, if the household have practiced soil and water conservation; 0, otherwise. It is hypothesized that access to irrigation has a positive relationship with the participation. (Nasir, 2017)

Marital status Household heads' (MARSTAT): Marital status is a dummy variable peculiar to the household head. It takes the value 1 if the household head is married, 0 otherwise. This is a greater opportunity of pooling together resources from different sources for household consumption. Married households usually reduce expenditure that would have been spent separately (Gutu, 2015). But, being married by itself is not an assurance to escape the risk of being food insecure. Rather it is mainly because of the fact that household size, level of income and other factors of in the household affect food security status in relation to marital status (Aschalew, 2006).

Thus, it was hypothesized that household marital status positively influences food security.

Table 3.2: Summary of variable types, definition, measurement and hypothesis

Variables	variable Typ	Measurement	hypothesis
Dependent Variable Food security status	Dummy	1 for food insecurity and 0 otherwise	
Independent Variables Age of household H	Continuous	Number of years	+/-
Family size	Continuous	AE	+/-
Dependency ratio	Continuous	Number	-
Marital status of households	Dummy	1 for married o otherwise	+/-
Off/non-farm income	Continuous	Birr per AE per year	+
Size of cultivated Land	Continuous	Hectare	+
Livestock ownership	Continuous	TLU	+
Oxen owned	Continuous	Number	+
Sex of household head	Dummy	1 for male headed and 0 otherwise	+
Education level of HH	Continuous	Number of class years	+
Use of fertilizer	Dummy	1 for fertilizer user and 0 otherwise	+
Use of improved seed	Dummy	1 for improved seed user, otherwise 0	+
Access to soil and water conservation (SWC)	Dummy	1 for use SWC and otherwise 0	+
Access to credit	Dummy	1 for credit access and otherwise 0	+

CHAPTER FOUR

4. RESULTS AND DISCUSSION

This section of the research presents background data about the study area as well as the household and demographic characteristics of the respondents. In addition to this, data collected from different sources regarding determinants of food security in rural households of the study area are discussed below using simple descriptive and econometric analysis.

4.1. Food security status

In this study, a seven day recall method of households' food consumption per AE per day is used to identify food secure and food insecure households. The calorie consumed by the household is compared with the minimum subsistence requirement per AE per day of 2,200 Kcal which is set by the Ethiopian Government (MoFED, 2008). Thus, this value of minimum subsistence requirement was used as a cut-off point between two groups. In case the household is said to be food secure if it met the minimum and if not insecure. The survey result in Table 4.1 indicates that, from all respondent 88 households met the minimum subsistence requirement per AE per day of 2,200 Kcal.

Table 4.1: Energy consumption in kcal per AE/day for the sample households

Energy Consumption per AE in (kcal)	food secured (N=88)	food insecured (N=168)	Total (N=256)
Minimum	2233.5	1051.33	1051.327
Maximum	3520.4	2086.88	3520.4
Mean	2530.74	1847.8	2209.89
S.dev (SD)	311.35	197.95	431.65

Source: survey result, 2018

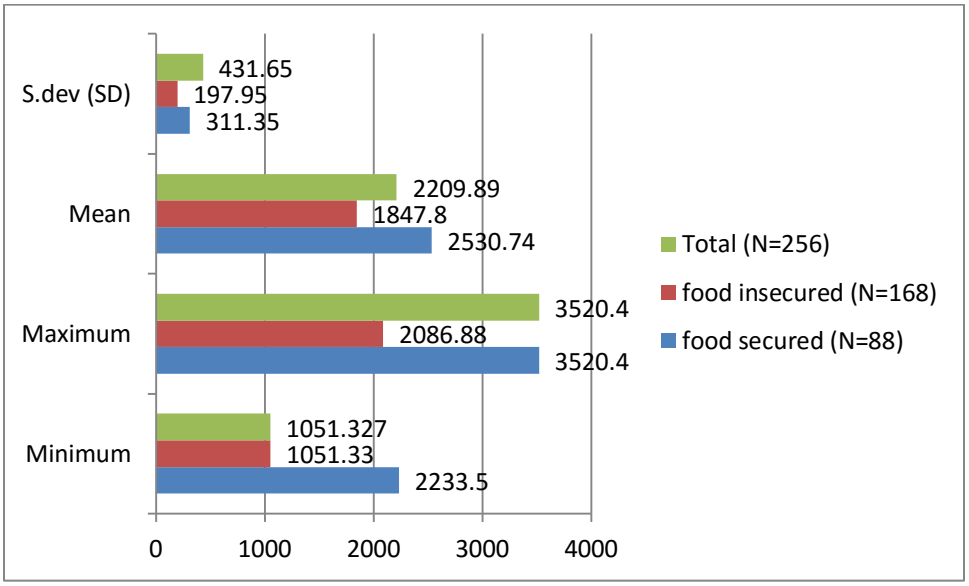

Figure 4.1 Energy consumption in kcal per AE/day for the sample households

4.2. Socio – economic Characteristics of the Households

In this study 256 households were participated to respond the questionnaires and all them properly replied for those questions. The socioeconomic characteristics of households were presented in the following table.

4.2.1. Descriptive Analysis

The different characteristics of sample households were compared to see if there are significant differences between food secure and food insecure groups. These including, age of the household head, family size, and dependency ratio, oxen holding, livestock holding, off/non-farm income, cultivated land, and educational level of the household head.

Age of the household head: The average age of the sampled household heads was 37.64 years with the minimum and maximum of 24 and 62 years respectively. The average age of food secure household heads was 36.74 years with a standard deviation of 6.77 whereas it was 38.34 years with a standard deviation of 6.63 for food insecure household heads.

Family size: - The mean family size for the sampled households was 5.54 persons with the minimum of 2 and maximum of 11. The mean family size was 4.54 persons with the standard deviation of 1.56 and 6.3 with the standard deviation of 1.94 for food secure and food insecure households

respectively.

Dependency ratio (DR): The average mean dependency ratio of the sample households was 0.53 with the standard deviation of 0.20, and with the minimum of 0.00 and maximum of 0.85 The mean dependency ratio was 0.45 with the standard deviation of 0.18 for food secure households and 0.58 with the standard deviation of 0.20 for food insecure households.

Total Income of Household (titinc): this is a count variable that accounts for the number of the household sources of income to the household (types of crop + sale of livestock+ sale of livestock by-products + type's non-farm+ types of off farm). The ability of a household to adapt to a given shock is high with diversified income sources (Gutu Tesso, *et al.*, 2012). It is positively related.

Off/non-farm income: It is very important for the wellbeing of the households in that it help the households to access food when income from agriculture is inadequate to enable households to access food throughout the year. Consequently, the sampled households who have engaged in off/non-farm activities have generated an average income of Birr 998.44 with standard deviation of 2249.13. The food secured household engaged and generated significantly higher off/non- farm income of Birr 1442.41 on average than their food insecure counterparts (Birr418.46) generate.

Cultivated land: The cultivated land per household for the sampled households varies from a minimum of 0.1 ha to a maximum of 1.5 ha. Average cultivated land of the sampled households was 0.56 ha with a standard deviation of 0.42. The average cultivated land was 0.81 ha with the standard deviation of 0.46 for food secure and 0.36 ha with the standard deviation of 0.26 for food insecure households respectively.

Education level of household head: The educational level of the household head is an important human capital, which is expected to affect food security status of households' positively. That is, the more education household head have, the more possibility of household to diversify their livelihood so that the more possibility the household to become food secure. The survey results presented in Table 4 shows that, the mean educational level of the total sampled household heads was 1.6.year. The mean educational level of the food secure household heads was 1.99 and for food insecure household heads, it was 0.51.

Table 4.2: Socio-demographic characteristics of household heads of Siliti Woreda,

Characteristics	Category	Frequency	Percent
Sex	Male	200	78.13
	Female	56	21.88
	TOTAL	**256**	**100**
Age	>15	0	0.00
	16-60	255	99.61
	≥60	1	0.39
	TOTAL	**256**	**100**
Marital status	Single	0	0.00
	Married	191	74.6
	other	59	19.92
	TOTAL	**256**	**100**
Education	Illiterate	159	62.1
	Reading and writing	97	
	Primary	92	35.94
	Secondary	5	1.95
	Above secondary	0	0.00
	TOTAL	**256**	**100**
Family size	1-3	38	14.84
	4-6	129	50.39
	7-9	80	31.25
	10-12	9	3.52
	TOTAL	**256**	**100**

Source: My own survey: 2018

As indicated in the above table 4.1, that about 99.61% of the farmers was within the age 16-60 years. This indicates that the households are expected to be very active on farm activities being more responsive to extension programs. This could also lead to a boost of agricultural activities with the fact that young people are energetic and have the capacity to use innovations. About 21.88 % of the households were females and the rest 78.12 % were males. The majority 62.1 % of the household heads did not have any formal education whereas 35.94 % of them had gone

through primary education and 1.95% secondary education. The education status of rural households enable them acquire knowledge and skill and this in turn increase their productivity (Table 4.2).

4.3. Farm related characteristics of the study area

Table 4.3: Farm related characteristics of households

Characteristics	Category	Frequency	Percent
Access to farm land	Yes	256	100
	No	0	0
	Total	256	100
Farm size (ha)	0.10-0.50	175	68.35
	0.51-1.00	45	17.58
	1.01-2.00	36	14.06
Fertilizer used	Yes	95	37.11%
	No	161	62.89%
	Total	256	100

Source: Own survey (2018)

As it can be clearly seen in the above table 4.2, the majority of the households (68.35%) owned less than 0.50 hectare of land and the remaining (31.65%) owned from 0.51 hectare to 2.00 hectare of land. Out of those households which have farm land only 39.09% of them have access to irrigation. Almost above 62.89% of households with farmland used fertilizers. Regarding on farm income, income from crop production and animal sell, the majority of households (95.45%) earned more than the mean (600 Eth. birr) annually (Table 4.2). This implies that Most of rural household's annual income relayed on farming income than off/non-farm income.

As it can be seen in table 4.3, and table 4.4, the descriptive statistics for continuous and discrete variables were presented separately for the sake of convenience. The variables are helpful to observe differences among food insecure and secure households include age of household head,

household family size and dependency ratio, landholding, off-farm/non-farm income, livestock ownership, farm income and income from livestock. The results show that there is significant mean difference between food secure and insecure households with respect to age, off farm income, landholding, asset possession, livestock possession, and farm income (table 4.3). Similarly, a chi-square test for the discrete choice variables indicate that greater proportion of food secure households 63.92 % are literate, use fertilizer and improved seed, and practice improved soil and water conservation practices (table 4.3).

Table 4.4. Descriptive Analysis for discrete variables

Description of variables	**Categories**	**Food security status**			
		Secure (%)		**Insecure (%)**	
		No	**%**	**No**	**%**
Education	Educated	52	59.09	34	26.29
	Not Educ	36	40.91	123	73.21
Use chemical fertilizer	Yes	65	73.86	72	42.86
	No	23	26.14	96	57.14
Use improved seed	Yes	78	88.64	98	58.33
	No	10	11.36	70	41.67
Access to credit	Yes	58	65.91	45	26.79
	No	30	34.09	123	73.21
Use modern tools	Yes	77	87.5	84	50
	No	11	12.5	84	50

Source: Household Survey (2018)

As it can be seen in the above table 4.3, in the study area, the overall prevalence of household food insecurity was found to be 70.83% of male headed households were food insecure while in females it was 29.17 %. Relatively the proportion of household food insecurity in the case of use of chemical fertilizer 42.86 % of households those who used were found to be food insecure. On the

other hand, out of the 256 households who did not used chemical fertilizer 57.14% were found to be food insecure.

An attempt was also made to examine the involvement of households in non-farm activities. It was found that about 256 households were engaged in non-farm activities out of which 60.54% of them were food secure. Among households that had farm land, and those who hadn‘t, 39 % of them were found to be food insecure. About 37 % of households having farm land size of max 1.50 ha were food insecure while in those that had max 1.5 and min 0.10 ha household were found to be food secured. The results implied that households who were improved their land (soil) fertility assured their household food security.

4.3. Households’ Coping Mechanisms against Food insecurity

Households develop diversified coping strategies and sequential responses, which used during times of decline in food availability. Households in the study area use alternative coping mechanisms such as: sale of more livestock than usual, borrowing of food, reduce number of meal, reduce size of meal, sale firewood and charcoal, seasonal migration, work as daily laborer, rely on less preferred and less expensive food, seeking relief assistance and becoming temporary trader.

Households in the study area practiced various coping strategies in a different manner during food insecurity problem. Households coping strategies are more diversified as to minimize possible shocks from food shortage. The way a household cope up with the food insecurity depends on the options available in terms of capabilities, assets and activities.

Table 4.5: Food insecurity coping mechanisms (%)

Household coping mechanisms	Food secure (%)	Food insecure (%)	Total (%)
Borrowing of food or cash	50.77	88.24	72.00
Sale of more livestock than usual	44.62	72.94	60.67
Reduce number of meals time	26.15	62.35	46.67
Reduce size of meal	36.92	48.24	43.33
Rely on less preferred food	49.23	57.65	54.00
Becoming temporary trader	43.08	12.94	26.00
Work as daily laborer	9.23	27.06	19.33
Sale fire wood and charcoal	12.31	43.53	30.00
Seeking relief assistance	7.69	29.41	20.00
Short term/seasonal migration	4.62	11.76	8.67

Source: Field survey (2018)

According to the response of households both groups practiced different surviving strategies at household level. The first most important coping mechanism used by the large number of surveyed households is borrowing of food or cash, which was about 50.77% and 88.24% of food secure and food insecure households respectively, which has significant difference between food secure and food insecure households. The second, third and fourth most important coping strategies used by large number of rural households were sale of more livestock than usual, relying on less preferred food, reduce number of meals per day, which was about 44.62, 49.23 and 26.15 percent of food secure respectively and 72.94, 57.65 and 62.35 percent's of food insecure households respectively.

The result of the study also indicate that working as daily laborer was other option that household used as coping strategies during food insecurity. Working as a daily laborer is widely adopted in the study district, particularly resource poor households are engaged in daily labor for their livelihood. Working as daily laborer includes agricultural laborer during the agriculture season and nonagricultural laborer such as house construction and work in government constructing infrastructures were the common activities that households undertaken specially by moving to

neighboring district.

Selling of firewood and charcoal are also common practices in the study area. The community has access to use forest resources, which accelerate deforestation and main cause of drought. Household collect firewood and prepare charcoal for selling purpose in order to satisfy food demand of his/her family. Therefore, these coping strategies have negative effects on the natural resources, which have indirectly impact on food security status of household in the study area. As the food shortage prolonged, it becomes sever and after households exhausted most of other coping strategies, the households practiced seasonal migration. Temporary migration to nearest town, district and rarely to nearby zone to search food for family Consumption are other coping strategies practiced by households in the study area. This finding is in line with the finding of Mary *et al*.(2015).

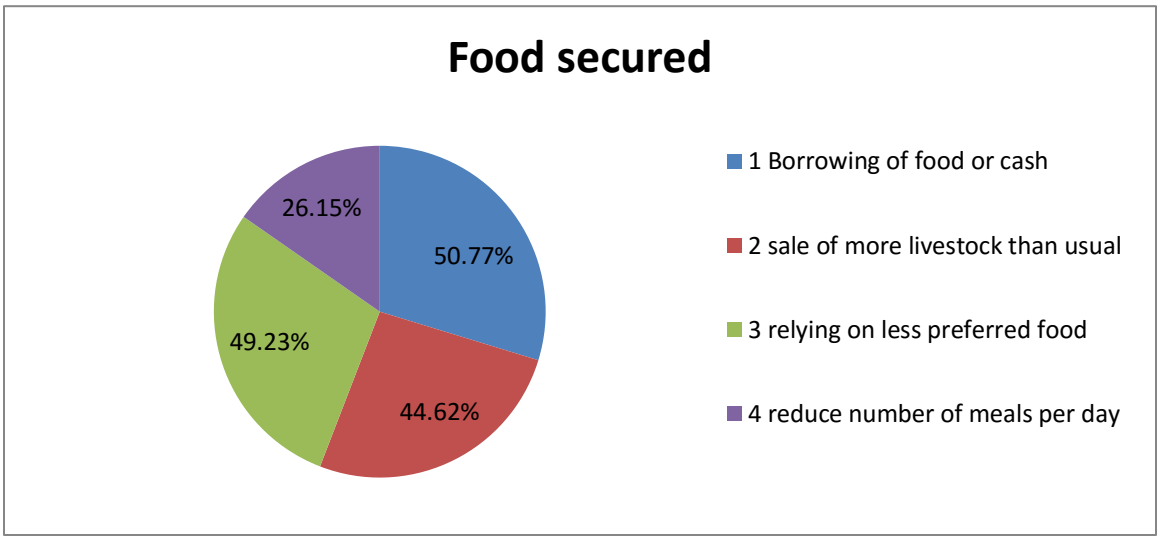

Figure 4.2 copping strategy from food insecurity status from food secured group

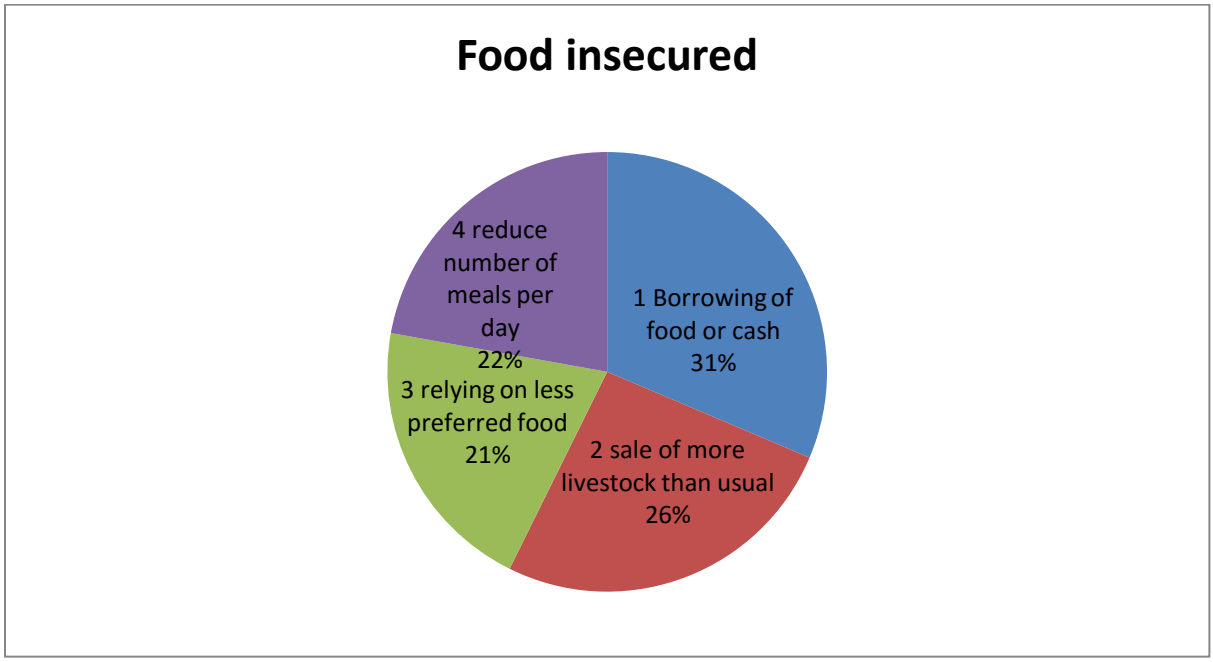

Figure 4.3 copping strategy from food insecurity status from food in secured group

4.5. Econometric Analysis

Logistic regression model was used to identify determinants of food security. Accordingly, variables assumed to have influence on household food security in different contexts were tested in the model and out of 13 variables 9 of them were found to be significant. Among variables fitted into the model sex of household head, family size, education status of household head, and use of chemical fertilizer, access to credit, major crops production and Total income. Age of household head, use of improved seed, use of modern tools, and access soil and water conservation of household were variables not fitted into the model.

Before interpreted the result, whether multicollinearity and Heterosecedasticity exists among the variables were checked. So as the correlation matrix result indicates did not exist in the two regression models. In addition to this to reduce problem of Hetroscedasticity made it robust the result model.

Table 4.5: The logistic regression results for the determinants of food security

fsstat	Robust Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]	Marginal Effect	Level of significances
sex	1.179205	.6766604	1.74	0.081	-.1470252	2.505435	.1109153	Significant 10%
age	.0155572	.0370854	0.42	0.675	-.0571289	.0882433	.0018378	
fasiz	-.5359158	.1776356	-3.02	0.003	-.8840752	-.1877563	-.0633086	Significant 1%
educs	.3687549	.1307589	2.82	0.005	.1124722	.6250375	.0435616	Significant 1%
usech	1.930191	.7622261	2.53	0.011	.4362554	3.424127	.2043557	Significant 1%
useis	-1.106273	1.008424	-1.10	0.273	-3.082749	.8702018	-.1494474	
cred	1.322428	.5734015	2.31	0.021	.1985819	2.446274	.1644667	Significant 5%
usemt	-.9959419	.6205341	-1.60	0.108	-2.212166	.2202827	-.1300247	
mcrop	.9347567	.4147327	2.25	0.024	.1218955	1.747618	.1104244	Significant 5%
socap	1.782297	.498806	3.57	0.000	.8046557	2.759939	.2401439	Significant 1%
totinc	.0001056	.0000494	2.14	0.032	8.85e-06	.0002024	.0000125	Significant 5%
depratio	-5.408996	1.355394	-3.99	0.000	-8.06552	-2.752472	-.638974	Significant 1%
SWCT	.6567532	.4839009	1.36	0.175	-.2916752	1.605182	.0762717	

Source Household survey (2018)

1. **Sex of Households head (Sex)**; as expected, it was found to have positive and significant effect on households' food security at 10% significance level. From the model result, the marginal effect showed that being male-headed household increases the probability of households' food security by 11.09%. This implies that male headed households are more likely to be food secure than female headed households. This is due to the fact that, mostly male headed households have better access to different types of resources, which ultimately enables them to produce, purchase and consume diverse and nutritious products. This finding supports the finding of Ahmed Mohammed (2015).

2. **Family size (fasiz):** Family size as we expected the coefficient for the family size of the respondents would have a negative sign and highly significant at less than 1% level of significance. The result Marginal effect revealed that remaining other thing constant if the number of family size increases says by 1 person, the probability of households' food security decreases by 6.3%. Hence, family size is one of the determinants of households' food security in the study area. The possible reason for such result might be an increase in family size implies more mouth to be fed from the limited resources. This result was in conformity with the (Fekadu and Mequanent, 2010). That is large family size has negative relationship with food security.

3. **Dependency ratio (depratio):** The dependency is burden to every household. As expected, it was found that dependence ratio and food security have negative relationship and significant at 1% probability level. The negative sign shows that the probability of becoming food secure is less for households where productive members are less than unproductive members. Other variables remaining constant, as the dependent age group (<15 and >65) increases by one person, the marginal effect that the household became food secure decreases by 6.4 percent. This result is in line with the result of study by Hussaini *et al.* (2016). This was a continuous variable expected to reduce the food security status of households. Moreover, the income acquired by the working members of the household may be small areas (Aschalew, 2006; Titus and Adetokunbo, 2007; Ayalneh, 2009). In this study, it was hypothesized that high dependency ratio accelerates household food security.

4. **Household head's Educational status (educ)**: It was found to have 1% level of significance influence and positive relationship with household food security status. Other variables remaining constant one more year of education increases the probability of marginal effect of food security increased by 4.4%. That is, the more the educational level of the household head, the more possibility that the household to become food secure. This finding is in line with the findings of Ehebhamen *et al.* (2017). The possible explanation for this might be literate households might have chance to apply their knowledge towards achievement of household food security. Similarly, Garrett and Ruel (1999) found positive and significant association between educational level of a household head and with food security. Whereas, others found out that it is mother's attendance of primary education that positively

contributes to food security (Bigsten et al., 2002). In the sample, a greater proportion of female headed households are food secure. It was assumed that a literate household head is often tends to adopt new skills, ideas and which in turn have negative effects on food insecurity. Because of this educated households are somehow in a better position (wealth) status than that of the illiterate households (Abiyot, 2011).

5. **Households used Chemical fertilizer (usech):-** Before the introduction of chemical fertilizer in the study area, farmers had been using rotation of cereals with legumes, green manure and fallowing to maintain and improve soil fertility. As land becomes scarcer, these traditional methods of maintain soil fertility are gradually diminishing. As marginal effect showed as using chemical fertilizer increase the probability of food security status increased by 20.44 % other variables keeping constant. Therefore, the hypothesis that food security and fertilizer use is positively associated is maintained at 1% level of significance. This result is in line with the result of study Nasir Ahmed, (2017).

6. **Access to credit for households (cred):** This variable was found statistically 1% level of significance and positive relationship to food security status. The positive sign showed that, the households with more access to credit have the possibility to increase the probability of being food secure. The result of this study reveals that, all other factors remaining constant, the marginal effect showed that, when the household with more access to credit increases, the probability of household food security status increases by 16.44 percent. The possible explanation behind this was credit access on households who access benefiting them the household being food security by getting purchasing or used input it promoted household food security status. However, the result agreed with its prior hypothesized and the work of (Tasfaye, 2005).
7. **Social Capital (Scap)**: This variable was found statistically 1 % level of significant and positive relationship to food security status. The positive sign showed that, the households with active participation and have strong bondage has the possibility to increase the probability of being food secure. The result showed in table 24.01 showed that social capital participation edir, equb, and relative kinship reveal that, all other variables remaining constant, when the

household with active participation with social capital increases, the probability of household to food security increases in marginal effect by 24.01 percent. The result implied that if active involvement in different groups have supported by them increasing the probability food security status. The result agreed with its prior hypothesized and the work of Dulla (2007).

8. **Households produce the major crops (Mcrops)**: It was found to have 5% level of significance influence and positive relationship with household food security. The marginal effect showed keeping other variable constant major crops production increase, the probability of food security by 11.04 percent probability level. This implies that the probability of being food secure households increases with production of major crop. Based on the above results, one may say that major crop production is important in ensuring food security of the farm households. This finding is in line with the findings of Fekede *et al.* (2016).

9. **Total Income (totinc) :** Total income variable has a positive sign as expected and it is highly significant at less than 1 percent level significance. The odd ratio show that remaining other thing constant if average monthly income of the household increases says by 1birr, the probability of households' food security by 0.00125 percent. The results indicate that households with high income tend to reveal a high food security. This result was in conformity with the (Fekadu and Mequanent, 2010). Studies revealed that the higher the income the higher the likelihood of the household becomes food secure (Titus and Adetokunbo, 2007; WFP, 2009a; Bashir *et al.*, 2013, Egigayehu and Edriss, 2012). It was hypothesized that income of the household head positively relates with food security.

CHAPTER FIVE

5. Summary, CONCLUSION AND RECOMMENDATION

5.1. Summary

This study was conducted in Siliti district of Silite zone of SNNPR with the specific objectives of to measure the food security status of the households, identifying the determinants of food security status of households, identifying food insecurity coping strategies used by households in the study area. To achieve these objectives, the study relied more on primary data, which were collected from 256 randomly selected households from seven randomly selected kebeles of the district.

The data were collected on household demographic and economic factors hypothesized to affect food security status of the households.

Data were analyzed using descriptive analysis and econometric model. The descriptive analysis was used to study the demographic and economic factors in relation to food security status of the households.

The sampled households were classified into food secure and food insecure groups based on kilocalories (kcal) consumed by the households during the previous seven days of survey data. Total amount of food commodity consumed by each household during the seven days was converted into equivalent daily (kcal) per adult equivalent (AE) and then compared with daily kcal recommended. Accordingly, 65.63 % of sample households were living on total daily food energy level per adult equivalent of less than the minimum recommended requirement. While remaining 34.38% of sampled households were living on total daily food energy level per adult equivalent of greater than the minimum recommended requirement.

Logistic model was used to analyze the determinants of households' food security status. The model result revealed that 08 out of the hypothesized variables had significant effect on household food security status. Family size, dependency ratio and use of improved seed were found to be Negative and significantly determined household's food security status.

The coping mechanisms practiced by most of the sample households in the study area were

borrowing cash or food from relatives or neighbors, sale of more livestock than usual, relying on less preferred and less expensive food, reduce the number of meal per a day, reduce the size of the meal and sale of firewood and charcoal.

5.2. Conclusions

Study area is considered as food insecure district by the government; in line with this, the result of the study shows that 56.64% of the surveyed households were unable to get the minimum daily energy requirement.

Used improved seed activities are found to be negatively and significantly influence food security status of the households. Because of it is crucial for expansion of the sources of farm house- holds' livelihoods. In this, case modern of production by providing the households with an opportunity to use the required inputs. The government especially agricultural and Natural resource should provide environmental adapted and resistant improved seed should provide to farming rural households to become food secured. It also minimizes the danger of food shortage during the time of unanticipated crops failure through food purchases. As a result, a great chance of famishment for themselves and their families during periods of chronic or transitory food insecurity has avoided and reduced largely.

Education level of household head showed positive and significant effect on food security status of the households. The education of household head could lead to awareness of the possible benefits of making agriculture a modern enterprise through advanced technological inputs, enhancing farmers to follow instructions on fertilizer packs and shall be used to diversification of household incomes that, in turn, would enable household food supply appropriately.

Social capital was found statistically significant and positive relationship to food security status. The positive sign showed that, the households with active participation and have strong bondage had the possibility to increase the probability of being food secure.

Major crop production found to have a significant influence and positive relationship with household food security. Therefore, those households who produce major crops like maize, wheat, teff and barley being in a better position than those who did not produce those major crops. Because, those mentioned major crop production is important to ensuring food security of the farm households.

Study area, households employed different consumption coping strategies to mitigate the incidence of food insecurity. Most of the coping strategies employed by household were effective in mitigating the food insecurity situation. The coping strategies employed were mostly not detrimental to livelihoods and future food security. The coping strategies employed by households were reversible. Thus, they were not detrimental to livelihoods and future food security of the households. However, some of the copping strategies were not reversible, meaning that they were detrimental to the livelihoods and food security situation of the households.

From the model results, we learn that technical interventions enhancing soil and water conservation practices of farmers reinforce the desirable effects of these practices on food security. As conservation structures are labor demanding while their effects are realized in the longer term, their contribution to food security might not be as immediate as the use of fertilizer or increased access to off/non-farm incomes. Although it is generally argued that property rights insecurity could hinder investment in abatement of soil degradation, expectation of higher returns in the future produces an incentive to invest in land management (Shiferaw, 2007).

5.3. Recommendations

In order to improve households' food insecurity situation in the study area, the following may be the major recommendable areas of intervention.

- Promotion total income in diversified source activity will be an issue in order to address issues of food security in study area. In this regard, promoting total income in diversified source activities can help rural households in solving capital problem, farm inputs, use for trade, etc. Hence, this calls for enhancing and expanding the total income in diversified source activities for the farm households in the study areas, and this should be one of the

areas of intervention and policy option.

- Expansion and strengthening the off-farm and non-farm activities by providing training and credit services can supplement their income and gradually relieve the diminishing landholding size.
- Food security interventions should integrate family planning, education and awareness raising programs in order to reduce the increasing population pressure on the available scarce resource.
- Improving the quality of the land through improved soil and nutrient management, promotion of labor-intensive technologies, and creation of labor intensive rural employment opportunities in the short-to-intermediate terms.
- The production and productivity of the livestock should be improved through the provision of adequate veterinary services, improved water supply point, introduction of artificial insemination services, launching sustainable and effective forage development program, effective marketing for the sale of the live animals and their product.
- The productivity of major cereal crops should be increased through the use of increased farm inputs such as fertilizers, improved seeds, pesticides, credit service, and access to irrigation facilities and post-harvest management.

- Regional government and concerned NGO need to work on the improvement of educational status of households especially the formal and adult literacy education program. Therefore, this leads to awareness of the possible benefits of making agriculture a modern enterprise through advanced technological inputs.

- Government as well as the international and local organizations have to major crops production and productivity in the nearby and this create a lot of opportunity for food insecure households and increases the households food security status.

- In view of the negative impact of large family size on the food security situation, farm households should be educated on the need to adopt the family planning program so that they may bear the number of children that resources can accommodate. There are no such enough jobs proportional to the members of the households; extra job creation should be the

first task to tackle this problem. Therefore, organizations working on the employment and youth need to create strategic approach for the utilizations of such available work force.

- ❖ Households should be supported to increases their credit access by enhancing income to overcome the households capital problem, there have to oxen restocking program for households who lost their oxen from drought or any other shock.

From the model results, we learn that technical interventions enhancing soil and water conservation practices of farmers reinforce the desirable effects of these practices on food security. As conservation structures are labor demanding while their effects are realized in the longer term, their contribution to food security might not be as immediate as the use of fertilizer or increased access credit total incomes from farming activity, non-farming income, from livestock product and selling livestock's. Although it is generally argued that property rights insecurity could hinder investment in abatement of soil degradation, expectation of higher returns in the future produces an incentive to invest in land management (Shiferaw, 2007).

The government especially agricultural and Natural resource should provide environmental adapted and resistant improved seed should provide to farming rural households to become food secured.

Finally, it is recommended to conduct a study that compares status of food security in rural households with urban households and its associated factors in the study area by looking Butajira, kibet and Worabe Town Administration.

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ANNEXES 1

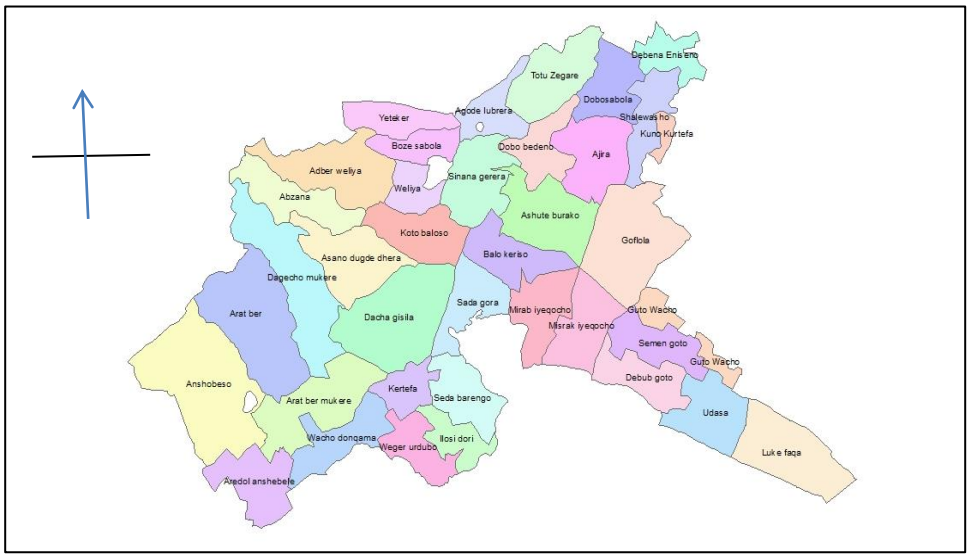

Figure 3.1 map of the study area

Annex 1: Formal survey questionnaire on food security

The main objective of this study is to identify the major factors influencing food security in the rural households of Siliti Woreda, Silite Zone, SNNPR, and Ethiopia.

Date at which questionnaire filled_____

Name of enumerator_____

Signature of the enumerator_____

Farmer's identification

A1: Study Area: Siliti Woreda

A2:Farmer's name:_____

A3: Peasant Association(PA):_____

A4:Farmer'snumber:_____

A5:Village:_____

Section 1. Household demographic characteristics

1.1. Name of household head_____

1.2. Sex of household head: 1=Male, 0=Female

1.3. Maritalstatus:1=Single, 2=Married, 3=Divorced, 4=Widowed

1.4. Religion: 1=Orthodox, 2=Muslim, 3=Protestant, 4=Other(Specify)_____

1.5. Age of household head (in years)_____

1.6. Years of farm experience(years):_____

1.7. Household size

Description	**Male**	**Female**
1.Members between 15 and 60 years old		
2.Members less 15 years old		
3.Members more than 60 years old		
4.Dependents in the household		
5.Full-time farm workers in the household		
6.Part-time worker in the household		

1.8. Education level of household head (mark the correctone)

Illiterate		Secondary (7-12)	
Read and write		Higher education (above 12)	
Elementary (1-6)		Others (Specify)	

1.9. Size of living house (in square meter): ----------

Section2. Cultivated land owned by household and other related issues

2.1. Farm size (hectar):_____

2.2. Major crops the household is growing during 2018 cropping year

Crops	**Area (kert[1])**	**Yield (quintal/kert)**	**Total production (quintal)**
1. Teff			
2. Wheat			
3. maize			
4. sorghum			
5. Enset			
3. Chickpea(Shibra)			
4. Lentils(Misir)			
5.Grass pea (Guya)			
6. Fenugreek(Abish)			
7. Linseed (Teleba)			
8.Oats (Aja)			
9. Other (specify)			

[1]*Kert = 0.25 ha*

2.3. Do you use modern tools to improve farm practices? 1. Yes 2. No

2.4. If NO, what are the constraints? _____

2.5. Do you have your own land for cropping andpasture?1=Yes,2=No

2.6. If YES, how much is the total farm land size in kert:----------

2.7. Slope of your land: 1=Plain 2=Hilly 3=Steep

2.8. How do you perceive the quality or fertility of your land?

1=Fertile, 2=MediumFertile,3=Less Fertile, 4=Overused,5=Poor

2.9. Have you used any of the following agricultural technologies during November 2018 production season?

Type of agricultural farm inputs	Answer	
	Yes	No
Chemical fertilizer		
Pesticides		
Improved seeds		
Farm credit		
Access to irrigation water		
Others (specify)		

2.10. How was the availability of rain on your fields during 2018 cropping year? 1=Enough, 2=Too Much, 3=Too Little, 4=Other_____

Section3. Livestock Number and related issues

3.1. Do you have/own livestock? 1=Yes 2=No

3.2. If yes to 3.1, how many of the following livestock do you have?

Type of livestock Currently owned on farm	Number
Oxen	
Bulls	
Cows	
Heifer	
Calves	
Sheep	

Goats	
Donkeys	
Horses	
Mules	
Chickens	
Camel	
Others	

Section4. Estimated income of the farm household

4.1. What employment and income earning opportunities are available in your area? (You may choose more than one)1=only own farming (self-employment)
2=own non-farm employment (trading crafts)
3=farm laborer (work on other farms)
4=migration to work in other areas

5=non-farm laborer (work in cities)

6=other (specify)_____

4.2. What is the estimated farm income of your household**?**

Description	**Income per month (Birr)**	**Income per year (Birr)**
Income from sale of own produced crops		
Income from livestock and their products		
Income from small-scale irrigation farming		
Income from non-farm activities		
Income from sale of food aid received from FFW activities		
Income from sale of firewood, charcoal, cow dung cake		
Income from off-farm jobs (daily labor, farm labor)		
Income women household activities (tella, areke, tej, kolo, bread selling)		
Remittance from relatives		
Total income		

4.3.During November 2017to November 2018, did you participate in any off farm income generating activities?1=Yes, 2=No

4.4.If NO, why don't you participate in any off farm activities? _____

*4.5.*Do you have access to credit facilities? 1=Yes, 2=No
4.6.If your answer is YES, state the type of credit facility.

1. Commercial bank/financial institutions4. NGOs Name (s)----------
2. Co-operative society 5. Others(specify)
3. Friends/relatives 6. Not applicable

4.7.If your answer is NO, pleases give reasons for the prevailing situation.

1. Lack of credit facilities
2. Do not require them
3. Have never heard of credit facilities
4. Others(specify)

4.8 Are you member or Participated in kinship, Equb, Edir and other form of associations? 1=yes 2=No

4.9. If yes what types of support provided from the member?(Multiple response)

1. Creating job opportunity ☐
2. Social services ☐
3. Credit access ☐
4. Food aid ☐

Section5. Household food consumption and related issues

5.1. What were the different sources of food for your family during last seven days?

Food items	Total amount using the local unit of measurement

	Own production	Received from food for work	Purchased from market	Received from Hiring out of labour	Received From food aid or relief
Maize					
Enset					
Wheat					
Barely					
Teff					
Sorghum					
Others					

5.2. Household food consumption during last seven days.

Food items	Total amount of food consumed (using the local unit of measurement)					
	Used for seed	Given out for Hiring in labor	Given out for sharing in oxen	Repayment Of crop loan	Marketed	Shared with Relative
Maize						
Wheat						
Barely						
Teff						
Sorghum						
Others						

5.3. During 2018, on average how much did you spend per month for the purchase of food and

non-food items?

S.N.	Expenditure Item	Estimated expenditure per month (Birr)	Estimated total expenditure per year (Birr)
1	Food & stimulant items Purchase of cereals, pulses, oil, fruits, vegetables, coffee, tea, chat, sugar, salt		
2	Non-food items Purchase of farm inputs(fertilizer, seed, pesticide, veterinary drugs)		
3	Clothing, foot wear, gas, candle, firewood, charcoal, medical expenditure, education and schoolfees for children		

5.4. What is your attitude towards food aid?1=Food aid is good, 2=Food is not good

5.5. How do you cope with the food shortage?(Rank)

Seasonal Migration		loans and gifts	
Remittances from family members and relatives who live in elsewhere		Reduce amount of frequency of food intake and meal size per day	
Selling of livestock		farm land rental	
Selling of firewood and charcoal		Off farm employment	
Cash for work and relief assistance		sale of key productive assets	
purchasing of grains		Others (specify)	
borrowing cash/ grains from others			

Section 6. Other related issues

6.1. Is there any farmers' cooperative in your area? 1=Yes, 2=No

6.2. Are you a member of farmers 'cooperative? 1=Yes, 2=No

6.3. If yes to 6.2, are you benefiting from the services of farmers' cooperative? 1=Yes, 2=No

6.4. What support you need to obtain from government, non-government and private enterprises to

be food secured?

1. ----------

2. ----------

3. ----------

Thank you for your cooperation!

Mifta Abdella

Annex 3

fsstat	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
sex	1.219475	.6440413	1.89	0.058	-.0428224	2.481773
age	.0157013	.0378224	0.42	0.678	-.0584293	.0898319
fasiz	-.540373	.1802408	-3.00	0.003	-.8936385	-.1871076
marst	-.3349037	.5865675	-0.57	0.568	-1.484555	.8147474
educs	.356328	.1377997	2.59	0.010	.0862455	.6264105
usech	1.93759	.7542693	2.57	0.010	.4592494	3.415931
useis	-1.091891	1.025946	-1.06	0.287	-3.102707	.918926
cred	1.287911	.5820366	2.21	0.027	.1471402	2.428682
usemt	-.9557872	.6406968	-1.49	0.136	-2.21153	.2999555
mcrop	.936793	.4141607	2.26	0.024	.1250529	1.748533
socap	1.810796	.5061671	3.58	0.000	.818727	2.802866
totinc	.0001026	.0000506	2.03	0.043	3.36e-06	.0002018
depratio	-5.537844	1.324797	-4.18	0.000	-8.134399	-2.941289
SWCT	.6610011	.4850947	1.36	0.173	-.2897671	1.611769
_cons	-2.57294	2.364978	-1.09	0.277	-7.208212	2.062331

```
. corr sex age fasiz marst educs usech useis cred usemt mcrop socap totinc depratio SWCT
(obs=256)
```

	sex	age	fasiz	marst	educs	usech	useis	cred	usemt	mcrop	socap	totinc	depratio	SWCT
sex	1.0000													
age	-0.1734	1.0000												
fasiz	-0.1530	0.1274	1.0000											
marst	-0.0390	0.0326	0.0377	1.0000										
educs	0.1495	-0.0799	-0.1992	-0.2310	1.0000									
usech	0.0649	0.0105	0.0364	-0.0124	0.0579	1.0000								
useis	0.0393	0.0111	-0.0102	-0.0809	0.1606	0.1246	1.0000							
cred	0.0953	0.0363	-0.1373	-0.1496	0.2511	0.1451	0.0073	1.0000						
usemt	0.1216	-0.0979	-0.1887	0.0042	0.2839	-0.0123	0.1658	0.3106	1.0000					
mcrop	0.1105	-0.1326	-0.2745	-0.1176	0.3206	0.0355	0.2713	0.2324	0.3876	1.0000				
socap	0.1379	-0.1354	-0.3116	-0.1229	0.2615	0.0976	0.0841	0.2024	0.2353	0.3953	1.0000			
totinc	0.1893	-0.1674	-0.4082	-0.1587	0.3854	0.0635	0.2415	0.3217	0.3907	0.5704	0.5236	1.0000		
depratio	-0.0782	-0.0007	0.3745	-0.0105	-0.0927	0.0425	0.0172	-0.0284	-0.2779	-0.2173	-0.1798	-0.1699	1.0000	
SWCT	0.0308	-0.1211	-0.1108	0.0162	0.0500	-0.0138	0.0758	0.1246	0.1779	0.1090	0.2554	0.1867	-0.0582	1.0000

```
. mfx

Marginal effects after logit
      y  = Pr(fsstat) (predict)
         =  .13189392
```

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
sex*	.1101867	.04695	2.35	0.019	.018159	.202215	.78125
age	.0017978	.00425	0.42	0.672	-.006531	.010126	37.6445
fasiz	-.0618716	.02024	-3.06	0.002	-.101537	-.022206	5.53516
marst	-.0383458	.06768	-0.57	0.571	-.170997	.094305	.75
educs	.0407988	.01802	2.26	0.024	.005476	.076122	1.23828
usech*	.1989855	.08175	2.43	0.015	.038749	.359222	.613281
useis*	-.1431466	.15092	-0.95	0.343	-.438948	.152654	.660156
cred*	.1552922	.08105	1.92	0.055	-.003554	.314138	.464844
usemt*	-.1207011	.09395	-1.28	0.199	-.304841	.063439	.628906
mcrop	.1072608	.04576	2.34	0.019	.017571	.196951	2.04688
socap*	.2380872	.07051	3.38	0.001	.09989	.376285	.414063
totinc	.0000117	.00001	1.87	0.061	-5.6e-07	.000024	13313.9
depratio	-.6340716	.17908	-3.54	0.000	-.985056	-.283087	.526163
SWCT*	.0744045	.05514	1.35	0.177	-.033672	.182481	.546875

(*) dy/dx is for discrete change of dummy variable from 0 to 1

```
. save "C:\Users\BMZ\Desktop\lastresult data.dta"
file C:\Users\BMZ\Desktop\lastresult data.dta saved

. sum fsstat sex age fasiz marst educs depratio usech useis cred usemt socap mcrop totinc
```

Variable	Obs	Mean	Std. Dev.	Min	Max
fsstat	256	.4335938	.4965413	0	1
sex	256	.78125	.4142084	0	1
age	256	37.64453	6.766889	24	62
fasiz	256	5.535156	1.981961	2	11
marst	256	1.691406	1.237678	1	4
educs	256	1.152344	2.200765	0	10
depratio	256	.5261634	.2030324	0	.8571429
usech	256	.6289063	.4840438	0	1
useis	256	.6875	.4644204	0	1
cred	256	.4023438	.4913311	0	1
usemt	256	.6289063	.4840438	0	1
socap	256	.390625	.4888462	0	1
mcrop	256	2.046875	.8247103	1	4
totinc	256	13313.91	13675.86	1000	45200

APPENDICES

Tables in Appendix

Appendix Table1: Conversion factor used to compute adult equivalent (AE) Age group (years)

Age group (years)	Male	Female
<10 years	0.6	0.6
10-13	0.9	0.8
14-16	1.0	0.75
17-50	1.0	0.75
>50	1.0	0.75

Source: Storck, et al. (1991)

Appendix Table2: Conversion factor used to compute tropical livestock unit (TLU)

Animal category	TLU	Animal category	TLU
Calf	0.50	Donkey (young)	0.35
Weaned calf	0.34	Sheep and goat (adult)	0.13
Heifer	0.75	Sheep and goat(young)	0.06
Cow /Ox	1.00	Chicken	0.013
Donkey Adult	0.70		

Source: Storck, et al. (1991)

Appendix Table3: Conversion factor used to estimate Kcal of food items

Food item	***Unit***	***Kcal***	***Food item***	***Unit***	***Kcal***
Barley	Kg	3723	Milk	Lt	737
Maize	Kg	3751	Sugar	Kg	3850
Sorghum	Kg	3850	Edible oil	Lt	8964
Wheat	Kg	3623	Coffee	Kg	1103
Lentils	Kg	3522	Peas	Kg	3553
Onion	Kg	713	Tomato	Kg	216

Pepper	Kg	933	Salt	Kg	1700
Butter	Kg	7364	Rice	Kg	3330
Spaghetti/Macaroni	Kg	3550	Meat	Kg	1148

Source: EHNRI, 1997