RURAL HOUSEHOLD FOOD INSECURITY STATUS AND COPING STRATEGIES IN DAMOT WOYDE WOREDA OF WOLAITA ZONE, SOUTHERN ETHIOPIA

M.Sc. THESIS

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As thesis research advisor, I hereby certify that I have read and evaluated this thesis prepared under my guidance, by Zeleke Zefine Omba entitled: "**RURAL HOUSEHOLD FOOD INSECURITY STATUS AND COPING STRATEGIES IN DAMOT WOYDE WOREDA OF WOLAITA ZONE, SOUTHERN ETHIOPIA.**" I recommend that it be submitted as fulfilling the thesis requirement.

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DEDICATION

I dedicate this thesis manuscript to *my beloved wife Tamirawit Goa, my son Minyahil Zeleke* and all *families* for their sacrifice in the success of my life.

STATEMENT OF THE AUTHOR

This thesis is my original work and that all sources of materials used for this thesis have been duly acknowledged. A thesis submitted to the school of graduate studies, college of agriculture and natural resource; department of agricultural economics, Dilla university, in partial fulfillment for the requirement of the degree of master of science in agricultural economics. I seriously declare that this thesis has not been presented for a degree, diploma or certificate in any other university.

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BIOGRAPHICAL SKETCH

The author, Zeleke Zefine Omba was born in Damot Woyde Woreda of Wolaita Zone Southern Region, in the special place Bedessa town on July, 1978 E.c. He attended his primary (1-8), secondary (9-10) and preparatory education (11-12) in Bedessa Primary School, Bedessa Secondary School and Boditti Secondary and Preparatory School, respectively. In 1997E.c. he joined Haramaya University, college of agriculture and graduated on June, 2000 with B.Sc. degree in crop production and protection. Soon after his graduation, he was employed as a food security and early warning expert in the Wolaita zone Damot Woyde Woreda agricultural and rural development department. Then, in November 2016, he joined Dilla University to pursue his M.Sc. degree in the Department of Agricultural Economics.

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ABBREVIATIONS AND ACRONYMS

AF	Adult Equivalent
CSA	Central Statistical Authority
DPPA	Disaster Prevention and Preparedness Agency
FAO	Food and Agricultural Organization
FDRE	Federal Democratic Republic of Ethiopia
FGD	Focus Group Discussion
HHBP	Household Building Program
HHH	Household Head
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
KAs	Kebele Administrations
Kcal	Kilocalorie
KIs	Key Informants
MoFED	Ministry of Finance and Economic Development
PSNP	Productive Safety Net Program
SNNPR	Southern Nations, Nationalities and Peoples Region
SPSS	Statistical Package for Social Science
SSA	Sub-Saharan Africa
UN	United Nation
UNDP	United Nations Development Program
UNICEF	United Nations International Children Emergency Fund
USAID	United States Agency for International Development
VIF	Variance of Inflation Factor
WANRD	Woreda Agricultural and Natural Rural Development
WB	World Bank
WFED	Woreda Finance and Economic Development
WFP	World Food Program
WZANRD	Wolaita Zone Agricultural and Natural Resource Development

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ABSTRACT

Food insecurity exists when people lack access to sufficient amount of safe food and key policy challenges. Due to these reason understanding the determinants with surviving strategy is important for interferences aiming at regulating it. Hence, this study conducted to state the determinants of rural household food insecurity and ascertain households coping strategies. For this primary and secondary sources were collected in the study area. The study drew 121 rural households through three stage sampling technique from four kebeles of the woreda based on agro-ecology; data gathered randomly using probability proportional to size. The survey data were analyzed by using descriptive and econometric methods. Binary Logit regression model were used to achieve the existing food insecurity status and determinants of it. The results from descriptive statistics show that of the total surveyed households, 59.5% and 40.5% were food insecure and secure respectively. The majority of the respondents viz. more than 58% and about 62% have no enough physical and economic availability and accessibility of food throughout the year respectively. The model results show that six variables were significant determinants of household food insecurity. These were sex of household head, age of household head, family size, education level of household head, cultivated land size and use of chemical fertilizer. Furthermore, rural households also used different coping strategies to against food deficit at initial and sever stage but the most common are ate less prepared food, borrowing grain (cash), reducing number and size of meals and sale of firewood/ charcoal or grass. Moreover, the results suggest that more attention should be given to older age households in food security projects, increasing family size creating awareness on family planning, agricultural sector should be given close attention to farmers providing and using recommended rate on time to the chemical fertilizer. Also attention should be given to pest and disease through providing necessary remedies. Therefore, based on the findings of this study, stakeholders should focus on the rural household food insecurity situation and coping strategies to better serve at any direction in the study area.

Key words: Food insecurity, coping strategies, rural household, Logit, Damot Woyde.

1. INTRODUCTION

1.1. Background of the Study

Absolutely, food is the foundation for human and economic development along with oxygen and water but, it is much more than nutrients. As a result, enough food in terms of quantity and quality for all people is an important issue for a nation to continue its development. Conversely, food insecurity is prevalent in today's world in general, and in sub-Saharan Africa in particular (GAO, 2011). As far as this, an unacceptably large number of people still lack the food for an active and healthy life. The latest estimates indicate that about 795 million people in the world - just over one in eight - were undernourished in 2014-16, down 167 million over the last decade, and 216 million lower than in 1990-92. In the same period, the prevalence of undernourishment has decreased from 18.6% to 10.9% globally, reflecting fewer undernourished people in a growing global population (FAO, 2015).

Despite the overall progress in developing countries as a whole, there is still considerable room to reduce undernourishment and improve food security. Food security explained by physical and economic access to the food needs of human beings is often associated with food availability, accessibility and utilization (FAO, 2014). As yet, the FAO report indicates that the number of people undernourished in the world has been on the rise since 2014, reaching an estimated 815 million in 2016. In fact, alleviating food insecurity and hunger is one of the millennium development goals. Ever more, it is recognized that improving food security is a foundation for reducing poverty, hunger and economic development. However, it has not been attained in most developing countries mainly in SSA; it continues to form a deep seated problem.

Food security situation gained great attention by policy makers, researchers, governmental and non-governmental organizations and development workers (WB, 2014). Despite the progress in developing regions as a whole, large differences remain across regions. Among SSA, in Ethiopia food insecurity, malnutrition and vulnerability remain high which accounts 29% absolute poor, 44% suffer from chronic malnutrition, 43% vulnerable to absolute poverty (WB, 2014). Since, its economy is dependent on agriculture, which contributes 43% of the GDP and 90% of exports. However, 5% of land is irrigated, and crop yields from small farms are below

regional averages (USAID, 2018). Furthermore, the country remains one of the poorest and the second most populous country in Africa, next to Nigeria, experiencing high annual population growth rate of about 2.6% (CSA, 2010). Likewise, Ethiopia's chronic and acute food insecurity is prevalent, especially among the rural populations and smallholder farmers.

Contrarily (WFP, 2014) reported that the country economy has shown fast real GDP growth of about 11% per annum during the past eight years between 2004 and 2012. Yet, according to (WB, 2012; UNDP, 2013) the poverty level in Ethiopia made it to be ranked 173rd out of 186 countries in human development index. This is indicative that the problem is still not well addressed and it has been a challenge to ensure food security. In addition, according to (FAO, 2016) report, an Ethiopian El Niño situation have been tripled since the beginning of 2015 and it caused severe drought leading to successive crop failures and widespread livestock deaths which produce 85% of Ethiopia's food. Nearly, 10.2 million people are food insecure and more will need food assistance according to the government and humanitarian agencies in 2016 than any other time in the past decade. Up-to-date the situation requires simultaneous and immediate scaling up of multispectral lifesaving and livelihood support along with investment in resilience building efforts in the most affected and at-risk areas.

However, in the phase of typical characteristics shock such as food price or natural disasters, households may employ food or non-food based coping strategy or a combination of both to protect their basic needs (Ayieko, Midikil and Ruel, 2010). In recently conducted studies, several coping strategies were found to be associated with household food insecurity at household and individual level. But, in Ethiopia, the seriousness of food insecurity varies from one area to another, depending on the state of natural resources and extent of development of food shortages. This condition was due to series of successive droughts, "poor and erratic" rainfall, global high food and fuel prices and global financial crisis (Tekle, 2015).

Based on (DPPC, 2010 and 2012) half year report, SNNPRS is one of the food insecure areas in Ethiopia. In region, 1.5 million people in 64 woreda are vulnerable to chronic and transitory food insecurity. Wolaita zone is part of Southern Nation Nationality State similar to other food insecure zone of the region. It is well known for its high fertility, population pressure and food insecurity stated in (Adugna and Wogayehu, 2012). Yet, the rural population is frequently and

increasingly vulnerable to droughts and famine according to (Yeshak *et al*., 2014). Consequently, an area represents one of the major food deficits and famine-prone part of Ethiopia (Almaz *et al*., 2015). Hence, the rural households who were part of the study Woreda strive for survive its livelihood through a number of strategies, but, mainly depend on small scale subsistence agriculture. For instance, many households are involved on farm and/or off farm activities in order to cover their daily food demand. However, food insecurity, malnutrition, and being destitute are still the common characteristics of the rural poor in these Woreda. Hence, it become very important to undertake research on rural household food insecurity status and coping strategies in Damot Woyde Woreda of Wolaita zone, Southern Ethiopia.

1.2. Statement of the Problem

The effort has been made by the Government and non-governmental organizations to alleviate food insecurity problem in the world. Besides, the government of Ethiopia placed significant attention on agricultural productivity improvement and implementation to achieve food self-sufficiency and reduced food aid dependency. Principal strategies engaged that contain agricultural extension program, diploma level development agents have been employed in each kebeles while the use of inputs and farm practices increased over the last years. However, it remains the main problem in our country and the requirement for food aid become increasing. Moreover, the country has failed to produce sufficient food (even under ideal weather condition) and has been heavily reliant on food aid in recent years.

Due to this matter, to solve these issues different food aid responses taken through emergency reliefs as well as development works. Like PSNP, it started covering 192 districts and 4.5 million beneficiaries by identifying chronically food insecure households in famine-prone areas of rural Ethiopia. But, know the size of the program expanded over the years both in geographic coverage and number of beneficiaries about 318 districts and 8.3 million beneficiaries in 2015 (Bonsa, 2016). Hence, poverty, inequality and food insecurity are the most crucial and persistent problems facing humanity. So, food security and poverty reduction remains as a top issue and prior agenda as far as rural development is concerned. To insure this

objective government and non-government organizations are working in the area. However, factors affecting food security and level of coping strategy remain a long-standing challenge.

Since, the scale of human activities expands; the capacity of eco-systems to regenerate the natural resource becomes more binding constraint to further development. With respect to agriculture, the country dependent on subsistence rain-fed, achieving food security has been a long lived problem and due to varieties of agricultural shocks unpredictable weather, harvest failure, rapid population growth, recurrent drought, pests and some other observed and unobserved factors faced by the rural households (MoFED, 2013). On the other hand it seems a paradox to hear that Ethiopia is one among the seven fastest growing country in the world. While, Human Development Index reported that, Ethiopia is the lowest in the world level where the country has been ranked 174th among 188 countries (UNDP, 2015). Therefore, it is wise to analyze areas, performing good or bad, because ensuring food security in developing countries is a global goal.

To overcome these, Ethiopian government in collaboration with international donors has been formulating and implementing different strategies such as increasing the level and stability of production, increasing food reserve and distributing of subsidize basic food items, increasing job opportunity etc. but still food security remains the main problem in the country and requirement for food aid is increasing (Bogale, 2014). Besides, (WZANRD, 2017) food security department report 102,112 people received food aid apart from 319,006 PSNP via direct cash support for a year and cash for public work for six months of the year.

As result, Food insecurity is the real and major problem in general for wolaita zone and particularly for Damot Woyde woreda. Since, the area relays on the food aid through governmental and non-governmental relief and safety-net program. Despite this, studies on food insecurity and coping strategy in rural households are few. But, various efforts of development and food security strategies from the government, non-government, community and other concerned stakeholders have been initiated and implemented. However, farming system in the area generally follows traditional method and the role of irrigation is very limited.

According to woreda (ANRD, 2017) report, food production of major food item in the area has not been sufficient to satisfy the food demand of the increasing population. Currently, all

kebeles are supported by the government through poverty reduction program such as PSNP which consist of 15,318 people direct cash support for a year and cash for public work for six months of the year, Household Building program (HHBP) and other package program. Consequently, in the woreda 7,676 people assisted and receive handouts from the government and different non-governmental organization in the form of emergency food aid based on the woreda food security early warning responses report in 2017.

In spite of all these efforts, most rural households of the area are facing food shortage. Further, determinants of food insecurity and coping strategies of rural households by the household's level remain a long-lasting challenge. Therefore, this study attempts to address the prevailing information gap and guide policy decisions of rural households in the study area.

1.3. Objectives of the Study

The general objective of this study is to identify food insecurity situation and coping strategies of rural households in Damot Woyde Woreda. In line with this, the following specific objectives were formulated; these are:

- To examine the existing food insecurity status of rural households in the study area;
- To identify the determinants of rural household food insecurity status in the woreda and
- To ascertain households coping strategies against food insecurity in the study area.

1.4. Research Questions

This study attempted to address the following analytical questions; these are:

1. What is the food insecurity situation of households in the study area looks like?
2. What are the factors that influence food insecurity status in the study area?
3. What are the coping strategies of the households against food insecurity?

1.5. Significance of the Study

The study would identify and understand food insecurity status; determinants that influence the problem as well as its coping strategies at rural household level; which were help policy makers and development agents to reform plans to the prevailing condition of each locality. It also

valuable to non-governmental organizations to efficient targets their programs along the intensity of the problem. More precisely, results of the study benefit; concerned body Southern Ethiopia, in general and Damot Woyde Woreda and individual households, in particular. In the end, the study will contribute to further research, extension and development schemes.

1.6. Scope and Limitations of the Study

Due to resource constraints, the study limited only to Damot Woyde Woreda; but, it provides important clues to other area in SNNPR. It focuses on the existing food insecurity status in households and coping strategies. The research covers only four kebeles out of 23 rural KAs for the sake of making the study more manageable and delimited. Studies carried out in many developing countries have pointed out that farmers are reluctant to provide correct information on the variables. Such as income level, farm size, livestock number, *etc*., due to the fact that taxes and other development contributions are distributed among them based on these factors. This study may not be free from these limitations. But, to mitigate this problem, possible attempt was made to convince households about the objectives of the study.

1.7. Organization of the Paper

This thesis organized in five chapters. First chapter comprises introduction which contains background, statement of the problem, research questions, objectives, scope and limitations and also significance of the study. Second chapter deals with literatures reviewed from various sources. Third chapter provides about the research methodology with background information about the Woreda, data sources, sampling techniques and size, method of data collection and analysis. Chapter four consists of the major research findings while; results obtained were discussed in detail. Finally, chapter five presents' summary, conclusion and recommendation can be debated based on the findings of the study.

2. LITERATURE REVIEW

In this section, different literature were reviewed to exploit the information for this study such as concept and definitions of food insecurity, food security indicators and measurement, household coping strategies against food deficit, theoretical review on food security, empirical findings on food insecurity and conceptual framework of the study are presented.

2.1. Basic Definitions and Concepts of Food Security and/Insecurity

Food security, as a concept, originated in the mid of the 1970's. The only thing considered at that time is physical availability of food in adequate supply, like food self-sufficiency. Thus, in the 1970s the issue of food security was the national food supply's capacity to meet the population's energy and nutrient needs. The concept of household food security has been understood by many development works as the availability of food in the world market place and on the food production systems of developing countries (Bedeke, 2012). Since then a number of definitions have been developed by different organizations at different times. (UN, 1975) defined as: "availability at all times of adequate world food supplies of basic food stuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices". While (FAO, 1983) defined food security as "ensuring that all people at all-time have both physical and economic access to the basic food they need."

Later (WB, 1986) defined food security as "access by all people at all times to sufficient food for an active and healthy life." Yet (USAID, 1992) defined "a situation achieved 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." This definition encompasses four core concepts which are "Sufficiency, Access, Security and Time". "Sufficiency" indicates enough supply of calories required including necessary intake of proteins micro nutrients for an active and healthy life, "Access to food comprises production, purchase and exchanges or gift and it marks the ability of households to get command over these supplies. "Security" is defined as a balance between vulnerability, risk and insurance. "Time" express where food insecurity can be chronic, transitory or cyclical (Maxwell and Smith, 1992). In contrast, food insecurity is lack of access to sufficient food that leads to poor health, reduced energy and other physical and

physiological deterioration *i.e.*, failure of livelihoods to guarantee access and entitlement to sufficient food at the household and individual levels.

Food insecurity is a situation in which individuals have neither physical nor economical access to the nourishment they need. A household is said to be food insecure, when its consumption falls to less than 80% of the daily minimum recommended allowance of caloric intake for an individual to be active and healthy. In particular, food insecurity includes low food intake, variable access to food and vulnerability a livelihood strategy that generates adequate food in good times, but it is not resilient against shocks. These out comes correspond broadly to chronic, cyclic and transitory food insecurity and all are endemic in Ethiopia (Devereux, 2000).

The most widely used definition of food security is the one forwarded by world food summit in 1996 which defines as: "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" (FAO, 1996). This definition integrates access, availability, utilization and stability of food. Hence, the current definition of food security recognizes the complex inter linkages between the individual, households, community, nation and international economy (Maxwell, 1996).

Similarly, over the years, it has been defined in a variety of ways, yet knows, it refers broadly to the ability of individuals to obtain sufficient food on a day-to-day basis. But generally, it is a situation defined as "When all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO *et al*., 2014 and USAID, 2015)". The concept of food security encompasses multiple dimensions such as food production, access and absorption. Hence, the determinants of household food security in effect comprise the factors that each component of food security. In general, determinants of food security are different at different levels of application, *i.e.* global, national, regional, household and individual levels (Khan *et al*., 2012).

Food security of the households corresponds to the application of this concept on the family level, with the center of attention focusing on the individuals making up the household (FAO, 2013). A household is food secure when its livelihood and its environment are guaranteed. The environment should consist of adequate stock and flow of food and income to satisfy basic

needs. People who do not satisfy the conditions in this definition are considered food insecure and it can be defined as a condition in which people lack the basic food intake necessary to provide them with the energy and nutrients required for fully productive lives. According to (FAO, 2010) it can either be temporary (transitory food insecurity) or continuous (chronic food insecurity).

Therefore, it exists when people lack access to sufficient amounts of safe and nutritious food for normal growth and development. Hence, food insecurity is the function of unavailability of food, insufficient purchasing power, inappropriate distribution or inadequate use of food at the household level. Identification of the paths through which food insecurity occurs is very difficult as it is the result of complex interaction between numerous variables and there is also a debate on the components of food security to be considered in empirical study as they are highly interrelated. Food security also depends on the range of agricultural and non-agricultural activities that, together, provide a variety of sources of food and/or income (FAO, 2012). Food security mainly constitutes four interrelated components (Barrett, 2010; Pieters *et al*., 2013; Sasi, 2015): availability, access, utilization, and stability (sustainability) and utilization. The state of food insecurity in the world 2013 introduced a suite of indicators organized around these four dimensions with a view to overcoming the drawbacks that arise from relying solely on the prevalence of undernourishment indicator. By measuring food security across its four dimensions, the suite of indicators provides a more comprehensive picture, and can also help in targeting and prioritizing food security and nutrition polices.

In this paper the working definition of food security will be taken to be the (FAO, 1996) which is: ("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"). Based on this definition, the following dimensions of food security are considered to be the main components. These are food availability dimension, food accessibility dimension and nutritional or dietary dimension and stability dimension.

Food availability is a necessary but not sufficient condition for food access, which is, in turn, a necessary but not sufficient condition for food utilization. However, even in the plentiful availability of food in the market, people may not have access to food, leading to food

insecurity. So, the above definition contains three distinct but interlinking concepts that are essential to attain a state of food security: **availability, access** and **utilization**.

Availability: denotes to the total food stock in the country (region) at the macro level or within the population (household) at the micro level; 'a measure of food that is, and will be, physically available in the relevant vicinity of a population during a given period, whether from the household's own farm or garden production or from domestic or international markets' (Hoddinott and Yohannes, 2002). It is defined by (USAID, 1992) as when: "Sufficient quantities of appropriate, necessary types of food from domestic production, commercial imports, commercial aid programs, or food stocks are consistently available to individuals or within their reach." However, food availability in general constrained by inappropriate agricultural knowledge, technology, government policies, inadequate agricultural inputs, family size, functioning of international and domestic markets, and the state of the physical economic infrastructure etc (Hoddinott, 1995; Yared, 2001).

Access: represents to the capacity of a household to obtain sufficient food to satisfy the nutritional needs of all its members; it is 'a measure of the population's ability to acquire available food during a given period' (FAO, 2013). Causes influencing access to food comprise economic (price of foodstuffs, incomes, employment opportunities), social and political issues (ethnic, religious or social discrimination, redistribution of resources within the population or the household, or access to the exchange network; transport difficulties or physical access to markets; mutual assistance, support from family and neighbours; government or humanitarian aid; credit), and also influences related to agricultural production (access to land, inputs), distance to market places, etc. (Hoddinott and Yohannes, 2002).

Utilization: refers broadly to the way in which actual food is consumed on a household individual (micro level) i.e. the distribution of food within the household and how it is stored, its preparation and then absorption at the individual level; it is 'a measure of whether a population will be able to derive sufficient nutrition during a given period' (FAO, 2015).

Food utilization has both a socio-economic and biological dimension. The socio-economic dimension argues to decisions related to what food is consumed and how the food is allocated within the household. Both decisions in turn are influenced by intra-household dynamics and

social duties. Depending on these influences, individuals within households may have access to food but still suffer from food insecurity. For instance, Women and children are particularly more likely to suffer from food insecurity because of their relatively limited control over assets and relatively weak intra-household bargaining power (USAID, 1992).

The biological dimension of food utilization refers to the ability of the human body to take food and transform it into energy for daily activities or to store it for future energy needs. Food utilization interrelates in complex ways with diet, nutritional status, the functioning of the immune system, and health and hygiene practices. In this context, it requires a healthy diet, a healthy body, and a healthy physical environment (safe drinking water and hygienic sanitary conditions) according to (USAID, 2009).

Food insecurity is a situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life according to (FAO, 2000). It may be chronic, seasonal or transitory. At times when an individual, household, or community is unable to avail and access food for the above mentioned reasons then the situation could be described as a state of food insecurity.

Food shortage: defined as when there is not enough food available for people to eat, which occurs when food supplies within a bounded region do not provide the energy and nutrients needed by that region's population. It is easily conceptualized as a production problem, not enough food is grown to meet regional needs but constraints on importation as well as storage can also cause or contribute to it. It also created where food is exported from areas where production is adequate or even abundant.

Malnutrition: can be defined as the physical and mental weakness and disability that results when the body doesn’t get the nutrients. It is generally caused by lack of nutrients resulting from inadequate food intake or ill health. This framework suggests the convergence between food security and nutrition, that is, without food security, good nutrition cannot be achieved; and without good nutrition, individuals have more difficulty being economically productive.

Undernourished: it means does not getting enough food or enough health food for good health and growth. People that fall into this category often go without meals and are hungry for much

of time; they may live in a country where there has been a drought or other natural disaster. It exists when caloric intake is below the minimum dietary energy requirement.

2.2. Food Insecurity Indicators

Food security as defined above by (FAO, 1996) is determined by availability, access, utilization and stability. Furthermore, these components are broad and complex concept viz. determined by interrelated agro-physical, socioeconomic, and biological factors (Von Braun *et al*., 1992). Assessment of food insecurity is a difficult issue as there no universally established indicators which serve as measuring tools. Food insecurity requires a multi-dimension since it is inlfuenced by different interrelated soci-economic, environmental and political factors. Because of these problem, assessing, analyzing and monitoring food insecurity follow diversified approaches; ranging from a mere quantitative to a combination of both qualitative and quantitative measurement. The major indicators that reflect food supply including production, access to resources, institutional development and market infrastructures. However, such indicators are in most cases aggregated and hardly serve to monitor food stress at household levels (Debebe, 1995).

According to (FAO, 2014) indicators for assessing availability include the adequecy of dietary energy supply; the average supply of animal-source proteins; and the average value of food production. The access dimension compraises indicators of physical access and infrastructure such as railway and road density; economic access, represented by the domestic food price index; and the prevaleance of undernurishment. The stability dimension is divided into two groups. The first group covers factors that measure exposure to food security risk with a diverse set of indicators such as the centeral dependency ratio, the area under irrigation, and the value of stable food imports as a percentage of total merchandise exports. The second group focuses on the incidence of shocks such as domestic food price volatility, fluctuations in domestic food supply, and political instability. The utilization dimension also falls into two groups. The first encompases variables that determine the ability to utilize food, notably indicators of access to water and sanitation. The second group focuses on outcomes of poor food utilization, i.e. nutritional failures of children under five years of age , such as wasting, stunting and underweight.

In general, (Frankenberger, 1992) classified the different types of indicators into two main groups: process indicators and outcome indicators. Process indicators provide estimates of food supply and food access situation, where as outcome variables such as the level changes in food consumption and the amount of food in store serve as a proxy estimates for measuring household food situation. Process indicators are divided in two. Those food supply and access reflect indicators. Food supply indicators provide information on the likelihood of shock or disaster that will adversely affect house hold food security. But, the importance of indicators that measure food access become apparent when it is realized that household food insecurity were occurring despite the availability of food. Outcome indicators are used to measure the status of food security at a given point in time, and grouped into direct and indirect indicators. The direct indicators of food consumption include actual food consumption rather than to marketing channel information or medical status. The indirect indicators include storage estimates, subsistence potential ration, household perceptions of food insecurity and nutritional status assessment (Nigussie *et al.*, 2012).

Some of the problems with outcome indicators like anthropometrics are their results may not exactly indicate the level of food crisis. It is because nutritional intake is affected by a number of factors such as health and sanitation. Both process and outcome indicators are important when assessing food security, but access indicators measure that food access become apparent when government and development agencies realize existence of household food insecurity and amine conditions are occurringdespite the availability of food. In recent years, access indicators have been seen as relatively more valuable in development planning, implementation and monitoring of food security interventions. At the household level, food security is measured by actual dietary intake of all household members using household income and expenditure survey. However, expenditure data is more reliable than income data (Tassew, 2006). Using a survey data the minimal standard of living is proxy by the level of consumption expenditure that will enable the household or individual to attain the basic needs.

2.3. Measurement of Food Security

Measuring household food security is essential at the outset of any development; *i.e.* to identify the food insecurity status, to assess the severity of their food deficit and to characterize the

nature of their insecurity. However, as defined and conceptualized above food security and its complement, food insecurity is inherently unobservable. According to (Von Braun *et al.*, 1992), different indicators are needed to capture the various dimension of food insecurity at the country, household and individual levels:

Country level: It to some extent be measured in terms of demand (requirement) and supply *i.e.* the quantities of available food and needs. According to (Hoddinot, 1999), the supply of food may be from current production and stocks and from previous production whereas the need has to be determined on the basis of biological or nutritional requirement of a given society for a certain period of time usually a year or a day. However, national-level measures inherently lend themselves only to addressing national-scale food availability shortfalls, not intra national access and utilization concerns.

Household level: Measured by direct survey of dietary intake (in comparison with appropriate adequacy norms). However, they measure the existing situation and not the downside risks that may occur. The level of, and changes in socio-economic and demographic variables such as real wage, employment, price ratio and migration properly analyses can serve as proxies to indicate the status of, and change in food security.

Individual level: Anthropometrics information can be a useful complement because the measurements are taken at the individual level. Yet such information is the outcome of changes of health and sanitation environment and other factors. Most importantly, this information indicates food security after the fact. Income and consumption has been traditionally used as a measure of food security. But, consumption is a better measure of longer-term household welfare as it is subject to less temporal variation than income. In addition, most analyses rely on measuring food consumption. (Hoddinot, 2001a) made comparison of different outcome measures of household food insecurity namely, individual intake, household calorie acquisition, dietary diversity and indices of household coping strategies in terms of time requirement, cost, skill and susceptibility to misreporting and briefly discussed them as follows:

I) Individual Food Intake: involves measuring the amount of calories or nutrients consumed by an individual in a given time period, usually 24 hours. In this way measuring the amount of food served to each person, and the amount of food prepared but not consumed ("plate waste")

is also measured. The type and quantity of food eaten as snacks and food consumed outside the household also included. In addition each household member regarding the food they consumed in the previous 24-hours period also considered.

II) Household Caloric Acquisition: this is the number of calories or nutrients available for consumption by household members over a definite 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 on the household.

III) 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. 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.

IV) Indices of Household Coping Strategies: this is an index based on how households adapt or preparing and serving meals is asked to the presence or threat of 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, the last two indicators could not capture consumption of particular quantities and as a result it is not possible to calculate kilocalories consumption per household. In household caloric acquisition method, conversion of gross household food consumption into calories, and dividing the calorie

figure by the number of adult equivalent in household and the number of days of the recall period results in a concise figure for average calories consumed per adult equivalent per day which is then compared with the minimum calorie requirement. In this study, since focus of analysis is household, household calorie acquisition was utilized. Similarly (FAO, 2013) reported that dietary or caloric intake is one measure of food security that captures availability and access dimension. Therefore, taking into consideration all these points in relation to the available data source, the study opts to use the household caloric acquisition methods as a means to compute the per capita per day calorie consumption.

In this study, 7-day food consumption recall method was used and estimated quantities of every food item consumed by the household in the 7-day period were calculated. The physical food consumption data were synthesized as follows: Using a structured questionnaire, respondents were asked to report food items consumed, in kind and amount purchased or otherwise, by their families in the one week's period preceding the survey. Converting the data into calories adjusted for household age and sex composition involved a series of steps. First, different units of local measurement were converted into a common measure for each food item. Second, the acquisition of each food item was converted to calories using the food composition table which was compiled by the Ethiopian Health and Nutrition Research Institute (EHNRI, 1997). Third, all food calories were added up and then converted into daily amounts.

Finally, the aggregate food calories were adjusted in adult equivalent units per household to make a meaningful analysis of intra-household caloric intake. To get the household daily per capita calorie intake, the household per capita calorie intake was divided by seven. Fourth stage is comparison of the per capita per day calorie consumption with the standard requirement of 2200 Kcal per capita per day calorie consumption which is set by (MoFED, 2013). The same author expresses the 2200 kcal food poverty line as an energy requirement that is only sufficient to an individual to walk and perform light tasks. Thus, those households beyond the estimated calorie requirement level ($\geq$ 2200 kcal per person per day) were deemed to be food secure and otherwise food insecure.

2.4. Food Security Situation in Ethiopia

Ethiopia is one of the most food-insecure and famine affected countries. A large portion of the country's population has been affected by chronic and transitory food insecurity (African Development Bank, 2014). The situation of chronically food insecure people is becoming more and more severe. Food security situation in Ethiopia is highly linked to recurring food shortage and famine in the country, which are associated to recurrent drought. Likewise according to an early report, 5.2 million people in Ethiopia can be considered as food insecure (UN, 2010); with the same author and time, the worsening food security situation is attributed primarily to poor rainfall in 2010 and "poor and erratic rainfall over the last two years." Thus, a series of successive droughts had been already weakened Ethiopia's food situation.

Global conditions such as the high food and fuel prices that have persisted in the country since 2008 and the global financial crisis have also contributed to Ethiopia's failing food security (WFP, 2010). In the 2010 Global Hunger Index, which ranks developing countries and countries in transition based on proportion of undernourished people, proportion of underweight children under five, and child mortality rate, Ethiopia was given a 29.8, on a scale of 0-100, with 0 being the best and 100 the worst possible score (IFPRI,2009). Ethiopia is one of the countries that made the most absolute progress improving its score between 1990 and 2010; in 1990 it had a score of 43.7, and now it's down to 29.8. However, this score is still highly troubling, it's ranked 80th out of 84 countries (IFPRI, 2009). Experience shows that food aid does not provide a sustainable solution for tackling chronic food insecurity. Indeed there are substantial doubts about the impact of 15 years of food aid to Ethiopia.

2.5. Causes of Food Insecurity

The exact causes of food insecurity vary throughout the world and are very much dependent on the specific conditions and location situation in a given country. In a broad term, the most severe food insecurity is associated with disasters such as drought, floods, war or earthquakes; most food insecurity is not associated with catastrophes (Barrett *et al.*, 2010). But in this study the major causes that have been widely explained as the contributing factors for food insecurity and famine situation tried to discuss.

Deterioration of food production capacity: Food production capacity declined due to drought or land degradation. Drought is the major cause for the loss of food production in areas where agricultural activity has been overwhelmingly depended on rainfall. In country like Ethiopia, the contribution of irrigated land in agriculture is very minimal and therefore, the whole food production activity has depended on rain-fed agriculture. Hence the disruption of rain for a season has brought a massive food shortage and consequently hunger and famine. Land degradation is also the major factor for the deterioration of food production; this may be because of soil erosion, loss of soil nutrient or soil compaction. Soil erosion is intense in the situation where vegetation cover of the land is reduced for different reasons such as providing fuel wood, grazing area and arable land.

Population pressure: Population growth is often considered a prime cause of food shortage in the globe. The rate of population growth would exceed the food production and beyond the carrying capacity of the earth. The rapidly growing global population affected by disasters is undernourished, which in turn represent a minority of those living in poverty at any given time. Yet, most food insecurity is due to regular seasonal shortages and associated price increases as a source of food insecurity for landless laborers and smallholder farmers according to (Devereux *et al.,* 2008). Thus, would result in famine and hunger because no corresponding increase would be possible in food production. Frequently, vulnerable households can no longer manage a balance between dietary needs over the short term (survival) and the management of their means of existence (livelihood) over the long term.

Instability and armed conflict: Food insecurity and famine are evident in the area where war and armed conflicts are prevalent. The impact of war, especially on the rural economy and the rural environment is very destructive through disruption of production, loss of local genetic resource stocks, and erosion of natural resources. Forced conscription of young men into the army disrupts the productive capacities of rural households. However, the causes of food insecurity, in sub-Saharan Africa are highly related with poverty and vary among households and localities.

In general, there are many causes of food insecurity, for instance, the unavailability of food, insufficient purchasing power or increased market prices, loss of livestock and other resources,

inappropriate distribution or inadequate use of food at the household level (FAO, 2000). More importantly, households are less able to cope with shocks because they cannot accumulate saving (*e.g*., livestock holdings and food stores) even in good years (FDRE, 2002). Similarly, like famines are the most severe form of food insecurity results from a varying mix of production failures (*e.g.,* due to natural disasters or environmental changes), exchange failures (*i.e*., market failures or poverty) and response failures (*i.e*., accountability failures by governments and international agencies) according to (Devereux, 2009).

2.6. Coping Strategies against Food Insecurity

2.6.1. Definition of coping strategy: In describing the concept of it common terms or phrases like "coping technique" and "survival methods" are often used interchangeably by writers and researchers. In this situation, coping strategy means "coping mechanism" or "technique" is implying mainly at a household and individual levels. Households or community members adopt and develop diversified mechanisms and sequential responses through which people used at times of decline in food availabilityand adjust to future disaster related risks by themselves without outside support (Mulugeta, 2002; Tesfaye, 2005).

Typically, there are four types of coping strategies that food insecure households use: such as changing the diet to include less costly and less preferred alternative foods, increasing food supplies through non-sustainable means (*e.g.,* borrowing money, consuming seed stocks, begging), decreasing the number of individuals being fed by the household (i.e., migration), and rationing available foods by reducing meal size or frequency (Maxwell *et al*. 2003). In the Southern Ethiopia another study conducted by (Negatu, 2011) found that a range of coping mechanisms used by respondents which includes: minimizing the number of meals and amount of food consumption, diversifying their livelihood, cultivating more crops, wage labor, seasonal migration to neighboring community during peak season and inter cropping are some of mechanisms used by households.

2.6.2. Household coping strategies: Although coping strategies vary with local conditions, there is common pattern in the sequence of resources (Clover, 2003) as the severity of food insecurity increases, the household responses become progressively more serious and treating to livelihoods. One of the firs responses is to reduce food intake, in order to preserve essential assets. Different studies present a variety of different coping strategies that the households are likely to adopt when faced with food shortage.

For instance when faced with famine, Ethiopian villagers were shown to draw on their savings, use food reserves, diversify sources of income and reduce expenditure on noon-food items in the initial stages on the famine; whereas during the later stages of the famine they switched to consuming famine foods and even migrated (Webb and Braun, 2009). At the same time they stated sale of livestock could make poor and insecure households more vulnerable and push them into poverty; once sold a cow / ox cannot be used as an input for farming activity and thus selling livestock will adversely affect agricultural income.

Adopting any of the coping strategies described above has implications for the household and its members and that is why we need to study these strategies. For instance, changes in food consumption patterns, due to a reduction in the number of daily meals a decline in the quality of food consumed, can be deleterious to the health of household members especially to the long-term well-being of children (Arimond and Ruel, 2004). Out migration directly influence not only the household but also the larger society because, the area to which the food insecure people migrate would need to provide for the immigrants as well as its local population. Therefore, study and anticipating these strategies becomes important. A study by (Frehiwot, 2007) in amhara region revealed that coping mechanisms used by farm households differ from area to area. However in general the sale of fire-wood or charcoal, requesting grain loans, selling cow dung, livestock sales, agricultural employment, and certain types of off-farm employment and migration to other areas are the most common.

In addition to that small scale trading and sale of crop residues, reduction of food consumption, and their houses for sale are practiced. But livestock sales are the last choice. (Mequanent, 2009) study in West Showa zone identified that coping mechanism include eating less preferred food as their first option followed by sale of seed kept for the next season planting. He also

identified that sale of productive equipment's, sale of agricultural tools as their third and fourth alternative. It depends on the severity of the crises and their experience. In the study area, households have used different coping strategies including, among the most important, sale of livestock, borrowing grains or cash, reducing number of and size of meals, sale of fire-wood or dried dung, engaging in daily labor, seasonal migration and renting-out farm land.

2.7. Theoretical Review on Food Security

Different theories viewied by different authors in relation to food security which clustered in three broad categories (Sen, 1981; Devereux, 1993).

I) Political economy theory: it mainly related with land tenure in security, weak targeting of safety nets, lack of accountability and transparency in local governance. Food insecurity is a political phenomenon that is not only caused by lack of food production nor by market irregularities, but due to polotical powerlessness. Thus, rather than sticking to the availability of food and people access to food as the only means out of food insecurity and famine, political economy theory proposes that interventions have to focus on state reconstruction, good governance and accountability (Arega, 2013).

II) Food economy theory: this theory incorporate two important food economy approach such as food entitlement decline and food availability decline approaches. In addition lack of delivery of inputs to increase agricultural production and weak marketing infrastructure, lack of access to purchase the basic needs are related to the food economy theories in respect to food availability and accessibility decline theories (Arega, 2013).

Food accessibility decline theories:- acadamic and policy focus started to shift towards micro level issues affecting food security of individuals, households and communities. Theoretical basis for this paradigm shift was set by Amartya Sen's 'entitlement approach'. The'entitlement approach' and later works that build on it focus on the access of households to food through own production, income, gathering of wild foods, community support (claims), assets and migration. Hence, during the 1980s, due to the growing incidence of hunger, famine and malnutrition in many parts of the third world, the concept of food security was redefined in such away that the unit of analyses shifted from national and global levels to household and

individual levels. It was also made to focus on food availability as well as on access to food. The argument on 'accesses' in the early 1980s was a turning point to the progress of the concept and assessment of various food security related problems. In this approach, hunger and famine are the results of failure in specific socio-economic groups in the societyto obtain adequate food by legitimate economic means. This means, lack of physical, human or social resources causes people's access to food to fall below their subsistance needs (FAO,1983).

Food availability decline theories:- according to this approach, people starve because of local, national or regional decline in food availability to the level below the minimum necessary for survival; because of high population pressure and climate change/ variability. Hence, the first version of food availability decline approach focuses on population growth. Looking the fastest growth of the Irish population Malthus hypothesized that the limited amount of farmland and hgh population growth would invitably lead to hunger, famine and disease. Malthus argued that population growth will lead to constantly increasing demand for food which agriculture, given limited farmland and other natural resources, would eventually be unable to satisfy the food demand of the population. The second version of FAD approch focuses on climate change/ variability at inter-annual and decadal time scales (Degefa, 2005; Devereux and Naera, 1996; Thomas *et al.*, 2007 cited in Arega, 2013).

III) Vulnerability Theory: high population pressure, living in marginal and drought-prone areas, druoght unpredictable rainfall and lack access to the basic capital assets can be summarized under vulnerability theory. The food entitlement approach, which was used before the emergance of vulnerability theory was not comprehensive enough to deal with the factoes in explaining risk, and hence it can be incomplete if it is, treated separetely. Thus, the main limitation of the entitlement approach was its failure to address famine and food insecurity as a socio-economic and political crisis in the analysis of food security (Arega, 2013). Therefore, in this study food economy theory was used to indicate the household food secure situation.

2.8. Empirical Studies on Food Insecurity

Various studies have been documented on the influence household food security situation in developing regions. Different literatures use different proxies as a measure of food security and use different methodologies. On the ground of that, these literatures find out various factors as

causes of food insecurity. A study in Pakistan by (Asghar and Muhammad, 2013) found that household size, household income, irrigation facility, and age determine food security. In contrast to the results by (Greenwell and Pius, 2012), found that age has a positive impact on household food security and justified that experience has more weight for a household status to be in food security.

According to a study in Bangladesh by (Majumder *et al*., 2012) profession and crop cultivated, farm size and professional support found to be significant determinant of the household food security. In this study, it seems that variables like age and other household characteristics are not controlled. In a South African township of Kwakwatsi a study revealed that male headed households, vulnerability to food insecurity increases with age of the household headed but it would decrease with an increase in household income and the employment status of the household headed. In female- headed households' vulnerability to food insecurity increases with household size and age of the household headed, while it decreases with household income (Ndobo, 2013).

(Greenwell and picus, 2012) in their study in Malawi, used reported food security status, a continuous dietary diversity index and food end time as measure of food security. Logistic, ordinary least square, and quintile regressions were used as an estimation method. This study found that household food security is determined by credit access, age, sex of the household head, extension information, assets or wealth and education. In this literature age is found to have negative association with the food security status. The justification given is that even if young farmers tend to be less experienced, yet they are more food secure due to their dynamic and energetic nature. The type of food insecurity observed in Sub-Saharan Africa is a combination of widespread chronic food insecurity, resulting from continuing or structural poverty, transitory emergency related food insecurity, which occurs in periods of intensified pressure caused by natural disasters, economic collapse, or conflict (FAO, 2004).

However, 99% of the food insecurity in Sub-Saharan Africa is grown under rain fed agriculture. Hence, food production is vulnerable to adverse weather conditions. The reason behind is that there was an over decline in farm input investment including fertilizers, seeds, and technology adoptions. Other causes include rapid population growth, limited access to

agriculture related technical assistance, under developed agricultural sector and lack of knowledge about profitable soil fertility management practices leading to expansion in to less-favorable lands (Boussard *et al*., 2005). The situation in Ethiopia is not much different from the conditions in other developed and developing regions. All these studies are conducted using cross-sectional data. Despite these works are carried out in different regions, we may need to know, if the determinants found to be similar or different.

According to (Hiwot, 2014) based on the results of the conditional logit model, among the priority variables fitted in to it, rainfall shock and household size negatively and significantly determine food security. While, farm land size, land quality and credit access positively and significantly determine food security at varying levels of significance. In the fixed effects model these same sets of variables significantly determine nutritional status in the same sign as they determined food security with only differences in magnitude and significance of the coefficient estimates. Additionally, off-farm income, fertilizer use and oxen ownership are priority variables that are found to be significant in this model.

A study by (Haile *et al*., 2005) at korodegaga, a peasant association found in Oromia region of Ethiopia, used cross- sectional data and a binary logistic regression as the econometric model. The study controlled for many factors which meant to have an impact on food security status of a given household in the district. Out of the eleven factors that were fitted to the model, farm land size, oxen ownership, fertilizer application, education of the household head, and household size found to be significant determinant of household food security. This study again did not take in to account rain fall shock.

Similarly, a study at Ada Berga, a district in the central Ethiopia, (Beyene and Muche, 2010) found that off-farm income, livestock and land holdings, agricultural practices and farming activities significantly affect household food security. Chemical fertilizer uses also affects food security positively. In a study in Jiggiga district of central Ethiopia, that uses an empirical analysis by a logit model, (Hussien and Janekarnkij, 2013) find out that fertilizer use, credit access, extension service, and household income have positive influence on food security. Generally complex sets of variables such as size of land, quality of available land, educational

level of the farm owner, quality and quantity of technology and capital available are important factors in influencing the level of food production (Foster, 1992).

A study done in Wolaita Zone Offa Woreda showed that education level of household head, access to credit, total cultivated land, household active labor forces, household members participation into income generating activities participation in rural institutions, participation in off-farm activities, dependency ratio, participation in non-farm activities, frequency to extension contact and livestock rearing were significantly associated with household food insecurity (Bogale, 2014). Thus, controlling for all these complex sets of variables is useful to obtain an unbiased estimate of it and their corresponding impacts on food security.

However, the analyses of determinants of food security of rural households remain a long-standing challenge. Thus, to identify the determinants of food security, assessing the status of household food security and its association with different demographic and socio-economic factors is the main drive of this study to guide policy decisions, devise appropriate interventions and integrated efforts to combat food security problem in the study area.

Generally, food security is defined differently by different organizations. Measuring of food security may include individual food intake, household caloric acquisition and indices of household coping strategies can be used as parameters. Hence, in this study, the aforementioned calorie level was taken as a frame of reference in individuals' calorie level. Though there are numerous studies conducted on food security in Ethiopia, the issues at the level of each woreda has not been yet supported with empirical study, which is also true for Damot Woyde woreda. Thus, this study is aimed at fulfilling the gap by providing concerned stakeholders with valid findings regarding the causes of food insecurity in the woreda.

2.9. Conceptual Framework

The problem of household food security in the study area was analyzed using the conceptual framework and developed based on literature reviewed and personal observation which shown in figure 1. These are demographic factors, institutional factors, economic factors and coping strategies. Hence, food security is a complex concept that includes many aspects. Therefore, understanding food security concept is a key to explore the determinants that influence food

insecurity at household level. Since many regions around the world face the problem of food insecurity since its implications is so sever, there is a need to accurately measure the components and causes of food insecurity and to devise appropriate context-specific solutions.

Household food security is also largely influenced by social environment, policy environment and physical environment. The nature and structure of social net-works and traditional means of supports affect the level of food security. Households' access to food is again affected by natural resource endowments and climate situation of the area. The three dimensions to be looked during assessments are: availability, access and utilization and their different causes under each dimension has to be investigated.

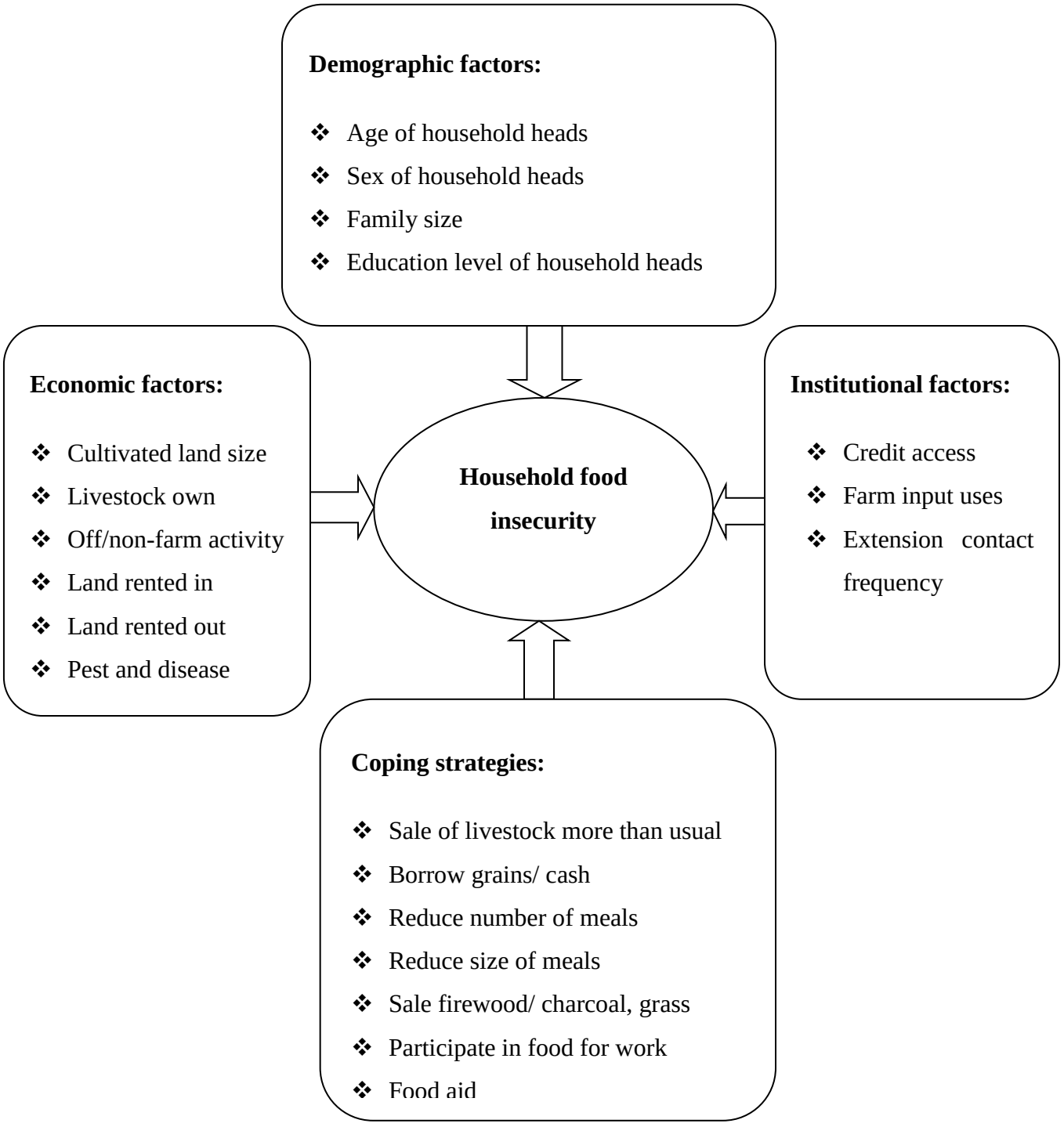


Figure 1: Conceptual framework of the study
Source: Developed by the Author

3. RESEARCH METHODOLOGY

Under this section, description of the study area, type and sources of data, sampling technique and sample size, method of data collection and analysis that were used for this research.

3.1 Description of the Study Area

The study was conducted in Damot Woyde woreda, which is one of the rural administrations out of twelve woreda in Wolaita Zone, Southern Regional State of Ethiopia. The Woreda is adjacent to Sodo Zuria, Damot Gale, Humbo and Duguna Fango woreda to the West, North, South and East respectively. The capital of the woreda, Bedessa is located at 145 km away from Hawassa town which is the capital city of Southern Region and 406 Km from Addis Ababa in the Southern direction and 26 km, away from Sodo, which is the capital of Wolaita, to the East. The Woreda is divided in to three agro-ecological zones such as Dega (14.35%), Woina-dega (56.95%) and Kolla (28.70%). An altitude ranging from1001-2500 meters above mean sea level, while the mean annual temperature varies from 17.6-25o^{c} with 1001-1400 mm per annum average annual rainfall.

The study area has bimodal distribution of rainfall *i.e. Belg* which occurs from February to April and *Meher* occurs from June to September. The total land coverage of the woreda is 32,398.26 ha out of which 11,403 ha (35.20%) is used to crop production and the rest 20,995.26 ha (64.80%) of the land is used for grazing, forest, degraded, water coverage and uncultivable and from out of the crop production land 77.35% is used to grow annual crops, and 12.43% for perennial crops. On this area, farmers undertake mixed cropping system (crop production as well as livestock rearing); but maize is the main dominant cereal crops grown in the area. Yet, most mainly cultivating crops are cereals, pulses and cash crops like fruits and root crops. However, the area is known for its low productivity due to erratic rainfall and prevalence of pests and diseases (DWWANRD, 2017).

As a result, income from Non/off-farm activity is the next most important source of livelihood in the study area. Those, nearer to small towns where engaged in these activities, especially, petty trading plays an important role in generating income. Apart from trading, income from daily labor and seasonal workforce movement during harvest time is another source of income.

According to the (CSA, 2016) estimation and Woreda FED report, the study area holds a total population of 125,811 out of this male 61,651 (49%) and female 64,160 (51%). The total households of the Woreda are 25,637 of which male household 20,786 and female household 4,851 and have a 23 rural kebeles administrative. The population density of the woreda is 384 persons per km^2 and dependency ratio is 102.68.

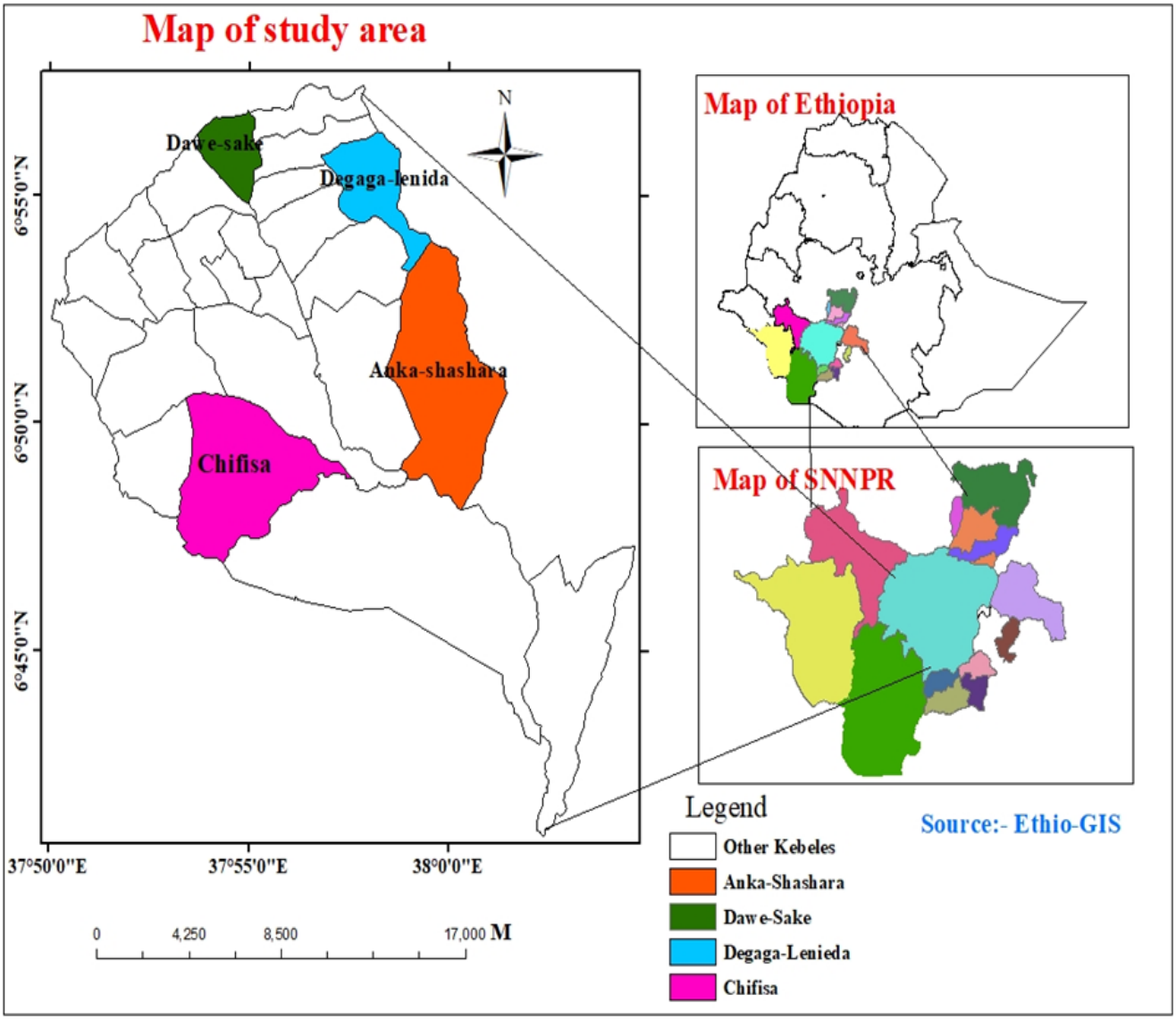


Figure 2: Map of the study area
Source: Ethio -GIS, 2017

3.2. Sampling Techniques and Sample size

This study takes place in Damot Woyde woreda. Because the woreda has been faced by food shortage in every year, the population is supported by PSNP and food aid is common in the area (WANRD, 2016). In general, a three stage sampling technique was used. The detail of sampling method applied is presented and discussed below. In the first stage, a total of 23 rural kebeles were stratified into three strata based on agro-ecology. Stratum 1(Dega) consists 3 rural kebeles while stratum 2 (Woina-Dega) consists 14 rural kebeles and stratum 3 (Kolla) consists of 6 rural kebeles. In the second stage, following simple random sampling method was used to select four sample kebeles (Dagaga Lenda, Chifisa, Dawe Sake and Anka Shashara). Finally, following systematic random sampling technique with probability proportional to sample size in each kebele 29, 64 and 28 rural households were sampled and interviewed from stratum 1, stratum 2 and stratum 3 respectively. The sample size for the study was determined following (Yamane, 1967); which is given as:

$$n = \frac{N}{1 + N(e)^2} \quad \text{---------(1)}$$

Where: n = sample size,

N = population size in the selected Kebeles and

e = precision level or sampling error which does not exceed 5-10%.

In this study 91% confidence level and e = 0.09 are inserted into above equation 1. Subsequently, final sample size of this research was calculated and given in table 2, *i.e.* 121 respondents were selected using systematic random sampling techniques.

Therefore, this calculated as:

$$n = \frac{5131}{1 + 5131(0.09)^2} = 121$$

Table 1: Sample Size Distribution by the Kebeles Administrations

Sample KAs	Total HHs	*Sample HH %	**Sample size
Dagaga Lenda	1209	23.56	**28**
Chifisa	1266	24.67	**30**
Dawe Sake	1455	28.36	**34**
Anka Shashara	1201	23.41	**28**
Total	5131	100	**121**

*percentage calculated by using (total population in individual KA divided to total population of all sample KAs) x 100.
**sample size calculated as (percentage x 121/ 100)
Source: Own Computed, 2017

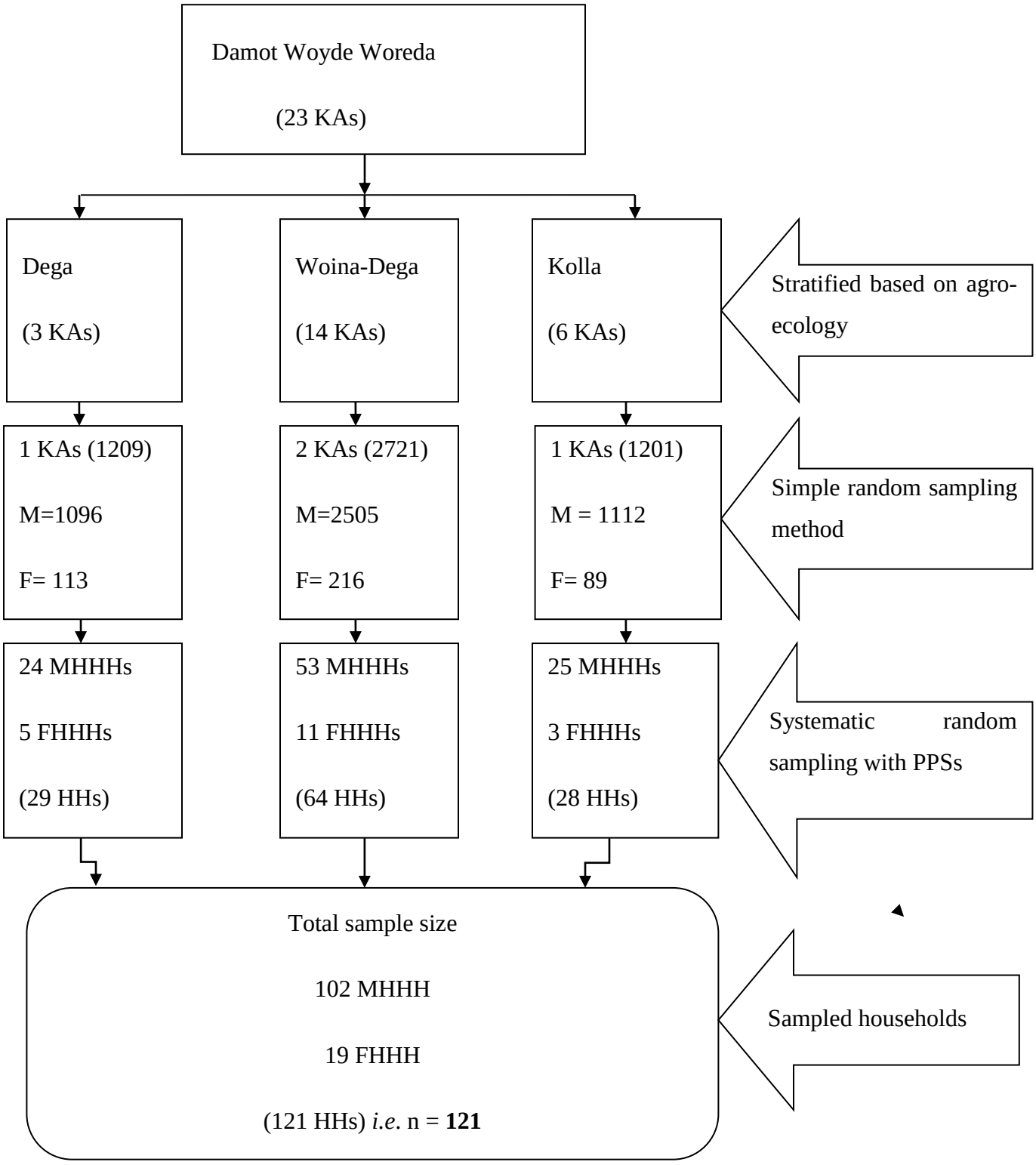


Figure 3: Schematic presentation of sampling techniques
Source: Woreda ANRD and Selected KAs

3.3. Sources and Methods of Data Collection

For this study both primary and secondary data were collected from different sources. The primary data was collected from the target respondents such as; sample households, key informants (KIs) and focus group discussants (FGDs) to address stated objectives. Quantitative data was collected through semi-structured questionnaries. To complement the quantitative data, qualitative data was also collected through focus group discussions, key informant interviews and personal obsevation. Secondary data which pertinent to the research were collected from relevant sources like ANRD, FED, published and unpublished documents and internets.

3.4. Methods of Data Analysis

In this study, both descriptive and econometric data analysis were employed.

3.4.1. Descriptive and inferential statistics

After completion of data collection, collected data were coded and entered into SPSS software for windows version 20. Hereafter, the data were cleaned and verified for analysis. Quantitative types of data such as; demographic and socio-economic factors of sample households and institutional conditions in the study area were analyzed using percentage, frequency, minimum, maximum, standard deviation, mean values and inferential statistics such as chi-square analysis and t-test. Interpretation and tabulation of data was done in order to analyze the data.

3.4.2. Econometric analysis

The purpose of this study was to assess the food insecurity status in rural households. The dependent variable in this case dichotomous varable, which took a value of one for food secure households and zero for food insecure ones. When one or more of the independent variables in a regression model are binary or dichotomous, we can represent them as dummy variables and proceed to analyze. Binary models assume that households belong to either of two alternatives and that depends on their characteristics. Hence, the aim of qualitative choice model is to determine the probability that a household was fall in one of either alternatives, in this study come to be food secure or food insecure.

The Probit and Logit models are commonly used and quite comparable in binary choice food security status (Gujarati, 2004). Therefore, in this study, Logit model was selected for its simplicity and less complexity of its interpretation. Moreover, (Train, 1986) pointed out it has got advantage over the others in the analysis of dichotomous outcome variable in that it is extremely flexible and which approaches zero at slower and slower rates as an independent variable (X_i) gets smaller and approaches one at slower and slower rates as X_i gets large. To identify determinants of rural households' food insecurity status the qualitative types of data were evaluated by using the structure of logistic regression model. The data analysis was conducted using STATA version 13. To these, the logistic distribution function is specified according to (Gujarati, 2004) as:

$$p_i = E(Y = \frac{f}{x}) = 1 \text{----------} (2)$$

$$p_i = E(y = \frac{1}{x}) = \frac{1}{1+e^{-(Bo+BiXi)}} \text{----------} (3)$$

For ease of exposition, the relationship between pi and Xi, which is non-linear, can be expressed as;

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

The slope show log-odd in favor of food security change as the respective independent variable change by a unit. The odds ratio is the probability that a household would be food secure (pi) to the probability that it was food insecure (1-pi) and can be expressed as:

$$(1-p_i) = 1 - \frac{1}{1+e^{-zi}} = \frac{e^{-zi}}{1+e^{-zi}} = \frac{1}{1+e^{zi}} \text{---------} (5)$$

So, $$\frac{p_i}{1-p_i} = \frac{1+e^{zi}}{1+e^{-zi}} = e^{z_i} \text{----------} (6)$$

This equation (6) indicates simply the odd-ratio in favor of a household would be food secured. The odds ratio is the probability that a household would be food secured (pi) to the probability that it will be food insecure (1-pi).

(Where: p_i is the probability that a given household being food secure ranges from 0 to 1, *e* represents the base of natural logarithms (2.718) and Z_i is the function of explanatory variables X_i, i= 1, 2, 3, ...m) which may be expressed as:

$$Z_i = \beta_o + \beta_1 x_1 + \beta_2 x_2 + - - - + \beta_m x_m$$

(Where: x_1 = age of household head, x_2 = Sex of household head, X_3=Educational level of household head, X_4= Family size, X_5=Income from off/non-farm activities, X_6= Cultivated land size, X_7=Use of inputs, X_8=Livestock ownership, X_9= Access to Credit, X_{10}= Land rented in, X_{11}= Land rented out, X_{12}= pest and disease, X_{13} = Frequency of extension contact and X_{13}= agro-ecology, β_o = intercept and $\beta_1, \beta_2, = - - -, \beta_m$ are slopes of the equation in the model).Finally, the logistic model is obtained by taking the natural logarithm of equation (6) as follows;

$$Li = \ln\left[\frac{p_i}{1-p_i}\right] = Zi - (7)$$

$$Z_i = \beta_o + \beta_1 x_1 + \beta_2 x_2 + - - - + \beta_m x_m$$

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

$$\ln\left(\frac{p}{1-p}\right) = Zi = B_o + B_1 X_1 + B_2 X_2 - - - - + B_n X_n + Ui - - - - - - - (8)$$

So, the logit model has $z_i = \beta_o + \sum \beta_i x_i + U_i$

(Where, $\beta_i s$ are parameters to be estimated by the model and the intercept ((β_o) tells how the log odds in favor of food insecurity of the households when all the independent variables are kept constant. Li = logs of the odds ratio, which is not only linear in X_i but also linear in terms of explanatory variables, zi = Vector of relevant explanatory variables). This procedure yields

unbiased and asymptotically efficient and consistent parameter estimates (Maddala, 1992; Gujarati, 1995 and Hosemer and Lemeshow, 1989). Changing an independent variable in this case, is expected to alter the probability that a given individual becomes food secure, and this will be helpful to predict the probability of achieving food security.

Before entering the selected variables in to the logistic regression model, the existance of multi-colinearity problems was cheched in terms of variance inflation factor (VIF) for the variables. Due to the existance of multi-colinearity affects serously the parameter estimates. If multi-colinearity turns out to be significance, the simultaneous presence of two variables will attenuate or reinforce the indiividual effects of these variables. However, omitting significant interaction terms incorrectly leads to a specification bias. Each selected continous explanatory variable (X_j) is regressed all the other continous explanatory variables, the coefficent of determination (R_j^2) being constructed in each case. If an approximate linear relationship exists among the explanatory variables then this should show up as a large value for R_j^2 in at least one of the test regressions. A popular measure of multicolinearity associated with the VIF (Xj) is expressed as: $$VIF(Xj) = (1 - R_j{}^2) - 1$$

Where: R_j^2 = is the cofficient of multiple determinations when the variable Y regressed on the other explanatory variable. A rise in the value of R_j^2 that is an increase in the degree of multi-colinearity does not indeed lead to an increase in the variances and the standard errors of the OLS estimators. As a rule of the thumb, when the variables having VIF values less than the cut off value (10) is believed to have no multicolinearity problems and those with VIF of above 10 is assumed to have a multicolinearity problem (Gujarati, 1995).

Similarly, there may also be interaction between two qualitative variables, which can lead to the problem of high degree of association between two variables. To detect this problem, contingency coefficients was computed from the survey data. The contingency coefficients are compute as follows: $$C = \sqrt{\frac{X^2}{N + X^2}}$$

Where: C=coefficient of contingency,

X^2= chi-square random variable and N= total sample size

Also heteroskedasticity problems were checked. The heteroskedasticity occurs when the variance of error term changes with changes in variables. The existance of heteroskedasticity can affect: the parameter estimators are efficient and the estimators of the variance are also biased and as a result the test of significance would be invalid. To detect this problem the Breusch-Pagan ttest were carried out.

3.5. Measuring Food Insecurity Status

There are different methods of food security measurement which have been widely used in most food security studies. In this study, household food insecurity status was measured by direct survey of consumption, from home production, purchase and /or gift/loan/ wage in kind for the last seven days food consumption recall method. According to (Guled, 2006), 7 days recall period is appropriate due to the fact that it is recent to recall of the food items for the household. If the time exceeds a week for instance 14 days, the respondent may not recall properly the size and pattern of food served. The same author added that this method was applied in many of poverty and livelihood studies conducted at national level in collaboration with International Food Policy Research Institute (IFPRI) and other international organizations.

The quantities were converted in to killo grams and the calorie content estimated by using the nutrient composition table of commonly used eaten food in Ethiopia (EHNRI, 1997) or the household per capita calorie intake was divided by seven, to get the household daily per capita calorie intake. Then the converted data was divided to household Adult Equivalent (AE). Therefore, the results were compared with the minimum subsistence requirement per AE per day (*i.e*. 2200 Kcal). This means that those households beyond which the estimated calorie requirement level (≥ 2200 Kcal per person per day) were said to be food secure otherwise, food insecure (MoFED, 2013).

Thus, food security index (Z) constructed which determine the food security status of each household based on the food security line using the recommended daily calorie requiement. This is given as: $$Zi = \frac{Yi}{R}$$

Where: Zi = food security status of i^{th} household i = 1,2,3... 121,

Yi = Daily per capita calorie intake of i^{th} households and R = The recommended per capita daily calorie intake. Then, those households whose Zi is greater or equals to 2200 Kcals per day were generalized as food secured (Zi = 1) and the others were concluded as food insecure (Zi = 0).

3.6. Definition of Model Variables

3.5.1. Dependent variables of the study

The dependent variable which was used in the logistic regression analysis is a binary variable which takes a value of one for food secured and zero for insecured households. The most important reason of a qualitative choice model is to determine the probability that an individual with a given set of attributes were make one choice rather than another. Household's food insecurity situation was determined by comparing total kilocalorie consumed in household per adult equivalent per day with the daily minimum requirement of 2200 Kcal/AE/day.

3.5.2. Independent variables of the study

After an analytical procedure clearly delineated, it is necessary to identify the potential explanatory variables that can influence the state of household food insecurity. Thus, the following explanatory variables were identified and their influences on household food insecurity situation were examined.

Sex of household head: It is a dummy variable and a person who economically supports or manages the household (*i.e.* 1 if the household head is male and 0 otherwise). Male-headed households have more access to agricultural technologies, more labor power and farm land as compared to female headed households. Whereas, Women farmers may need a long adjustment period to diversify their income sources fully and become food secure (Christina *et al*., 2001; Adugna Eneyew, 2008). Hence, male headed households are in a better position to pull labor force than the female-headed ones. Thus, it is hypothesized that male headed households are less likely to be food insecure than female headed households.

Age of household head: Age is a continuous explanatory variable peculiar to the household head. As age of household increases, it is assumed that farmers could acquire more knowledge

and experience. According to (Haile, 2005) an older households heads are expected to have better access to land than younger heads, because younger mean either have to wait for land redistribution, or have to share land with their families. However, as the age of the head of the household increases there is unable to work hard for the survival of his family members. In light of this, age of the head of the household and food insecurity is positively correlated.

Education level of household head: It is a dummy variable which takes a value of 1 for illiterate and 0 for literate. The education level of the households head in particular and the education levels of the households' members in general affect the households' livelihood in various ways (Tesfaye, 2003; Adugna, 2008). An educated household head has the capacity to innovate and to adopt timely technology and has better understanding of the cash crops that can help them to have a better income than the non-educated households (Fekadu, 2008). It has negative relationship between education level of the household head and household food insecurity according to the study of (Frehiwot, 2007). So, education status is hypothesized as negative relationship with food insecurity.

Family size: Is the continuous variable; which refers to the total number of household members who lived and eat with household head at least for six months. The larger the size of family accompanied by the more dependency ratio results livelihood insecurity in faming households (Bezmer, *et al*., 2002). Hence, an increase in household size implies more mouth to be feed from the limited resources. Similarly according to (Hilina, 2005) expectation is that, as the family size increases the probability of the household to have disguised unemployment increases which would in turn affect the well-being of the household. Therefore, it is hypothesized that large family size has positive relationship with food insecurity.

Cultivated land size: Is a continuous explanatory variable measured in hectare. It is prominent resource associated with household food security status. As the cultivated land size increases, provided other associated production factors remain the same, the possibility that the household gets more output is high. (Lewin and Fisher, 2010) point out that size of cultivated land and food insecurity has negative relationship. Therefore, it is hypothesized that households with large cultivated land will have less likelihood to be food insecure and vice versa.

Off/non-farm activities participation: This is a dummy variable which representing whether or not participation of a household head in diversified income. The presence of off-farm activity and ability to generate additional income had a positive association with household food security status (Tsegaye, 2009). Hence, households who did not engage in off-farm activities are more likely to face food deficit, if farm income is not enough. Yet, **(**Basher, 2010) indicated that the availability of off/non-farm income and food security has positive relationship. It is hypothesized that, households who managed to earn higher off/non-farm income are less likely to be food insecure. Thus, off/non- farm income is expected to have a negative impact on food insecurity.

Pest and disease: Is dummy variable and one of the factors affecting production and reducing yield. (FSB, 2007) reported that among the major challenges, pests and disease plays grate role of food security in Ethiopia. Hence, it is expected that households affected by pest and disease have positive linkage with household food insecurity than not affected households.

Farm inputs use: Is a dummy variable and refers to improved seed, chemical fertilizer, pesticide and herbicide. A household who used it produce more than non-users and have positive relation with food security status according to (Mequanent *et al.*, 2014). Therefore, it is hypothesized that use of inputs would be negative relation with household food insecurity.

Livestock owned (TLU): It is a continuous variable measured in tropical livestock unit (TLU). Livestock contributes as a source of transport, nutrition and income. It also serves as a means of coping mechanism during shortage of food or crop failure (Almaz, 2015). The types of animal reared in the woreda include cattle, sheep, goat, donkey and chicken these are the prominent sources of wealth to farm households. Hence, Households with large livestock size are expected to be less vulnerable to food insecurity. Therefore, it is hypothesized that livestock owned would be negative relation with household food insecurity.

Access to credit: It is a dummy variable and serves as a means to boost production and expand income generating activities, so that derived revenue increases and purchasing power of the household to escape from risk of food insecurity advances. Thus, it initiates investment in on-farm and/or off-farm activities and enhance sustainable food security (Devereux, 2006). Moreover, it helps to smooth consumption when household face with temporary food problem

(Tekle and Berhanu, 2015). So, it hypothesized that households who have access to credit are expected to be food secure.

Land rented in: It is a dummy variable that takes value of one if the household rent in land and zero otherwise. In most cases households rent in additional land for agricultural purposes in terms of fixed cash or share cropping (Yared, 1999). The arrangement allows an increment in cropped land and production which in turn increases food security. Thus, it is hypothesized that land renting in has negative correlation with household food insecurity.

Land rented out: This is a dummy variable that takes value of one if household rent out land and zero otherwise. Land rent out is renting own land in terms of fixed cash or sharecropping for agricultural purpose (Yared, 1999). This arrangement is hypothesized to be correlated positive with the household food insecurity.

Frequency of extension contact: Is a continuous variable and the effort to disseminate new agricultural technologies are mainly successful if there is smooth and frequent contact between development agent and the rural household. Here, extension contact between a farmer and development agent has potential force to accelerate effective dissemination of adequate agricultural information, which in turn, enhances farmers' decision to adopt new technologies (Kidane *et al*., 2005). Therefore, it is hypothesized that households who frequent extension contact would have negative relation with household food insecurity than zero contact.

Agro-ecology: This is measured as a dummy variable which take value 0 for Kolla and 1 for Dega and Woina-dega each representing the agro-climatic zone respondent belongs to. It was hypothesized that households who lives in Kolla were more likely to be food insecure.

Table 2: Summary of variables, definitions, measurement and hypothesis

Name of Variable	Descriptions of variables	Variable types	Variable Value	Sign
AGEHHH	Age of household head	Continuous	Year	+
SEXHHH	Sex of household head	Dummy	1=Male,0=Female	-
FAMISIZE	Family size	Continuous	Number	+
EDULHH	Educational level of head	Dummy	1=illiterate, 0=literate	-
CULTLAN	Cultivated land holding	Continuous	Hectares	-
INPUT USE	Use of inputs	Dummy	0= No, 1= Yes	-
PESTDIS	Pest and disease	Dummy	0= No, 1= Yes	+
LIVOWN	Livestock	Continuous	TLU	-
CREDACC	Accesses to credit	Dummy	0= No, 1= Yes	-
OFF-FAAC	Off/non-farm activity	Dummy	1= participate, 0	-
LANREIN	Land rented in	Dummy	1 =if rent in, 0	-
LANREOU	Land rented out	Dummy	1=rent out, 0	+
FREXTCONT	Extension contact frequency	Continuous	Number	-
AGR-ECO	Agro-ecology	Dummy	1= Dega and Woina-Dega, 0= Kolla	-

Source: Own computation, 2017

3.7. Coping strategies

Data regarding the local coping strategies practiced by the rural households differ among households as the level and intensity of food insecurity conditions vary at different stages. In order to identify the different coping strategies at different stages, initial and severe stage coping strategies employed by vulnerable groups were collected. To obtain this information, list of alternative coping strategies at initial and severe stage were presented to the respondents. So, they can rank according their preferences in such a way that they give one for the strategy they employed first and five for least, at each stage. Then, simple descriptive statistics (percentages and frequencies) were employed in addressing the local coping strategies of rural households.

4. RESULTS AND DISCUSSION

In this section, the analytical results of the study are presented and discussed. The first section presents the descriptive results of the study pertaining to previously determined specific objectives. It followed by the discussion of econometric model results; while the final section deals with households coping strategies.

4.1. Descriptive Results

In this subsection, the descriptive analysis were addressed through describing the characteristics of the sample households in terms of the major independent variables; these are demographic characteristics (sex of household heads, age of household heads, family size and educational level of household heads), socio-economic factors (cultivated land size, livestock owned, off/non-farm participation, pest and disease problem, land rented in or out), institutional factors (credit access, frequency of extension contacts and use of farm inputs) and coping strategies (Sale of more livestock than usual, Borrowing of food, Sale of firewood/ charcoal and short term migration).

4.1.1. Household characteristics for continuous variables

This section presents some of the demographic and socio-economic characteristics of the respondent households which are unceasing considered in this study, those variables have influential relationship to the food insecurity situation of a household in the study area. As indicated in the table 3, age is an important demographic characteristics of the household assumed to bring food insecurity difference among the rural households. The average age of the total sampled household heads was 50.82 years while, the age of sampled respondents ranges from 25 up to 77 years. Similarly, the mean age of food secure and insecure household heads were 45.71 and 54.29 years respectively. The t-test value (4.482) revealed that there is significant mean difference between the two household groups with respect to their age at less than 1% probability level. Compared to food insecure households, the food secured households had small age. The reason for this could be, when age gets older the household head becomes physically weaker and potentially unable to undertake different productive activities.

The average total sampled household size was 6.13 while the maximum and minimum sample respondent family sizes were 9 and 2 respectively. Furthermore, the mean family size of the food secure and food insecure households were 4.67 and 7.13 respectively. In addition, there is significant mean difference between the two household groups with respect to their family size at less than 1% probability level. The survey result showed that the households with large family numbers were more likely to be insecure than their counterparts.

The cultivated land holding per sampled households ranged from 0.094 ha to 2.75 ha and the average total cultivated land size was about 0.889 hectare with mean cultivated land size of food secure and insecure households were 1.497 (SD. 0.623) and 0.476 (SD. 0.539) respectively. There was statistically significant difference between food secure and insecure households in their mean cultivated land at less than 1% probability level. In addition, during in the time of FGD, the discussants confirm that the study area is categorized by very small and highly fragmented land holdings. Thus, the result shows that food insecure households were relying on very small pieces of land to meet their food requirement.

Livestock production is also an important source of livelihood which contributes as a source of transport, nutrition, income and serves as coping strategies during food deficit. The survey results revealed that, the minimum and maximum livestock holding range from 0 up to 8.3 TLU and its average size of livestock is 2.329 TLU. The mean livestock holding for food secure and insecure households were 3.688 (SD=1.967) and 1.404 (SD=1.313) TLU respectively. The t-test value for means between food secure and insecure households shows that there was statistically significant mean difference at less than 1% probability level.

Also, during in the time of FGD concisely discussed that the livestock ownership is detrimental to the food insecurity situation in the study area. Especially, those who lack ox/oxen ownership are highly exposed to food insecurity, since farming activity mainly performed with oxen power and ownership of it determines the amount of production and income of a household. In general households with large livestock size are less vulnerable to food insecurity.

Rural farm households who have access to frequent extension services are more likely to adopt better technologies to improve production and productivity. Hence, it was hypothesized as, farmers who use frequent services are found to be food secure than those less contact. In this

study, farmers advised and visited a number of times by development agents per a year to identify and analyze their production problems by making them aware of opportunities for improvement. The survey result revealed that the mean frequencies of extension contact for the food secure and insecure households were 17.29 and 7.44 per year respectively. The maximum and minimum extension contact frequency in the sample households was 24 and two times per a year. The t-test value showed that there is a significant mean difference between the two household groups at less than 1% probability level. Thus, extension agents are the major sources of information provides; technical support, advice on use of technology, encourage participation for extension package and other development issues which have cumulative impact for enhancing production and productivities (Table 3).

Table 3: Household characteristics for continuous variables

Variables	**Food insecurity status**		**Mean**	**SD.**	**Mean**	**Min.**	**Max**	**t-value**
Age HH	Insecure	72	54.29	10.548	50.82	25	77	4.482***
	secure	49	45.71	10.186				
Family size	Insecure	72	7.13	1.162	6.13	2	9	10.094***
	Secure	49	4.67	1.505				
Cultivated land in ha	Insecure	72	0.476	0.539	0.889	0.094	2.75	-9.597***
	Secure	49	1.497	0.623				
livestock (TLU)	Insecure	72	1.404	1.313	2.329	0	8.3	-7.663***
	Secure	49	3.688	1.987				
Extension contact frequency	Insecure	72	7.44	4.847	11.43	2	24	-11.391***
	Secure	49	17.29	4.383				

Note: ***Significant at 1% probability level
Source: Own survey results, 2018

4.1.2. Household characteristics for discrete variables

As represented (table 4), the 121 sample households were used to collect relevant data pertaining to the objectives. Responses were collected from the household heads; of the total households, 102(84.3%) were male-headed and female-headed constitute about 19(15.7%). Among food secure households, 30.6% were male-headed and the remaining 9.9% were

female-headed. On the other hand, from food insecure households 53.7% were male-headed and the remaining 5.8% were female-headed.

Education is an important determinant of food insecurity to perform farming activities based on cropping calendar and to manage resource properly like modern agricultural technologies which assist to increase production and improves availability and accessibility of enough food. In the study area, the survey result revealed that 56.2% of the sample household heads were illiterate of which about 11.6% were from food secure and 44.6% were from food insecure group.

The availability of off-farm activity participation supports the households' food security by increasing income. Among food secure and insecure households 39.6% were found to have experience of participation in off-farm activity. On the other hand, the rest 60.4% households were not participated in off-farm activity. However, the chi-square test value (χ^2= 0.045) result revealed that there is no statistically significant difference between the household off-farm activity and food insecurity situation. But, during on the KIs and FGD sample households strongly mentioned that the off-farm income used as a means to cope the challenges at the food shortage period.

From the total interviewed respondents about 16.5% and 36.4% households of the food secure and insecure households were found to be affected by pest and disease problem respectively. However, 23.1% and 24% of the food insecure and secure households were found to be not affected by pest and disease problem respectively. Moreover, during on the KIs and FGD the discussant households strongly mentioned that the pest and disease problems are the main challenges of the crop production in last cropping season in the study area.

As of 121 sampled households, about 51.2% of the respondents reported to have used chemical fertilizer in the last cropping season, of which food secure households constitute 35.5% and 15.7% for food insecure. Similarly, above 50.4% of the sample respondents used improved seed variety in the last cropping season. The chi-square test value result revealed that there is a significant difference between the household of inorganic fertilizer and improved seed variety users and non-users at less than 1% probability level.

Access to credit hypothesized that income generating activity which helps the households to purchase agricultural inputs in order to escape from risk of food insecurity in the study area. However, the survey results revealed that from total sample households about 69(57%) have access to credit and 52(43%) have not credit access. Among food secure and insecure households 33% and 24% were found to have access to credit respectively. Likewise, about 7.4% and 35.5% of the food secure and insecure households' have not access to credit respectively. The t-value (20.348) confirmed that there is significant difference between food insecure and secure households in terms of credit access. Hence, households which have access to credit are more food secure than households which have not access to credit.

Rural households who had accessibility to rent in land were capable to increase income of the household improving production and productivity. The survey result in this regard revealed that the percentage of respondents who undergone land rented in was about 36.3% in the study area, of which food secure and insecure households contribute 22.3% and 14% respectively. Shortage of land, poor land fertility and excess agricultural labor and inaccessibility of farm land to undertake agricultural activities were the major reasons to carry out this arrangement. On the other hand, from the total households about 37.2% of the sample respondents confirmed as rented out the land, of which food secure households contribute 2.5% and 34.7% for insecure. Shortage of agricultural labor, lack of draught oxen, excess land possession and inability to purchase agricultural input such as improved seed, chemical fertilizer and chemicals; and lack of access to credit is the underlined reasons for renting out their land as a means of solution to endure the challenges that is strongly mentioned on the FGD and KIs discussion. The results revealed that there was significant difference on the land rented in/ out activity to the household of food insecurity situation at less than 1% probability level.

Agro-ecology is also the most important determinant of food insecurity to adopt farming activities such as modern agricultural technologies. In the study area, the survey result revealed that 9.1% and 31.4% of the sample households were agro-ecologically food secure in kola and dega and woina-dega; whereas, 13.2% and 46.3% were food insecure in kola and dega and woina-dega respectively. Hence, households who adopted agro-ecological based technology are more food secure than households who not adopted (Table 4).

Table 4: Household characteristics for discrete variables

Variables	**Categories**		**Total households (N=121)**		x^2 **-value**
			Frequency	Percentage	
Sex HH	Insecure	Male	65	53.7	4.804*
		Female	7	5.8	
	Secure	Male	37	30.6	
		Female	12	9.9	
Education level HH	Insecure	Literate	18	14.9	25.533***
		Illiterate	54	44.6	
	Secure	Literate	35	28.9	
		Illiterate	14	11.6	
Off/non-farm participation	Insecure	Yes	28	23.1	0.045
		No	44	36.4	
	Secure	Yes	20	16.5	
		No	29	24	
Pest and disease problem	Insecure	Yes	44	36.4	4.820*
		No	28	23.1	
	Secure	Yes	20	16.5	
		No	29	24	
Chemical fertilizer	Insecure	User	19	15.7	43.947***
		Non-user	53	43.8	
	Secure	User	43	35.5	
		Non-user	6	5	
Improved seed variety	Insecure	User	18	14.9	45.934***
		Non-user	54	44.6	
	Secure	User	43	35.5	
		Non-user	6	5	
Credit access	Insecure	Yes	29	24	20.348***
		No	43	35.5	
	Secure	Yes	40	33	
		No	9	7.4	
Land rented in	Insecure	Yes	17	14	12.495***
		No	55	45.5	
	Secure	Yes	27	22.3	
		No	22	18.1	
Land rented out	Insecure	Yes	42	34.7	34.026***
		No	30	24.8	
	Secure	Yes	3	2.5	
		No	46	38	
Agro-ecology	Insecure	Kolla	16	13.2	0.001
		Dega and wo-dega	56	46.3	
	Secure	Kolla	11	9.1	
		Dega and wo-dega	38	31.4	

Note: * and***are significant at less than 10% and1% probability level respectively.
Source: Own survey results, 2018

4.1.3. Household food insecurity status of sample households

Food insecurity status at household level measured in many ways. In this study, it was assessed by direct survey of consumption/caloric acquisition from sample households per AE per day employed to identify the food secure and food insecure households. Data on food consumption including own production, purchases and transfers in terms of gifts or wage in kind the last seven days were collected and further converted into calorie values using Food Composition Table for Ethiopia (EHNRI, 1997). Following this, the amount of energy in Kcal available for the household was calculated on a person- day basis. Then, the results were compared with the minimum recommended calorie; *i.e.* 2200 Kcal (MoFED, 2013). Based on this criterion, the household categorized as food insecure if their caloric consumption is less than 2200 Kcal per AE per day and food secure if its consumption was above.

As a result, from the total sample respondents, 72(59.5%) households were found to be food insecure and 49(40.5%) of them food secure. The minimum and maximum calorie consumed by a single adult in a day for food insecure households were 959 and 2166 Kcals and that of the food secure households were 2208 and 5059 Kcals respectively. The mean calorie amounts became 3029.35 kcals for food secure and 1898.49 kcals insecure households. Consequently, the standard deviation for food insecure and food secure households were found to be 692.81 kcals and 324.37 kcals respectively. The t-test (9.037) value indicates that, there was statistically significant mean difference in calorie consumption between food insecure and secure households at less than 1% probability level. The survey results revealed that, the majority (59.5%) of households were not able to meet the recommended daily calorie intake (2,200 kcal) per day per AE. Hence, the study area was regarded as food insecure and special consideration is needed to address those to meet the recommended calorie intake (Table 5).

Table 5: Households' food insecurity status

Calorie consumption per AE	**Food secure (N=49)**	**Food insecure (N=72)**	**Total (N=121)**
Minimum	2208.00	959.00	959.00
Maximum	5059.00	2166.00	5059.00
Mean	3029.35	1898.49	2356.44
SD	692.81	324.37	751.65
t-value = 9.037* **	**mean difference = 1130.86**		

Note: *** Significant at less than 1% probability level
Source: Own survey result, 2018

4.1.4. General food insecurity situation of the sample household

As shown in Table 6, from the 121 respondents more than 58% stated that strongly disagree and disagree on the availability of food to feed their family members throughout the year. This indicates that the majority of respondents in the study area have no enough physical availability of food throughout the year. Likewise, about 62% of sample households conveyed that strongly disagree and disagree on the accessibility of good physical and economic access to food for their family members throughout the year. This indicates that the majority of respondents in the study area have no enough physical and economic accessibility and availability of food throughout the year.

The result shows that from the total sample households, about 10% mentioned that agree and strongly agree on the acceptability of food that was nutritious and safe, and produced in environmentally sustainable ways throughout the year for their family members. This shows that, about 86.8% of the respondents have no adequate food for their family members. In addition, from the total sample households about 84% are reported that agree and strongly agree on the availability of food and access to food are unstable. This confirms that in the study area there was no food stability throughout the year for their family members. Also, more than 87% of the respondents were reported that strongly disagree and disagree on the utilization of healthy diet for all their family members throughout the year (Table 6).

Table: 6 General food insecurity situation of the sample household

Variables	Categories	Frequency	Percentage
There is enough food available in your farm land to feed the family members throughout the year	Strongly disagree	28	23.1
	Disagree	43	35.5
	Neutral	5	4.1
	Agree	43	35.5
	Strongly agree	2	1.7
	Total	**121**	**100**
All family members in your farm land have good physical and economic access to food through the year.	Strongly disagree	35	28.9
	Disagree	40	33.1
	Neutral	6	5.0
	Agree	34	28.1
	Strongly agree	6	5.0
	Total	**121**	**100**
All family members in your farm land have access to food that is nutritious and safe, and produced in environmentally sustainable ways	Strongly disagree	71	58.7
	Disagree	34	28.1
	Neutral	4	3.3
	Agree	10	8.3
	Strongly agree	2	1.7
	Total	**121**	**100**
There are periods where all family members in your farm land are food insecure b/c availability of food or access to food is unstable	Strongly disagree	3	2.5
	Disagree	9	7.4
	Neutral	7	5.8
	Agree	52	43.0
	Strongly agree	50	41.3
	Total	**121**	**100**
In your farm land all family members use their food in ways that amount to a healthy diet	Strongly disagree	64	52.9
	Disagree	42	34.7
	Neutral	4	3.3
	Agree	7	5.8
	Strongly agree	4	3.3
	Total	121	100

Source: Own survey results, 2018

4.2. Econometric Analysis

In this section binary logistic regression model was used, which specified in the methodology part of this study, to see the relative influence of household‘s demographic, socio-economic and institutional variables on food insecurity situation. Before running the model, the presence of strong multicollinearity among the hypothesized continuous and dummy explanatory variables were checked by using Variance Inflation Factors (VIF) and contingency coefficient (CC) test respectively. The result revealed that there was no strong multicolinearity problems

among the variables included in the model (Appendix Table 4 and 5) respectively. Hence, none of the continuous and dummy variables were excluded from the model due to multicolinearity problem. Heteroscadesticity was also checked as shown (Appendix Table 6) that there is no problem of Heteroscadesticity. The overall model goodness of fit represented by model count R-square is very good and about 87.8% of the households were correctly predicted out of the 121 household heads. This indicates that the model has adequately estimated the respondents in terms of the variables considered.

4.2.1. Determinants of rural household food insecurity

This section presents and discusses empirical findings of econometric model result. The estimates of variables expected to determine the rural household food insecurity status are displayed (Table 7). The result shows that, from the total of fifteen explanatory variables which were included in the model, six variables were found to be statistically significant in influencing the food insecurity situation, while the remaining nine variables were statistically insignificant. Those statistically significant variables are sex of household heads, age level of household head, education level of household head, family size, cultivated land in hectare and use of chemical fertilizers (Table 7).

Sex of the household head:

According to the estimation result, female headed households were found more food insecure than the male headed households. But, this result is contrary to what was expected and theoretically difficult to interpret. It was found statistically significant at 10% probability level with the associated negative relationship between sex of household heads and food insecurity. It means that being female headed decreases the likelihood of food insecurity by 0.843%, all other things being equal. However, during the survey there are small numbers of sample female headed households; these might have influenced the result.

Age of household head:

Age is a continuous explanatory variable that matters in any occupation and peculiar to the household heads. In the study area, this variable was significant at less than 5% probability level and affects food insecurity situation negatively. The negative relationship implies that

older age household heads have better chance to be food insecure than younger ones due to they are less productive and physically weak as well as potentially unable to undertake different productive activities. Furthermore, they could not participate in other income generating activities hence; they lead their life by gifts. On the other hand, older aged head face family labor shortage. This result confirms with the findings of (Ojogho, 2010).

Education level of household head:

This variable affects food insecurity situation positively and significantly influence at 10% probability level. The positive relationship indicates that the literate households are more food secure than illiterate households due to they are more sensitive to adopting technology and visionary in creating conducive environment to ensure better living condition than illiterate ones. Also the coefficient indicating that, an illiterate household heads to be increases the probability of the household to be food insecure of the households by 0.438% (Table 7). The finding of this study was the same with what had been found by (Mequanent, 2014).

Family size:

Family size was hypothesized to have negative influence on household food security. Accordingly, it is significant at less than 5% probability level and had a negative association with household food insecurity which implies that the probability of being food secure decreases with an increase an individual in household size by 6.132 influence (Table 7). That means households with large family size, mainly composed economically non-productive population could face the probability to be food insecure due to high load put on active population. This result coincides with findings of (Guled, 2006); (Tekele and Berhanu, 2015).

Cultivated land in hectare:

The study result shows that cultivated land size is positively related with food security and statistically significant at 5% probability level. The coefficient of the variable implies that increasing cultivate land size, increases availability of yield to the households by a 0.889 factor (Table 7). That means, when cultivated land increases the household would be able to produce more which in turn helps to reduce food insecurity problem and ensure food security. Moreover, holding of high size of land is an alternative for factors such as access to credit,

wealth and income which raise the possibility of investment in purchase of farm inputs. This outcome agrees with (Zerihun, 2009) and supported by (Tekele and Berhanu, 2015).

Use of chemical fertilizer:

This variable was one of an important determinants affecting household food security. It has a positive relationship with food security in the study area and statistically significant at 10% probability level. The positive relationship indicates that households who were used chemical fertilizer are more likely food secure than not chemical fertilizer user.

Table 7: Determinants of rural household food insecurity model result

Variables	**Coef.**	**Std. Err.**	**Mfx**	**Z**
Sex of household head	-3.514095	1.98261	.842975	-1.77*
Age of household head	-.1674226	.0765602	50.8182	-2.19**
Family size	-1.635254	.7216841	6.13223	-2.27 **
Education level of HHH	3.316999	1.766811	.438017	1.88*
Cultivated land in ha	2.277062	1.076896	.889554	2.11**
Total livestock unit (TLU)	-.2025827	.3948598	2.32893	-0.51
Frequency of extension contact	.1154729	.1237186	11.4298	0.93
Off/non-farm participation	-1.39617	1.517001	.396694	-0.92
Pest and disease problem	1.785298	1.596879	.528926	1.12
Use of chemical fertilizer	4.47037	2.45237	.512397	1.82*
Use of improved seed	.4946738	1.149024	.504132	0.43
Credit access	-2.741383	2.217062	.570248	-1.24
Land rented in	.0968179	1.578717	.363636	0.06
Land rented out	-1.435723	1.890613	.371901	-0.76
Agro-ecology	-.3661503	1.23216	.77686	-0.30
Constant	14.39349	6.927866		2.08**
Number of obs = 121				
LR chi^2 (15) = 135.19				
Pro > chi^2 = 0.0000				
Pseudo R^2 = 0.8277				
Adj Count R^2 : 0.878				

Note: ** and * means significant at less than 5% and 10% probability levels, respectively.
Source: - Own survey results, 2018

4.4. Coping Strategies to Against Food Insecurity

Food shortage in the study area is common phenomenon due to irregular rain fall situation viz. it does not come on time and excess during harvest time, soil infertility problem and population density. However, the respondents employed different coping strategies to escape initial and severe stage of food shortage. As illustrated (Table 8), the survey result revealed that, the households used several coping strategies to mitigate the effects of food shortage at different stages. At initial stage 62% ate less preferred foods, 68.6% borrow grains or cash from relatives/friends, 59.5% reduce number of meals, 59.5% reduce size of meals and sale of firewood, charcoal or grass as their 1st, 2nd, 3rd, 4th and 5th rank of coping strategies respectively. Similarly, the sample households respond differently when the food shortage becomes severe.

Unlike to the initial stage of food shortage the respondents replied to the sever stage in a different way. These are sale of more livestock than usual (76.9%) as their first option followed by food for work (72.7%), like wise they also employed sale or consume of seed meant (62.8%) for next season planting, sale of production equipment (61.2%) as their fourth and food aid (52.1%) as fifth alternative and also short term migration of some family member, sale of agricultural tools and children discontinue from school respectively were also among the important coping strategies used in the study area.

Table: 8 Categories of coping strategies at **initial** and **sever** stage of food deficit

Rank	Variables	Frequency	Percentage
1st	Ate less preferred food	75	62
2nd	Borrow grain or cash from relatives/friends	83	68.6
3rd	Reduce number of meals	72	59.5
4th	Reduce size of meals	72	59.5
5th	Sale of firewood /charcoal, grass	98	81
	At sever stage		
1st	Sale of livestock more than usual	93	76.9
2nd	Participate in food for work	88	72.7
3rd	Sale/consume seed meant for production	76	62.8
4th	Sale of production equipment	74	61.2
5th	Food aid	63	52.1

Source*:* - Own survey results, 2018

5. CONCLUSION AND RECOMMENDATIONS

On the base of the findings of the results presented in the preceding chapters, this chapter attempts to present the general conclusions and useful recommendations.

5.1. Conclusion

This study was conducted to examine food insecurity situation of rural households and coping strategies using descriptive statistics and binary logistic regression model to ascertain factors that influence rural households in Damot Woyde Woreda. The survey result of this study indicated that, from total sample households 59.5% were food insecure and unable to get the minimum daily energy requirement. Also, in the study area, only 40.5% of the household were food secure while their own production was not covering yearly consumption requirement of rural households.

In general, the majority of respondents in the study area have no enough physical and economic availability and accessibility of food throughout the year i.e., from the total respondents more than 58% and about 62% respectively were conveyed that strongly disagree and disagree. Similarly, more than 84% household respondents were confirmed that there was no adequate, stable and utilization of food for their family members throughout the year.

The output of the binary logistic regression model revealed that, out of fifteen independent explanatory variables entered in the model, six variables were found to be statistically significant in influencing food insecurity status while the remaining variables were statistically insignificant. These significant variables are; sex of household head, age of household head, family size, education level of household head, cultivated land in hectare and use of chemical fertilizer.

The study was also investigated some coping mechanisms employed during food shortage. So, the survey result of this study indicated that, 62%, 68.6%, 59.5%, 59.5% and 81% of the vulnerable groups use shifting to less preferred food staples, borrowing cash or grain from relatives/friends, reducing number of meals, reducing size of meals and sale firewood, charcoal or grass as their 1^{st}, 2^{nd}, 3^{rd}, 4^{th} and 5^{th} coping strategy respectively during at initial stage of

food deficit. Similarly, 76.9%, 72.7% , 62.8%, 61.2% and 52.1% of the vulnerable households employ sale of more livestock than usual, food for work, sale or consume seed meant for next season planting, sale of production equipment and sale of agricultural tools as their 1st, 2nd, 3rd, 4thand 5th coping strategy respectively during at sever stage of food stress.

5.2. Recommendations

Based on the findings of this study, the following recommendations are stated as a possible area of interventions to improve food insecurity situation and coping strategies:

- Age of household head has significant association with household food insecurity. The households which led by older age should be taken in to account by policy maker government body and non-governmental organization during the design and implementation of whatever rural development programs in general and food security programs and projects in particular. This can be done to build their capacity through benefiting them to improve their households' food insecurity status.
- Household size was found to be directly related with household food insecurity. Therefore, a rapidly increasing population needs to be delayed through designing and implementing appropriate decisions and measures. This can be done in collaboration with agricultural and health sector offices through creating strong awareness and training different family planning alternatives as far as the issue are concerned.
- Education is another determinant for the rural household food insecurity. The effect of education on household food insecurity confirms significant role of the variable in consideration for betterment of living condition. Hence, it is vital to develop their skills how to use and control farm lands, apply farm inputs and adopting new technologies and others. Therefore, more emphasis should be given to adult learning education to the illiterate households of in the study area by government or other concerned parties to reduce food insecurity.
- Farm size is one of critically determinant factor which influences the rural household food insecurity. Agricultural strategies should be designed and implemented that would have effect on maintaining the existing land size on one hand through promoting intensive agriculture and livestock production on the other hand. By doing this, the rural

households have to keep the quality of the cultivated lands with good physical and biological conservation measures to improve the fertility of soils and raise land productivity.

- Chemical fertilizer is the most important factor for crop production. Therefore, government and non-government should taken attention by providing it and to use the recommended rate on time.
- Different coping strategies were used up at initial and sever stages by rural households to against food deficit in the study area. The study result indicates that source of income and diversifications of activities were very much important factors to determine the most vulnerable households. Thus, interventions should be carried out so as to reduce vulnerability of food insecure through economically feasible alternatives. Therefore, the government should have to give technical skill training in order to increase the income of the household and link these rural food insecure households for the different projects which are food and cash for work activities.
- In general, attention should be focused in order to achieve farm household's food security by designing strategies addressing the identified factors as well as other determinants that are useful to achieve rural household food security.

6. REFERENCES

Abebaw S., 2003. Dismensions and determinants of food security among rural households in Dire Dawa, Eastern Ethiopia. MSc. Thesis Presented to the School of Graduate Studies of Alemaya University. Ethiopia, Alemaya, 152p.

Adugna E. and Wagayehu, B., 2012. Causes of household food insecurity in Wolayta: Southern Ethiopia. *Agr. Res. Rev.*, 1(1): 153-161.

Adugna E. and Wagayehu, B., 2012. Causes of household food insecurity in Wolayta: Southern, Ethiopia.

Adugna Eneyew, 2008. Livelihood Strategies and food security in wolayta, Southern Ethiopia: The case of Boloso Sore District. M.Sc. Thesis Haramaya University, Ethiopia.

African Development Bank, 2014. Africa Food Security Brief: Special focus on climate Africa Food Security change Impacts. Statistics Department, Issue No 5, April 2014.

Almaz Balta, Ayele Tesema and Debebe H/wold. 2015. Assessment of Household Food Security and Coping Strategies in Wolaita Zone: The Case of Soddo Zuria Woreda. Hawasa University and National University of Ireland; College of Cork. Vol.18, 2015.

Amaral, Cristina, Gary Eilerts, Laouali. Ibrahim, Joyce Luma, and Jean Senahoun, 2012. Reflections from a Joint Multiple-Agency Examination of the Sahel Food Security Crisis.

Arega Bazezew Berile. 2013. Determinants of Rural Household Food Security in Drought Prone Areas of Ethiopia: Case study in Liay Gaint District, Amhara Region.

Arimond and Ruel, 2004. Measuring food insecurity. The American Society for Nutritional Sciences.

Aschalew FA., 2006. Determinants and dimensions of household food insecurity in Dire Dawa city, Ethiopia: Case study in LiayGaint District, Amhara Region.

Asghar, Z. and Muhammad A., 2013. Socio–Economic Determinants of Household Food Insecurity in Pakistan. Munich: MPRA.

Ayalew Y., 2003. Identification and Intensity of Food Insecurity and Coping Strategies of Rural Households in North Shoa: The Case of Lalomama. M.Sc. Thesis presented to the School of Graduate Studies of Alemaya University, Alemaya. 221p.

Ayieko MA, Midikila K., 2010. Seasonality of Food Supply, Coping Strategies and Child Nutritional Outcome in Sabatia-Kenya. *Advance Journal of Food Science and Technology*.

Barrett, C.B., 2010. Measuring Food Insecurity. Science.327, 825.

Barrett, Christopher B., and Erin C. Lentz, 2010. Food insecurity, in: Denemark, R.A. (Ed.), The International Studies Encyclopedia, volume IV. Wiley-Blackwell, Chichester, UK.

Basher Sheikh, 2010. Analysis of Food Security Status and Copping Strategy in Kabribayah District of Jigjiga Zone of Somali Regional State. An M.Sc Thesis Presented to the School of Graduate Studies of Haramaya University. 60p

Bedeke S., 2012. Food insecurity and coping strategies: a perspective from Kersa district, East Hararghe Ethiopia. *Food Science and Quality Management*.Vol 5, 2012.

Beyene, F.; Muche, M., 2010. Determinants of Food Security among Rural Households of Central Ethiopia: An Empirical Analysis. *Quarterly Journal of International Agriculture* 49 (2010), No. 4: 299-318

Bezmer, D. J. and Lerman, Z., 2002. Rural livelihoods in Armenia: The center for Agricultural Economic Research, the department of Agricultural Economics and management Discussion Paper No. 4.03.

Bill and Melinda, 2010. Gates Foundation "Accelerating Ethiopian Agriculture Development for Growth, Food Security and Equity", Addis Ababa.

Bogale Gebeyehu, G.R., Mesfin Tebeje, 2014. Rural Households Food Security and Livelihood Strategies: The case of Offa Woreda, in Wolaita, SNNPRS, Ethiopia. ijeress, july, 4(7).

Bonsa J., 2016. Ethiopia Productive Safety Net Program: Chasing two Rabits, Catching Neither- September 8, 2016. *Special to Addis Standard.*

Boussard, J., Ganul, K. and Benoit, D., 2005. Food Security and Agricultural Development in Sub-Saharan Africa: Building a Case for More Support. Background Document for FAO.

Chantarat Sommarat, Christopher Barrett, Andrew Mude, and Callum Turvey, 2007. Using Weather Index Insurance to Improve Drought Response for Famine Prevention. *American Journal of Agricultural Economics*, 89(5), 1262-1268.

Chirtina H., M. Tomas, S. Jenifer and S. Anderson, 2001.Addressing food security in Africa Via multiple livelihood strategies of women farmers. *Journal of food policy*, 1:177-207.

Clover J., 2003. Food security in Sub-Saharan Africa. *African food security review*.1:2000-2009

CSA, 2010.Central Statistical Authority (CSA). Ethiopian Population & Housing censes 2007, Addis Ababa, Ethiopia

Debebe Habtewold, 1995. Food security: A brief review of concepts and indicators, proceedings of the inaugural and first annual conference of the Agricultural economics society of Ethiopian June 8-9, Addis Ababa, Ethiopia.

Degefa, T. 2005. Rural Livelihoods, Poverty and Food Insecurity in Ethiopia: A Case Study of Ernessa and Garbi Communities in Oromiya Zone. Amhara National Regional State. Published PhD Thesis, Norwegian University of Science and Technology, Norway.

Devereux S, Vaitla B and Haunstein S., 2008. Seasons of hunger: fighting cycles of quiet starvation among the world's rural poor. London: Pluto Press.

Devereux, S. and I. Sussex, 2000. Food Insecurity in Ethiopia, a discussion paper for DFID. Addis Ababa.

Devereux, S. and Naeraa, T. 1996. Drought and Survival in Rural Namibia. *Journal of Southern African Studies* 22 (3):421-440.

DPPC, 2010. Disaster Prevention and Preparedness Commission. Half year report on food security situation of SNNPR, Ethiopia.

DPPC, 2012. Report on regional disaster prevention and preparedness activities to regional agricultural bureau. DPPC: Addis Ababa, Ethiopia.

DWWANRD, 2017. Damot Woyde Woreda Agricultural and Natural resource Development Office. Annual Report on Emergency, Food Security and Early Warning. *Econometrica 2(81):761-766*.

EHNRI, 1997. The government of Ethiopia through former Ethiopia nutrition institute and Ethiopian health and nutrition research institute (EHNRI). Food composition table for use in Ethiopia.

Endale W, Mengesha ZB, Atinafu A, Adane AA, 2014. Food Insecurity in Farta District, North West Ethiopia: a community based cross-sectional study. BMC research notes 7: 130 doi: 10.1186/1756-0500-7-130 [PMC free article] [PubMed].

FAO, 1983. World Food Security: A Reappraisal of the concepts and approaches. Director Generals report. Rome, FAO.

FAO, 1996. Rome Declaration on World Food Security and World Food Summit Plan of Action. World Food Summit 13-17 November 1996.

FAO, 2000. Guidelines for National FIVIMS: Background and Principle. Food and Agriculture Organization, Rome.

FAO, 2004. Food and Agricultural Organization. The State of Food Insecurity: Report 2004 Food and Agricultural Organization, Rome, Italy.

FAO, 2010. The state of food security in the world: Food and Agriculture Organization (FAO). Addressing food insecurity in practical crises UNFAO. Rome, Italy.

FAO, 2012. The State of Food Insecurity in the World 2012, Food and Agriculture Organization (FAO) Report, Rome:

FAO, 2013. The Sate of Food Insecurity in the World: The Multiple Dimensions of Food Security Director Generals Report. Rome: Food and Agriculture Organization (FAO) of the United Nations.

FAO, 2015. The State of Food Insecurity in the World 2015.Meeting the 2015 international hunger targets: taking stock of uneven progress. Rome, FAO.

FAO, 2016. Ethiopia EL NIÑO situation report.

FAO, IFAD and WFP, 2014. The State of Food Insecurity in the World 2014. Strengthening the Enabling Environment for Food Security and Nutrition, FAO, Rome.

FAO, WFP, 2014. The State of Food Insecurity in the World 2014: Strengthening the enabling environment for food security and nutrition. Rome, FAO.

FDRE, 2002. Federal Democratic Republic of Ethiopia: *Food Security Strategy*. Federal Democratic Republic of Ethiopia, Addis Ababa.

Fekadu N., 2008. Determinants of household food security the case of Bulbula in Adami Tulu JidoKombolcha, Oromia region. M.Sc Thesis Addis Ababa University, Ethiopia.

Foster, J., J.Greer and E. Thorbecke, 1984. A Class of Decomposable Poverty Measures,

Frankberger, T.R., 1992. Indicators and data collection methods for assessing household food security.A Technical review. UNICF: New York.

Frehiwt Fantaw, 2007. Food Insecurity and Its Determinants in Rural Households in Amhara Region of Ethiopia, M.Sc Thesis Paper, Addis Ababa University, Ethiopia. 90p.

Gebermedhin B. and Pender J., 2008. Impact of policy and technologies in dry land agriculture: Evidence for North Ethiopia. *Paper presented at symposium of challenges and strategies of dry land agriculture in to the new millennium*, 13: 192-220.

Gebeyehu, G.R., Mesfin Tebeje, 2014. Rural household's food security and livelihood strategies: the case of Offa woreda, in Wolaita zone, SNNPRS, Ethiopia. July, 4 (7).

Genene Tsegaye, 2006. Farmers Perceptions of Land Degradation and Determinants of Household Food Security Status at Middle Catchments of Bilate Watershed.

GOA, 2011. United States Government Accountability Office. Food insecurity in Sub-Saharan Africa, Washington, DC.

Greenwell, C.M. and C. Pius, 2012. Estimating Effects of Constraints on Food Security in Malawi: Policy Lessons from Regressions Quantiles, *Applied econometrics and International Development* 12(2).

Guajarati, D.N., 2004. Basic econometrics, 4th Edition, McGraw-Hill Companies, Inc. New York.; 1003.

Gujirati, Domadar N., 1995. Basic Econometrics.Third Edition. McGraw- Hill, New York.

Guled A., 2006. Food Insecurity and Copping Strategies of Agro-Pastoral Households in Awbare Woreda, Somali Region, Ethiopia. M.Sc. Thesis Presented to the School of Graduate Studies of Haramaya University. 109 pp.Alemaya, Ethiopia.

Haile, H.K., Z.G. Alemu and G. Kudhlande, 2005. Causes of household food insecurity in koredegaga peasant association, Oromiya zone, Ethiopia Working Paper, South Africa: University of the Free State.

Hilina Mikrie, 2005. Dimensions and Determinants of Poverty in Pastoral Areas of Eastern Ethiopia:

Hiwot Yirgu Astemir, 2014. Determinants of Food Security in Rural Farm Households in Ethiopia.The hague, The Netherlands November.

Hoddinott J. and Yohannes Y., 2002. Dietary diversity as a food security indicator. Food and consumption http://www.unicef.org/ethiopia/ UNICEF Ethiopia Sit Rep 3 May and June 2014 .pdf.

Hoddinott, J. (edn), 2001a. Methods for rural development projects. Food security in practice, Vol., 1. IFPRI, Washington D.C.

Hoddinott, J., 1999. Operationalzing Household Food Security and Development Strategies. International Food Policy Research Institute (IFPRI). Technical Guideline, No. **1**, Washington.

Honddinott, J., 1995. Choosing outcome indicators of Household Food Security, Technical Guide #7, IFPRI, Washington D.C. USA.

Hosmer, D. W, and Lemeshew S., 1989. Applied Logistic Regression. A Wiley- Inter-Science Publication, New York.

Hussein W, PJ anekarnk P., 2013. Determinants of Rural Household Food in Jigjiga District of Ethiopia.Developing countries. *Journal of Social Sciences*, 34(2):171-180.

IFAD, 2011. International Fund for Agricultural Development (IFAD). Rural Poverty Report. New Realities, New Challenges, New Opportunities for Tomorrow's Generation, Italy.

IFPRI, 2009. Key Facts and Findings. Global Hunger Index in 2009. International Food Policy Research Institute (IFPRI). Insecurity in the World. Rome, pp. 26.

Khan, R.E.A., Azid, T., and Toseef, M.U. 2012. Determinants of food security in rural areas of Pakistan.*International journal of social economics*.Vol. 39, no.12, pp. 951-964.

Khush, G., Lee, S., Cho, J.-I. andJeon, J.S., 2012. Biofortification of Crops for Reducing Malnutrition. Plant Biotechnology Reports **6: 195-202.**

Kidane H., Alemu ZG. And G.Kundhlande, 2005.Cause of Household Food Insecurity kordegaga Peasant Association, Oromia Zone, Ethiopia.

Kothari, CR, 1990. Research Methodology: Methods and Techniques. Viswa Parkashan pub. New Dehlhi.

Lewin, P. and Fisher, M., 2010. The determinants of food insecurity in rural Malawi: implications for agricultural policy. Malawi Strategy Support Program. *Policy note,* 4:1-3

Majumder, S., B.K. Bala and M.A. Hossain, 2012. Food Security of Hill Tracts of Chittagong in Bangladesh, *Journal of Natural Resources Policy Research,* 4:1, 43-60.

Maxwell D., 1996. Measuring food insecurity: the frequency and severity of coping strategies. *Food Policy* 21: 291-303

Maxwell, D., Watkins, B., Wheeler, R., and Collins, G., 2003. The Coping Strategies Index: A tool for rapidly measuring food security and the impact of food aid programs in emergencies.

Maxwell, S. and Smith, M., 1992. Household Food Security: A conceptual review. In S. Maxwell & T.R. Frankberger, (ed.) Household Food Security: Concepts, Indicators, measures: A technical review. New York and Rome: UNICEF and IFAD

Mequanent M., 2009. Determinants of household food security and coping strategies: The case Adaberga woreda, Ethiopia. Haramaya University,

Mequanent Muche, Birara Endalew, Tesfalem Koricho, 2014. Determinants of Household Food Security among South West Ethiopia Rural Households Department of Agricultural Economcs and Extension, College of Agriculture and Veterinary medicen, Jimma University, Ethiopia.

MoFED, 2011. Ethiopian economy profile in Growth and Transformation Plan 2011/12. Volume I Main Text. Ministry of Finance and Economic Development. Addis Ababa, Ethiopia.

MoFED, 2012. Ethiopia's Progress Towards Eradicating Poverty: An Interim Report on Poverty Analysis Study (2010/11). Addis Ababa: Ministry of Finance and Economic Development**.**

MoFED, 2013. Development and Poverty in Ethiopia. Addis Ababa, Ethiopia: Ministry of Finance and Economic Development, Federal Democratic Republic of Ethiopia.

Mulugeta T., 2002. Determinants of household food security in Eastern Oromiya, Ethiopia: The case of Boke District of Western Hararge Zone. M. Sc. Thesis Presented to the School of Graduate Studies of Alemaya University. 151p. Alemaya, Ethiopia. Nutrition Technical Assistance Project (FANTA).

Ndobo, F., 2013. Determinants of vulnerability to food insecurity in a South Africa township: A Gender Analysis. *Mediterranean Journal of Social Science*, 4(14).

Nigatu R., 2011. Small holder farmers coping strategies to household food insecurity and hunger in Southern Ethiopia.*Ethiopian Journal of Environmental Studies and Management, 4(1): 42.*

Nigussie Z., Alemayehu, G., Yehuala, S., Siraw, G. and Worku, G., 2012.Analysis of Internal and External Factors in Establishing Inter-And-Trans-Disciplinary Training and Research Framework in Amhara Region, Ethiopia. *Educ. Res.*, 3: 612-619.

Ojogho, O., 2010. *Determinants of Food Insecurity among Arable Farmers in Edo State: Nigeria*. Agricultural Journal **5**(3): 151-156.

Pieters, H., Guariso, A. and Vandeplas, A., 2013. Conceptual framework for the analysis of the determinants of food and nutrition security. Food Secure Working paper no. 13.

Pindyck S. and Rubinfeld, L., 1981. Econometric models and economic forecasts. Second edition. Mc Grew-Hill, New York.

Ramakrishana G. and Demeke A., 2002. An Empirical Analysis of Food Insecurity in Ethiopia: The Case of North Wollo. Africa Development 27 (1and 2).

Ruel MT, Garrett JL, Hawkes C, Cohen MJ, 2010. The food, fuel, and financial crises affect the urban and rural poor disproportionately: a review of the evidence. *The Journal of Nutrition,* 140: 170S–176S. doi: 10.3945/jn.109.110791 [PubMed] School of Graduate Studies of Haramaya University.

Sen, A. 1981. Poverty and Famine: An Essay on the Entitlement and Deprivation. Oxford: Larendon Press.

Sasi, M., 2015. A Spatial, Non-parametric Analysis of the Determinants of Food Insecurity in Sub-Saharan Africa, *African Development Review*, 27(2): 92–105.

Sila, O. and Pellokila, R, 2007. Socio-Economic Indicators Affecting Food Security. University of Philippines at Los Banos.

Smith, Lisa C., Harold Alderman, and DedeAduayom, 2006. Food Insecurity in Sub-Saharan Africa: Research Report 14. IFPRI: Washington, DC.

Tassew, W., 2006. Measuring and Monitoring Poverty in Ethiopia: Department of Economics, Addis Ababa University, Ethiopia.

Tekele L., 2015. Determinants of Rural Farm Household Food Security in Boloso Sore District of Wolaita Zone in Ethiopia. *Asian Journal of Agricultural Extension, Economics and Sociology.*

Tesfaye Kumbi, 2005. Household food insecurity in Dodota-Sire District, Arssi, Zone: Coping Strategies and Policy Options. An M. Sc. Thesis presented to the School of Graduat Studies of Alemaya University, Alemaya. 133p. The Case of Shinile Zone in Somali National Regional State.

Thomas, D. S., Twyman, C., Osbahr, H. and Hewitson, B. 2007. Adaptation to Climate Change and Variability: Farmers Responses to Intra-Seasonal Precipitation Trends in South Africa. *Journal of Climatic Change,* 83:301–322.

Train, K., 1986. Qualitative choice analysis: Theory, econometrics and an application to automobile demand. The MIT Press, London.

Tsegay Gebrehiwot, 2009. Determinants OF Food Security in Rural Households of the Tigray Region; M.Sc. thesis Submitted to Addis Ababa University, Faculty of Science, the department of statistics.

UN, 2010. Food assistance needs in Ethiopia rising for 2010, UN relief wing reports. UN News Service, February 3, 2010.

UNDP, 2013. 'Summary of Human Development Report 2013- The Rise of the South: Human Progress in a Diverse World' Human Development Report, USA: United Nations Development Programme (UNDP).

UNICEF, 2012. The State of the World's Children, 2012.

UNICEF, 2014. Ethiopia Humanitarian Situation Report, available online at United States Agency for International Development, 2015. Food security country framework for Ethiopia.

United Nations, 1975. Report of World Food Conference, Rome 5-16 November 1974.

USAID, 1992. Food Security Indicators for the use in the Monitoring and Evaluation of Food Security Program.

USAID, 2009. Livelihood & Food Security conceptual framework. Washington, DC 2009. The lift project.org.

USAID, 2015. United States Agency for International Development (USAID).Food Security Country Framework for Ethiopia.

USAID, 2018.Assistance fact sheet-Ethiopia. Available https://www.usaid.gov/ethiopia/food-assistance

Von Braun, J.; Bouis, H.; Kumar, S. and Pandya-Lorch, R. 1992. Improving Food Security of the Poor: Concept, Policy, and Programs. International Food Policy Research Institute. Washington, D.C, U.S.A.

Webb patric, and Joachim von Braun., 2009. Famine and food security in Ethiopia: Lessons for Africa, John Wiley and Sons: New York.

World Bank, 1986. Poverty and Hunger: Issues and Options for Food Security in Developing Countries. Washington, DC: World Bank Publications.

World Bank, 2006. Repositioning Nutrition as Central to Development (Washington).

World Bank, 2012. Ethiopia Country Brief, the World Bank Group. Washington DC: The World Bank.

World Bank, 2015. *New 2015 Global and Regional Poverty Forecasts.* Washington DC: The World Bank.

WFP 2010. Emergency Food Security Assessment Handbook. 2nd edition. World Food Programme (WFP) Food Security Analysis Service

WZANRD, 2017. Wolaita Zone Agricultural and Natural Resource Development Office. Annual food security and early warining report. WolaitaSodo, Ethiopia.

Yamane Taro, 1967. Statistics, introductory Analysis, 2nd Ed. New York. Harper and Row.

Yared Amare, 2001. Food security livelihood strategies and food Security Policy in Ethiopia, In Food security and Sustainable livelihoods in Ethiopia, AddisAbaba.

Yared, A., 1999. Household Resources, Strategies and Food Security in Ethiopia: A Study of Amhara Household in Wagda, North Shewa. The Department of Sociology and Social Administration and Addis Ababa University Press, Ethiopia.Row.

Yilma, Muluken. 2005. Measuring Rural Household Food Security Status and its Determinants in the BenishangulGumuz Region, Ethiopia: The Case of Assosa Woreda. MSc Thesis, Haramaya University, Haramaya, Ethiopia.

Yishak Gecho, GezahegnAyele, Tesfaye Lemma, DawitAlemu, 2014. Rural Household Livelihood Strategies: Options and Department in the Case of Wolaita Zone, Southern Ethiopia. *Social Sciences*, 3: 92-104.doi:10.11648 j.ss.20140303.15

7. APPENDICIES

Appendix table 1: Conversion factor used to estimate Kcal of food items

Food item	Unit	Kcal
Maize	Kg	3751
Wheat	Kg	3623
Sorghum	Kg	3850
Barley	Kg	3723
Onion	Kg	713
Lentils	Kg	3522
Pepper	Kg	933
Milk	Lt	737
Sugar	Kg	3850
Edible oil	Lt	8964
Coffee	Kg	1103
Peas	Kg	3553
Tomato	Kg	216
Salt	Kg	1700
Meat	Kg	1148
Butter	Kg	7364
Irish potato	Kg	3550
Sweet potato	Kg	1360
Teff	Kg	3589
Broad beans	Kg	3514
Kocho	Kg	2111

Source: - EHNRI, 1997

Appendix table 2: Conversion factor used to compute adult equivalent (AE)

Age group (years)	Male	Female
< 10	0.6	0.6
10-13	0.9	0.8
14-16	1.0	0.75
15-50	1.0	0.75
>50	1.0	0.75

Source: -Storck, *et al.,* 1991

Appendix table 3: Conversion factor used to compute tropical livestock unit (TLU)

Animal category	**TLU**	**Animal category**	**TLU**
Cow and ox	1.00	Sheep and goat (adult)	0.13
Calf	0.5	Sheep and goat (young)	0.06
Heifer and bull	0.75	Chicken	0.013
Donkey (adult)	0.70	Donkey (young)	0.35

Source: - Storck, *et al.,* 1991

Appendix table 4: Variance Inflation Factor (VIF) for continuous variables

Variable	**VIF**	**1/VIF**
Cultlan	4.61	0.216894
Listown	3.73	0.268198
Extnfrq	3.3	0.303076
Famsize	3.22	0.310301
Age	2.05	0.487626
Mean VIF	**3.11**	

Source: Own survey, 2018

Appendix table 5: Contingency of Coefficient (CC) for dummy variables

	Sex	**Edulev**	**Offinc**	**Pestdis**	**Chmfrt**	**Seedva**	**Credit**	**larenin**	**Larout**	**Agroe**
Sex	1.0000									
Edulev	-0.0768	1.0000								
Offinc	0.1178	0.3737	1.0000							
Pestdis	0.0933	-0.0678	0.0545	1.0000						
Chmfrtl	-0.0575	0.3613	0.0475	-0.2250	1.0000					
Seedvar	-0.0646	0.3758	0.0271	-0.1412	0.3884	1.0000				
Credit	-0.0535	0.2280	-0.1151	-0.3691	-0.1169	0.3221	1.0000			
Larenin	-0.0043	0.3368	0.1245	-0.0782	0.2562	0.2686	0.1357	1.0000		
Lareout	-0.0439	-0.3691	-0.0997	0.3494	-0.4467	-0.4339	-0.2646	-0.4039	1.0000	
Agroec	0.0415	0.1131	0.1100	-0.1479	-0.0066	0.1037	0.0159	-0.0075	-0.0804	1.0000

Source: Own survey, 2018

Appendix table 6: Heterosckedasticity test

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: fitted values of food insecurity situation
chi2 (1) = 0.78
Prob> chi^2 = 0.3763

Source: - Own survey results, 2018

8. ANNEXES

Household Survey Questionnaire from Sampled Respondents and key informants

Master of Science Thesis Questionnaire in Agricultural Economics in Dilla University

Dear, Sir/Madam: - Good Morning/After noon, this survey planned to collect data from household head and key informants on **RURAL HOUSEHOLD FOOD INSECURITY STATUS AND COPING STRATEGIES IN DAMOT WOYDE WOREDA OF WOLAITA ZONE, SOUTHERN ETHIOPIA** for academic purpose. Thank you very much for your commitment to meet me respecting our appointments and devoting your precious time. Kindly, note that your genuine and relevant information will greatly contribute to the success of this study. Please, stop me at any point for more clarity if the need arises.

Thank you in advance for your collaboration!!

General information: Identification of Household Profile

- Respondent code: _____
- Woreda: D/W, kebeles: _____ local area: _____ and Agro-ecology_____
- Name of the enumerator _____
- Date of Interview (dd /mm/yy): _____/_____/_____ and Signature _____

Part One: Demographic Characteristics of the Household

1. Fill the required information on the table:

No	1	2	3	4	5
	HH members	Sex	Age	Relationship to HH head	Education level

***Remark*: -** please, use the codes to fill in the provided space on the table:

Codes for 2: Male =1, Female = 0, Codes for 4: Head=1, Wife=2, Son=3, Daughter=4, Codes for 5: 1= Literate (read and write), 0= Illiterate

Part Two: Socio-economic Characteristics of the Household

2. Do you possess your own farm land? 1) Yes ☐ 0) No ☐

3. If your answer is yes to the above question no 2, then total land is how many hectares? ____

4. If yes, how do you obtain the land? ____ 1) Land distribution 2) My parents 3) Other Specify

5. Who control the land you till? __1) Peasant association 2) Government 3) myself 4) parents

6. From the total land you have, what part is: 1) cultivated ____hectare 2) Grazing land ____ hectare 3) Fallow land _____ hectare 4) Forest area_____ hectare 5) Other specify

7. Do you think the land your own is sufficient for your household annual crop production?

1) Yes ☐ 0) No ☐

8. If no, state your reason___ 1) Land infertility 2) Small sizes of land 3) Large family 4) others

9. Do you have your own livestock? _____ 1) Yes ☐ 0) No ☐

10. If yes your response, then indicate the type of livestock owned

No	Type	Type of livestock		No owned in the last 12 months		No sold in the last 12 months		Reason for sale*
		Improved	Local	Improved	Local	Improved	local	
1	Ox							
2	Bull							
3	Cow(milking)							
4	Cow(non-milking)							
5	Heifer							
6	Sheep							
7	Goat							
8	Donkey							
9	Mule							
10	Horse							
11	Chicken							
12	Others							

***Remark*: -** use codes to fill reasonfor sale*: 1) To purchase agricultural inputs 2) To pay taxes and other debts 3) To Purchase food 4) To purchase clothes 5) Social obligations 7) others, ___

11. If yes your response, then indicate number of livestock owned (TLU_____

12. What do you use to till your land? _____ 1) Hand tools/hoe 2) Rented oxen 3) oxen 4) Other, specify_____

13. If you use oxen, how many oxen do you have? _____

14. If no, what do you do? ___ 1) Hire from someone 2) Coupling with other farmer 3) Borrow from friends 4)Contributing labor for who has oxen 5) Share cropping 6) Others,_____

15. What are the main sources of your livelihood? ____ 1) Agriculture only (including livestock) 2) Petty trade 3) Remittance 4) handcraft 5) Safety Net/NGO 6) others, _____

16. Do you or your household member have off/non-farm activity? _____ 1) Yes ☐ 0) No☐

17. If yes, indicate the type of work and annual income in birr: please, if payments made in kind, please convert them in to birr at price prevailing at time.

Type of work	Annual income (birr)	Remark
Sales of fire wood/charcoal/tree		
Rent of land and pack animals		
Sale of labour (Agricultural wage)		
Handcrafting		
Petty trade		
Remittance		
Trading		
Others		
Total		

Part Three: Institutional Characteristics of the Household

18. How many times did you contact extension agents in last year? _____

19. Did you get any training from extension organization? _____ 1) Yes ☐ 0) No ☐

20. If yes to Q19, specify the kind and duration of training_____

21. Did you face insect and pest infestation problem? _____ 1) Yes ☐ 0) No ☐

22. List types of insects and pests attacking your agriculture in order of importance. _____

23. Did you use any chemical fertilizer during last one cropping year? 1) User ☐ 0) non-user

24. If no, state the reason? _____ 1) Too expensive 2) unavailable timely 3) Inadequate supply 4) lack of transport 5) others, specify _____

25. Did you use any improved seed varieties? _____1) Yes ☐ 0) No ☐

26. If no, indicate the reason? _____1) Too expensive 2) unavailable timely 3) Inadequate supply 4) lack of transport 5) others, specify _____

27. Where do you sell your farm products? _____ 1) On farm 2) on local market 3) through multipurpose cooperatives 4) others, specify _____

28. What means of transport do you use to transport your produce? _____ 1) Trucks 2) Animal power 3) Human power 4) Others, specify_____

29. Have you received any type of credit in 2009 E.C? _____ 1) Yes ☐ 0) No ☐

30. If yes, from whom did you get credit? _____ 1) Relative 2) Traders 3) Bank 4) NGO 5) Micro finance institutions 6) Local money lenders 7) Friends 8) Others, specify _____

31. For what purpose did you take the money (multiple answers possible)? _____1) To buy agricultural inputs 2) Purchase of livestock 3) Purchase of farm implements 4) For household consumption 5) For social obligation 6) for petty trade 7) others, specify____

32. If you didn't need credit, why? _____ 1) Fear of ability to pay 2) Lack of asset for collateral 3) No access to credit 4) High interest rate 5) No need for credit 6) others, specify _____

33. Have you rented in land for agricultural purpose? _____1) Yes ☐ 0) No ☐

34. If yes, why? ___ 1) Shortage of agricultural land 2) Excess agricultural labor 3) To produce for commercial 4) To produce more for household consumption 5) Others, specify_____

35. If no, why? _____ 1) I have sufficient agricultural land 2) I don't have money to rent in agricultural land 3) I don't want to rent in 4) I don't have information 5) Other ,specify

36. Did you rented out your land last year? _____1) Yes ☐ 0) No ☐

37. Why did you rented out your land? _____ 1) To get money 2) Lack agricultural labor 3) lack of oxen 4) To pay taxes 5) Drought 6) Other, specify_____

38. Did you participate in any social leadership in the last year? _____ 1) Yes ☐ 0) No ☐

39. If yes, what is your social status in your area? ___ 1) Village Chairman 2) Religious Leader 3) Village Committee Member 4) Leader of local association like Iddir 5) Others, specify___

40. Does the rain came on time in the study area the last year? _____ 1) Yes ☐ 0) No ☐

41. Does the rain stop on time in the study area in the last year? _____1) Yes ☐0) No ☐

42. Mention types of food items consumed in the household by recalling seven days back.

Group	Food items consumed	Source					
Field crops		Unit	Home produced	Purchased	1. Own 2. Gifted/loan 3. Purchased 4. Others		Total food consumed
			Quantity	Quantity	Quantity	Source	
	Maize refined						
	Teff						
	Wheat whole						
	Wheat flour						
	Barley						
	Sorghum						
	Sorghum flour						
Roots & Tubers	Enset						
	Potato						
	Cassava fresh						
	Yam						
	S. potato						
Grain legumes	Haricot bean						
	Pea						
	Bean						
Vegetables	Onion						
	Pumpkin						
	Carrot						
	Cabbage						
	Tomato						
	Green pepper						
Animal products	Egg						
	Milk						
	Butter						
	Cheese						
	Meat						
Fruits	Avocado						
	Mango						
	Papaya						
	Banana						
Others	Coffee						
	Oil (Edible)						
	Sugar						
	Honey						

43. Questions on (availability, accessibility, acceptability, stability and utilization) components.

	Responses*				
	1	2	3	4	5
There is enough food available in your farm land (either from own production or imported) to feed the family member through the year.					
All family members in your farm land have access to food that is nutritious and safe, and produced in environmentally sustainable ways.					
All family members in your farm land have access to culturally acceptable food, which is produced and obtained in ways that do not compromise people dignity, self-respect or human rights.					
There are periods (e.g. certain seasons/years) where all family members in your farm land are food insecure because availability of food or accesses to food is unstable.					
In your farm land all family members use their food in ways that amount to a healthy diet.					

***Remark*: -** Use the codes to fill the responses*:1) Strongly disagree 2) Disagree 3) Neutral 4) Agree 5) Strongly agree

Part Four: Coping Characteristics to against Food Insecurity

44. How do you (your family) used to cope during minor and major crop failure?

Stages	Coping strategies (Rank)	Code for the strategies
At initial stage of a food shortage	1. _____ 2. _____ 3. _____ 4. _____ 5. _____	1. Sale of livestock more than usual 2. Borrow grains or cash from relatives/friends 3. Reduce number of meals 4. Reduce size of meals 5. Sale firewood/charcoal, grass 6. Participate in food for work 7. Food aid 8. Seasonal migration (some of family members) 9. Go for beggaring 10.Ate less preferred food 11.Sale of agricultural tools 12. sale/consume seed meant for production 13. Children discontinue from school 14.Sale of production equipment 15.Child laboring 16. Others, specify _____
At severe stage of afood shortage or deficit	1. _____ 2. _____ 3. _____ 4. _____ 5. _____	

Remark: **-** Please put in order (rank) the mitigation method to the each stage for the food scarcity occasion.

Guiding Checklist for the key Informant Interview:

In this case,the facilitator guides the semi-structured questionnaire to the members then, they talk freely and spontaneously about an issue. Its aim is to obtain detail information on concepts, perceptions and ideas of the food security situation.

1. What are the main sources of Livelihoods in the district /kebele?

2. In your opinion, what do you think the cause of food insecurity in your district/kebele?

3. Can you realize that the household characteristics (variables such as sex, age, education level, farm experience, family size etc…) that have relation with household food security? And how they affect the food security status?

4. How is the use of input (fertilizer, improved seed, pesticide etc.) in the woreda?

5. Was there any development support programs (PSNPand others) accessibility and government intervention in doing to bring food security to the community in the last 12 months in the woreda?

6. What were the survival strategies used by people in the area to cope major and minor crop failure?

Guiding Questions used for Focus Group Discussion (FGD):

1. What are the main sources of Livelihoods in the district especially in your kebele?

2. In your opinion, what do you think the cause of food insecurity in your District/ especially in your Kebele?

3. How is the use of input (fertilizer, improved seed, pesticide etc.) in the woreda especially in your kebele?

4. Did you produce enough food for family in the last production year?

5. Was there any development support programs (PSNPand like others) accessibility and government intervention in doing to bring food security to the community in the last 12 months in the woreda?

6. What were the survival strategies used by people in the area to cope up with food stress?