DETERMINANTS OF MULTIDIMENSIONAL FOOD INSECURITY IN ETHIOPIA

MSc THESIS

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DETERMINANTS OF MULTIDIMENSIONAL FOOD INSECURITY IN ETHIOPIA

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DECLARATION

I hereby declare that this MSc Thesis is my original work and has not been presented for a degree in any other University, and all sources of material used for this thesis have been duly acknowledge.

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This is to certify that the thesis entitled **"Determinants Multi-dimensional of Food Insecurity in Ethiopia"** submitted in partial fulfillment of the requirements for the degree of masters with specialization in Development Economics to the graduate program of the department of economics, has been carried out by Abel Tenkir under our supervision. Therefore, we recommend that the student has fulfilled the requirements and hence hereby can submit the thesis to the department.

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ACRONYMS AND ABBREVIATION

CSA	central statistical agency
FAO	Food and Agriculture Organization
FEWSNET	Famine Early Warning Systems Network
MOFED	Minster of finance and economic development
PCA	Principal Component Analysis
SNNPR	South Nation Nationality peoples region
WFP	World Food program
WB	World Bank

Abstract

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. Food insecurity is a global phenomenon which affects continents, nations and people differently Ethiopia, one of the least developed countries, was ranked 174th out of 188 countries by the 2017 human development report, in terms of both its per capita income and human development indices. This position of a country indicated that in Ethiopia food insecurity is an urgent and immediate challenge and will continue to be so far some time. Based on this fact the aim of this study was to assess the determinants of multidimensional food insecurity in Ethiopia so as to help proper understanding of factors associated with multidimensional food insecurity which is a key to policies and practical steps that the government can take in ordered to curb food insecurity. This study used data from Ethiopian socio economic survey of 2016 which include 22,296 households from all parts of the country. The data was analyzed by both econometric and descriptive analyses. Descriptive study shows that 27.5 percent of sample households by Ethiopian demographic and health survey of 2016 which was collected by CSA are multidimensional food insecure. The logit model of this study was demonstrated household family size, access to clean water, access to credit, household health stats, off farm activity and education are significantly affect multidimensional food insecurity. Based the result the main conclusion of the study is that the incidence of multidimensional food insecurity is widespread in Ethiopia. This problem calls urgent interventions aimed at dropping this incidence of multidimensional food insecurity. Thus multidimensional food insecurity alleviation policies that based on those variables should be key ingredients of a multidimensional food insecurity reduction strategy and the targeted groups should involve in any development efforts that could address multidimensional food insecurity in Ethiopia.

Key Words: *Ethiopia, multidimensional food insecurity, indicators, logit*

CHAPTER ONE
Introduction

1.1. Background of the Study

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. It should be stressed that food security and famine and hunger are not to be confused, food security refers to the availability of food whereas famine and hunger are the consequence of the non-availability of food, in other words the results of food insecurity. Food security is a multidimensional issue which cannot be adequately recorded by a single indicator. World Food Summit declared and subsequently reconfirmed in 2019, food security consists of four essential parts: food availability, food access, food utilization and stability. Food might be available but that does not determine access; similarly, access might be viable but does not guarantee utilization and all three can be disrupted by a lack of stability caused by climate change, conflict, unemployment, disease or other factors. Stability or the lack of it can affect any or all of the other three components of the food insecurity framework.

Africa, a continent gifted with immense natural and human resources as well as great cultural, ecological and economic diversity, remains underdeveloped. The majority of the countries classified by the UN as a poor are in Africa. African nations typically fall toward the bottom of any list measuring economic position, such as income per capita or GDP per capita, despite a wealth of natural resources. According to World Bank Over the last 30 years, worldwide food insecurity has fallen sharply (from about 40% to under 20%). But in African countries the percentage has barely fallen. Still today, over 40% of people living in sub-Saharan Africa live in absolute poverty and food insecurity (World Bank, 2017).

According to FAO (2019), conflict and insecurity are the major drivers of food insecurity in Sub Sahara African countries, and the number of food-insecure people across the world has been increasing over time. Food security situation in Ethiopia deteriorated sharply in 2017. In Ethiopia, the number of food-insecure population was increased from 5.6 million in December 2016 to 8.5 million in August 2017 (ACAPS, 2018). An estimated 3.6million children and women in Ethiopia were acutely malnourished in 2017 (IFRC, 2018). Ethiopia has been facing challenging problems ranging from those induced by environmental crises to those caused by demographic and socio-economic constraints that adversely affect peoples'

production system (Alem, 2017). Ethiopia is among the poorest and most food insecure countries of the world where 44% of its population live below the national poverty line (World Bank, 2018); and 46% of its population get below the minimum levels of dietary energy consumption compared with other sub-Saharan and developing countries (World Bank,2019). According to the study conducted by Foziya (2017) in Ethiopia food insecurity is severely affecting the livelihoods in most southern and south eastern pastoral and agro pastoral areas of SNNPR, southern Oromia and south eastern Somali Regions, where cumulative seasonal rainfall was up to 60 percent below average. In these areas, pasture and water availability have declined to extremely low levels, severely affecting crop production and livestock conditions, leading to large scale animal deaths.

According to world food program (2018) More than one million people are displaced in Ethiopia, most of whom have been displaced by conflict starting in September 2017 and many of whom are displaced along the Oromia-Somali regional border, this displacement has disrupted households' ability to engage in their typical livelihoods activities, such as seasonal cultivation and rising of livestock, and has resulted in food security crisis in the region where conflict has been reported to be most severe, this shows the seriousness of food insecurity. Another factor driving the food security crisis in Ethiopia is the fall armyworm outbreak, which affects large parts of the country; especially maize-producing parts of SNNPR, Western Oromia, Amhara, Gambela, and Benshangul Gumuz (ACAPS, 2018; FEWS, NET and WFP, 2018). In Ethiopia, the seriousness of the food shortage problem varies from one area to another depending on the state of the natural resources and the extent of development of these resources. According to WB (2019), food security situation in Ethiopia remain acute in 2020 with the reduced output of 2019 harvests, decreased food access as a result of poor purchasing power, and the exhaustion of coping mechanisms.

In Ethiopia different studies has been undertake on determinants of food insecurity, those studies are based on household-level survey data and in all studies calorie acquisition by households was used to categorize the sample households into food secure and food insecure, however Food security is a multidimensional issue which cannot be adequately recorded by a single indicator. A multidimensional index of food insecurity are preferred and means that countries can be compared on a complex matter like food security and also provide an instrument for policy analysis where trends and changes can be identified, and for informing public Policy.

1.2. Statement of the problem

Food insecurity is a global phenomenon which affects continents, nations and people differently. It affects people in various depth and levels at different times and phase of existence. Food insecurity exists when the people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development (FAO, 2018). In Sub Sahara African countries the situation of food insecurity is further aggravated by the difficult and degraded environmental conditions in which they live which are easily prone to various forms of disaster (Mduduzi, 2017).

Ethiopia, one of the least developed countries, was ranked 174th (out of 188 countries) by the 2017 human development report, in terms of both its per capita income and human development indices (UNDP, 2017). This position of a country indicated that in Ethiopia food insecurity is an urgent and immediate challenge and will continue to be so for some time. In Ethiopia, food insecurity is predominantly chronic in its nature (Mebratu,2018). Chronic food insecurity is a condition affecting the population that usually experiences food shortage even when weather and market conditions appear to be generally good. Chronically food insecure areas coincide with areas of low and unreliable rainfall, high population density and low resource endowments (Shiferaw, 2017). According to Alem (2018), in Ethiopia the impact of recurrent drought has decreased the asset base further these repeatedly drought affected areas of the country, leading to destitution. The problem deepens when resource poor or people with no assets are further affected by extended drought effects. A loss of assets in general makes it very difficult for households to get back to their normal life within a short time unless and otherwise there are appropriate responses (Foziya, 2017).

Household food insecurity in Ethiopia has been studied by many researchers, who came up with different findings. Richard et al. (2017) reviewed determinants of food insecurity situation in southern Ethiopia and causes of food insecurity, and found that about 11% of south Ethiopia's citizens are chronically food insecure and this figure rises to more than 15% during frequent drought years. According to those studies, the deteriorating food security situation in Ethiopia is caused by multifactor, which include population pressure, drought, shortage of farmland, lack of oxen, deterioration of food production capacity, outbreak of plant and animal disease, poor soil fertility, frost attack, shortage of cash income, poor farming technologies, weak extension services, high labor wastage, poor social and infrastructure facility and pre-and post-harvest crop loss. To address food security issue in

Ethiopia, they suggested that household heads and members of the households should engage in different income generating activities for means of living and coping mechanism. Using empirical analysis, Foziya and Aragaw (2017) examined determinants of food Insecurity in rural households in Northern Ethiopia. Household calorie acquisition was analyzed to measure the status of household food security. They estimated the logit model to identify variables which can significantly influence household food security in the study area. Accordingly, they found that variables like experience in farming activities, off farm and non-farm incomes, land and livestock holdings, as well as soil and water conservation practices significantly influence household food security.

According to Mebratu (2018), In Ethiopia, the seriousness of the food shortage problem varies from one area to another depending on the state of the natural resources and the extent of development of these resources. The study conducted on food insecurity in rural areas of Eastern Ethiopia also indicated that socioeconomic factors can influence food insecurity Socio-economic variables like family size, annual income, amount of credit received, access to irrigation, age of household head, farm size, and livestock owned have significant influence on food insecurity in rural areas of Dire Dawa, Eastern Ethiopia (Bogale and Shimelis, 2009). A study conducted by Lemesa et al. (2017) reviewed literature to seek an answer for the question "why does food insecurity persist in Ethiopia?" They found that macro-economic challenges like increasing food prices and unemployment determine the prospect of food security in the country. Therefore, according to them, there is an urgent need to transform access to agricultural technology by farmers and employment opportunity.

Most of previous studies have focused on household level and those studies are based on cross sectional data at specific part of the country, however interrelated causes of household food insecurity require an analysis at a national level and it is a multidimensional issue which cannot be adequately recorded by a single indicator. Depend on this condition this study has a number of differences with the above perversely conducted researches such as methodological differences spatial and time difference of the respective studies.

This study was addressed the following questions?

- What is the extent of multidimensional food insecurity in Ethiopia?
- What are the determinants of multidimensional food insecurity in Ethiopia?
- How regional state of Ethiopia is affected by multidimensional food insecurity

1.3. Objective of the Study

1.3.1 .General Objective

The general objective of the study is to examine the determinants of multidimensional food insecurity in Ethiopia

1.3.2. Specific objective

Specifically, the study addressed the following objectives:

- To examine the extent of multidimensional food insecurity in Ethiopia
- To analyze the determinants of multidimensional food insecurity in Ethiopia
- To compare regional distribution of food insecurity in Ethiopia

1.4. Significant of the Study

A study of multi-dimensional determinants of household food insecurity is vital because it provides with information that will enable effective measures to be undertaken so as to improve food security status and bring the success of food security development programs. It will also enable development practitioners and policy makers to have better knowledge as to where and how to intervene in country to bring food security or minimize the severity of food insecurity. Identification of determinants of the food insecurity will ease the implementation of different development projects in the country. In addition, the government can incorporate this research outputs to design programs that can tackle food insecurity.

1.5. Scope of the Study

Food security is consists of four essential parts: food availability, food access, food utilization and stability. This study examined determinants of multidimensional food insecurity in Ethiopia based on the selected variables like a dependent variables of household characteristic and village characteristics and dependent variable of Multidimensional food insecurities. Even if food insecurity can be determined by many socio economic variables this study focused on some selected variables.

1.6. Limitation of the study

The study focused on identifying some of the factors that were expected to influence household food insecurity in Ethiopia. Due to lack of database, the study could not incorporate some of the most important influencing factors such as climate and weather (rainfall, temperature); topography; natural disasters and ecological conditions. The study did not make a comparative analysis of food insecurity problem between urban and rural Kebeles. The study was concerned about transitory food insecurity faced by household for any magnitude ranging from mild to severe and hence did not deal with causes of chronic food insecurity. In identifying multidimensional food insecure households the study used uncertainty about the household food supply, insufficient quality (including variety and preferences of the type of food), and inadequate quantity (including the physical consequences) dimensions of household food security. All methods have serious measure error issues that can be reduced by fully understanding the principles underlying them.

1.7. Organization of the study

Chapter one is about introduction of the study including: background of the study, problem statement, objective of the study, significances of the study and scope of the study. The rest of the chapters are organized as follows. In chapter two Reviews of related literatures is discussed. The third chapter deals with the methodology of the research. In the fourth chapter data presentation and analysis were discussed. The last parts of the paper are chapter five; under this section some conclusion and recommendation were forwarded.

CHAPTER TWO
LITERATURE REVIEW

2.1. Theoretical literature review

2.1.1. Definitions of Food security

The definition of food security is generally understood as a situation whereby "all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO 2002).

A further component in the definition of food security concerned the actual quality and type of food supplied and a requirement that it should not merely satisfy protein energy needs but provide the nutritional balance necessary for a healthy and active life; in addition to this was the recognition of preferences, traditional habits and socially acceptable food types when considering the definition of food security. The World Food Summit's 1996 definition includes these aspects when it mentions: access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life. This generally accepted definition describes what are known as the Four Pillars of food security: accessibility, availability, utilization and stability.

Food security clearly depends on agro-climatic conditions and aggregate food production; it also depends on socio-economic conditions, including the distribution, access, and affordability of food. People in rural areas depend on agriculture and natural resources to generate cash income as well as food for home consumption, and food production affects both supply-side and demand-side indicators of food security. Now food security has gone beyond the idea of food supply and encompasses access, vulnerability, and sustainability. Surveys at household level, is vital for data collection but it takes time to collect the data and often the geographical area surveyed should be wider and the time period longer.

The definition of food security means that either a currently inadequate diet or a high probability of an inadequate diet in the future both render a person food insecure (Christiaensen and Boisvert 2000). According to Barrett (2002), a useful conception of food security must consider changes over time and people's perceptions of and responses to these changes (e.g. consumption smoothing), and must reflect uncertainty and risk.

2.1.2. Definitions of Food Insecurity

Food insecurity is an evolving concept. There are many definitions of food insecurity, which is a clear indication of differing views and approaches to the problem. FAO (2019,) defined food insecurity as "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 this definition, factors that may lead to a situation of food insecurity include non-availability of food, lack of access, improper utilization and instability over a certain time period. In other words, food availability, access, stability and utilization form the four pillars of food security. The four pillars must be fulfilled simultaneously in order to realize food security objectives.

Based on duration, food security analysts have identified two types of food insecurity, which are chronic and transitory (FAO, 2008). Chronic food insecurity is long-term or persistent, and occurs when people are unable to meet their minimum food requirements over a sustained period of time. Contrarily, transitory food insecurity is short-term and temporary, and occurs when there is a sudden drop in the ability to produce or access enough food to maintain a good nutritional status. While chronic food insecurity results from extended periods of poverty, lack of assets and inadequate access to productive or financial resources, transitory food insecurity is caused by short-term shocks and fluctuations in food availability and food access, including year-to-year variations in domestic food production, food prices and household incomes. There is also a concept of seasonal food insecurity which falls between chronic and transitory food insecurity (FAO, 2008). It occurs when there is a cyclical pattern of inadequate availability and access to food. This is associated with seasonal fluctuations in the climate, cropping patterns, work opportunities and disease.

Food insecurity exists when people do not have such access, and households experience food insecurity whenever they are unable to absorb, reduce or mitigate the impact of a negative food shock (Misselhorn 2005; Webb et al. 2006). With this understanding, food insecurity is not the result of an agricultural failure to produce sufficient food; rather, it is a failure of local livelihoods to guarantee food access (Devereux and Maxwell 2001). Food insecurity is related to, yet distinct from, concepts such as poverty and malnutrition (Webb et al. 2006), and is experienced at a range of spatial scales from households to regions, as well as a range of time scales.

It is important to note that aggregate food availability is a poor predictor of other food insecurity indicators, and food insecurity "does not arise exclusively –or even predominantly– because of covariate shocks to an entire population" (Barrett 2002). Furthermore, research that calculates average food availability from national food production and imports cannot shed light on how this food is distributed among communities, households, and individuals (Misselhorn 2005). Rather, the correlates and causes of food insecurity are likely to be found at the level of households and individual livelihoods.

At one time food security's terms of reference applied at the regional, national or even global level and described a situation where supplies did not meet needs. Over the years as certain groups were observed to be experiencing inadequate food intake despite there being an overall adequate food supply, the term food security began to be applied at a community, local, household or individual level (Foster 1992). Most works consider there to be three interlinked components embedded in the definition of food security: (1) the availability of food in terms of its physical presence in a given country/household; (2) the access to food as reflected by people's ability to obtain food from own stock/home production, or through market purchases, gifts or borrowing; and (3) the utilization of food, in terms of the ability to derive full biological benefits from food, based on food safety and nutritional/ socio-cultural value (Thompson et al. 2010).

2.1.3. Food Insecurity Multidimensional Index

Food security is a multidimensional issue which cannot be adequately recorded by a single indicator. A multidimensional index of food insecurity are preferred and means that countries can be compared on a complex matter like food security and also provide an instrument for policy analysis where trends and changes can be identified, and for informing public opinion.

The literature supports the statistical evidence that the multidimensional approach is the right one to follow. Amartya Sen stresses the imperative of taking a multidimensional approach to both poverty and development: "Human lives are battered and diminished in all kinds of different ways, and the first task… is to acknowledge that deprivations of very different kinds have to be accommodated within a general overarching framework" (Sen 2000). At one time food security's terms of reference applied at the regional, national or even global level and described a situation where supplies did not meet needs. Over the years as certain groups were observed to be experiencing inadequate food intake despite there being an overall

adequate food supply, the term food security began to be applied at a community, local, household or individual level.

World Food Summit declared and subsequently reconfirmed in 2019, food security consists of four essential parts: food availability, food access, food utilization and stability. Food might be available but that does not determine access; similarly, access might be viable but does not guarantee utilization and all three can be disrupted by a lack of stability caused by climate change, conflict, unemployment, disease or other factors. Stability or the lack of it can affect any or all of the other three components of the food insecurity framework.

i. Availability

The World Food Program (2019) defines availability as "The amount of food that is present in a country or area through all forms of domestic production, imports, food stocks and food aid". This term can be applied to food available at a regional or national level rather than at the household level, which can lead to some confusion as the word "availability" sometimes is used at the micro-level. According to FAO (2018) the following variables can be considered as indicators for availability: arable land (hectares per capita), cereal per yield (kg per hectare),cereal domestic supply (kg per capita) share of food aid (% of food aid in the total dietary energy Supply, permanent cropland (% of land area), food production index, Land under cereal production (hectares per capita). Food availability is a function of the combination of domestic food production and food stocks, commercial food imports, and food aid, as well as the determinants of these factors. The term 'availability' is usually used in reference to food supplies at the regional or national level (Riely et al. 1999). Availability is directly compromised by adverse shocks such as unemployment spells, price spikes, or the loss of livelihood-producing assets. The multidimensional nature of individual or household availability makes it complicated to measure. Access rests on a wide variety of activities, and the lack of a 'typical' set of activities makes it difficult to define a universal set of indicators (Swindale and Bilinsky, 2006).

ii. Access

The World Food Summit defines access as having "physical, economic and social access" WFS, 2019). Access is still not commonly accepted as an essential part of food security despite Amartya Sen's introduction of the concept in the early 1980s. Many people only consider access within an economic or financial context, particularly since the 2005 Niger food crisis and the start of food price volatility in 2008.

According to World Food Program food access consists of three elements, which are physical, economic/financial and socio-cultural. The physical dimension can be illustrated by a situation where food is being produced in one part of a country but an inefficient or non-existent transport infrastructure means that food cannot be delivered to another part suffering from a lack of food. From the economic viewpoint, food security exists when people can afford to buy sufficient food. The third element is the socio-cultural dimension which arises when food may be physically available and the potential consumer has the money to buy the food but is prevented from doing so for being a member of a particular social group or even gender. Social conflict and civil strife can seriously disrupt food production and lead to the loss of livestock for example with dire consequences for a household's future food security.

Access depends on the range of food choices open to people, given their income, market prices, market accessibility, employment, distribution of wealth, and formal or informal safety net arrangements. Access rests on having adequate resources, or entitlements, to acquire a sufficient quantity of food, and while consumers' purchasing power in the form of real incomes and food prices is important, entitlements are not necessarily monetary. Instead, they include all commodity bundles within a person's control, given the legal, political, economic, and social arrangements of the community. Thus, they may also include traditional rights, such as a share of common resources (Morton 2007). Whereas availability reflects the supply side of food security, access reflects the demand side and in practice typically results in inequality of inter- and intra-household food distribution.

iii. Utilization

The World Food Summit's definition of utilization (the third element of food security) is "safe and nutritious food which meets their dietary needs". The availability of and access to food on their own are not enough, people have to be assured of "safe and nutritious food" (WFS,2019). The food consumed has to provide sufficient energy to enable the consumer to carry out routine physical activities. Utilization also covers factors such as safe drinking water and adequate sanitary facilities to avoid the spread of disease as well as awareness of food preparation and storage procedures. Utilization therefore covers a range of aspects that hinge on the consumer's understanding of what foods to select and how to prepare and store them.

Utilization is related to health and reflects concerns about whether individuals make good use of the food to which they have access (Barrett, 2010). There are two forms of food utilization: physical and biological utilization. Physical utilization reflects the level of a

household's physical means to safely use the food available, and depends on the sanitary conditions along the entire food chain (Morton, 2007). This may include adequate housing, access to potable water, cooking utensils, cultural feeding hierarchies, family structure, and caretaker behaviour, knowledge, and workload. Biological utilization is a measure of the body's ability to effectively use the nutrients consumed, and it depends on hygiene, infestation (e.g., hookworms), increased nutrient demand resulting from infection, and dietary quality (Renzaho and Mellor 2009). Particular attention is given to micronutrient deficiencies, and utilization encompasses both food consumption in the short term (e.g., breast-feeding, food intake, food habits and practices) and nutritional status parameters in the long run.

iv. Stability

The World Food Summit says that stability must be present "at all times" in terms of availability, access and utilization for food security to exist (WFS, 2019). The literature distinguishes between chronic food insecurity where food needs cannot be met over a protracted period of time and transitory food insecurity, where the time period is more temporary (Maxwell and Franken Berger 2012). Combining composite indicators into a quality framework is not an easy undertaking depending as it does on the quality of the original data and the quality of the procedures used. Data can only really be believed "fit for use" if, first, the data are accurate; second, they are in time to be of use; third, they can be easily accessed; and finally, they do not conflict with existing data

At the household level, vulnerability can be thought of as the likelihood that at a given time in the future, a household will have a level of welfare (often expressed in terms of income or consumption) below some benchmark, such as the expenditure required to meet the minimum caloric requirement per capita per day (Hoddinott and Quisumbing 2003). This concept is forward-looking and related to expectations and uncertainty.

At the all Availability, access, and utilization, also referred to as the three 'pillars' of food security, are inherently hierarchical, with availability as necessary but not sufficient to ensure access, and access as necessary but not sufficient for effective utilization.

2.1.4. Construction of a Composite Index of Food Security

Several papers have combined various food security indicators into a single composite index. This seems to build on the literature of multidimensional poverty indices (e.g. Alkire and

Foster 2007), and it allows for the ranking of different countries, regions, populations, or households in terms of the severity of food insecurity. Such an exercise may be useful in order to target resources and policies toward those most in need and to track changes over time. An index may be constructed in five steps: (1) identification of the dimensions of food security, (2) selection of indicators for each dimension, (3) standardization of indicators, (4) weighting of indicators, and (5) ranking of units (e.g. households or countries) according to summed scores. When building such an index, the main challenges are to select the most appropriate indicators and to calculate the weights attached to each component in order to best represent their values in practice.

The WFP's Vulnerability Analysis and Mapping Unit apply Principal Component Analysis (PCA) to generate a food security and vulnerability index for household profiling (WFP 2009). PCA is a statistical technique that can reduce the dimensions found among multiple variables into a single measure that captures as much as possible of the variation in the original data set (Abeyasekara 2005). Thus, from a handful of food security indicators, PCA can identify a latent food security variable and can assign a food security score to each household. The Famine Early Warning System Network (FEWSNET) outlines a method to construct a household index of chronic vulnerability. Elements in the index may include drought risk, the diversity of income portfolios, and reliance on export crops. These variables are each converted into comparable units (z-scores), weighted, and summed to generate a simple ranking of households (FEWS, 1999). Demeke et al. (2011) use PCA to create a food security index for Ethiopia that includes several household-level variables related to food availability/access and vulnerability. The authors find the index to be highly correlated with factors such as per capita consumption expenditures and value of food consumption per month, which seems to validate the index as a reliable measure of household food security. Alinovi et al. (2009) also use PCA to build an index of resilience to food insecurity, considering resilience to be a latent variable comprised of income and food access, assets, access to public services, and social safety nets, as well as two cross-cutting dimensions: stability and adaptive capacity.

Although these studies each build an index that measures either food security or one of its aspects, none includes a discussion of the merits and limitations of doing so. While the argument for creating an index is compelling, there may be drawbacks to collecting diverse factors into one score, particularly when trying to understand the determinants of food

security and the channels of impact. For example, Ravallion (2011) notes that while he does not deny that poverty is multidimensional, he is skeptical about the value of a single (uni-dimensional) index for sound development policy making in practice. His reasoning is that, in practice, policymakers can already refer to multiple indicators to measure different aspects of poverty, but the use of a single index measure necessarily relies on assumptions regarding which aspects of poverty should have been included in the measure and how they should be weighted. The same argument can be levied at the construction of a multidimensional food security index. While an acknowledgement of food security's multiple dimensions merits consideration, it is not clear that collapsing these dimensions into a single composite index can be useful.

2.1.5 Indicators of household food security

The accurate measurement of food security is necessary to recognize crises as they occur, to target resources toward those most in need or at risk of sliding into hunger, to track the impact of food security-focused interventions, and to quantitatively analyze the dynamics of food security. Policymakers need to know how many people are at risk of food insecurity, who and where they are, and how best to reach them. While accurate measurement of household food security is essential for effective research and well-targeted policies and programs, there is no standard methodology for measuring food security, and despite an improved theoretical understanding of food security, the FAO notes that there exists no "perfect single measure that captures all aspects of food insecurity" (FAO 2002).

Food security is an unobservable, cross-cutting, multifaceted process of complex causality, and there are considerable conceptual and measurement problems associated with estimating the incidence and intensity of food insecurity (Barrett 2002). For this reason, it is rare for impact assessments of food security interventions or agricultural development programs to include an indicator explicitly called 'food security' (Maredia 2009). Commonly used indicators of household-level food availability may include variables such as household crop or food production (e.g., average cereal yields per hectare or food production per capita) or livestock ownership (Renzaho and Mellor 2009). Although there are no exact indicators of access failure, commonly used proxy measures include household income relative to food prices, food expenditures, and per capita food, calorie and nutritional intake. However, each of these proxies is a partial measure of the multifaceted phenomenon of food access (Webb et al.2006), and the pathways or mechanisms through which these indicators affect food security

are implied rather than empirically determined and calculated (Maredia 2009; Webb et al. 2006). A common indicator of utilization is the growth/ nutritional status of children under five years of age as measured by height and weight (Webb et al. 2006), or 'hygiene' measures, such as type of latrine or source of water (Coates et al. 2003).

While most measures reflect past or current levels of food security (e.g. past or current food production and income; current expenditures and dietary diversity; or current health and nutritional status), ideal food security indicators would also reflect stability/vulnerability, or the probability of adequate consumption in the future. Vulnerability is essentially forward-looking, and is determined by the risks a household or individual faces in making a living, the livelihood options available, and the ability to handle this risk (Alinovi et al. 2009). Indicators of vulnerability include a household's asset stock as a measure of wealth, land owned as a measure of production security, and an index of income diversification (Coates et al. 2003). A simple access-based indicator of vulnerability is how much 'buffer' there is in current income for accommodating higher food prices. A food security indicator concerned with caloric sufficiency but not the proportion of income spent on food may misclassify a household as food secure (Maxwell et al. 1999; Løvendal and Knowles 2005). Other indicators include access to assets and asset liquidity, and crop and income diversification. Measures of stability should account for the choices and tradeoffs households face when allocating their resources over time to balance current access and jeopardizing future food consumption (Wolfe and Frongillo 2000).

Though many of these indicators are similar, they are also somewhat unique in what they are measuring (Barrett 2010), and different indicators capture different dimensions of food security. The FAO concludes that "no individual measure suffices to capture all aspects of food insecurity" (FAO/FIVIMS 2003), and the absence of such a 'gold standard' measure of food insecurity makes it unreasonable to use a single benchmark to proxy a (non-existent) gold standard. In light of the multidimensional nature of food security, it is generally agreed that a suite of indicators and methods are needed for its assessment (CFS 2011). These different measures are needed for complementary analysis and the triangulation or cross-referencing of indicators (a convergence of evidence approach) (Coates 2003; Maxwell et al. 1999; Migotto et al. 2005). In particular, conventional measures based only on household expenditures are considered to miss many aspects of food security, and a non-monetary approach illuminates some of the deeper mechanisms of food insecurity (e.g. vulnerability,

persistence) that are often overlooked by conventional, money-metric analysis (Dasgupta and Baschieri 2010).

2.2. Empirical Literature Review

A majority of the world's poorest countries today are in Africa. Of course some African countries like South Africa and Egypt are not quite as poor as others like Somalia and Ethiopia. And though in recent years food insecurity in Africa has shown some slight falls, African income levels have actually been dropping relative to the rest of the world (Leke, 2017). According to Ben (2018) food insecurity has been exacerbated in developing countries by low level of social development resulting from corruption, misallocation of funds, poor investment habits, poor family planning habits, minimum wage and declining life expectancy.

The major challenge to food security in poor countries are the underdeveloped and underperforming agricultural sector that is characterized by over-reliance on primary agriculture, low fertility soils, ecological degradation, significant food crop loss both pre- and post-harvest, low levels of education, social and gender inequality, poor health status, cultural insensitivity, natural disasters, minimal value addition and product differentiation and inadequate food shortage of preservation that result in significant commodity price fluctuation (Mwaniki, 2005). All factors, however, can be related in some fashion to two basic causes: insufficient national food availability and access to food by households and individuals.

2.2.1. Food Insecurity in Developing Countries

The lest developing countries suffer spells of drought, with resulting famines and such conditions have strong influence on the living standard of the whole population. In Sub Sahara African countries these major shocks have important implications for the welfare of both urban and rural households. In urban areas of Sub Sahara African the impact of the socks is felt mainly through higher food prices and increased rural urban migration, often contributing to increased food insecurity. While local, regional, and national food production are extremely important determinants of food security, the inability of poor households to secure food through markets and non-market channels may limit their food security, even when food is abundant (Barrett 2018). Of course, this conceptualization includes several feedback loops, with appropriate utilization necessary for achieving adequate access (via health and other human capital effects), and access necessary for maintaining food availability (through enhanced labour productivity and the avoidance of resource depletion).

While food availability is still a problem for some countries, the root cause of food insecurity in developing countries today is believed to be the inability of people to gain access to food due to poverty (Von Braun et al, 1994). The study by Mwaniki (2005) supported this view and reported that the root cause of food insecurity in developing countries is the inability of people to gain access to food due to poverty. According to Bonnard (1999), much of the sub-Saharan African population, particularly in rural areas, experiences some degree of hunger over the rain or "hungry" season, when food stocks dwindle and roads become muddy and impossible. Grain was short during the planting season and the problem was largely attributed to poor allocation of resources and poor rationing (Bonnard, 1999). Migration of male labour was also recognized as a cause of seasonal hunger.

A study conducted in a Lesotho village found that women and children suffered from lack of food and poor hygiene because women were too exhausted to cook and clean at times of peak agricultural work (Driba, 1996). Haswell (1953) observed that growing cash crops at the expense of subsistence crops has largely contributed to seasonal food deficit among the Gernier in Gambia. Illness of adults at critical times in the production process adversely affected labour efficiency and productivity, which in turn contributed to seasonal food shortage (Haswell, 1953). A study conducted by Obamiro et al (2003) in South-western Nigeria showed that illness will decrease productivity; therefore increases in day's loss to

illness will decrease food availability and accessibility. As a result illness will likely shift family members from the food secure to the food insecure status.

In several African countries, deterioration in the ecological conditions of production has also been seen as a cause of seasonal hunger. Ogbu (1973) noted insufficient farmland, low yields on farms and high storage losses of staples were the principal causes of seasonal food shortage in Nigeria. A study conducted in Mali by Toulmin (1986) reported that seasonal food shortages that are mainly induced by two principal factors: (i) low and highly variable rainfall making the people very vulnerable to crop failure, and (ii) high levels of mortality, varying levels of fertility and vulnerability of all producers to sickness and disability. Generally the main causes of food insecurity in lest developing countries are prolonged drought, conflict and insecurity, crop disease, etc.

2.2.2. Food insecurity and its dynamics in Ethiopia

Ethiopia has experienced high economic growth in the past decade, and objective poverty measures indicate that the poorest have also experienced rising living standards, leading to, e.g., reduced infant mortality and increased average calorific intake. Despite this, however, food insecurity remains high; the share of households that perceive themselves food insecure has barely changed at all in the same period (Yonas, 2018).

Household food insecurity in Ethiopia has been studied by many researchers, who came up with different findings. Endalew et al. (2015) reviewed food security situation in Ethiopia and causes of food insecurity, and found that about 10% of Ethiopia's citizens are chronically food insecure and this figure rises to more than 15% during frequent drought years. According to them, the deteriorating food security situation in Ethiopia is caused by multifactor, which include population pressure, drought, shortage of farmland, lack of oxen, deterioration of food production capacity, outbreak of plant and animal disease, poor soil fertility, frost attack, shortage of cash income, poor farming technologies, weak extension services, high labour wastage, poor social and infrastructure facility and pre-and post-harvest crop loss. To address food security issue in Ethiopia, they suggested that household heads and members of the households should engage in different income generating activities for means of living and coping mechanism. In addition, the government should incorporate different research outputs to design programs that can tack food insecurity.

Using empirical analysis, Beyene and Muche (2010) examined determinants of household food security among rural households in the Ada Berga district in Central Ethiopia. Household calorie acquisition was analyzed to measure the status of household food security. They estimated the logit model to identify variables which can significantly influence household food security in the study area. Accordingly, they found that variables like experience in farming activities, off farm and non-farm incomes, land and livestock holdings, as well as soil and water conservation practices significantly influence household food security. Besides, difference in fertilizer use has a positive impact on food security, in which food security was improved as the intensity of fertilizer use increases. Result of the study further indicated that development interventions aiming at income diversification, improved fertilizer supply; increasing land and livestock productivity will enormously contribute to the attainment of food security in the study area.

The study conducted on food insecurity in rural areas of Eastern Ethiopia also indicated that socioeconomic factors can influence food insecurity (Bogale and Shimelis, 2009). According to Bogale and Shimelis (2009), socio-economic variables like family size, annual income, and amount of credit received, access to irrigation, age of household head, farm size, and livestock owned have significant influence on food insecurity in rural areas of Dire Dawa, Eastern Ethiopia. Their findings implied that improvement in food security situation in the study area requires building household assets, improving the functioning of rural financial markets and promoting family planning.

The food security situation in Ethiopia has been extremely unstable due to the combination of environmental, socio-political and developmental instabilities. Lack of food in the household imposes inordinate strains on the daily burdens of its members. Coping mechanisms have been eroded in many households due to significant depletion of assets and displacement. Woldemariam's (1991) investigation in Northcentral Ethiopia indicates that most farmers could not produce enough to meet the annual requirements from the farmers' annual requirement perceptions. Tolosa (1996) in his study conducted in Arssi, a zone considered to be a surplus grain producer at an aggregate level, examined the seasonal food shortage among farm households and variations between households practising double cropping (during meher and belg seasons) and those relying on a single harvest (meher).

Fentaw (2018) came out with model that demonstrated the major factors for farm households' vulnerability to famine. He stated that vulnerability to famine is a product of a system, that is, a subsistence production system, which consists of three components: the peasant world, the natural forces (physical environment) and the socio-economic forces. Regarding the relationship between these factors, Woldemariam (1984) argued that an agricultural population must first be made vulnerable to famine by socioeconomic and political forces before any adverse natural factor initiates the process of food shortage that leads to famine.

Mebratu (2018) identified factors influencing food insecurity in the south western Ethiopia. The study used household-level survey data collected from 122 sample households in Woliso district, and systematic random sampling technique was employed to select the sample households. Calorie acquisition by households was used to categorize the sample households into food secure and food insecure. According to Mebratu's finding of descriptive about 25.4 % and 74.6 % of the sample households were found to be food insecure and food secure, respectively. In this study Comparison of percentage of food insecurity was also conducted between two groups for some discrete variables, and results revealed that food insecurity significantly varies between the two groups. According to Mebrat (2018) household's education level, dependency ratio, amount of amount of land and fertilize have significantly influenced the level of food insecurity in the study area.

The study conducted by Fentaw (2018) explored the determinants of household food insecurity in Dawachefa district, the finding of this study shows that the natural factors like, environmental crisis, unpredictability of rainfall, soil erosion and socio-economic factors such as traditional practices and farming system, population pressure, poor infrastructure were identified as the determinants of household food insecurity in the Dawachefa district.

Using empirical analysis Alem (2017) identified some factors that influence household food insecurity in Tehuludere district, South Wello Zone, the study revealed that only 30.8% of the sample households were food secured. The food insecure households (69.2%) felt short of the recommended calorie requirement by 37% while food secure households exceeded the recommended calorie requirement by 44%. According to Alem (2017) non-participation in off-farm activities, having large family size (larger than the sample mean), low annual production or yield (less than the sample mean annual yield), small farm size (smaller than the sample mean farm size), dependency attitude on food aid, poor wealth status (less than the sample mean Tropical Livestock Unit) and insecure land tenure perception as positive and

significant factors that contributed to high food insecurity. In Tehuludere district, South Wello Zone holding other variables constant, a shift to participation in off-farm activities decreases the probability of household food insecurity by 66%. Holding other variables constant, a shift to smaller family size (smaller than the sample mean family size) decreases the probability of food insecurity by 63%. (Alem,2017).

Generally the above review of few empirical works on food insecurity in Ethiopia showed that even though, the effect food insecurity in Ethiopia getting sever, Multi-dimensional determinants of food insecurity are not studied at all and a few studies that has been conducted on determinants of food insecurity were stick to similar methods. This study will be an attempt to fill the aforementioned gaps using different methods, focusing on multi-dimensional determinants of food insecurity.

2.3 Conceptual framework

Food security is a multidimensional issue which cannot be adequately recorded by a single indicator. According to the above literatures food security consists of four essential parts: food availability, food access, food utilization and stability. Food might be available but that does not determine access; similarly, access might be viable but does not guarantee utilization and all three can be disrupted by a lack of stability caused by climate change, conflict, unemployment, disease or other factors. Stability or the lack of it can affect any or all of the other three components of the food insecurity framework.

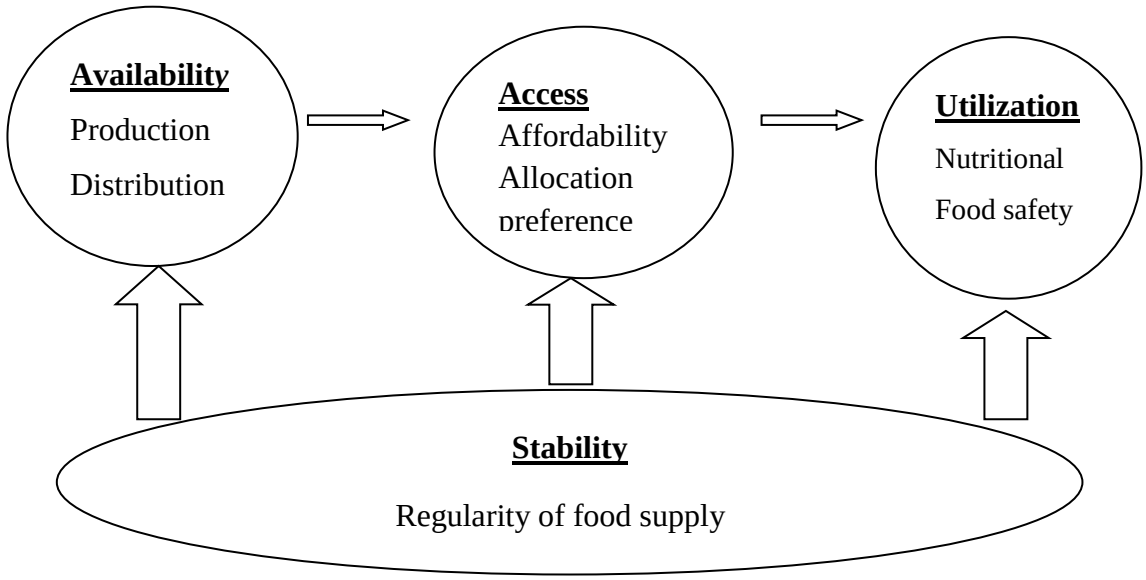


Figure2.1. Conceptual frame work (developed by researcher)

CHAPTER THREE
RESEARCH METHODOLOGY

3.1. Types and Sources of Data

Any research analysis depends on the availability and quality of data employed. Thus, this research depends on secondary data which was collected from various institutions such as, Minister of finance, Central statistical agency (CSA), World Bank, and it also used books, journals, research papers, and annual reports. All the data used were annual observations of the various institutions, especially this study were based on Ethiopian socio economic survey of 2016. Due to the absence of recent data from CSA this study were based on Ethiopian socio economic survey of 2016 which include 22,296 households from all parts of the country.

The Ethiopia Socioeconomic Survey (ESS) is implemented in collaboration with the World Bank Living Standards Measurement Study (LSMS) team as part of the Integrated Surveys on Agriculture program. The objectives include the development of an innovative model for collecting agricultural data; inter institutional collaboration, and comprehensive analysis of welfare indicators and socioeconomic characteristics. ESS is a nationally representative survey of 22,296 households living all parts of the country. The ESS is designed to collect panel data in rural, small town, and urban areas on a range of household- and community-level characteristics linked to agricultural activities. The first wave was implemented in 2011–12, the second wave was implemented in 2013–14, and the third wave was implemented in 2015–2016.

3.2. Building Multidimensional Index for Food Insecurity

Food security is a multidimensional issue which cannot be adequately recorded by a single indicator. In such kind of analysis the phenomenon to be measured may be indirectly observed by several indicators, which describe different features/aspects of the phenomena of food insecurity. Income and expenditure as measures of food security may also obscure the true extent of food insecurity as prices vary across urban and rural locations, as well as across provinces. Furthermore the amount spent, even only on food, gives no indication of the nutrient quality and diversity of the consumption bundle.

Aside from the problem of inconsistent measurement of food insecurity across these measure s, each of these tools has weaknesses in assessing the depth or severity of food insecurity. According to literatures for these reasons it is widely recognized that studies making use of single measures are likely to miss the complexity of the experience that characterizes food insecure households and individuals. While the need for a measure that incorporates the multiple experiences of food insecurity is undisputed, the method of doing so has not been so obvious (Joanna, 2015). According to South Africa labor and development research unit (2015) one promising avenue is to employ the Alkire Foster methodology of multidimensional poverty measurement to the analysis of food insecurity. The methodology of multidimensional poverty measurement forms the basis for the development of the multidimensional food insecurity measure.

In this study we were use Alkire Foster methodology which lay the foundation for the creation of the Multidimensional Food Insecurity Index. The Alkire Foster method can identifies who is multidimensional food insecure by considering the range of deprivations they suffer. It aggregates that information to reflect food insecurity in a way that is robust and can be easily broken down to reveal how people are multidimensional food insecure. Measures constructed using the Alkire Foster method can identify interconnections among deprivations and improve policy design. The method captures the percentage of people who are multidimensional food insecure (incidence) and the intensity of multidimensional food insecurity experienced by the food insecure households. It is flexible and can incorporate a wide range of dimensions, indicators, cutoffs and weights.

Food Insecurity Dimensions, Indicators and Cut-offs of the Index

i. Anxiety and uncertainty about the household food supply
ii. Insufficient quality (including variety and preferences of the type of food)
iii. Inadequate quantity (including the physical consequences)

According to Maxwell, 2013 those dimensions are capture the identifiable elements of the FAO definition of food insecurity. Based on literatures such as Coates (2006), Maxwell (2013), and Marion (2017) this study were consider the following indicators as they measure and capture the concepts of each of the three dimensions: stunting are considered as indicator of physical consequences of food insecurity dimension, perceptions of household about food adequacy is considered as indicator of anxiety and uncertainty dimension, diversity of dietary and proportion of food expenditure are considered as indicator of quality of food

dimension. The following diagram shows the structure and weight of each dimension and indicators.

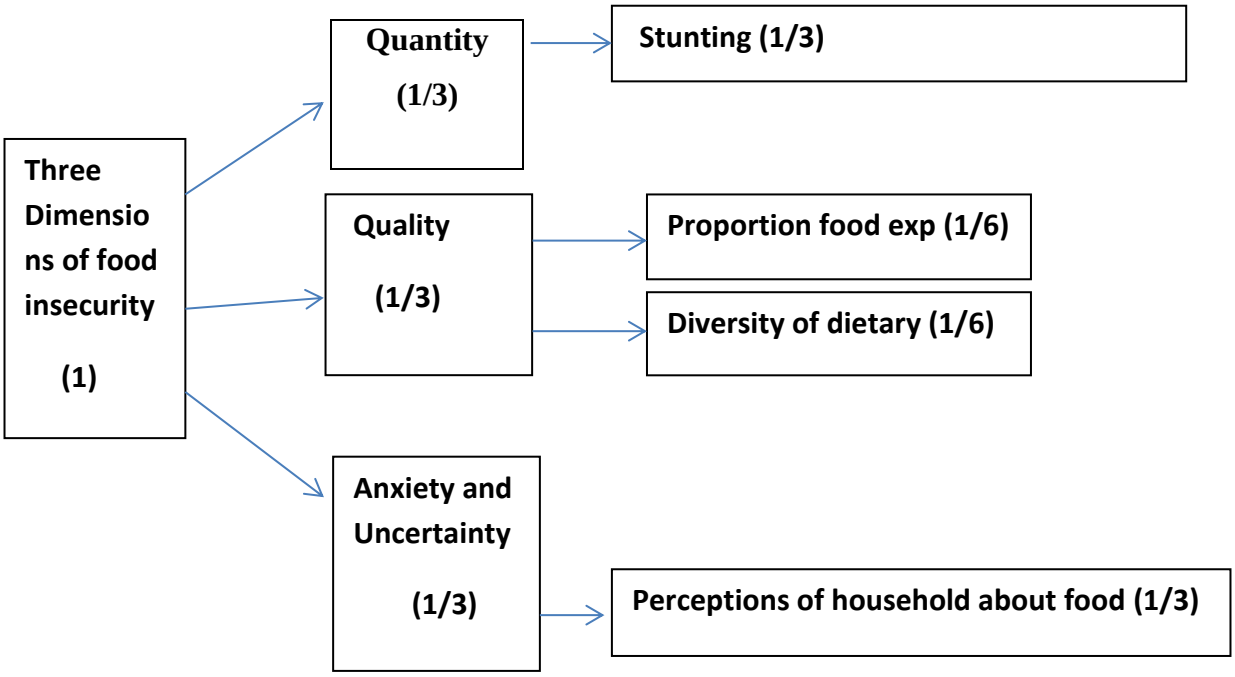


Figure2: The structure and weight of dimension and indicators (based on literatures, 2020).

In principle setting the deprivation cut off for each indicator is guided by the literatures, based on this fact, in the absence of an invariable and updated national food insecurity line, in this study a household is identified as food insecure if they are deprived in at least two of the four weighted indicators or if the overall deprivation scale is greater than or equal to 0.5.

3.3. Econometric Model and Method of Constructing Indicator

In addition to descriptive analysis econometric model was used to analyze multi-dimensional determinants food insecurity in Ethiopia. In this study to identify multidimensional food insecure households the study used uncertainty about the household food supply, insufficient quality (including variety and preferences of the type of food), and inadequate quantity (including the physical consequences) dimensions of household food security. stunting is considered as indicator of physical consequences of food insecurity dimension, perceptions of household about food adequacy is considered as indicator of anxiety and uncertainty dimension, diversity of dietary and proportion of food expenditure are considered as indicator of quality of food dimension. Share of total household expenditure spent on food is considered as an indicator of quality dimension of food insecurity because it is widely documented that the poorer and more vulnerable households, the larger the share of

household income spent on food. This indicator of household food insecurity is commonly calculated and used with data from household consumption and expenditure survey at national level that include the monetary value of household consumption disaggregated into food and non-food items (Keynos,2018). Based on this situation the share of household expenditure on food can be obtained for each 22,296 households as follows and used as one indicator from total of 4 indicators

$$\frac{Expenditure\ on\ food}{Total\ expenditure} * 100$$

While no internationally agreed threshold exists, Smith and Subandoro (2017) have proposed that household spending over 75% of their income on food can be considered very vulnerable and consequently food insecure in quality dimension. In principle setting the deprivation cut off for each indicator is guided by the literatures, based on this fact, in the absence of an invariable and updated national food insecurity line, in this study a household is identified as food insecure if they are deprived in at least two of the four weighted indicators

As the dependent variable has a dichotomous nature (Multidimensional food insecure or secure), a binary logistic regression was used where the estimated probabilities lie between logical limit 0 and 1 (Gujarati, 1995). Accordingly, variables assumed to have influence on the probability of being multidimensional food insecure or secure in different contexts were tested in the model. The general description of the model and its application is described below. The study was employed Logistic regression model (Equation 1) with the dependent variable (the status of respondents regarding to multidimensional food insecure) being a binary variable having a value of one if a respondents will be found multidimensional food insecure , and a value of zero otherwise:

$$Pi = E(y = 1\ /Xi) = \frac{1}{1 + e^{-zi}} = \frac{e^{zi}}{1 + e^{zi}} \quad ----------3.1$$

Where e is an exponential term Pi is the probability of respondent to be multidimensional food insecure. Y is the observed status of a respondent regarding to multidimensional food insecurity. Xi is the respondent set of explanatory variables Zi is a function of n-explanatory variables (Xi) which can be expressed in linear form as:

$$Zi = \beta 0 + \beta 1X1 + \beta 2X2 + \cdots + \beta nXn$$

From Equation 3.1, the probability of a respondents being multidimensional food secure is given by (1 – Pi) which can be written as:

$$1 - pi = \ 1 - \frac{1}{1 + \mathrm{e}^{-\mathrm{zi}}} = \frac{1 + \mathrm{e}^{-\mathrm{zi}} - 1}{1 + \mathrm{e}^{-\mathrm{zi}}} = \frac{\mathrm{e}^{-zi}}{1 + \mathrm{e}^{-\mathrm{zi}}} - - - - - - - - - - - - - - - - - - -3.2$$

Therefore, the odds ratio $\frac{pi}{(1-pi)}$ is given by:

$$\frac{pi}{(1 - pi)} = \frac{1 + e^{zi}}{1 + e^{-zi}} = e^{zi} -3.3$$

Now, $\frac{pi}{(1-pi)}$ is the odds ratio in favor of being multidimensional food insecure and it is simply the ratio of the probability that a respondent would be multidimensional food insecure (Pi) to the probability that a respondent would be food secure (1-Pi). According to Gujarati, 1995 if we take the natural log of the above equation (equation 3) we obtain a very interesting result.

$$Li = \ln\left\{\frac{pi}{1 - pi}\right\} = Zi \ - 3.4$$

Where, Li is the log of odds ratio which is not only linear in variables but also (from the estimation view point) linear in parameter. The above equation is logit and hence the name logit model for models likes the above model. If the disturbance term is introduced, the Logistic regression model in Equation 4 is represented below:

$$Zi = \beta\ 0 + \beta_1 \mathrm{X}1 + \ \beta 2\mathrm{X}2 + \ \beta\ 3\ \mathrm{X}\ 3 + \ldots\ldots\ldots + \beta \mathrm{n}\ Xn + \ \varepsilon \ \ - - - - - - - - - 3.5$$

In Equation 3.5, the terms βi are parameters to be estimated, and X1 to Xn are explanatory variables such as: family size of the household, marital status of household head, education of the household head, occupation of household head and other variable associated with multidimensional food insecurity. In this logit model the slope coefficient of a variable gives the change in the log of odds ratio in favor of being multidimensional food insecure associated with a unit change in that variables ,holding all other variable constant. But in the logit model the rate of change in the probability of an event happening is given by $pi(1 - pi)\beta i$ where βi is the (partial regression) coefficient of the ith explanatory variable (Gujarati, 2004). Depend on this in our case the rate of change in the probability of being multidimensional food insecure is given by $(1 - pi)\beta i$.

$$\frac{\partial pi}{\partial Xi} = pi(1 - pi)\beta i - 3.6$$

This equation shows us the marginal effects of each explanatory variable on the probability of being multidimensional food insecure were calculated from the estimated Logistic regression model.

Diagnostic test for Econometric model

In this study logistic regression combines the explanatory variables to estimate the probability of the household to be food insecure or not. Econometric theory tells us that we are likely to encounter heteroscedasticity frequently in econometric data, particularly with cross-sectional data. Inaddition to heteroscedasticity in most econometric data it is likely that independent variables are correlated with each other. In econometric analysis those problems are not to be tolerated, therefore in this study we have the following diagnostic test:

Test for Heteroscedasticity: This problem is more serious on cross section data. In logit model of this study the likelihood ratio (LH) statistics is used to test the existence of heteroscedasticity problem. Likelihood ratio (LH) statistics of test will hypothesis of homoscedasticity is obtained by $LR = 2(logLu - logLr)$ where logLu is the maximum value of unrestricted log-likelihood function and Lr is the maximum value of restricted log-likelihood function estimated only with constant term. If the value of test statistics (LR) became larger than a X^2 (n) distribution with "n" is degree of freedom and it's the number of independent restriction then the null hypothesis (homoscedasticity) is rejected.

The log-likelihood ratio test (LR): LR test for the model of this study is based on the same concepts as the F test in a linear model. This is based on the difference in the likelihood function for the unrestricted and restricted models. The null hypothesis states all the scope coefficients are equal to zero.LR statistics is given by LR = 2(logLu - logLr) Where LogLu is the maximized value of unrestricted log likelihood and logLr is the maximized value of restricted likelihood function estimated only with constant term. The null hypothesis will be rejected if f LR >X^2 n, where n is the number of independent restriction.

Multicollinearity: Multicollinearity means the existence of a perfect or exact linear relationship among some or all explanatory variables of a regression model. Multicollinearity is a question of degree and not of kind (Gujarati, 2003). In econometric models the meaningful distinction is not between the presence and the absence of multicollinearity, but

between its various degrees. According to econometric literatures we do not have one unique method of detecting multicollinearity. what we have are some rule thumb, this study used rule of thumb that if the pair wise or zero order correlation coefficients between two explanatory variable is high, say, in excess of 0.8, then multicollieanity is a serious problem.

Measures of goodness of fit and predictive power of the model: Goodness of fit is so called percent correctly predicted. Mcfadden (1974) quoted in Wooddridge (2000)suggests the measure of goodness fit $\frac{Lur}{Lo}$ Where Lur is the log-likelihood function for estimated model and Lo is the likelihood function in the model with only an intercept.

This is analogues to R squared for OLS regression which can be written as $1 - \frac{SSRur}{SSRo}$ In addition to the above measure of goodness of fit we can found count R^2 to measure goodness of fit, Count $R^2 = \frac{number\ of\ correct\ prediction}{Total\ number\ of\ observation}$

The sustainability of a model in this study for econometric analysis depends on how much it predicates from the actual observation.

3.4 .Method of Data Analysis

The data was analyzed by both econometric and descriptive analyses. The data was subjected to analyses by using different software's such as Stata version 13. Descriptive and econometric technique of presentation was employed. The specific statistic used includes percentage, mean, and standard deviation in descriptive statics and Logit model of regression in the econometric analysis.

3.5. Descriptions of explanatory variable and expected signs

In econometric model two main variables were explored: the dependent variable (in this case the probability of being multidimensional food insecure) and independent variables (the determinants multidimensional food insecurity in Ethiopia). According to economic literatures on the issues of multidimensional food insecurity a number of explanatory variables could determine multidimensional food insecurity directly as well as indirectly, due to this reason only few determinants of multidimensional food insecurity in Ethiopia were analyzed. In many econometric models the dependent variable and independent variables can be cause and effect of the other, but in our case we assumed a one direction relationship between both variables and the dependent variable (the probability of being multidimensional

food insecure) is determined by the explanatory variables. At the all in this model the dependent variable is categorized as multidimensional food insecure and secure and model is estimated by using Maximum likelihood technique. Depend on this context the description of explanatory variables and hypothesis statement are provided below.

i. **Household Family Size**: Family size affects the level of income required for house hold to escape from multidimensional food insecurity. Rise in family size would imply decline in the level of income or another indicator of welfare essential to escape from food insecurity. In this study it is hypothesized that the rise in family size expected to raise the chance of being multidimensional food insecure.

ii. **Education of Household Head:** The education of the household head also expected to have an impact on the chance of being multidimensional food insecure or not. In principle the literate house hold expected to have more chance to escape from food insecurity. Therefore, it is hypothesized that rise in year of education is expected to decreases the probability of being multidimensional food insecure.

iii. **Water source:** As the source of water to household head changed from safe to other source or vice versa it may moves into multidimensional food insecurity or security. This variable takes a binary value. If the source of water is safe (piped and protected) it takes 1 and 0 for otherwise. In this study it was hypothesized that this explanatory variable may have negative or positive sign.

iv. **Marital status:** Marital status is identified as one of important demographic factors that affect the probability that a household will be multidimensional food insecure. This explanatory variable takes a binary value and married household head takes 1 and 0 for otherwise. In light of this it was hypothesized that being married household head has less or high probability of being food insecure than others this means this study was expected being married household head may have negative or positive effect on the probability of being food insecure.

v. **Household Health Status:** In principle household with poor health condition will have a poor living standard. Most of time when household head get sick, all member of the household faces different problems and one of among others is food insecurity. Households with frequent patient members take value of 1, 0 otherwise. In this study households with frequent patient member are expected to have high probability to be multidimensional food insecure.

vi. **Household Head Occupation or Employment**: This explanatory variable refers type of occupation that the household head is engaged in. To see the role of household heads work in effecting food insecurity status, the study will use the head work as a binary. If a Household heads does any work for salary it takes value 1, 0 otherwise. This study was expected being salary workers head may have negative or positive effect on the probability of being multidimensional food insecure.

vii. **Age of Household Head:** Age of head of household is measure in complete years. In principle people in productive age group is believed to earn more income than others. The study will treat age of household as continues variable. In economic literatures there is no clear relationship between food insecurity and age of the household head. Based on this it was hypothesized age of household head may have negative or positive effect on the probability of being multidimensional food insecure.

viii. **Off farm activity**: Access to off farm activity play a crucial role in achieving global food security by increasing access to food. More importantly, off farm activity can boost source of income which will reduce multidimensional food insecurity. This variable is a dummy, 1 if the respondent has off farm activity, 0 otherwise. Hypothesized that increase in year of education is expected to decreases the probability of being multidimensional food insecure.

ix. **House Ownership:** Ownership of house can be taken as proxy for wealth. It is a dummy variable 1 if the respondent has house, 0 otherwise. In this study it is expected that household who own their house would have a low probability to being multidimensional food insecure than those who are paying rent.

x. **Access to Credit:** In developing countries like Ethiopia access to financial institutions are very limited. In principle household with access to credit have better chance to escape from food insecurity. This variable is a dummy variable 1 if the respondent has access to credit, 0 otherwise. In this study it is expected the probability to be multidimensional food insecure is less for household with access to credit.

CHAPTER FOUR
RESULT AND DISCUSSION

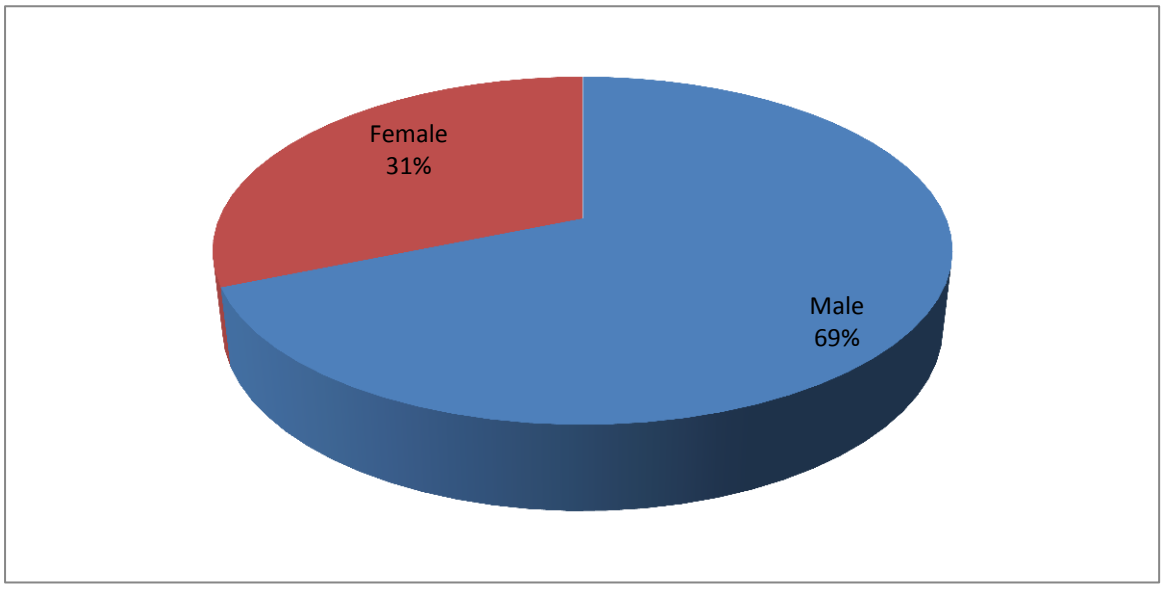
4.1. Descriptive Analysis

This section discusses the important findings and results obtained from descriptive analysis of the study. The first part of this section presents the general characteristics of sampled households in Ethiopian demographic and health survey of 2016, followed by analyses for level of food insecurity, its depth and severity, and finally food insecurity analysis with respect to household demographics is presented.

4.1.1. General Characteristics of Households in the study

This study has covered about a total of 22,296 sample households from Ethiopian demographic and health survey of 2016 which was collected by CSA. The basic information regarding to demographic and socio economic characteristics of the sample household described as follows.

Figure4.1: Distribution of sampled household head by gender



Source: CSA Survey and own calculation result, May2020

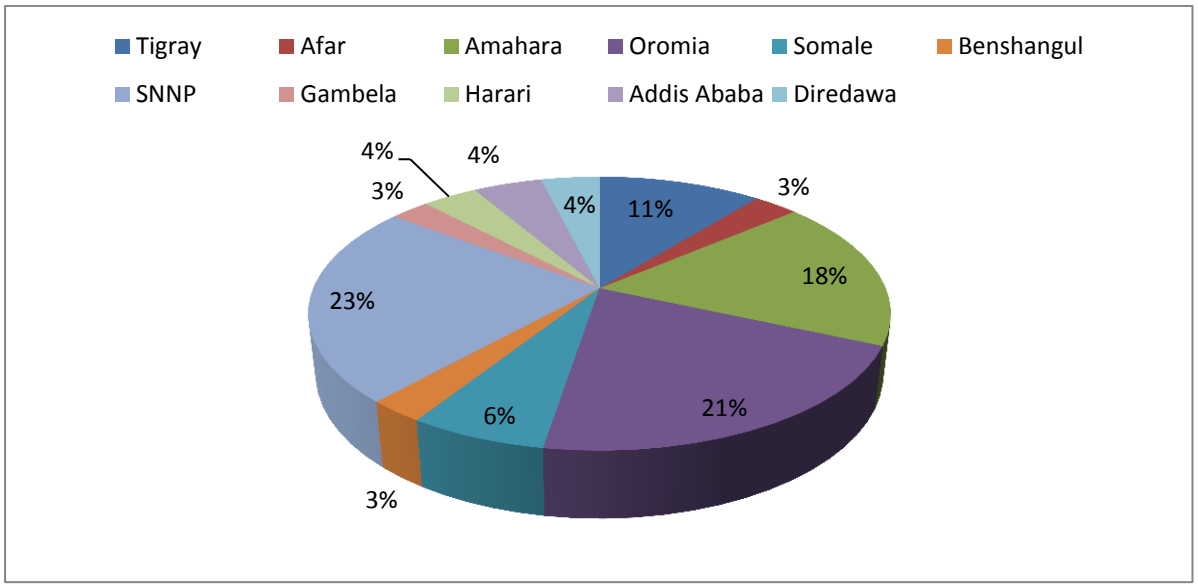
Figure 4.1 shows from the total households covered by this survey male head households comprise 68.77 percent. While the remaining are female headed. In Ethiopia number of household headed by male is quite larger than the ones headed by females.

Considering family size the overall average household size is 5 with a minimum of 1 household members and a maximum of 16 household members.

The data on age shows a wide range of response where the average is found to be 46with a minimum and maximum age is 13 and 99 respectively. Regarding to marital status the result reveals that 47 percent, 41.64 percent, 4.65 percent, 5.91 percent of sampled households are never married, married, divorce and widow respectively. The survey result showed that the mean number of schooling years of sample household heads was calculated to be 8 years with minimum of 0 years attending and a maximum of 35 years of attending, the majority of sample household heads where attend primary education level followed by tertiary education and secondary education level. The total real food expenditure per capita is range from 477 to 278,389 with average of 3963. Regarding to real no food expenditure it ranges from 0 to 58,676.6 with average of 1,203.

The demographic and health survey of 2016 was collected from all regions of the country including two city administrations.

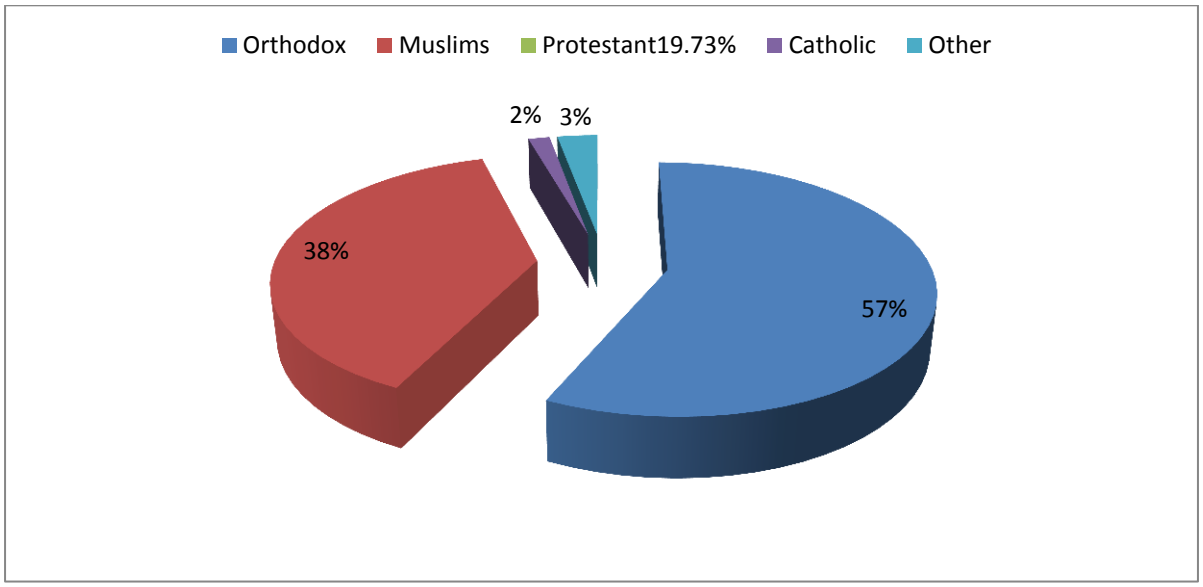
Figure 4.2: Regional distribution of sampled households



Source: CSA and own survey result, May 2020

Figure4.2 shows that from the total households covered by this survey 10.84 percent, 2.96 percent, 17.83 percent, 20.95 percent, 6.47 percent, 2.67 percent 23.56 percent, 2.61 percent, 3.66 percent 4.57 percent and 3.88 percents are from Tigri, Afar, Amahara, Oromia, Somale, Benshangul, SNNP, Gambela, Harari, regional state Addis Ababa, and Diredewa city administration respectively.

Figure4.3. Distributions of sampled household by religious



Source: CSA and own survey result, May 2020

Figure4.3. shows that distribution of religion of sampled households and from total sampled households 46.5 percent are Orthodox, 31.39 percent are Muslims, 19.73 percent are Protestant, 1.26 percent are Catholic religion and 2.38 percent's are followers of other religious.

4.1. 2. Analysis of Multidimensional food insecurity, Its Depth and Severity

Food security is a multidimensional issue which cannot be adequately recorded by a single indicator. The literature supports the statistical evidence that the multidimensional approach is the right one to follow. In this study anxiety and uncertainty about the household food supply, insufficient quality (including variety and preferences of the type of food) and inadequate quantity (including the physical consequences) are considered as three important dimensions of food insecurity. In the absence of an invariable and updated national food insecurity line, in this study a household is identified as food insecure if they are deprived in at least two of the four weighted indicators or if the overall deprivation scale is greater than or equal to 0.5.

The earliest and perhaps the most commonly used statistics to measure the extent of poverty and food insecurity and to aggregate the information on individuals' welfare are Head Count Index (P0), food insecurity Gap index (P1) and Severity Index (P2). Depend on this fact the study was used those indices of poverty as follow.

According to South Africa labor and development research unit (2015) we can employ the Alkire Foster methodology of multidimensional poverty measurement to the analysis of food insecurity. Based on the above food insecurity line or cut off and Alkire and Foster Methodology the summary results related to level of food insecurity, its depth and severity in Ethiopia are given below:

Head count index**:** This index gives the proportion of households who are Multidimensional food insecure. This index computes the proportion of people who have been identified as multidimensional food insecure in the population.

$P0 = \frac{Np}{N}$ Where Np is total number of multidimensional food insecure households and N is total number of households in the survey.

$$P0 = \frac{Np}{N} = \frac{6{,}132}{22{,}296} = 0.2750$$

The above result shows simply 27.5 percent of sample households by Ethiopian demographic and health survey of 2016 which was collected by CSA are multidimensional food insecure. This index provides a single measure of food insecurity. It gives no indication of the breadth of food insecurity; the problem is if a food insecure household becomes deprived in an additional indicator head count ratio will remain the same. This violates what is termed 'dimensional monotonicity' which states that if a person becomes deprived in an additional indicator then overall poverty should increase (Alkire & Foster, 2009). For example, if an individual is deemed deprived in at least two indicators, this individual is then counted as being deprived. The same is true of an individual who is deprived in four of the six indicators. However, the intensity of deprivation of the second person is double that of the first. By considering this problem Alkire & Foster (2009) suggested the adjusted headcount ratio which is multiplying the headcount ratio by the average deprivation share.

In our case household is identified as food insecure if they are deprived in at least two of the four weighted indicators or if the overall deprivation scale is greater than or equal to 0.5. This shows that the average proportion of indicators in which they are deprived is 0.5, or between 2 and 3 of the 4 indicators. The adjusted headcount ratio of Ethiopia, which accounts for both the depth and the severity of food insecurity, is 0.1375 (multiplying the headcount ratio by the average depri1vation share).

4.1.3. Decomposition of Multidimensional food insecurity in Ethiopia

In this study the multidimensional food insecurity is decomposed by subgroup to investigate socioeconomic differences; geographic applications such regional contributions and urban and rural contributions for multidimensional food insecurity at national level.

The important feature of such type of analysis is it can be decomposed by subgroup to investigate. The following table provides a summary of multidimensional food insecurity in Ethiopia as a whole, and the sub populations of urban and rural areas, and for the nine regions and two city administrations:

Table4.1: Share of regions from Multidimensional food insecurity at national level

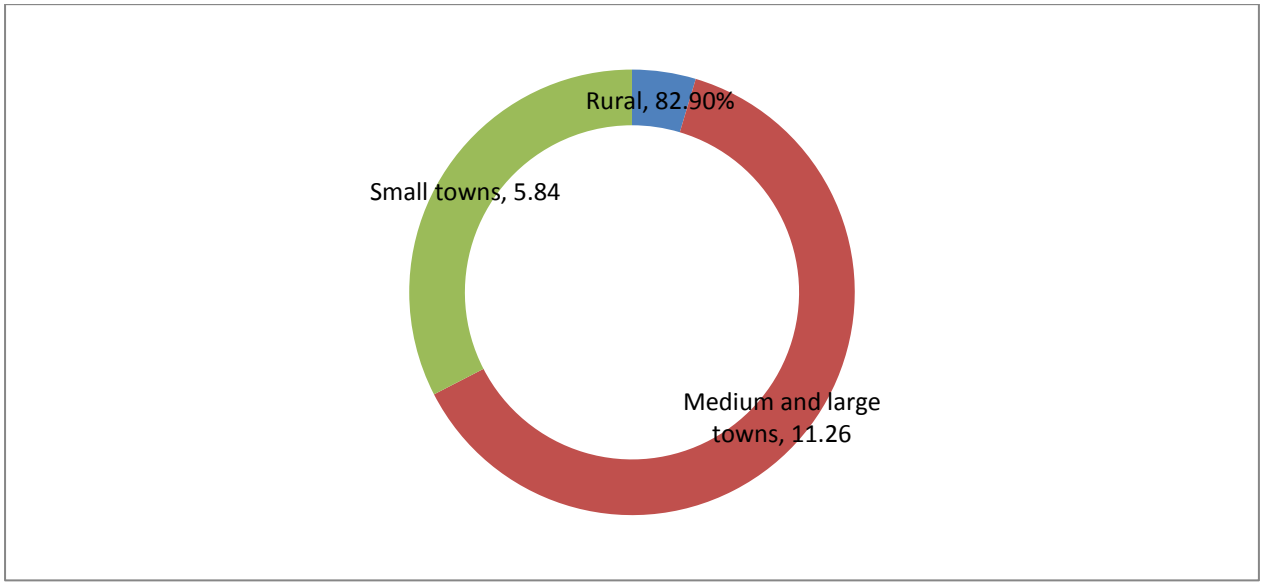
Regions	Head count Index	Contribution in percent
Tigray	0.21	8.19
Afar	0.43	3.65
Amhara	0.18	11.59
Oromia	0.31	23.32
Somali	0.432	10.12
Benishangul Gumuz	0.27	2.64
SNNP	0.33	28.47
Gambela	0.22	2.07
Harari	0.24	3.2
Addis Ababa	0.11	1.96
Dire Dawa	0.33	4.79

Source: Own calculation result, May 2020

The table 4.1.shows the contributions of each regions to the national multi-dimensional food insecurity, and there head count index. SNNP is the greatest contributor, account for 28.47 percent of multidimensional food insecure households at national level. Addis Ababa city administration is contributes the least which is 1.96 percent

In table 4.1 Head count index of each regional state shows the proportion of people in each region who have been identified as multidimensional food insecure in the population. The result shows 43.2 percent of sample households from Somali region are multidimensional food insecure, and this is maximum result. The leas Head count index is 11 percent which the head count index of Addis Ababa city administration, this result shows 11 percent of sample households from Addis Ababa city administration are multidimensional food insecure. In addition to considering the share of each regional state, in this study the multidimensional food insecurity is decomposed to identify the contributions urban as well as rural areas to national multidimensional food insecurity.

Figure 4.4: Urban -rural contributions for multidimensional food insecurity at national level.



Source: CSA Survey and own calculation result, May2020

Figure 4.4 shows the contribution of rural areas to national food insecurity is well over half, at above 82.9 percent, with that of medium and large town areas being 11.26 percent and the rest 5.84 percent is contributed by small towns. This result shows the contribution of rural area is very high; the reason behind this outcome is that, the survey of 2016 was collected from all regions of the country including two city administrations and 71.06 percent of

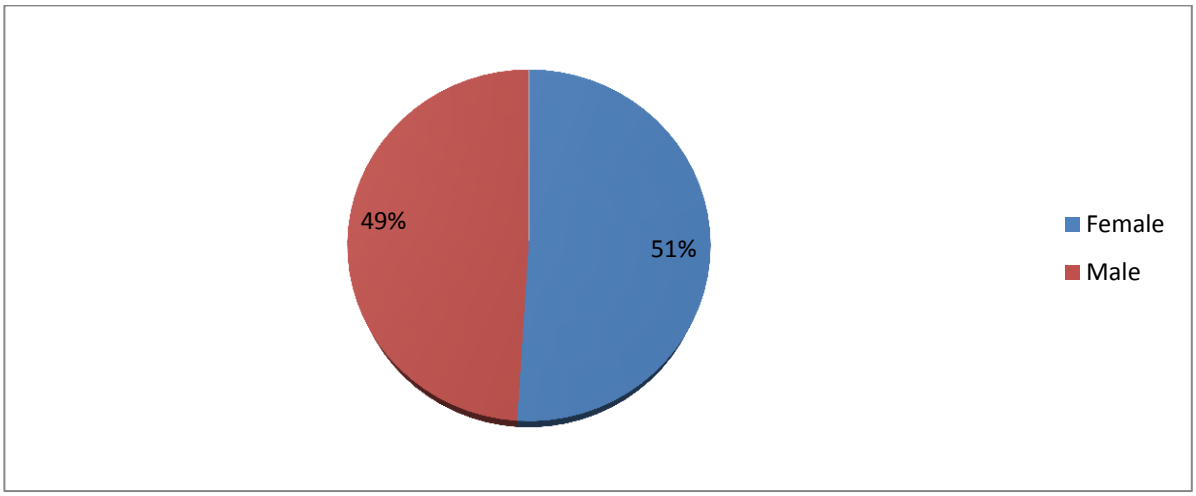
sampled households are from rural area which is around 15,844 households from the total of 22,296 sampled households. Head count index shows the proportion of people in each area who have been identified as multidimensional food insecure in the population. The survey result shows 32.5 percent of sample households from rural area are multidimensional food insecure, 14.8 percent of sampled households from medium and large towns are multidimensional food insecure and 20.03 percent of sampled households from small towns are insecure. Those suffering acute food insecurity are mostly concentrated in rural areas, as reflected in the headcount index. These finding are not surprising, and confirm other relative measures of food insecurity in rural Ethiopia.

4.1.4. Multi-dimensional Food insecurity and Explanatory Variable

Food insecurity is a multidimensional concept and usually it is determined by demographic and socioeconomic variables. Under this section the study discuss the link of food insecurity with demographic and socioeconomic variable in Ethiopia. In addition to this, under this part the study tested whether a particular independent variable is significant or not holding other variable constant. The study used t test to test a hypothesis about any individual partial regression coefficient (Appendix 6). The partial regression coefficient measures the change in the probability of being food insecure per unit change in explanatory variable.

Gender and Food insecurity: The consideration of gender in analysis of food insecurity conditions is important because of gendered opportunities and constraints in terms of access to income, resource and services. The following figure shows the percentage share of male and female headed food insecure households.

Figure 4.5: Gender share from multidimensional food insecurity at national level.

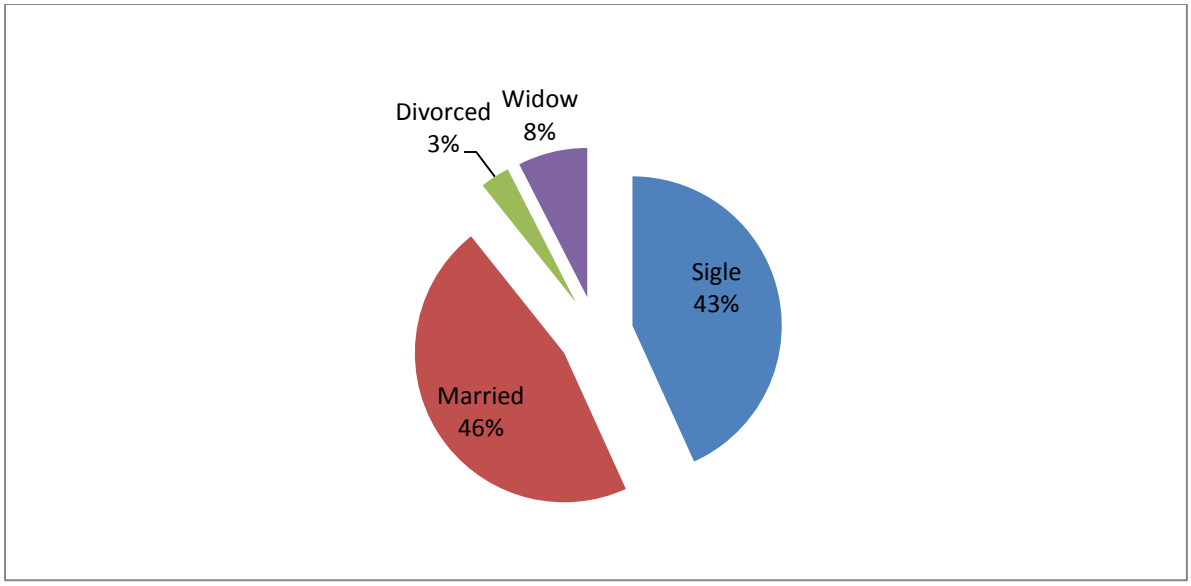


Source: Owen calculation based on survey result, May 2020

The above figure shows that about 51 percent of multidimensional food insecure households are headed by female and 49 percent of multidimensional food insecure households have male household head. The study compares the head count index of multidimensional food insecurity across the gender of the household heads. The result shows that the 27.4 percent of the total sampled female headed households are multi dimensionally food insecure and the head count index for male headed households are 0.275. A comparison between male and female headed households shows that there are small differences in the indices of multidimensional food insecurity among male and female headed households. The result head count is higher for female household heads than male household heads, and t value result showed all of these differences are statistically significant at 1 percent significance level (Appendix, 6).

Marital Status of Household and Food Insecurity: As pinpointed in various literatures, marital status is identified as one of important demographic factors that affect the probability that a household will be food insecure. In light of this it was hypothesized that being married household head has a negative or positive relationship with the probability of multidimensional food insecure. Marriage will increase livelihood of a households by distributing the responsibility of carrying the families among husband and wife.

Figure 4.6: Marital Status share from multidimensional food insecurity at national level.



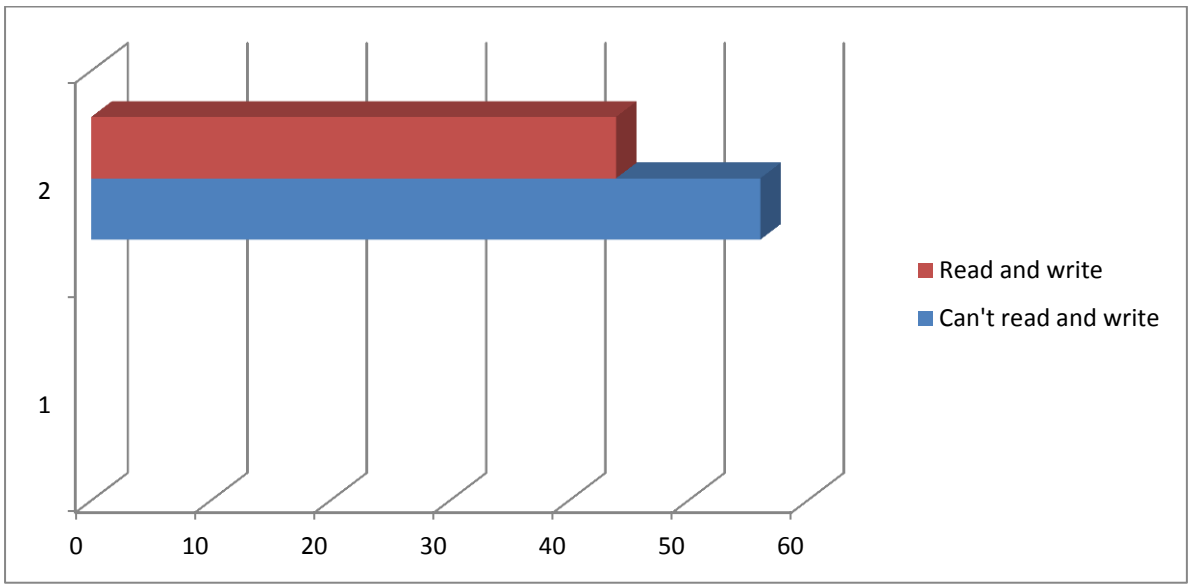
Source: Owen calculation based on survey result, May 2020

The result of this study showed that in Ethiopia married households have high percentage share from the total multidimensional food insecure households relative to single, divorced

and widowed households. Figure 4.6 shows that about 46 percent of multidimensional food insecure households are married and 3 percent of multidimensional food insecure households have divorced marital status. The t value to test a hypothesis about any individual partial regression coefficient indicates that the differences are significant at 5 percent significance level (Appendix 6).

Education and Multi-dimensional Food insecurity: Education is an important indicator of socio economic status. Education is expected to decreases the probability of being multidimensional food insecure. From the total multidimensional food insecure sample household 43.95 percent, 56.05 percent cannot read and write and read and wright respectively.

Figure 4.7: Level of education and multidimensional food insecurity at national level.



Source: Owen calculation based on survey result, May 2020

Figure 4.7 shows that the proportionate contribution of households those can read and write to the multidimensional food insecurity at national level is less than the contribution of illiterate households. The t test result showed all of these differences are statistically significant at 1 percent significance level (Appendix 6). This is expected because household heads with higher levels of educational attainment improve their chance of obtaining a better means of income generation. This result is in agreement with Tsion (2017) which pointed out that educational level of household heads has negative significant effect food insecurity.

Family Size and Multidimensional Food insecurity: As pinpointed in various economic literatures, household family size is identified as one of the important demographic factors that affect the probability that a household food insecure. In this study, the family size was found to be highly significant to determine the probability of multidimensional food insecure.

In light of this it was found that family size has positive relationship with multidimensional food insecurity status of the household in Ethiopia. The following table compares household size and multidimensional food insecurity status of sampled households.

Table4.2: Household family size and Multidimensional food insecurity in Ethiopia

Multidimensional food security	Household family size				
	1-3	4-6	7-9	>10	Total
Insecure households	666	2802	2290	374	6,132
Percentage share	10.55	45	38.35	6.1	100
Secure households	2,706	7,621	4,737	1,100	16,164
Total	3372	10,423	7027	1474	22,296

Source: Owen calculation based on survey result, May 2020

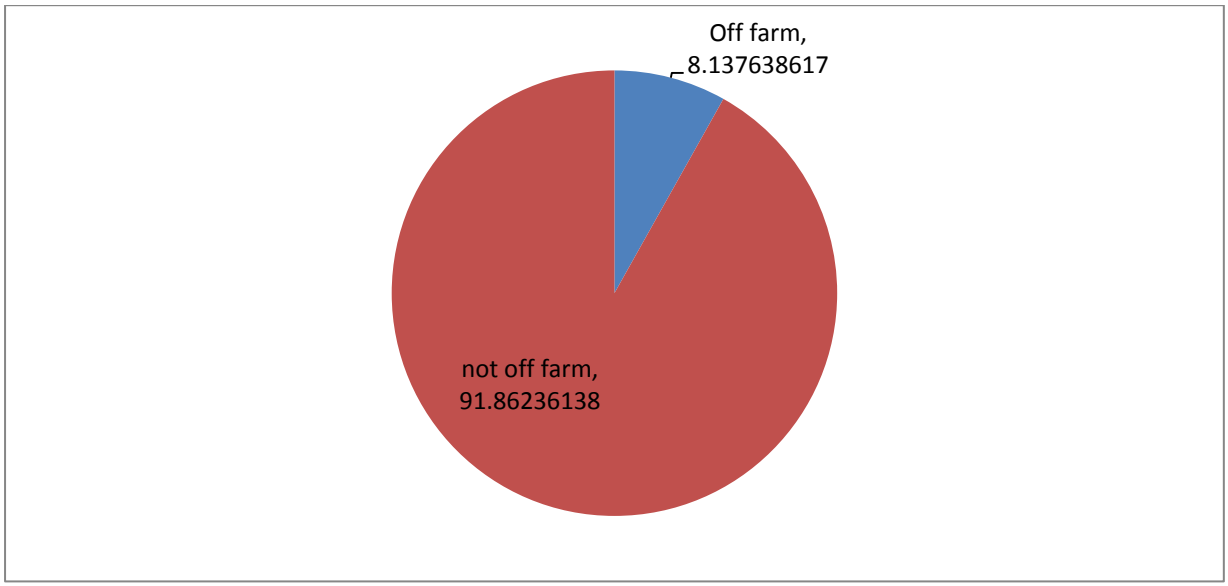
Table 4.2 shows that from the total multidimensional food insecure households 10.55 percent 45 percent, 38.35percent, 6.1 percent, of them are in family size range of 1-3, 4-6, 7-9,and more than 10 respectively. This result indicated multidimensional food insecure households have large number of family size relative to food secure households. The t test result indicates that the difference of probability of being multidimensional food insecure based on family size is statistically significant at 1 percent significance level (Appendix 6). This result is in agreement with Mebratu (2018), who pointed out that households with larger family size have more probability of being falling into food insecure category than those with lesser family size

Occupation and Multidimensional food insecurity: Household who has access to employment is less likely to be multi-dimensional food insecure. The type occupational type of household head can determine the probability of household to be multidimensional food insecure. According to literatures multidimensional food insecurity is found to be more widespread among some occupational groups. In this study the type of economic engagement is significant in affecting the probability that a household will be multidimensional food

insecure. The type occupational type of household head can determine the probability of household to be multidimensional food insecure.

As it observed from the following figure among the total multi-dimensional food insecure households , 91 percent of them are do not engaged on off farm economic activity.

Figure4.8: Farm activity and Multidimensional food insecurity in Ethiopia



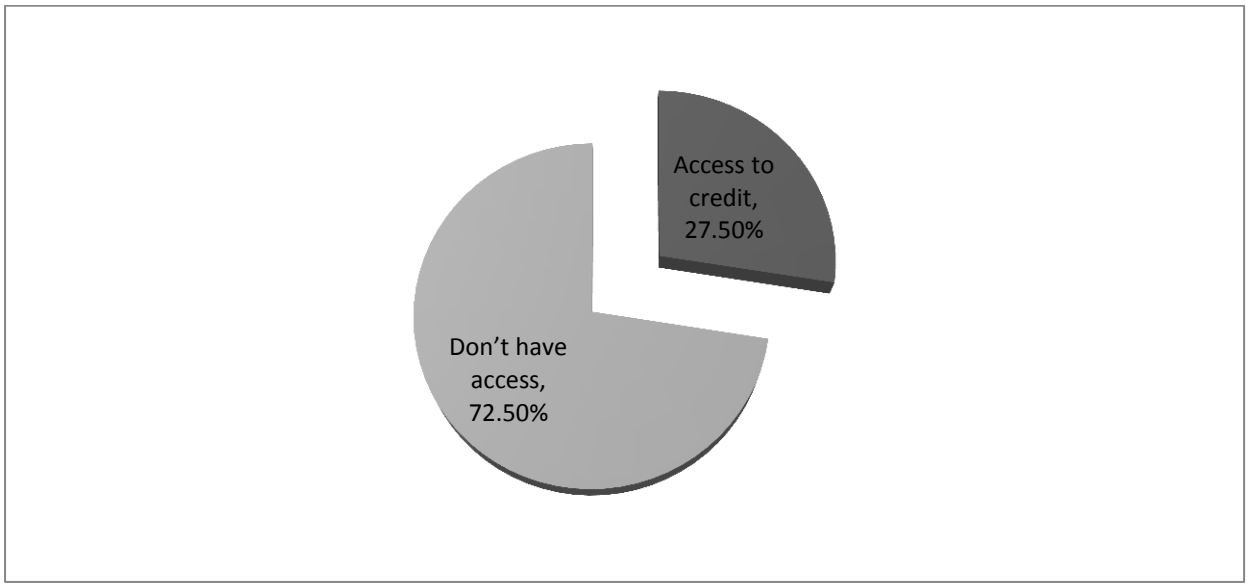
Source: Owen calculation based on survey result, May 2020

Figure 4.4 shows the contribution of households who are engaged in farm activity area is very high; the reason behind this outcome is that, the survey of 2016 was collected from all regions of the country including two city administrations and 71.06 percent of sampled households are from rural area which is around 15,844 households from the total of 22,296 sampled households.

Access to credit and Multidimensional food insecurity: Household with access to credit has better chance to escape from multidimensional food insecurity. In developing countries like Ethiopia access to credit is very limited, due to the inaccessibility of financial institutions. According to Mebratu (2018) access to credit is also an important instrument for household in purchasing modern agricultural technologies when the household faces budget deficit. It also normalizes consumption at the hard time. Figure 4.5 shows that households that have access to credit are more food secure than those was having limited access to it.

The following figure shows from the total multidimensional food insecure households 75.2 percent of them are don have access to credit.

Figure4.9: Access to credit and Multidimensional Food insecurity in Ethiopia



Source: Owen calculation based on survey result, May 2020

Household Health and Multidimensional food insecurity: Household with poor health condition will have a high probability of being multidimensional food insecure. In developing countries like Ethiopia when household head get sick, all member of the household face the problem of food insecurity. In the CSA survey a question introduces to assess the health condition of sampled households was" Do you have health problem in the last 12 months?"

Figure 4.10: Household health and Multidimensional food insecurity in Ethiopia

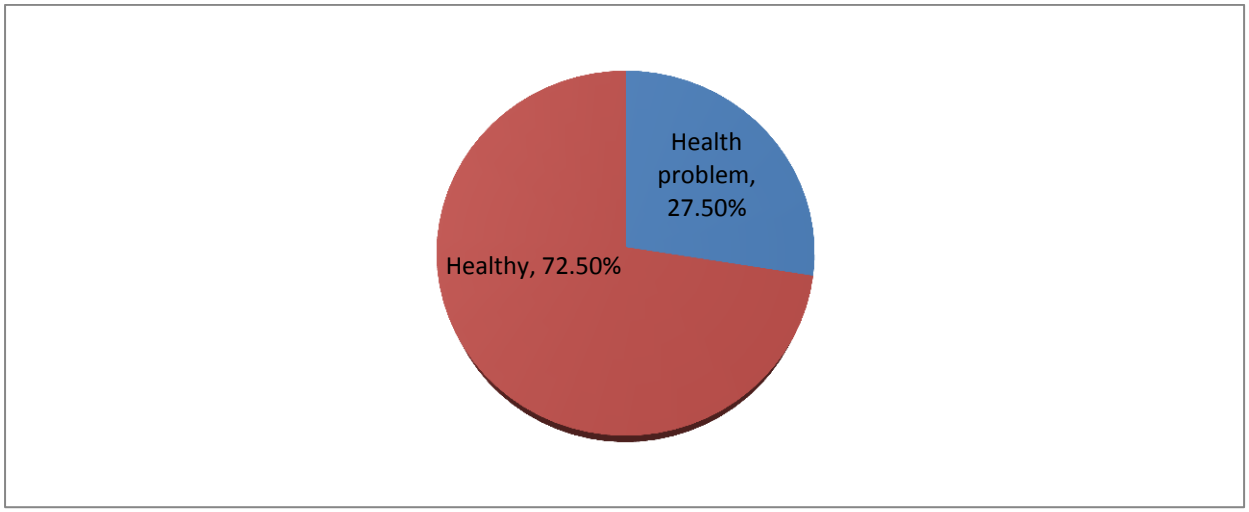


Figure 4.10 shows the percentage share of households' health conditions from the total multidimensional food insecure e households.

4.2. Econometric Analysis

In addition to descriptive analysis econometric model was used to examine determinants of Multidimensional food insecurity in the Ethiopia. As the dependent variable has a dichotomous nature, a binary logistic regression was used. In this model the dependent variable is categorized as multidimensional food insecure and multidimensional food secure and the logit model is estimated by using maximum likelihood technique.

4.2.1 The Result of Logit Maximum Likelihood Estimation

As introduced earlier under methodology part logistic regression is used to examine relationship between a dichotomous dependent variable and independent variable of dummy and continuous form. In this study logistic regression combines the explanatory variables to estimate the probability of the household to be multidimensional food insecure or not. Econometric theory tells us that we are likely to encounter heteroscedasticity frequently in econometric data, particularly with cross-sectional data. In addition to heteroscedasticity in most econometric data it is likely that independent variables are correlated with each other. In econometric analysis those problems are not to be tolerated.

It should be noted that in binary regress models goodness of fit is secondary importance what matter is the expected sign of the regression coefficients and their statistical or practical significance (Gujarati, 2003). Goodness of fit is no usually as important as statistical and economical significance of explanatory variable (Wooldridge, 2000). Depend on economic theory and literatures before passing into the analysis of the results of the estimation of logit model, test on the possible existence of the problem encounters econometric data is important for this study. Therefore, before going to analysis of the result, the study undertake different test to check whether the basic assumption of the model are met or not.

Test for Heteroscedasticity: In this study the likelihood ratio (LH) statistics is used to test the existence of heteroscedasticity problem. Likelihood ratio (LH) statistics of test will hypothesis of homoscedasticity is obtained by: LR=2(logLu-logLr) where logLu is the maximum value of unrestricted log-likelihood function and Lr is the maximum value of restricted log-likelihood function estimated only with constant term. If the value of test statistics (LR) became larger than a X^2 (n) distribution with "n" is degree of freedom and it's the number of independent restriction then the null hypothesis (homoscedasticity) is rejected. In logit model of this study, the value of likelihood with only constant term (restricted log-likelihood) is 13,114.14 and the maximized log-likelihood value of full model (unrestricted)

is -2205.12. Therefore LR=2[-2205.12-(-13,114.14)] =10909. Lr > X^2 10 therefore the null hypothesis (homoscedasticity assumption) is rejected and the model has heteroscedasticity. Due to this situation white heteroscedasticity robust standard errors regression model was estimated to correct for the heteroscedasticity problem.

The log-likelihood ratio test (LR): LR test for the model of this study is based on the same concepts as the F test in a linear model. This is based on the difference in the likelihood function for the unrestricted and restricted models. The null hypothesis states all the scope coefficients are equal to zero. LR statistics is given by LR = 2(logLu - logLr) Where LogLu is the maximized value of unrestricted log likelihood and logLr is the maximized value of restricted likelihood function estimated only with constant term. The null hypothesis will be rejected if f LR > X^2 n, where n is the number of independent restriction. In the above logit model this study, the value of the likelihood with only constant term is -13,114.14 and the maximized log likelihood value of the model -2205. Therefore the results of Lr = 2[-2205.12-(-13,114.14)] =10909. The critical value of the $X^2$10 less than log likelihood ratio test at 5 percent significance level, therefore the null hypothesis that all slope coefficients are equal to zero is rejected and this implies that the model of this study is statistically acceptable since it is has some explanatory variables.

Multicollinearity: Multicollinearity means the existence of a perfect or exact linear relationship among some or all explanatory variables of a regression model. Multicollinearity is a question of degree and not of kind (Gujarati, 2003). In econometric models the meaningful distinction is not between the presence and the absence of multicollinearity, but between its various degrees. According to econometric literatures we do not have one unique method of detecting multicollinearity. what we have are some rule thumb, this study used rule of thumb that if the pair wise or zero order correlation coefficients between two explanatory variable is high, say, in excess of 0.8, then multicollieanity is a serious problem. Depend on this condition all explanatory variables in the model, where checked for multicollinearity. The results of the test confirmed that there is moderately high collinearity between age and marital status (0.56) whereas the rest of explanatory variable are relatively didn't showed significant collinearity between each other.

4.2.2. Results for Explanatory Variables in Logit Models

In logit model, a more meaningful interpretation is in terms of odds and in terms of marginal effects. The odds are obtained by taking antilog of the various slope coefficients and marginal effect is the effect on the dependent variable that results from changing on independent variable by a small amount.

Table 4.3: Marginal effects and logit maximum likelihood estimate of explanatory variable in logit model

Variable	Coefficients	P value	Marginal effects dy/dx
hh_size	0.713	0.000*	0.012
House	-0.098	0.103	-0.017
water	-0.516	0.000*	-0.092
Offarm	-0.357	0.008*	-0.057
Employ	-0.107	0.799	0.019
Credit	0.317	0.000*	0.057
Health	0.538	0.000*	0.093
Educ	-0.786	0.000*	-0.137
Age-hh	0.003	0.195	0.001
Martial	0.056	0.034**	-0.010
Constant	0.228		

Source: Own computation, Ma, 2020

The estimated results for logit model of this study demonstrated that from a total of 10 variables 7 variables are statistically significant at 1 percent and 5 percent significance level. The coefficient associated with the size of household implies that the probability of being multidimensional food insecure is positively affected by household size; in this model this variable is significant at 1 percent level of significance. Other thing remains constant, having one more family member will increase probability of becoming multi dimensionally food insecure by 0.012 units. One way to think about this relationship between multidimensional food insecurity and household size is to look at how the family size distribution of people in multidimensional food insecurity compares to that of the population as a whole. This result is in agreement with Mebratu (2018), who pointed out that households with larger family size

have more probability of being falling into food insecure category than those with lesser family size

The sign of the coefficient of source of safe water to household showed a negative relationship with the probability of household falling into multidimensional food insecurity and it is statistically significant at 1 percent significance level. Keeping other thing constant the marginal effect of water source implies that if the household have a safe water source, the probability of such household falling into multidimensional food insecurity decreases by 9.2 percent relative to household who does not have a safe water source. This showed the probability that a household will be multidimensional food insecure is lower for households with safe (piped, protected) water source.

Results of logistic regression revealed that the coefficient for access to off farm activity is found to be negative and statistically significant at 1 percent significance level. Marginal effect of access to off farm activity implies that if the household have access to off far activity, the probability of such household falling into multidimensional food insecurity decreases by 5.7 percent relative to household who does not have access to off farm activity keeping other factor constant. This result is in agreement with Alem (2017), who pointed out household not access to off farm activity have more probability of being falling into food insecure category than those who are access to off farm activity.

Access to credit affect the probability of falling into multidimensional food insecurity positively and significant at 1 percent level of significance. The positive relationship indicates that in Ethiopia households who have credit access has a high probability to be poor. The marginal effect of access to credit implies that if the household have a credit, the probability of such household falling into multidimensional food insecurity increases by 5.7 percent relative to household who does not have credit.

Household health conditions have an implication for the probability of household to multidimensional food insecurity. Result of logistic regression revealed household health status in the last 12 months is positive and statistically at 1 percent significance level. The marginal effect of this explanatory variable showed that the probability of house hold falling into multidimensional food insecurity is increases by 9.3 percent for household with health problem in the past one year. Education of household head is largely contributed to ensure better living condition of household. This variable affects the probability to be

multidimensional food insecure and significantly at 1 percent significance level. The negatively relationship indicates that literate households have less probability to be food insecure than illiterate household. Other thing remain constant marginal effect of education implies that if the household can read and write, the probability of such household falling into multidimensional food insecurity decreases by 13.7 percent relative to household who does not read and write keeping other.

This is due to educated household head plays a significant role in shaping household members and educated household head have opportunities to get employments with good income. This result is in agreement with Tsion (2017) which pointed out that educational level of household heads has negative significant effect food insecurity.

Marital status of the household has an implication on the probability of household falling into multidimensional food insecurity. Literatures recommend that married headed households have high probability to be food insecure. The justification is that household headed by married is supposed to have large family size and in the context of developing countries like Ethiopia large family size are leads to high incidence of food security. Result of logistic regression of this study showed a positive relationship between marital status and the probability of household falling into multidimensional food insecurity and it is statistically significant at 5 percent significance level. This implies in Ethiopia marriage will increase the probability of household to be multidimensional food insecure. The result of this study showed that in Ethiopia married households have high probability of being multidimensional food insecure relative to other types of marital status.

CHAPTER FIVE
CONCLUSION AND RECOMMENDATION

5.1. Conclusion

The aim of this study was to assess the determinants of multidimensional food insecurity in Ethiopia so as to help proper understanding of factors associated with multidimensional food insecurity which is a key to policies and practical steps that the government can take in ordered to curb food insecurity. In doing so, maximum a likelihood estimation method was applied to estimate logit regression model and to identify the determinants of multidimensional food insecurity in Ethiopia. The study used Alkire Foster methodology of multidimensional poverty measurement to the analysis of food insecurity. In principle setting the deprivation cut off for each indicator is guided by the literatures, based on this fact, in the absence of an invariable and updated national food insecurity line, in this study a household is identified as multidimensional food insecure if they are deprived in at least two of the four weighted indicators or if the overall deprivation scale is greater than or equal to 0.5.

Based on this condition the finding of this study showed that in Ethiopia the proportion of people who are multidimensional food insecure are 27.5percent. This means from the total 22,296 surveyed households 6,132 of them are found multidimensional food insecure. Regarding to the contributions of each regions to the national multi-dimensional food insecurity, and there head cunt index. SNNP is the greatest contributor, account for 28.47 percent of multidimensional food insecure households at national level. Addis Ababa city administration is contributes the least which is 1.96 percent

Explanatory Variables, which were hypothesized as determinants of multidimensional food insecurity in Ethiopia, were selected and analyzed. These variables were household family size, education of household head, household health, household head occupation, age of head of household, Source of water, access to credit, house ownership, and marital status of household head and off farm activity. The relationship between these variables and multidimensional food insecurity in Ethiopia were analyzed through descriptive statistics. A Logit regression model was employed to examine quantitatively the relationship between these determinants and multidimensional food insecurity. The data were subjected to analyses by using different software's such as Stata version 13.The specific statistic used includes percentage, mean, and standard deviation in descriptive statics and Logit model of regression in the econometric analysis.

The descriptive analysis in the study has already clearly identified the demographic and socio economic character respondent in a survey of CSA. The findings of logit maximum likelihood estimation of the study showed from total of 10 explanatory variables only 7 variables are statistically significant at 1 percent and 5 percent significance level. These variables are household family size, education of household head, household health, Source of water, access to credit, and marital status of household head and off farm activity.

Based on both descriptive and econometric method of analysis furthermore by using the result of marginal effect the study was explained the effect on the dependent variable that results from changing on independent variable by a small amount. The most important determinants of multidimensional food insecurity that plays a significant role in affecting incidence of multidimensional food insecurity are household family size, education of household head, household health, Source of water, access to credit and off farm activity. As in line with other studies it has been found that the coefficient for those six variables are statistically significant at 1% significance. The coefficient associated with household size shows it is significant at 1 percent level of significance. Other thing remains constant as family size increases by one member the probability that a household will be multidimensional food insecure increases by 1.2 percent.

Furthermore, the result of the study showed the coefficient of source of safe water to household showed a negative relationship with the probability of household falling into multidimensional food insecurity and it is statistically significant at 1 percent significance level. Keeping other thing constant the marginal effect of water source implies that if the household have a safe water source, the probability of such household falling into multidimensional food insecurity decreases by 9.2 percent relative to household who does not have a safe water source. The coefficient for access to off farm activity is found to be negative and statistically significant at 1 percent significance level. Marginal effect of access to off farm activity implies that if the household have access to off far activity, the probability of such household falling into multidimensional food insecurity decreases by 5.7 percent relative to household who does not have access to off farm activity keeping other factor constant. Access to credit affect the probability of falling into multidimensional food insecurity positively and significant at 1 percent level of significance. The marginal effect of access to credit implies that if the household have a credit, the probability of such household falling into multidimensional food insecurity increases by 5.7 percent relative to household

who does not have credit. Result of logistic regression revealed household health status in the last 12 months is positive and statistically at 1 percent significance level. The marginal effect of this explanatory variable showed that the probability of house hold falling into multidimensional food insecurity is increases by 9.3 percent for household with health problem in the past one year. Education of household head is largely affects the probability to be multidimensional food insecure and significantly at 1 percent significance level. Other thing remain constant marginal effect of education implies that if the household can read and write, the probability of such household falling into multidimensional food insecurity decreases by 13.7 percent relative to household who does not read and write keeping other.

According to this study there is a positive relationship between marital status and the probability of household falling into multidimensional food insecurity and it is statistically significant at 5 percent significance level. This implies in Ethiopia marriage will increase the probability of household to be multidimensional food insecure. The result of this study showed that in Ethiopia married households have high probability of being multidimensional food insecure relative to other types of marital status. The justification is that household headed by married is supposed to have large family size and in the context of developing countries like Ethiopia large family size are leads to high incidence of food security.

Finally, the main conclusion of the study is that the incidence of multidimensional food insecurity is widespread in Ethiopia. This problem calls urgent interventions aimed at dropping this incidence of multidimensional food insecurity. Depend on their effect and urgency to curbing food insecurity factors associated with multidimensional food insecurity can be used as a key to policies and practical steps that the government and non-government organization can take in ordered to this problem.

5.2. Recommendation

Based on the findings of this study and the possible area of intervention that emanate from the results of the research, the following recommendations can be presented:

The strong negative relationship between health status and the probability of being multidimensional food insecure point out that there must be a need to consider households source of water and health condition by government and non-government organization in designing policies targeted to curb food insecurity. That means any intervention of the government that can determine the wellbeing of food insecure households should not adversely affect their health. Moreover, it implies that planning projects which can provide safe water can assists the government to mitigate food insecurity because the availability of safe water and the health status of household are highly interdependent.

As household size and the probability of household falling into multi-dimensional food insecurity are positively related serious attention has to be given to limit the increasing population in Ethiopia. This can be achieved by creating sufficient awareness of effective family planning in Ethiopia by targeting food insecure households. Further, household heads are advised to reduce the size of their household and this will help them to escape from multidimensional food insecurity. In this study the effect of education on the probability of household falling into multidimensional food insecurity confirms the significant role of the variable in consideration for betterment of living condition. Therefore, strengthening both formal and informal education and vocational or skill training should be promoted to eradicate the incidence of multidimensional food insecurity in Ethiopia. Off farm activity is highly significant and negatively related to the probability of being food insecure. Therefore; development partner and government should adopt a holistic approach to facilitate off farm activity to curb multidimensional food insecurity. Although occupation or access to employment of household was found insignificant indicator of poverty it is correlated positively. Permanent workers have higher probability to escape from multidimensional food insecurity. This shows the payment to causal worker is not sufficient to escape from food insecurity. Therefore; both government and civil society organizations have roles to play in addressing these issues. The policy initiatives that will do most to enhance the potential for self-employment are basic condition in reducing multidimensional food insecurity.

This study has attempted to examine the determinants of multidimensional food insecurity in Ethiopia with defined scope however a lot remained to be unanswered. To provide basic information on the determinants of multidimensional food insecurity, the political, social, natural and environmental dimensions, role of urban agriculture in reducing multidimensional food insecurity, demands future researchers' attention.

In general, the study has provided evidence that certain demographic and socioeconomic variables play a key role in determining multidimensional food insecurity. Thus multidimensional food insecurity alleviation policies that based on those variables should be key ingredients of a multidimensional food insecurity reduction strategy and the targeted groups should involve in any development efforts that could address the problem identified

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Appendix

1. Correlation matrix for explanatory variable

```
. cor hh_size hous water offarm employ credit health educ age_hh marital
(obs=4696)
```

	hh_size	hous	water	offarm	employ	credit	health	educ	age_hh	marital
hh_size	1.0000									
hous	-0.2902	1.0000								
water	-0.0866	0.2202	1.0000							
offarm	0.0410	0.0864	0.1037	1.0000						
employ	0.0003	0.0647	0.0214	0.0333	1.0000					
credit	0.0910	-0.0531	-0.0288	0.0086	0.0064	1.0000				
health	0.1019	-0.0022	-0.0244	0.0349	0.0222	0.0374	1.0000			
educ	0.0391	0.2386	0.1996	0.1348	0.0443	-0.0058	0.0569	1.0000		
age_hh	0.0156	-0.2493	-0.0679	-0.0850	-0.0095	-0.0490	-0.1621	-0.3409	1.0000	
marital	-0.2846	-0.0138	-0.0275	-0.0763	-0.0283	-0.0691	-0.0923	-0.3046	0.3308	1.0000

2. Result of unrestricted log likelihood model

```
. logit multidimensionalfoodinsecurity hh_size hous water offarm employ credit health educ age_hh marital

Iteration 0:   log likelihood = -2677.4264
Iteration 1:   log likelihood = -2222.9605
Iteration 2:   log likelihood = -2205.4666
Iteration 3:   log likelihood = -2205.3394
Iteration 4:   log likelihood = -2205.3394

Logistic regression                             Number of obs   =       4696
                                                LR chi2(10)     =     944.17
                                                Prob > chi2     =     0.0000
Log likelihood = -2205.3394                     Pseudo R2       =     0.1763
```

multidimensionalfoodinsecurity	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
hh_size	.0712645	.01748	4.08	0.000	.0370043	.1055247
hous	-.0983453	.0586423	-1.68	0.094	-.213282	.0165914
water	-.5161842	.0785073	-6.57	0.000	-.6700557	-.3623127
offarm	-.3569219	.1339706	-2.66	0.008	-.6194994	-.0943443
employ	.1070001	.5501381	0.19	0.846	-.9712508	1.185251
credit	.3169974	.0879757	3.60	0.000	.1445681	.4894267
health	.5384872	.0222678	24.18	0.000	.4948431	.5821314
educ	-.786288	.08673	-9.07	0.000	-.9562757	-.6163003
age_hh	.0036006	.0027613	1.30	0.192	-.0018115	.0090127
marital	.0568075	.0267567	2.12	0.034	.0043653	.1092497
_cons	-1.475279	.2192184	-6.73	0.000	-1.904939	-1.045619

3. Result of restricted log likelihood model

```
. logit multidimensionalfoodinsecurity

Iteration 0:   log likelihood = -13114.393
Iteration 1:   log likelihood = -13114.393

Logistic regression                             Number of obs   =      22296
                                                LR chi2(0)      =       0.00
                                                Prob > chi2     =          .
Log likelihood = -13114.393                     Pseudo R2       =     0.0000
```

multidimensionalfoodinsecurity	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_cons	-.9692656	.0149982	-64.63	0.000	-.9986614	-.9398697

4. Result of Robust standard regration model

```
. logit multidimensionalfoodinsecurity hh_size hous water offarm employ credit health educ age_hh marital, robust

Iteration 0:   log pseudolikelihood = -2677.4264
Iteration 1:   log pseudolikelihood = -2222.9605
Iteration 2:   log pseudolikelihood = -2205.4666
Iteration 3:   log pseudolikelihood = -2205.3394
Iteration 4:   log pseudolikelihood = -2205.3394

Logistic regression                             Number of obs   =       4696
                                                Wald chi2(10)   =     712.60
                                                Prob > chi2     =     0.0000
Log pseudolikelihood = -2205.3394               Pseudo R2       =     0.1763
```

multidimensionalfoodinsecurity	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
hh_size	.0712645	.0175902	4.05	0.000	.0367883	.1057408
hous	-.0983453	.0603904	-1.63	0.103	-.2167084	.0200178
water	-.5161842	.07865	-6.56	0.000	-.6703354	-.362033
offarm	-.3569219	.1339051	-2.67	0.008	-.619371	-.0944727
employ	.1070001	.4195185	0.26	0.799	-.7152411	.9292412
credit	.3169974	.0891896	3.55	0.000	.142189	.4918059
health	.5384872	.0222163	24.24	0.000	.494944	.5820305
educ	-.786288	.0867224	-9.07	0.000	-.9562608	-.6163152
age_hh	.0036006	.0027784	1.30	0.195	-.0018449	.0090462
marital	.0568075	.0267306	2.13	0.034	.0044164	.1091986
_cons	-1.475279	.2224696	-6.63	0.000	-1.911312	-1.039247

5. Marginal Effects of Explanatory Variable

```
. mfx compute

Marginal effects after logistic
      y  = Pr(multidimensionalfoodinsecurity) (predict)
         =  .22321075
```

variable	dy/dx	Std. Err.	z	P>|z|	[	95% C.I.	]	X
hh_size	.0123564	.00306	4.04	0.000	.006367	.018346		4.72998
hous	-.0170519	.01045	-1.63	0.103	-.037535	.003432		1.40843
water*	-.0928776	.01457	-6.38	0.000	-.121429	-.064327		.63586
offarm*	-.05714	.01966	-2.91	0.004	-.095664	-.018616		.111584
employ*	.0190946	.07696	0.25	0.804	-.13174	.169929		.004898
credit*	.0576033	.01693	3.40	0.001	.024419	.090788		.222743
health	.0933671	.00401	23.29	0.000	.085511	.101223		.740417
educ*	-.1367649	.01493	-9.16	0.000	-.166035	-.107495		.510221
age_hh	.0006243	.00048	1.30	0.195	-.000319	.001568		46.4544
marital	.0098497	.00463	2.13	0.034	.000766	.018934		2.84796

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

6. t test for partial effects of each explanatory variable

```
. logit multidimensionalfoodinsecurity hh_size

Iteration 0:   log likelihood = -13114.393
Iteration 1:   log likelihood = -13063.882
Iteration 2:   log likelihood = -13063.822
Iteration 3:   log likelihood = -13063.822

Logistic regression                             Number of obs   =      22296
                                                LR chi2(1)      =     101.14
                                                Prob > chi2     =     0.0000
Log likelihood = -13063.822                     Pseudo R2       =     0.0039
```

multidimensionalfoodinsecurity	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
hh_size	.0639345	.0063541	10.06	0.000	.0514807	.0763883
_cons	-1.352196	.0413718	-32.68	0.000	-1.433283	-1.271109

```
. logit multidimensionalfoodinsecurity water

Iteration 0:   log likelihood = -13114.393
Iteration 1:   log likelihood = -12979.114
Iteration 2:   log likelihood = -12978.661
Iteration 3:   log likelihood = -12978.661

Logistic regression                             Number of obs   =      22296
                                                LR chi2(1)      =     271.46
                                                Prob > chi2     =     0.0000
Log likelihood = -12978.661                     Pseudo R2       =     0.0103
```

multidimensionalfoodinsecurity	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
water	-.5022902	.0304195	-16.51	0.000	-.5619112	-.4426691
_cons	-.6738372	.0228089	-29.54	0.000	-.7185417	-.6291326

```
. logit multidimensionalfoodinsecurity credit

Iteration 0:   log likelihood = -13114.393
Iteration 1:   log likelihood = -13056.592
Iteration 2:   log likelihood = -13056.431
Iteration 3:   log likelihood = -13056.431

Logistic regression                             Number of obs   =      22296
                                                LR chi2(1)      =     115.92
                                                Prob > chi2     =     0.0000
Log likelihood = -13056.431                     Pseudo R2       =     0.0044
```

multidimensionalfoodinsecurity	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
credit	.3682209	.0338584	10.88	0.000	.3018598	.4345821
_cons	-1.063598	.0176056	-60.41	0.000	-1.098104	-1.029091

```
. logit multidimensionalfoodinsecurity offarm

Iteration 0:   log likelihood = -13114.393
Iteration 1:   log likelihood = -13056.506
Iteration 2:   log likelihood = -13056.382
Iteration 3:   log likelihood = -13056.382

Logistic regression                             Number of obs   =      22296
                                                LR chi2(1)      =     116.02
                                                Prob > chi2     =     0.0000
Log likelihood = -13056.382                     Pseudo R2       =     0.0044
```

multidimensionalfoodinsecurity	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
offarm	-.5384304	.0521754	-10.32	0.000	-.6406923	-.4361685
_cons	-.9128408	.0157728	-57.87	0.000	-.9437549	-.8819267

```
. logit multidimensionalfoodinsecurity health

Iteration 0:   log likelihood = -13114.393
Iteration 1:   log likelihood = -11421.811
Iteration 2:   log likelihood = -11391.331
Iteration 3:   log likelihood = -11391.127
Iteration 4:   log likelihood = -11391.127

Logistic regression                             Number of obs   =      22296
                                                LR chi2(1)      =    3446.53
                                                Prob > chi2     =     0.0000
Log likelihood = -11391.127                     Pseudo R2       =     0.1314

------------------------------------------------------------------------------
multidimensionalfoodinsecurity |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------------------------+----------------------------------------------
                        health |   .4921496   .0090544    54.36   0.000     .4744034    .5098958
                         _cons |  -1.438108   .0185119   -77.69   0.000     -1.47439   -1.401825
------------------------------------------------------------------------------
```

```
. logit multidimensionalfoodinsecurity educ

Iteration 0:   log likelihood = -11274.823
Iteration 1:   log likelihood = -11072.529
Iteration 2:   log likelihood = -11071.317
Iteration 3:   log likelihood = -11071.316

Logistic regression                             Number of obs   =      19594
                                                LR chi2(1)      =     407.01
                                                Prob > chi2     =     0.0000
Log likelihood = -11071.316                     Pseudo R2       =     0.0180

------------------------------------------------------------------------------
multidimensionalfoodinsecurity |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------------------------+----------------------------------------------
                          educ |  -.6592988   .0328449   -20.07   0.000    -.7236737    -.594924
                         _cons |  -.6903655   .0228324   -30.24   0.000    -.7351162   -.6456149
------------------------------------------------------------------------------
```

```
. logit multidimensionalfoodinsecurity marital

Iteration 0:   log likelihood = -9220.6392
Iteration 1:   log likelihood = -9218.3905
Iteration 2:   log likelihood = -9218.3894
Iteration 3:   log likelihood = -9218.3894

Logistic regression                             Number of obs   =      16345
                                                LR chi2(1)      =       4.50
                                                Prob > chi2     =     0.0339
Log likelihood = -9218.3894                     Pseudo R2       =     0.0002

------------------------------------------------------------------------------
multidimensionalfoodinsecurity |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------------------------+----------------------------------------------
                       marital |    .029294   .0137258     2.13   0.033     .0023918    .0561961
                         _cons |  -1.145127   .0316698   -36.16   0.000    -1.207198   -1.083055
------------------------------------------------------------------------------
```