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DETERMINANTS OF RURAL HOUSEHOLD FOOD INSECURITY IN NORTHERN ETHIOPIA: AN EMPIRICAL STUDY

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ABSTRACT

The current study attempted to investigate the determinants of rural household food insecurity in Northern Ethiopia by taking Werie Leke District as a case study. Primary data were collected from 357 randomly selected farming households. Descriptive and inferential statistics as well as econometric models were used to analyze the data. Results of the descriptive analyses showed that 59.7% of the sample households were food insecure. Findings of two sample t-test showed that food secure households had larger average household size, size of cultivated land, size of irrigated land, total crop value and total TLU. Moreover, the probability of a household being food insecure increases with household head age and access to credit services and decreases with farm size, ownership of irrigated land and access to market information. In general, the results of the study implied that integrated strategies along these variables are required to reduce food insecurity and to ensure sustainable food security in the study area and other comparable areas in the country and beyond.

Keywords: Ethiopia, Food (in)security, Food Consumption Score, Determinants, Logistic Regression

INTRODUCTION

Food insecurity, hunger and malnutrition would be continuing issues in the development process of countries in the developing world including Ethiopia. Meeting food requirements of the growing population, the second most populous country in Sub-Saharan Africa (von Braun & Olofinbiyi, 2007; Schmidt & Dorosh, 2009), is one of the major development policy concerns and challenges in contemporary Ethiopia (Berhanu, 2004). Despite the reported economic growth in the country and various initiatives put in place to tackle poverty and food insecurity, food insecurity remains one of the pressing and challenging issues in Ethiopia due to mismatch between rapid population growth (increasingly high demand) and the declining cereal productivity (declining supply) (von Braun & Olofinbiyi, 2007; Messay, 2009). This forced the country to depend on food aid[1] and external sources of cereal supply to feed its population (Gebreselassie, 2004; Frehiwot, 2007; von Braun & Olofinbiyi, 2007; Yishak *et al*., 2014). Furthermore, increasingly unbearable food prices, both global and domestic, are also contributing to the food insecurity crisis of the country. As stated in Sasson (2012), Ethiopia was one of the 30 countries identified and listed by the FAO as the most hit by the soaring global food prices in 2011, particularly since the 2008 global food crisis. Berhane *et al*. (2013) and Yishak *et al*. (2014) also asserted that the effect of food prices was significant on the food consumption of the population of the country and increased the proportion of people in need of food assistance.

Empirical studies in Ethiopia show that food insecurity is deep rooted in rural areas (Shiferaw *et al*, 2003; Berhanu, 2004; Gebreselassie, 2004; Frehiwot, 2007). The rural population depends on agriculture as its primary source of livelihoods (von Braun & Olofinbiyi, 2007). Smallholders, who dominate the agricultural sector (von Braun & Olofinbiyi, 2007), are exponentially vulnerable to food insecurity given their situations because the majority are resource poor (MoFA, 2007; Messay, 2009) and have limited livelihood options like off/non farm employment, petty trade and remittance. These households primarily depend on crop production and livestock for their livelihoods. Due to this, when they are stricken by drought and natural calamities, they are immediately exposed to loss of food consumption and face the challenges of feeding their families. This situation persisted in the people's everyday life today. For instance, in 2015/16, more than 8.2 million people faced food shortage and were vulnerable to sever famine due to irregularity of rainfall and consequent drought (Ethiopian Reporter-Amharic Version, 2015). The situation was even getting worse at that time and predicted to continue into the foreseeable future. Smallholder farmers in the study area are no exception to the overall country problem smallholder farmers are facing today. Due to the limited infrastructural development and poor market systems in the study district, the food insecurity situation of these smallholders might even be worse compared to some other localities.

[1] Stephen Devereux (2000) quotes a popular saying in Ethiopia-"*It doesn't matter if it is raining here if it is raining in Canada*."

Despite recent interest in case studies[2], most food security studies tend to analyze food security at boarder level and employ calorie intake as an indicator of food security. But studies at national level do not capture the real cases at household and individual levels (Messay, 2009). Moreover, several studies focused on food production and availability giving little attention to access to food and utilization of food. There is a clear gap in the usage of proxy indicators for food security as well as accounting of the determinants of food security at household level. Access to sufficient and nutritious food remains the basics of better health and productivity of households which in turn contributes to increased development and welfare (Schmidt & Dorosh, 2009). Indeed, this could have significant contribution to sustainable economic development of localities and nations. Thus, it is worth studying the access to food and food consumption as well as its determinants.

The current study tries to fill these gaps by employing the food consumption score (FCS) as proxy indicator of food security at household level. This indicator captures issues of food sources (which ranges from availability to access and to gift and aid), food diatery diversity and food consumption frequency or quantity of food intake (World Food Programme (WFP), 2008; Kennedy *et al.*, 2010; Brown, 2012). Moreover, the study employs vast array of determinants of food security beyond the commonly used socio-demographic variables used in earlier studies and the study experimented this activity in a remote rural area where such studies have never been done before. Thus, the study will add immensely to the current and limited literature on food security in the country as well as food (in)security studies in the developing world. It will, particularly, contribute to the growing case study approach in food security studies, which is a key element of sustainable livelihoods and sustainable development, by taking a new locality and household level investigation. Thus, this study aims at:

- Describing the food security status of households in the study district
- Comparing households with different status of food security in the study district
- Investigating the determinants of food insecurity of households in the study district

The manuscript is structured in such a way that it contains five sections. The second section presents review of literature. The third part deals with the methodological approach adopted for the study. Results and discussions are presented in section four. The fifth part is concerned with the conclusions and recommendations.

REVIEW OF LITERATURE

Theoretical Review

The issue of food security has grabbed massive attention from different directions, say academics, politics, development practitioners, humanitarian activists and others for the past several decades. Owing to this, it has been conceptualized and defined in different ways, which evolved overtime. Barrett (2002) states that the widespread hunger and malnutrition that persists today, despite considerable growth in per capita food availability, has prompted an evolving conceptualization of food security and of mechanisms to attain and maintain food security. Hoddinott (1999) stated that there are nearly 200 definitions and 450 indicators of food security. Hence, it is difficult to review and present these definitions and such indicators in this piece of research and, indeed, it is not the purpose of the study. However, some of the most commonly cited and relevant definitions

[2] Some of them are reviewed and referred to in this study.

and indicators could be presented. Initially, food security emerged as global concern during the 1970s[3] following global crisis that took place during that period. In 1974, where the World Food Summit defined it, food security focused on the volume and stability of food supply. The World Food Summit defined it as:

> Availability at all times of adequate world food supplies of basic food stuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices.

At this submit, the conception of food security focused on only food supply. According to Sasson (2012), food insecurity is not just about insufficient food production, availability, and intake; it is also about the poor quality or nutritional value of the food. The access and consumption aspects of the demand side were underemphasized. Based on Sen's influential work on the entitlement approach, these missed aspects were later included and the World Food Summit of 1996 defined food security as:

> Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life (Food and Agriculture Organization (FAO), 2008:1).

This follows the notion that food security problems, including hunger and famine, are not solely due to lack of production and scarcity of food but because of malfunctions of institutions, markets and distribution and makes food security a multidimensional issue (Wiesmann *et al*., 2009). Indeed, the definition rightly established the four dimensions of food security which are discussed below. Moreover, the definition underlines that food security is no more attributed to only food availability but also to access to food, proper utilization of food and uninterrupted availability of and access to food simultaneously (Degefa, 2005; FAO, 2008; Jones *et al*., 2013).

Food insecurity is conceived to be the opposite situation of food security. The bulk literature on food (in) security identifies two types of food insecurity situations, namely transitory[4] (temporary) and chronic (continuous) (Broca, 2002; Devereux *et al*., 2004; Degefa, 2005; Ministry of Federal Affairs (MoFA), 2007).

Food security is a complex issue having a number of influencing factors (Cohen, 2005) and it is multidimensional (Migotto *et al*., 2005; Bogale & Shimeles, 2009). Similar to its definition, many views exist about the dimensions and indicators of food security. The standard[5] definition of food security given by the World Food Summit of 1996 has four dimensions, namely food availability, food access, food utilization and food stability.

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[3] Although some sources (e.g. Jones *et al*., 2013; Pangaribowo *et al*., 2013) state that the concept of food security was first introduced in the 1940s, particularly in 1943. Maxwell and Smith (1992) documented the historical landmarks in the study of food security as well as global initiatives dating from 1943 to 1990.

[4] It is interchangeably used with acute food insecurity

[5] Because it is widely used in today's literature and food security assessment (Jones *et al*., 2013)

The field of food security has entertained different paradigm shifts from earlier views on food availability to food access then to utilization and stability. According to Frankenberger (1992), the food crisis that stroke Africa in the mid-1980s led to a paradigm shift in the way famines were conceptualized. Food security focused on availability of food at global and national levels in the 1970s but the focus shifted to issues of access to food at household and individual levels (Maxwell & Smith, 1992). Gill *et al*. (2003) stated that forty or fifty years ago, food availability issues tended to dominate the discussion, but, largely following the work of Amartya Sen on famines, the debate is now characterized more by entitlement and access issues. Similarly, Battersby (2011) stated that Sen's work on famine from entitlement perspective, led to the shift of framings of food insecurity from macro-level food availability to household level access and utilization issues. Moreover, the famous work of Robert Chambers (1989) on sustainability (sustainable livelihoods where food security is regarded as an essential element of livelihood security) also contributed immensely to the ever evolving and improving thinking about food security. According to Swaminathan (2001), ensuring food security is subset of the sustainable development thinking. Furthermore, the very recently enacted sustainable development goals (SDGs) capture food security issues in one way or the other (UN, 2018). In the words of Pe´rez-Escamilla (2017), "Food security is related to all of the United Nations Sustainable Development Goals (SDGs)." Indeed, the SDG2, "to End hunger, achieve food security and improved nutrition and promote sustainable agriculture", is all in about food security. Other works on vulnerability[6], shock and coping mechanisms also added pulse to the paradigm shift in food security research. These factors have contributed to the formulation of food security theories with different perspectives, and resulted in considerable shifts in thinking and concern regarding food security over the last several decades.

Maxwell (1996) identified three main shifts in thinking about food security since the World Food Conference of 1974: (1) from global and national to household and individual; (2) from a "food first" perspective to a "livelihood" perspective; and (3) from objective indicators to subjective perceptions. Degefa (2005) gave great account to the theoretical shifts that took place in food security studies. He discussed the theories that correspond to the first shift as food availability decline (FAD) which basically centers on demographic and climatic explanations; economic theories such as food entitlement decline (FED) and market failure; and political economy explanations about food insecurity (2005:80-88). These theories are critically analyzed by Maxwell and Smith (1992) as well.

The other shift is from "food first" perspective, which holds that people are motivated and concerned with lower order and basic necessity needs of food before any other need to satisfy, to "livelihood" perspective which holds that food security is rather subset of people's overall livelihood security (Chambers, 1989; Maxwell, 2000).

These shifts resulted in wider range of indicators of food (in) security, multiple measurement and assessment approaches, food security and coping strategies and better targeting of the food insecure and needy locations and sections of a given population. Moreover, the paradigm shifts enticed numerous academic and practical researches over the past forty decades or so and persisted today.

[6] The risk of entitlement failure (Maxwell, 1995)

Food Security Strategies and Researches in Ethiopia

Food security is a long standing issue in Ethiopia where substantial proportion of the population suffers from chronic hunger and remain malnourished (Fekadu & Mequanent, 2010). A country that had an experience of food surplus and food self sufficiency, at least until early 1960s, is suffering from chronic and seasonal food shocks and shortages (Degefa, 2005; Frehiwot, 2007). Beginning from the early 1970s, Ethiopia has faced horrific food shortages and famines[7]. The 1984 famine is one of the darkest incidences in the history of the country. The country also faced large scale famine during the 2002 due to malfunctioning market system and institutions (von Braun & Olofinbiyi, 2007). Food shortages and food supply fluctuations are common in the country now days. It is becoming a common understanding that the majority of rural households face severe food shortages during the rainy and planting seasons in the country as well (Berhane *et al*., 2013) and the country faces high risk of drought which causes high food shortage (von Braun & Olofinbiyi, 2007). This recurrence of food shortage and famine persisted today. According to the Ethiopian Reporter News paper-Amharic version (2015), more than 8.2 million people are in need of emergency food aid in the country as disclosed by the Government. A budget close to 12 Billion Birr is required to provide food for these famine stricken people of which 4 Billion will be allocated by the Government and the remaining to be raised from different sources (Ethiopian Reporter News paper-Amharic version, 2015). The Tigray region is one of the regions of the country most hit by recurrent drought and food security challenges where most of the population lives under situations of food shortages and hunger (Tagel & van der Veen, 2010). The situation of the study district is the sub set of the region's overall situation in that the district is characterized by chronic food insecurity due to soil infertility, erratic rain and high population density (Ministry of Rural and Agricultural Development (MoRAD), 2007).

Since the 1970s, Ethiopia has been challenged by lack of food security over the past three decades (Shiferaw *et al*., 2003) and has been structurally food deficit over the last four decades- at least from 1980 (Devereux, 2000). Frehiwot (2007) describes the situation further in that the extent of food insecurity in Ethiopia in recent years has become alarming and its coverage in drought periods has reached as high as 45 percent of the population. A bit lower percentage of the total population (40%) than stated by Frehiwot, Gebreselassie (2004) stated that food insecurity is the major challenge for Ethiopia. Further, Fekadu and Mequanent (2010) indicated that close to one fourth of the Ethiopian population is malnourished where most of it suffers from chronic hunger. All in all, the previous empirical studies reviewed show that food insecurity is prevalent, recurrent and deep rooted in the country.

Who to blame for the persisted food insecurity in the country? The recurrent food shortages and food insecurity problem in the country is attributed to different but interrelated factors. But, at times, there are polarized viewpoints with regard to the causes of food insecurity in the country. Devereux (2000) recaps what look as two mutually exclusive approaches to the analysis of food insecurity in the country, namely 'physical ecology cluster' and 'political economy cluster'. The former cluster blames natural factors such as population growth, deteriorating soil fertility, and drought among others (Malthusian approach) whereas

[7] von Braun and Olofinbiyi (2007) state that the country has a history of famine where the recent worst famine being the one that occurred between 1983 and 1985.

the later focuses on government policies, weak and thin markets and institutional failures (governance approach). This idea is shared by Tagel and van der Veen (2010) although there is slight difference in the way the authors presented the debate. Whereas Devereux (2000) recommends a holistic "livelihoods" approach to analyze and address food insecurity in the country, Tagel and van der Veen (2010) believe that integrated policies and technologies which contribute to improved productivity, better food security and combat the causes food security should be put in place.

Empirical research[8] in the country shows that crop failure due to natural factors (von Braun & Olofinbiyi, 2007; Fekadu & Mequanent, 2010), mismatch between agricultural production and population growth (von Braun & Olofinbiyi, 2007; Messay, 2009), lack of modern and appropriate agricultural technologies (Degye *et al*., 2013; Jemal & Kim, 2014), malfunctioning market systems (Gabre-Madhin, 2003; von Braun & Olofinbiyi, 2007; Degye *et al*., 2013), institutional and organizational failures (Devereux, 2000; von Braun & Olofinbiyi, 2007), misguided policies (Devereux, 2000; Tagel & van der Veen, 2010), household level factors such as lack of human capital (Fekadu & Mequanent, 2010) and other socio-economic factors (Degye *et al*., 2013) are the underlying causes of food insecurity. Tagel and van der Veen (2010) grouped the causes of persistent food insecurity and inconsistent food security situations in the country into natural causes, socio-economic factors, and policy failures. Devereux (2000) gave his verdict on the conceptualization of food insecurity in Ethiopia as small landholdings, population increase further reducing landholdings, fragile resource base, very low soil fertility, recurrent droughts and food production shocks, and limited off-farm employment opportunities. He further underlined that low performance of agriculture takes large part of the explanation for food insecurity in the country. These and similar studies gave detail review and analysis on the underlying causes of food insecurity in the country and forwarded recommendations that could help address this pressing issue.

Many believe that Ethiopia has the potential to become self sufficient in food (e.g. MoFA, 2007; Walsund, 2011) and propose different policy recommendations. Messay (2009) strengthened this idea in that the country is endowed with varieties of natural resources and agro-climatic makeup that could help produce more food but agricultural productivity remains low. Berhanu (2004) also stated that there is a huge food availability gap in the country, which resulted in heavy dependence on food aid, and food import (which takes 40% to 60% of import capacity). Similarly, MoFA (2007) underscores the potential and need for improved agricultural production, economic growth and employment opportunities to ensure food security. In sum, agricultural productivity remains poor on the one hand and there is an increasingly high demand for food due to rapid population growth, soaring food prices, and using food grains for industrial production resulting in high food availability gap in the country. This implies that Ethiopia is unable to produce sufficient food to feed its population (Gebreselassie, 2006). Based on the inability of

[8] The current review is based on but not limited to previous works such as Devereux (2000), Shiferaw *et al*. (2003), Berhanu (2004), Gebreselassie (2004), Degefa (2005), Kidane *et al*. (2005), Abonesh *et al*. (2006), Frehiwot (2007), MoFA (2007), von Braun and Olofinbiyi (2007), Bogale and Shimeles (2009), WFP-Ethiopia (2009), Fekadu and Mequanent (2010), van der Veen and Tagel (2011), Walsund (2011), Habtamu (2013), Woldegebrieal *et al*. (2013), Jemal and Kim (2014), Asmelash (2014), Biru (2014), Amsalu and Wendimu (2014), Mequanent *et al*. (2014), Shishay and Messay (2014) and Yishak *et al*. (2014).

the country to produce sufficient food, researchers and government strategies mainly focus on food production and availability issues and propose policy interventions that enhance agricultural productivity through improved technologies.

This position tends to neglect the other important dimensions of food security. The other side of the argument holds that food self sufficiency is neither a necessary nor a sufficient condition for food security (Hoddinott, 1999; Cleaver, 1993 as cited in Shiferaw *et al*., 2003; MoFA, 2007). It is also believed that food production and availability may not guarantee food security at micro/household level as there exists unfair distribution (Frehiwot, 2007) and weak markets where markets remain thin (Gabre-Madhin 2003; von Braun & Olofinbiyi, 2007) and, therefore, improving food entitlement (MoFA, 2007) is required. Devereux (2000) also strengthens this idea by noting that this logic was shown to be misguided in 1996 when the FSS was drafted. As to Devereux, despite record harvests and food prices 20-40% lower than their inflation-adjusted average since the 1984 famine, many households remained unable to access adequate food and argues that food insecurity in Ethiopia derives directly from dependence on undiversified livelihoods based on low-input, low-output rain-fed agriculture where its production is highly variable and unpredictable. Hoddinott (1999:2) argues that:

> adequate access can be achieved without households being self-sufficient in food production more important is the ability of households to generate sufficient income which, together with own production, can be used to meet food needs.

In sum, the factors that determine food (in) security are diverse, multidimensional and complex (Bogale & Shimeles, 2009; Tagel & van der Veen, 2010; Amsalu & Wendimu, 2014) and consist of aspects of the four dimensions of food security (Jemal & Kim, 2014) and, therefore, comprehensive food policies and strategies need to include the four dimensions to properly combat food insecurity in the country. Indeed, food security depends and requires cross-sectoral integrated approaches and actions including improving domestic agricultural production and access to food in the form of food imports and donations, employment opportunities and income earnings, intra-household food distribution and individual level food utilization (Bogale & Shimeles, 2009) in a sustained manner.

Owning to these situations and debates, the Government of Ethiopia developed different strategies and programs to ensure food security and address the food (in) security causes and issues in the country since late 1996. The research community also devoted effort to conduct different studies to augment the government's efforts to combat food insecurity by designing policy recommendations. The current Government of Ethiopia has initiated food security strategy since November 1996 and regional food security programs and projects were subsequently designed based on that strategy (MoFA, 2007). The strategy considers that the food insecurity problem in Ethiopia is of both chronic and acute, has supply (availability) and demand (entitlement) dimensions, food insecurity affects both urban and rural poor, long term and short term factors cause it, and the strategy addresses food security at national and household level. The strategy and subsequent programs, basically, aim at enabling households to stabilize their food consumption by narrowing periodical food gaps and eventually reduce food insecurity (Berhane *et al*., 2013). The food security strategy (FSS) acknowledges the impact of high population growth rates, epidemics such as HIV/AIDS, gender disparity and environmental (un)sustainability to the pursuit of food security in the country. Ethiopia's food security strategy highlights the government's plans to address the causes and effects of food insecurity at household level (MoFA, 2007). The rural food insecurity (both chronic and transitory) profiling by the FSS includes resource

poor households, landless or land scarce households, ox-less households, poor pastoralists, female headed households, elderly, disabled and sick, poor non-agricultural households, newly established settlers and areas and households prone to drought (MoFA, 2007). The recurrent food shortages and vulnerability to hunger and food insecurity of significant proportion of the population show that the country is lagging behind to build resilient economy which can cope up with unexpected fluctuations and stochastic as well as idiosyncratic shocks.

Thus, the access and consumption dimensions of food security are the focus of this manuscript. Hence, socio-economic, market and institutional factors are considered in the analysis of food consumption and food (in) security of the study district.

METHODOLOGY

Description of the Study District

The study was conducted in Werie Leke District of the Tigray Regional State in Northern Ethiopia which is 106 kms far from Mekelle town-a capital of the region. The District covers a total area approximately of 125,830.05 ha (Office of Agricultural and Rural Development (ARD) of the District, 2012). It is the home for a total population of 151,212 of which 73,526 were males and 77,686 were females (Central Statistical Authority (CSA), 2007) with an average population growth of 2.58% and population density of 120.2 people per square kilometer (CSA, 2007; MoRAD, 2007; Office of ARD of the District, 2012). Further, 37, 073 households (male headed 24, 966 and female headed 12, 107) live in the District of this, 32, 086 households (male headed 22, 144 and female headed 9, 972) i.e. 86.5% households lives in the rural areas. The average members of a household are 4.69 in towns and 4.5 in rural areas (Office of ARD of the District, 2012). The District is located at an altitude ranging from 1450-2350 meters above sea level and has a varying average rainfall of 450mm-550mm per year (MoRAD, 2007). The agro-ecology of the District consists of 84% lowland (*kolla*) and 16% midland (*woina degua*). The District has 30 rural *Tabia*[9]*s* and 3 town *Tabias* where the total becomes 33 and 117 *Kushet*[10]*s*. Out of the 3 town *Tabias*, *Ketema Edaga Arbi* is the capital city of the District. The dominant market centers in the District include *Edaga Arbi*, *Maiknetal*, and *Nebelet* (where the market day is Saturday) and *Edaga Hamus* and *Wechi-Edaga Hamus* (conducting market transactions on Thursdays). The nature of the road facilities is more of community roads and there is one asphalt road that crosses part of the District. Transport facilities are limited as a result dwellers walk on foot, use donkeys, camels, and man power to transport their baggage. Vehicles are available on the main road but few use that service.

[9] *Tabia* represents the lowest level in the Country's Administration, below District

[10] *Kushet* is a village or locality within *Tabia* (also known as Sub-*tabia*)

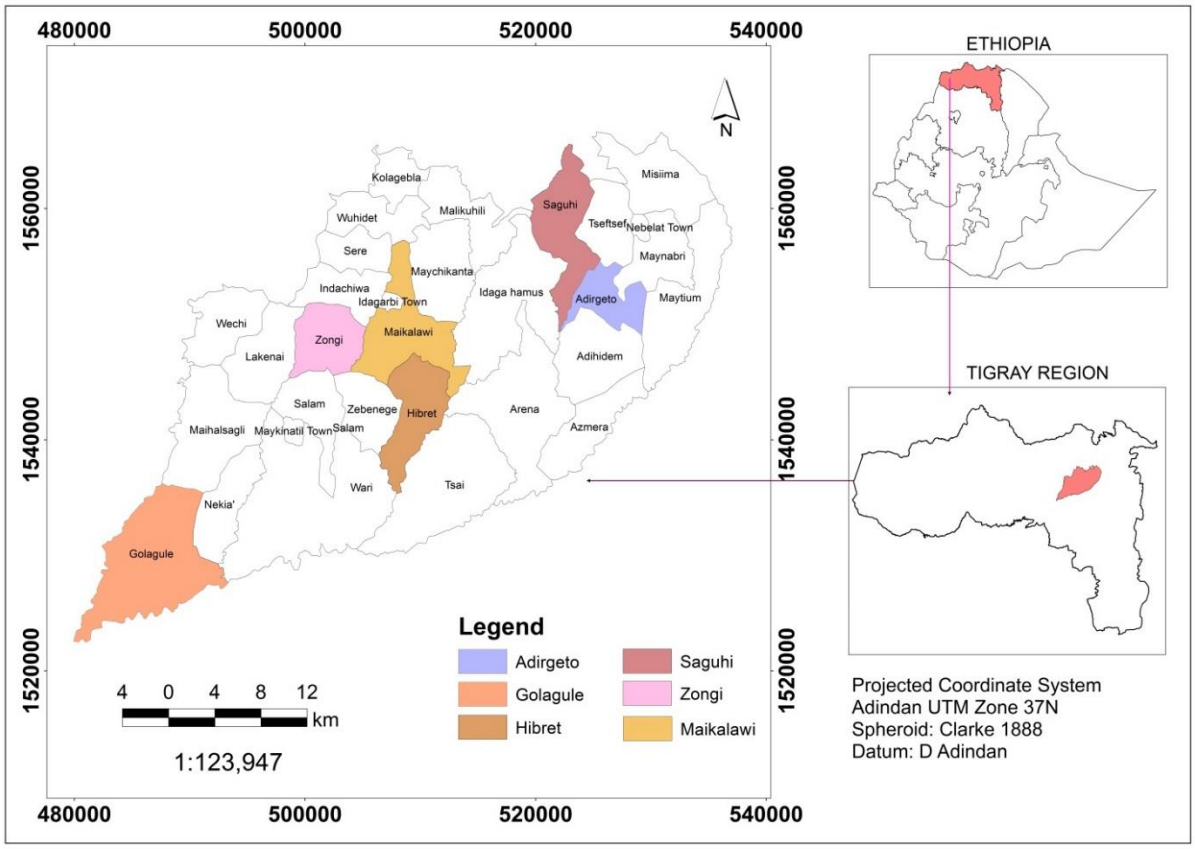

Figure 1: Map of the Study District

Source: Own Construction based on Ethiopian Mapping Agency (2013)

The district has several development domains and sources of livelihoods (MoRAD, 2007; Yemane, 2010; Office of ARD of the District, 2012). The major occupations and sources of livelihoods and incomes of households living in the district include mixed agriculture (livestock and crop farming), petty trade, food for work or food safety net programs, off-farm employment and hand craft, selling minerals, sand and stones and some level of engagement in tourism. Agriculture is the main source of livelihoods of rural households in the District and the basis of its development. Although products vary across agro-ecology, the dominant staple crops include Teff, maize, wheat, barley, sorghum, finger millet, horse bean and *Hanfets* (mixed wheat and barley). Dominant cash crops include garlic, sweet pepper, spices, cabbage, lotus, salad, lean seed, tomato, papaya, and lemon. Beehives, sheep, cattle, goat, chicken, donkey, and camel are among dominant livestocks in the district. Households gain incomes from the sales of crops as well as livestock and livestock products such as goats, sheep, chicken, milk, butter, and eggs.

Sampling Procedure and Data Collection Methods

Primary data were collected from various sources through a combination of different tools such as structured survey questionnaire (quantitative data), focus group discussions, in-depth interviews and key informant interviews (qualitative). Rural household heads or members of a household were the main sources of data. A multistage sampling procedure was employed

in this study. Out of 30 *tabias* in the district, *Seguh, Adirgeto, Maekelawi, Zongi, Hibret* and *Golagule* were randomly selected. A sampling frame was established for each tabia to select 357 sample respondents using systematic random sampling. The total sample size was disaggregated across household head and was divided proportional to the population size of each Tabia. This study employed quantitative approach as a dominant approach to generate and analyze data for the study. Standardized questionnaires/Structured interviews were used to obtain the primary quantitative data. The questionnaire contained questions or variables on themes such as household characteristics, household asset ownership, physical factors, social capital factors and livelihood service factors and food security status of the study households. Most of the questions were adopted from previous studies that were tested for validity and reliability and first designed in English followed by translation into the local language-Tigrigna. Moreover, document analysis, in-depth interviews, key informant interviews and focus group discussions were used to collect qualitative data.

Analytical Model and Working Hypotheses

CSPro6, STATA version 11, SPSS version 20 and Microsoft Excel 2007 were used as data management and analysis software. Then, a combination of descriptive, statistical and econometric analysis was employed. Inferential statistics such as two sample t-test, one way ANOVA, Tukey's Post Hoc test and diagrams were used to test some of the hypotheses formulated elsewhere in the manuscript. Econometric analyses were used to investigate determinants and causative relationships. Logistic regressions were in investigating the correlates of household food security. The basic model is specified as follows.

Several previous studies (e.g. Shiferaw *et al*., 2003; Bogale & Shimeles, 2009; Tagel & van der Veen, 2010; Mequanent *et al*., 2014) employed binary logit model to estimate the determinants of rural household food (in) security. Following such comparable studies, the current study also applied this model which is clearly specified as follows. The basic logistic model is presented in a series of equations as follows (Gujarati, 2007).

$$P_i = E(Y = 1 | X_i) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n)}} \quad (1)$$

$$P_i = \frac{1}{1 + e^{-Z_i}} \quad (2)$$

$$Z_i = \beta_0 + \beta_i X_i \quad (3)$$

Where,

P_i = the probability that a household will be food insecure

Z_i = is the function of the a vector of n explanatory variables

If P_i represents the probability that a household will be food insecure, $1-P_i$ is the probability that a household will be food secure. Thus,

$$1-P_i = \frac{1}{1+e^{Z_i}} \quad (4)$$

We obtain odds ratio by dividing equation (2) by equation (4).

$$\frac{P_i}{1-p_i} = e^{Z_i} \quad (5)$$

Equation (5) represents the odds ratio which is the ratio of the probability that a household will be food insecure to the probability that it will be food secure. The natural logarithm of the odds ratio is given as follows.

$$L_i = \ln\left(\frac{p_i}{1-P_i}\right) = Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n \quad (6)$$

Where,

β_0 is the intercept, $\beta_1 \ldots \beta_n$ are slopes of the equation/coefficients of the predictors in the model and $X_1 \ldots X_n$ are the predicting variables in the model. The logit (L_i) shows the log odds in favor of the food (in)security status changes as the respective independent variable changes by a unit (Tagel & van der Veen, 2010).

If the error term u_i is taken into account, the logit model becomes:

$$L_i = \ln\left(\frac{p_i}{1-P_i}\right) = Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n + u_i \quad (7)$$

The intercept and coeffecients of the explanatory variables can be estimated using the maximum likelihood (ML) method (Gujarati, 2007; Bogale & Shimeles, 2009).

Model Dependent Variable: Food Security (Food Consumption Score)

The dependent variable is the food consumption score (FCS) and it is used as a proxy for the food security status of the households under investigation. FCS is one of the prominent[11] measurement tools and proxies of food security, particularly, to measure caloric intake and diet quality at household level (WFP, 2008). It is widely accepted that food security has two actual dimensions i.e. caloric intake and diet (quality) (WFP, 2008) which are indicated by dietary diversity and food frequency (Weismann *et al*., 2009). These indicators better serve as proxy for food security because other indicators are built on this indicators (WFP, 2008; Brown, 2012). The two indicators resulted in what is commonly known as food consumption score (FCS). "The FCS is a composite score based on dietary diversity, food frequency and relative nutritional importance of different food groups" (WFP, 2008: 5). The fact that the FCS captures both food quality and food frequency and having positive correlation with caloric intake makes it strong proxy for the measurement of food security (WFP, 2008; Brown, 2012). The method helps assess households' economic access to food (Kennedy *et al*., 2010). The score shows dietary patterns and consumption of specific food groups or items (WFP, 2008; Kennedy *et al*., 2010; Brown, 2012). The FCS is validated, standardized and is applied across developing countries and has cut-off points to categorize households into three consumption groups (WFP, 2008; Wiesmann *et al*., 2009). The score and the three consumption categories are used in the WFP's Comprehensive Food Security and Vulnerability Assessments (CFSVA) and its Emergency Food Security Assessments (EFSA) (WFP, 2008; Wiesmann *et al*., 2009; Brown, 2012; Jones *et al*., 2013). But it lacks validation for cross cultural comparison and, therefore, should be adapted to local contexts. It involves list of local foods, grouping them into food groups (commonly eight food groups), weighting of the food groups based on the dietary density and quality of nutrients, and frequency of consumption based on local values attached to the food items. It is a multiplicative-additive procedure and after summing of the weights, it develops cut points to categorize households into poor food consumption, borderline food consumption and acceptable food consumption households. Higher FCS shows improved food security (WFP, 2008; Maxwell *et al*., 2013).
During the field survey, respondents were asked whether anyone in the household consumed a food item and if they respond "yes", how many days a week. Moreover, they were asked the source(s) of the foods they consumed or the main ingredient used to cook the food. By doing so, it was possible to identify the primary and secondary sources. The food items were then grouped into eight food groups. This facilitated the analysis process. It also reduces the upward inflation of the food consumption score which is calcultaed below. The WFP (2008) underlines that larger number of food items will bias the score upwards. This bias could be controlled by either limiting the number of food items in the questionnaire or by setting the upper limit of the food frequency of any single group (after grouping the food items into respective groups) to a maximum of 7 (WFP, 2008). Both means are considered in this study. The food consumption analysis utilized here is based on the analysis of the FCS and the resulting food consumption clusters and food consumption groups (FCG).

The food groups were assigned with food weights based on their nutritional density based on the recommendation by the World Food Program (WFP, 2008). The food group frequency, based on the number of days each food item/food group was consumed 7 days prior to the date of survey, was established for each food group. In case where the sum of the number of days of food items grouped into one food group is higher than 7, a maximum frequency of 7 was taken.

[11] It is one of the most explored and tested methodologies (WFP, 2008).

Following this, the food group weight was multiplied by food group frequency as follows to produce household food consumption score.

$$FCS = a_{staple}x_{staple} + a_{pulse}x_{pulse} + a_{veg}x_{veg} + a_{fruit}x_{fruit} + a_{animal}x_{animal} + a_{sugar}x_{sugar} + a_{dairy}x_{dairy} + a_{oil}x_{oil}$$

Where,

FCS Food consumption score

x_i Frequencies of food consumption = number of days for which each food group was consumed during the past 7 days (7 days was designated as the maximum value of the sum of the frequencies of the different food items belonging to the same food group)

a_i Weight of each food group

The household food consumption score is then compared with the predetermined cutoffs to classify the households into three food consumption groups. These groups reflect the food consumption status of the households surveyed.

The value of the FCS falls between 0 and 112. Theoretically, households could have an FCS of either of the extremes (0 or 112). But, practically, it rarely exists that a household would a have an FCS of 0 (which means no food consumed by household members for 7 days) and an FCS of 112 (which means all food groups were consumed on all 7 days by household members). To estimate the determinants of the probability that the households under study will be food insecure, they were categorized into food secure and food insecure households by taking 42.1 FCS as a threshold. Based on the FCS methodology, a household is food secure if it is classified as having "acceptable consumption" (Maxwell *et al.*, 2013). All households that had an FCS of 42 or less are food insecure and those that had an FCS greater than 42 are food secure. Thus, the dependent variable is assigned 1 if food insecure and 0 otherwise.

Independent Variables used in the Model and their *a priori* **Expectations**

Several varaiables that are expected to influence the probability that a household will be food insecure are included in the logit model after making a thorough and critical review of global as well as national literature. These variables have different characteristics and affect different dimensions of food security. Variables that may affect the food consumed, the food sources employed and the frequency of consumption, which are included in the FCS, are included in the model. The variables are grouped based on their nature and their expected impacts on food security are discussed subsequently.

Table 1: Independent Variables used in the Model and their *a priori* Expectations

Variable	Label	Measurement	Expected effect	Source
Household head age	HEADAGE	Continuous; age in years	±	Bogale & Shimeles, 2009; Bashir et al., 2012
Household head sex	HHSEX	dichotomous variable; 1= Male; 0= female	-	Sekhampu, 2013
education of the household head	HHEDUC	categorical variable	-	Kaloi et al., 2005; Kidane et al., 2005
household size	HHSIZE	Continuous; number of members of a household	-	Bogale & Shimeles, 2009; Fekadu & Mequanent, 2010; Aidoo et al., 2013; Sekhampu, 2013
size of landholding	FSIZE	Continuous; measured in units	-	Bogale & Shimeles, 2009; Fekadu & Mequanent, 2010
Access to irrigated land	IRRIGATED_LAND	Continuous; measured in units	-	Bogale & Shimeles, 2009
Ownership of livestock	TLU_TOTAL	Continuous; measured in TLU	-	Bogale & Shimeles, 2009; Fekadu & Mequanent, 2010
Ownership of mobile phone	OWNMOB	Dichotomous; 1= yes; 0= otherwise	-	
ownership of radio	OWNRADIO	Dichotomous; 1= yes; 0= otherwise	-	Matchaya & Chilonda, 2012
Total farm produce	CROP_VALUE_TOTAL	Continuous; crop value in Ethiopian *Birr*	-	Kuwornu et al., 2013
Nonfarm employment	NONFRM_EMPLYT	Dichotomous; 1= yes; 0= otherwise	-	Shiferaw et al., 2003; Bogale & Shimeles, 2009
Distance to the nearest market	DTMKT_TIME	Continuous; walking time in minutes	-	Shiferaw et al., 2003
Access to market information	MKTINFO	Dichotomous; 1= yes; 0= otherwise	-	
Membership to a local farmer association or cooperative	MEMBERSHIP	Dichotomous; 1= yes; 0= otherwise	-	Woldegebrial et al., 2013
Contact with development agents/extension workers	CONTACTDA	Dichotomous; 1= yes; 0= otherwise	-	
Access to training service	TRAINSERV	Dichotomous; 1= yes; 0= otherwise	-	
Access to credit service	CREDSERV	Dichotomous; 1= yes; 0= otherwise	-	
Use of productive inputs	PRODUCINPUT	Dichotomous; 1= yes; 0= otherwise	-	Fekadu & Mequanent, 2010; van der Veen & Tagel, 2011
organizational support	ORGASUPPORT	Dichotomous; 1= yes; 0= otherwise	-	

RESULTS AND DISCUSSIONS

This section presents descriptive and econometric results and discussions.

Descriptive Results and Discussions

Classifying Households into Food Consumption Groups

As indicated elsewhere in the manuscript, there are two thresholds to classify households into food consumption groups (see Table 2 below). The thresholds work depending on the consumption of oil and sugar (WFP, 2008). The basic and most commonly used threshold is the one that excludes oil and sugar consumption. This happens when the consumption of these food groups is insignificant quantities/frequencies and when there is heterogneigty of consumption among the population of study. The higher and homogeneous consumption of these food groups by the majority of the population implies an upward inflated score (WFP, 2008). Thus, the thresholds are kept at higher levels.

Table 2: Food Consumption Groups and Cutoffs

Food Consumption Group	Food Consumption Score without Oil and Sugar	Food Consumption with Oil and Sugar
Poor Diet	0-21	0-28
Borderline Diet	21.5-35	28.5-42
Acceptable Diet	>35	>42

Source: WFP (2008)

The correlation between the two thresholds is 0.7394 or their relationship is 73.94% which is significant at $p<0.01$. When we perform bivariate correlation analysis between each of the FCGs and FCS, the FCG with Oil and Sugar is more related (87.1%) to the FCS than the FCG without Oil and Sugar (80.5%). All the correlations were significant at $p<0.01$. Thus, as there is high frequency of consumption of oil and sugar in the study area, the 28 and 42 cutoffs are used. But for comparison pupose, the 21 and 35 cutoffs are also considered in the analysis.

Table 3: Summary Statistics of the FCS and FCGs

FCS	Mean	St.Dev	Range
	39.31	**10.625**	**14-74**
Correlation b/n FCG2 and FCG1 = 0.739**			
Correlation b/n FCS and FCG1 = 0.805**			
Correlation b/n FCS and FCG2 = 0.871**			

**. Correlation is significant at the 0.01 level (2-tailed), No. of Obs= 357

Source: Computed from Survey Data (2014)

The mean FCS of the sample households is 39.31 with a standard deviation of 10.625. This is below the cut-off point for acceptable consumption and for being food secure (Maxwell *et al.*, 2013) which is 42.1. Thus, on average the sample

households were food insecure. Moreover, the maximum FCS is 74 and the minimum 14 resulting in a range of 60 between them.

The proportions of food consumption groups of the study households are presented in Figure 2 as follows.

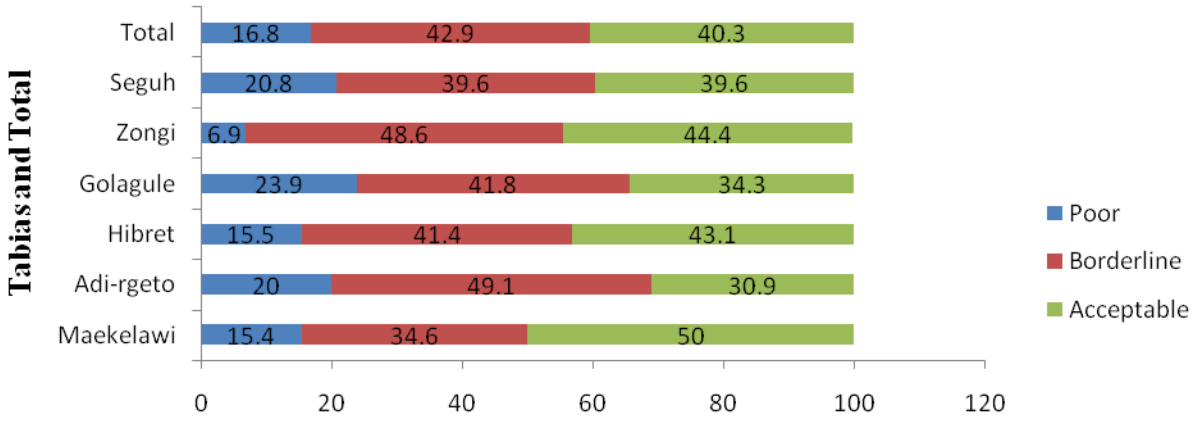

Figure 1: Percent of households with poor, borderline and acceptable food consumption by *Tabia*

Source: Computed from Survey Data (2014)

Figure 1 revealed that 16.8% of the sample households had poor diet, 42.9% had borderline diet and 40.3% had acceptable diet during the reference period. It is evident from this result that 59.7% of the sample households were food insecure and 40.3% of them were food secure. This descriptive finding is in agreement with previous studies' findings. For instance, Fekadu and Mequanent (2010) in their study in west Shewa found out that 64% of the sample households were food insecure. Similarly, Degye *et al*. (2013) found out that based on the daily calorie intake, 42.7% of the sample households were food secure. Another study conducted by Asmelash (2014) in one of the districts of the Central Zone where the current study was carried out revealed that 68.8% of the sample households were food insecure. A very similar result was obtained by Jemal and Kim (2014) where they revealed that 51.8% of the sample households were food insecure. These findings show that Ethiopian rural households' level of food insecurity is quite high regardless of the measurement and analysis approach used.

The proportion of food consumption groups can also be disaggregated for each Tabia. As indicated in Figure 2, Maekelawi is better in that 50% and 34.6% of its sample households had acceptable diet and borderline diet respectively. Golagule and Seguh had high proportion of their households who had poor diet with 23.9% and 20.8% of their respective sample households. Tabia Zongi had very small proportion of its households (6.9%) who had poor consumption followed by Maekelawi (15.4%) and Hibret (15.5%). Agro-ecology wise, the lowland agro-ecology was a home for 60% of those who had poor diet. 26.6% of the households who had poor diet were found in the midland agro-ecology.

When we disaggregate the three food consumption groups by household sex and marital status (as shown in Figure 3), there was clear variation, descriptive wise, in that the male headed households and married households were in a better status compared to their respective counterparts.

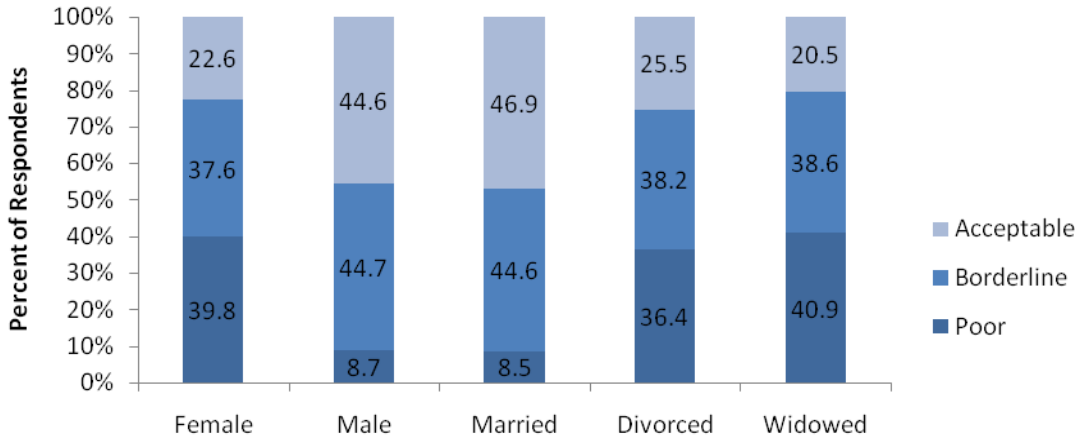

Figure 2: Food Consumption Groups by Sex and Marital Status

Source: Computed from Survey Data (2014)

Moreover, the characteristics of households with differing food consumption categories were tested for statistical significance of the differences. The results of one way ANOVA test (see Annex 3) showed that there were statistically significant differences among the three food consumption groups in terms of sex of household head (Prob > F = 0.0000), household size (Prob > F = 0.0000), farm size (Prob > F = 0.0000), travel time to market (Prob > F = 0.004), total crop value (Prob > F = 0.0000), total HCI (Prob > F = 0.0000) and total TLU (Prob > F = 0.0000). But there was no statistically significant difference between the consumption groups across *Tabias*. Tukey's post hoc test was conducted to investigate where the differences exist. For instance, as indicated in Annex 3, the farm size of households with acceptable consumption was quite different from that of both poor diet and borderline diet households but there was no difference between the farm size of the poor diet and borderline diet households. The three consumption groups had different amounts of crop value, commercialization index and TLU.

Characteristics of Households with Different Food Security Status

The basic hypothesis of this study is that food secure households have better endowments than food insecure households. To test this hypothesis, two sample t-tests were run and the following results were obtained. The results of the two sample t-test show that food secure households have larger average household size, size of cultivated land, size of irrigated land, total crop value and total TLU. The differences are also statistically significant at different significance levels.

Table 4: Mean Comparisons of Characteristics of Households with Different Levels of Food Security

Variable	Food Security Status		Two sample t-test (Pr(|T| > |t|))
	Food Secure	Food Insecure	
	Mean Value	Mean Value	
Household Size	5.6875	4.788732	0.0001***
Size of Cultivated Land	3.427083	2.789906	0.0000***
Size of Irrigated Land	.1575	.0370892	0.0001***
Distance to Market in minutes	124.1181	140.9245	0.0565*
Crop Value Total	7220.063	4753.42	0.0000***
TLU Total	3.071181	2.129577	0.0000***

Source: Computed from Survey Data (2014)
: significance levels are at ***1%, **5% and *10% respectively

As depicted in Table 4, the average value of distance to the nearest market in travel time of the food secure households is smaller than that of the food insecure households. The result is statistically significant and theoretically accepted. Households close to the nearest market are more food secure. Thus, building private asset holdings by increasing the size of cultivated land, irrigated land, livestock holding, and improving crop productivity and improving access to markets by reducing time could be useful strategies to enhance the food security status of households in the study district and similar areas in the country.

Frequency of Food Consumption over the 7 Days Period

As implied elsewhere in this Chapter, the WFP (2008) guideline for the analysis of food consumption adheres to a maximum of 7 days consumption of each food group. Indeed, the number of days of consumption range from 0 day to 7 days where the first implies not consumed at all and the later meant consumed everyday of the week. Thus, calculating a mean number of days of consumption is helpful in analyzing and comparing food consumption and dietary intake of the sample households. Figure 3 depicts the mean number of days of consumption of each food group by residence *Tabia* of households.

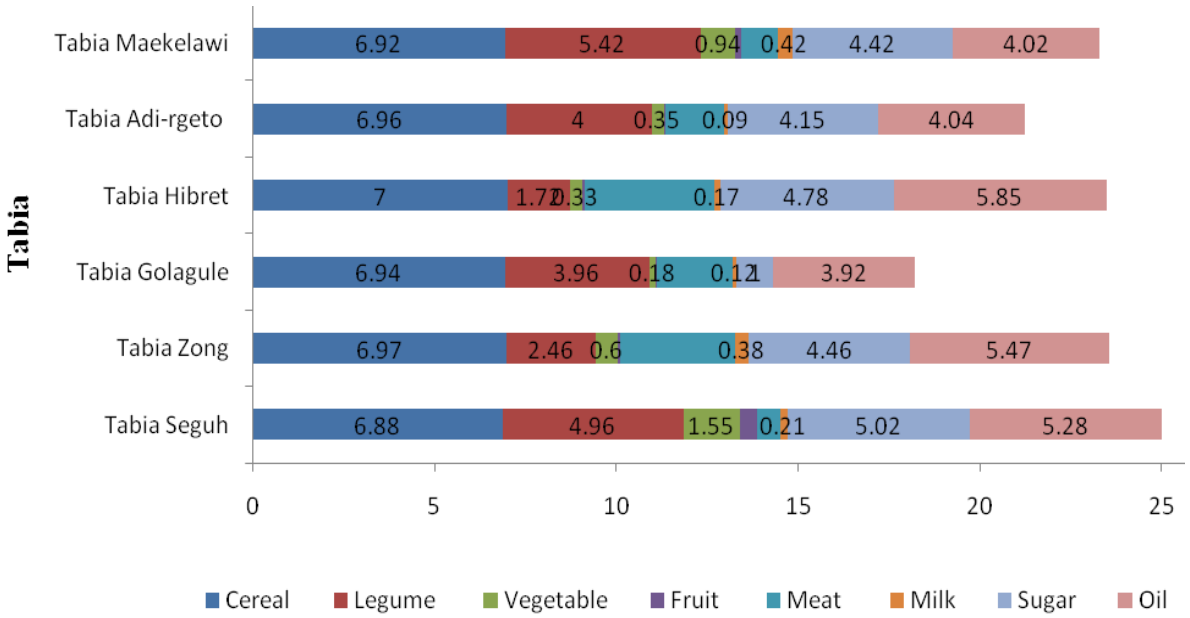

Figure 3: Mean number of days of consumption (out of 7) of all food groups by *Tabia*

Source: Computed from Survey Data (2014)

Households in all Tabias consumed cereals almost all days (6.88 days on average or more) during the reference period which is consistent with the common Ethiopian diet. On the other hand, the mean number of days of consumption of vegetables, fruits, milk and related products and meat and related products were too small, less than a day in most of the Tabias. Sugar and oil consumption was high, close to five days a week during the reference period. The findings is in line with the CFSVA[12] report of Ethiopia by WFP and CSA (2014) which revealed that rural households are likely to fill themselves up with cheap, energy giving staples but forego key nutrients and micronutrients. The report further implied that the national average for dairy and meet products is 1.5 days which supports the result of this study. Thus, one can deduce that the sample households consume less nutritious foods.

Econometric Results and Discussions

This subsection presents the results of the logistic regression analysis which was run to analyze the determinants of the probability that a household will be food insecure as indicated in the model specification stage. Both the logit, logistic and marginal effect estimations were done to make thorough analysis of the model predictors. Moreover, robust standard error was employed. The odds ratio is used in the interpretation of the analysis results. Table 5 presents the final logistic regression model outputs.

The results of the fitted logistic model indicated that five variables were found statistically significant determinants of the probability that a household will be food insecure. The log of odds of a household being food insecure increases with household

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head age and access to credit services and decreases with farm size, ownership of irrigated land and access to market information.

Table 5: Estimation of Logistic Regression for the Determinants of Household Food Insecurity

Variable	Coefficient	Robust Std. Err.	Odds Ratio
HHSEX	-.379347	.2408326	.6843081
HEADAGE	.0274707**	.0119982	1.027852**
HHSIZE	-.0371074	.0641264	.9635726
FSIZE	-.246908**	.077558	.7812125**
IRRIGATED_LAND	-.7003475*	.1834959	.4964128*
OWNMOB	-.2195875	.2482479	.8028499
OWNRADIO	.2619575	.3651519	1.299471
NONFRM_EMPLYT	-.3805803	.2104275	.6834647
MKTINFO	-.4938005*	.1818167	.6103025*
MEMBERSHIP	-.4413332	.1881023	.6431784
TRAINSERV	.1512464	.3637558	1.163283
CREDSERV	.6578381**	.5915741	1.930614**
CONTACT_DA	.164045	.4156114	1.178267
PRODUCINPUT	-.5575987	.3933046	.5725823
ORGASUPPORT	-.1658859	.2767988	.8471429
CROP_VALUE_TOTAL	-.0000643	.0000409	.9999357
TLU_TOTAL	-.0749329	.0779515	.9278057
Educ_New	-.4266688	.1905765	.6526797
_cons	1.730012*		
Log pseudolikelihood =	-207.85151	Number of obs = 357	Prob > chi2 = 0.0000
		Wald chi2(18) = 59.64	Pseudo R2 = 0.1366

Source: Computed from Survey Data (2014)

Other things being constant, an increase of one year of the age of the household head increases the log of odds of being a household food insecure by 2.8% which is statistically significant at 5%. This implies that households with older heads in the study area had poorer food consumption and, therefore, were food insecure. This result is inline with the hypothesis set and findings of several researchers in various parts of the world. For instance, a study by Tagel and van der Veen (2010), revealed that as the age of household head increases, the probability of being food secure decreases. Recent article published by Shishay and Messay (2014) also revealed similar result. Similarly, Bashir *et al.* (2012) found out that an inverse relationship exists between the age of the household head and food security. This might be due to several factors. Older household heads naturally could have more dependents to feed, redistribute their holdings to children and grandchildren, and may face physical incapability to work more and engage in multiple activities to support their household and ensure food security.

Contrary to this, Bogale and Shimeles (2009) found out that age of the household head affects food insecurity negatively and significantly. Their justification is that when household heads' age increase, they gain experience, better planning and accumulate wealth, and, therefore, better tendency to be food secure. Fekadu and Mequanent (2010) also concluded that as age increases, the probability of being food secure also increases. A similar findings by Arene and Anyaeji (2010) also showed that age of household heads had a positive effect on the food security status of housholds. Yet, another contratsing result by Aidoo *et al.* (2013) revealed that age did not have an impact on household food security.

The results of the logistic model indicated that the log of odds of a household being food insecure decreases by 22% as the size of landholdings increases by 1 Tsimdi, *ceteris paribus* which is statistically significant at 5%. The result is in line with the *a priori* expectation as well as previous empirical findings (e.g. Bogale & Shimeles, 2009).

Statistically significant at 10%, ownership of irrigated land decreases the probability of a household being food insecure by 50%, other things being constant. This is consistent with the established hypothesis as well as previous research results (Abonesh *et al.*, 2006; Bogale & Shimeles, 2009). Irrigation helps farming households to produce more than once in a year and complement rainfed production. The cumulative effect is an increase of farm output for food consumption as well as for sale in the market and to buy food items in return and ensuring sustainable food security-one of the top priorities of sustainable development and sustainability (Pe´rez-Escamilla, 2017).

Similarly, keeping other things constant, access to market information reduces the log of odds of a household being food insecure by 39% which is statistically significant at 10%. This means households that have access to market information are more food secure than those who do not have. This result is consistent with the set hypothesis and previous research findings. Mango *et al.* (2014) indicated in their findings that access to market information has positive effect on household's dietary diversity and negative effect on food insecurity.

The last variable which affects the household food security status is access to credit service. Contrary to the hypothesis, having access to credit service increases the log of odds of a household being food insecure by 93%, *ceteris paribus* and statistically significant at 5%. It also contradicts with previous research findings (Aidoo *et al.*, 2013; Hussein & Janekarnkij, 2013). This might be due to the purpose of spending of the loan taken. Households who took credit may spend the money on purchasing or repaying earlier loan for farm inputs which is the common practice in the country. This implies that it inversely affects the food consumption of the households because of the burden of principal and interest payment deteroriates the food security of households.

Finally, based on the marginal effect analysis-see Annex 4, the variables with the strongest effect on the probability of a household being food insecure are access to irrigated land (-0.17), access to credit services (0.16) and access to market information (-0.12). On the other hand, the variables with weakest impact on the probability of a household being food insecure are age of the household head (0.007) and farm size in Tsimdi (0.06). Thus, improving access to and performance of irrigation, access to market information and proper use of credit services would help reduce food insecurity in the study district.

CONCLUSIONS AND RECOMMENDATIONS

A thorough review of the theoretical foundations of food security was made coupled with the related food security measurement approaches. An equally critical and relevant review of food security strategies and researches in Ethiopia was conducted. The study conducted empirical analysis and investigation by emphasizing on food consumption and food sources and determinants of household food insecurity in Werie Leke District located in central Tigray, Northern Ethiopia. Descriptive and inferential

statistics as well as the logistic regression model were used as empirical analysis tools. The study considers food security as consumption security and uses the food consumption score as the measurement of household food (in)security. The results of the descriptive analyses showed that 59.7% of the sample households were food insecure. Moreover, 16.8%, 42.9% and 40.3% of the sample households had poor diet, borderline diet and acceptable diet respectively. This further indicated that food insecurity is still deep rooted and widespread problem in the study district. Importantly, there was a statistically significant difference among these consumption groups in terms of several criteria. Cereal and cereal products were more frequently consumed giving little room for more nutritious diets. Oil and sugar were consumed substantially. The results of the logistic regression analysis indicated that productive assets such as farm size, irrigated land and crops produced play vital role in the food security status of the households of the study district. Moreover, market information is found to be decisive determinant of household food (in)security. Proper use of credit services would be worth considering in addressing food insecurity in the study district. Lastly, the study clearly indicated that older household heads need to be properly targeted when planning and providing food supports to ensure acceptable food consumption of their household members. In general, the results of the study implied that integrated strategies along these variables are required to reduce food insecurity and sustain food security and achieve the SDG2 in the study area and other comparable areas in the country and beyond. Building private asset holdings by increasing farm size, expanding and availing irrigated land, and improving access to market information could be useful strategies to enhance the food security status of households in the study district. Moreover, creating awareness about the purpose of taking credit and how to optimally utilize it should be at the heart of the provision of credit services besides the expansion of such services.

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Annexes:

Annex 1: Summary Statistics of Continuous Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
FCS	357	39.30532	10.62482	14	74
HEADAGE	357	47.67787	12.20977	21	83
FSIZE	357	2.393557	1.481587	0	7
CULTV	357	3.046919	1.443239	0	9
NFARMINC	357	133.4314	362.312	0	2500
DTMKT_KM	356	13.02416	7.835487	.3	35
DTMKT_TIME	356	134.1264	81.63991	3	390
IRRIGATE_D~E	357	.0856583	.2900212	0	3
CEREAL_SOLD	357	553.042	734.3427	0	3900
CROP_SOLD_~L	357	977.4454	1749.374	0	17265
EQUIP_VALU~L	357	742.7843	515.0628	0	2165
CEREAL_VALUE	357	4999.074	3354.397	0	24900
CASH_CROP_~E	357	749.7983	1959.982	0	19175
CASH_CROP_~D	357	423.1429	1525.268	0	13990
TLU_TOTAL	357	2.509384	1.891039	0	8.5

Annex 2: Summary Statistics of Discrete Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
FCS_PROBIT	357	.5966387	.4912606	0	1
HHSEX	357	.7394958	.4395258	0	1
TABIYA	357	3.408964	1.65092	1	6
OWN_LAND	357	.8683473	.3385873	0	1
OWNEQUIP	357	.7983193	.4018182	0	1
OWNMOB	357	.232493	.4230145	0	1
OWNRADIO	357	.2717087	.4454648	0	1
NONFRM_EMP~T	357	.2212885	.4156969	0	1
OWNLIVES	357	.8459384	.3615145	0	1
NROAD	356	3.292135	1.373407	2	5
MKTINFO	357	.6554622	.4758843	0	1
MEMBERSHIP	357	.5182073	.5003697	0	1
COOPERATION	357	.9887955	.1054043	0	1
CONTACT_DA	357	.6778711	.4679479	0	1
TRAINSERV	357	.372549	.484162	0	1
EXTSERV	357	.4061625	.4918049	0	1
CREDSERV	357	.7282913	.4454648	0	1
PRODUCINPUT	357	.9495798	.2191175	0	1
ORGASUPPORT	357	.4509804	.4982897	0	1

Annex 3: One Way ANOVA and Tukey's post hoc tests for Food Consumption Groups

ANOVA						
		Sum of Squares	Df	Mean Square	F	Sig.
Sex of HH Head	Between Groups	9.659	2	4.829	28.920	.000
	Within Groups	59.114	354	.167		
	Total	68.773	356			
Residence Tabia	Between Groups	.692	2	.346	.126	.881
	Within Groups	969.600	354	2.739		
	Total	970.291	356			
HHSIZE	Between Groups	148.329	2	74.165	16.857	.000
	Within Groups	1557.503	354	4.400		
	Total	1705.832	356			
Farm Size	Between Groups	35.583	2	17.791	8.444	.000
	Within Groups	745.872	354	2.107		
	Total	781.455	356			
Total Crop Value	Between Groups	715009051.014	2	357504525.507	21.354	.000
	Within Groups	5926654519.299	354	16741961.919		
	Total	6641663570.312	356			
Total HCI	Between Groups	5031.496	2	2515.748	16.691	.000
	Within Groups	53054.154	352	150.722		
	Total	58085.649	354			
Total TLU	Between Groups	146.374	2	73.187	22.995	.000
	Within Groups	1126.692	354	3.183		
	Total	1273.066	356			
Travel Time to the Nearest Market	Between Groups	73971.023	2	36985.511	5.696	.004
	Within Groups	2292130.289	353	6493.287		
	Total	2366101.312	355			

Tukey's Post Hoc Tests

Dependent Variable	(I) RECODE of FCS	(J) RECODE of FCS	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Sex of HH Head	Poor Diet	Borderline Diet	-.388*	.062	.000	-.53	-.24
		Acceptable Diet	-.471*	.063	.000	-.62	-.32
	Borderline Diet	Poor Diet	.388*	.062	.000	.24	.53
		Acceptable Diet	-.083	.047	.189	-.19	.03
	Acceptable Diet	Poor Diet	.471*	.063	.000	.32	.62
		Borderline Diet	.083	.047	.189	-.03	.19
Residence Tabia	Poor Diet	Borderline Diet	.107	.252	.905	-.49	.70
		Acceptable Diet	.029	.254	.993	-.57	.63
	Borderline Diet	Poor Diet	-.107	.252	.905	-.70	.49
		Acceptable Diet	-.078	.192	.913	-.53	.37
	Acceptable Diet	Poor Diet	-.029	.254	.993	-.63	.57
		Borderline Diet	.078	.192	.913	-.37	.53
HHSIZE	Poor Diet	Borderline Diet	-1.353*	.320	.000	-2.11	-.60
		Acceptable Diet	-1.871*	.322	.000	-2.63	-1.11
	Borderline Diet	Poor Diet	1.353*	.320	.000	.60	2.11
		Acceptable Diet	-.518	.244	.086	-1.09	.06
	Acceptable Diet	Poor Diet	1.871*	.322	.000	1.11	2.63
		Borderline Diet	.518	.244	.086	-.06	1.09
Farm Size	Poor Diet	Borderline Diet	-.20768	.22111	.616	-.7281	.3127
		Acceptable Diet	-.77569*	.22304	.002	-1.3007	-.2507
	Borderline Diet	Poor Diet	.20768	.22111	.616	-.3127	.7281
		Acceptable Diet	-.56801*	.16853	.002	-.9647	-.1714
	Acceptable Diet	Poor Diet	.77569*	.22304	.002	.2507	1.3007
		Borderline Diet	.56801*	.16853	.002	.1714	.9647
Total Crop Value	Poor Diet	Borderline Diet	-2112.13889*	623.263	.002	-3579.0605	-645.2173
		Acceptable Diet	-3983.81250*	628.726	.000	-5463.5908	-2504.0342
	Borderline Diet	Poor Diet	2112.13889*	623.263	.002	645.2173	3579.0605
		Acceptable Diet	-1871.67361*	475.066	.000	-2989.7969	-753.5503
	Acceptable Diet	Poor Diet	3983.81250*	628.72595	.000	2504.0342	5463.5908
		Borderline Diet	1871.67361*	475.066	.000	753.5503	2989.7969
Total HCI	Poor Diet	Borderline Diet	-5.77105*	1.88314	.007	-10.2033	-1.3388
		Acceptable Diet	-10.65719*	1.89771	.000	-15.1238	-6.1906
	Borderline Diet	Poor Diet	5.77105*	1.88314	.007	1.3388	10.2033
		Acceptable Diet	-4.88614*	1.42768	.002	-8.2464	-1.5259
	Acceptable Diet	Poor Diet	10.65719*	1.89771	.000	6.1906	15.1238
		Borderline Diet	4.88614*	1.42768	.002	1.5259	8.2464
Total TLU	Poor Diet	Borderline Diet	-1.27625*	.27175	.000	-1.9158	-.6367
		Acceptable Diet	-1.85835*	.27413	.000	-2.5035	-1.2131
	Borderline Diet	Poor Diet	1.27625*	.27175	.000	.6367	1.9158
		Acceptable Diet	-.58210*	.20713	.014	-1.0696	-.0946
	Acceptable Diet	Poor Diet	1.85835*	.27413	.000	1.2131	2.5035
		Borderline Diet	.58210*	.20713	.014	.0946	1.0696
Travel Time to the Nearest Market	Poor Diet	Borderline Diet	34.181*	12.349	.016	5.12	63.25
		Acceptable Diet	41.475*	12.456	.003	12.16	70.79
	Borderline Diet	Poor Diet	-34.181*	12.349	.016	-63.25	-5.12
		Acceptable Diet	7.294	9.356	.716	-14.73	29.31
	Acceptable Diet	Poor Diet	-41.475*	12.456	.003	-70.79	-12.16
		Borderline Diet	-7.294	9.356	.716	-29.31	14.73

Annex 4: Marginal Effect of Determinants of Household Food Insecurity

```
margin, dydx(*) atmeans

Conditional marginal effects                      Number of obs   =        357
Model VCE    : Robust

Expression   : Pr(FCS_PROBIT), predict()
dy/dx w.r.t. : HHSEX HEADAGE HHSIZE FSIZE IRRIGATED_LAND OWNMOB OWNRADIO
NONFRM_EMPLYT MKTINFO
               MEMBERSHIP TRAINSERV CREDSERV CONTACT_DA PRODUCINPUT ORGASUPPORT
CROP_VALUE_TOTAL
               TLU_TOTAL Educ_New
at           : HHSEX           =    .7394958 (mean)
               HEADAGE         =    47.67787 (mean)
               HHSIZE          =    5.151261 (mean)
               FSIZE           =    2.393557 (mean)
               IRRIGATED_~D    =    .1512605 (mean)
               OWNMOB          =     .232493 (mean)
               OWNRADIO        =    .2717087 (mean)
               NONFRM_EMP~T    =    .2212885 (mean)
               MKTINFO         =    .6554622 (mean)
               MEMBERSHIP      =    .5182073 (mean)
               TRAINSERV       =     .372549 (mean)
               CREDSERV        =    .7282913 (mean)
               CONTACT_DA      =    .6778711 (mean)
               PRODUCINPUT     =    .9495798 (mean)
               ORGASUPPORT     =    .4509804 (mean)
               CROP_VALUE~L    =    5748.368 (mean)
               TLU_TOTAL       =    2.509384 (mean)
               Educ_New        =    .6386555 (mean)

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       HHSEX |  -.0898508   .0833891    -1.08   0.281    -.2532904    .0735887
     HEADAGE |   .0065066   .0027682     2.35   0.019      .001081    .0119323
      HHSIZE |  -.0087891   .0157664    -0.56   0.577    -.0396907    .0221124
       FSIZE |  -.0584818   .0233777    -2.50   0.012    -.1043012   -.0126624
IRRIGATED_~D |  -.1658819   .0877945    -1.89   0.059     -.337956    .0061923
      OWNMOB |  -.0520107   .0732673    -0.71   0.478     -.195612    .0915905
    OWNRADIO |   .0620463   .0667465     0.93   0.353    -.0687744    .1928671
NONFRM_EMP~T |  -.0901429   .0731109    -1.23   0.218    -.2334376    .0531518
     MKTINFO |  -.1169599   .0706388    -1.66   0.098    -.2554095    .0214897
  MEMBERSHIP |  -.1045327   .0691505    -1.51   0.131    -.2400652    .0309999
   TRAINSERV |   .0358237   .0740773     0.48   0.629    -.1093652    .1810125
    CREDSERV |   .1558133    .072684     2.14   0.032     .0133553    .2982712
  CONTACT_DA |   .0388551   .0835346     0.47   0.642    -.1248697      .20258
 PRODUCINPUT |  -.1320709    .162583    -0.81   0.417    -.4507278    .1865859
 ORGASUPPORT |  -.0392912   .0773719    -0.51   0.612    -.1909374    .1123551
CROP_VALUE~L |  -.0000152   9.73e-06    -1.57   0.117    -.0000343    3.83e-06
   TLU_TOTAL |  -.0177484   .0198805    -0.89   0.372    -.0567135    .0212168
    Educ_New |  -.1010593   .0693412    -1.46   0.145    -.2369655     .034847
------------------------------------------------------------------------------
```