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Analysis of Household Food Insecurity and its Covariates in Girar Jarso Woreda, Oromia Regional State, Ethiopia

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Abstract
Food insecurity are the most crucial and persistent problems facing humanity. What so ever the struggle to achieve food security at the household level in the rural areas of Ethiopia dates back a long period, it has remained a challenging goal even today. Making their living on marginal, moisture stressed, heavily degraded and less productive land, households in rural areas of Girar Jarso face persistent food shortages. This study aims to analyze the status and determinants of household food insecurity in four PAs of Girar Jarso wereda. An attempt to fill in the research gap observed in food insecurity studies at disaggregated level in Ethiopia, this study was carried out. The analysis was based on survey data gathered from randomly selected 120 sample rural households using a three stage sampling techniques. Both primary and secondary data were used for the study. Data collection was conducted through interview schedules, FGD and key informant interviews. The data collected were analyzed and discussed using descriptive statistics, Foster – Greer – Thorbecke (FGT) indices, logit regression model. The headcount, depth and severity of food insecurity respectively were found to be 37.5%, 10.9% and 4.19%. The empirical results estimated using the survey data revealed that total annual income, total off-farm income and number of oxen at less than 1% level of probability; family size, at less than 10% and access to extension services at less than 5 % level of probability showed theoretically consistent and statistically significant effect on food insecurity among rural households. However, estimated coefficients of age, sex, education, dependency ratio, total size of cultivated land, TLU, access to credit and owning saving account were found to be statistically insignificant in determining household food insecurity in the study area. The findings imply that improvement in food security situation needs to have comprehensive combination of interventions aiming at income diversification in rural areas such as off-farm activities, promoting family planning, promoting education, and commercialization among others. These areas could provide entry points for policy intervention to reduce food insecurity and augment livelihood opportunities.
Keywords: Food insecurity, Foster-Greer-Thorbecke (FGT), logit regression, Girar Jarso

INTRODUCTION

1.1 Background of the study

Poverty, inequality and food insecurity are the most crucial and persistent problems facing humanity. The current report of State of Food Insecurity in the world pointed out that about 795 million people - just over one in nine- are undernourished in the world. Although progress continues in the fight against hunger, an unacceptably large number of people still lack the food they need for an active and healthy life (FAO, 2015).

Sub-Saharan Africa has the lowest regional scores in the Global Food Security Index (The economists, 2013) for a number of reasons with an estimated food-insecure people of 254 million, 28.4 percent in 2015, virtually unchanged from 2014. Over the next decade, food security in this region is projected to deteriorate at the aggregate level. The share of food insecured population is expected to rise to just over 15 percent contributing to the increase in food-insecure people, although prospects vary widely among countries within the regions. It is now receiving most food aid, one in every four people, or 23.2 percent of the population (USDA, 2015; FAO, 2015).

Ethiopia is a country with significant agricultural potential because of its water resources, fertile land and large labor pool. More than four out of every five Ethiopians live in rural areas and are engaged small-holder rain-fed agricultural production (World Bank, 2014), but the agricultural production and productivity showed a declining trend from the 1960s onwards (Fransen and Kuschminder, 2009). The performance of agriculture in terms of feeding the population is poor and food insecurity along with all key dimensions is predominantly chronic in nature. By early 2016, it is anticipated that 15 million people will require emergency food assistance and exacerbated by the effects of El Niño, the successive years of crop failure resulted in deteriorating agricultural, livestock, food security, and nutrition conditions in north eastern and central Ethiopia (USAID, 2015).

Increasingly frequent extreme weather events and natural disasters have taken a huge toll in terms of human lives and economic damage, hampering efforts to enhance food security (FAO, 2015). A number of factors aggravated growing problem of food insecurity in Ethiopia. The deteriorating situation is compounded by high staple food prices (WFP, 2009; FEWS NET, 2015). Adverse climatic changes combined with high human population pressure, natural resources degradation, technological and institutional factors have led to a decline in the size of per capita land holding (Anley et al., 2007). This was worsen by policy-induced stagnation of agriculture, inter-communal conflicts and refugee influxes from neighboring countries and instability in the past resulting in the widening of the food gap for more than two decades, which had to be bridged by food aid (Degefa, 2002; SIDA, 2015).

Most famines and food crisis in Ethiopia have been geographically concentrated in two broad zones of the country. The first consist of the central and northern highlands, stretching from northern Shewa through Wello and Tigray, and the second is made up of the crescent of low-lying agro-pastoral lands ranging from Wello in the north, through Hararghe and Bale to Sidamo and Gamo Gofa in the south (Ramakrishna and Demeke, 2002). To combat threats of famine and pervasive poverty and thereby ensure food security for its population, the government strategy has rested on increasing the availability of food grains through significant investments in agricultural technologies, and rural infrastructure. The impacts of these policies, however, have been shadowed as there are still millions of people who experience extreme hunger in the country (Bogale and Shimelis, 2009). Although various policy measures have been designed to address the problem, and despite the implementation of major market liberalization in the country as well as surpluses in food grain production in recent years, there have been reports that food availability still remains at low levels and food insecurity persists (Jemal et al., 2014).

In Ethiopia, the status, causes and consequences varies from one area to another, depending on the state of natural resources and extent of development of food shortage (Mitiku et al., 2012). Depending on rain fed agriculture characterized by low productivity, low use of farm inputs, water logging problems, heavily degraded land for their livelihood; Girar Jarso is facing debilitating food shortages. The study area is one of the woredas most affected by recurrent drought and food security problems. It was repeatedly prone to seasonal food insecurity even during the periods of good rain and harvest season. Besides, the woreda has been labeled as typical food insecure area despite various food and nutrition security interventions made by the government and non-government organizations. Due to these facts, this disaggregated household survey analyzes the status and household level covariates that affect the probability of rural household food insecurity at a particular time and through that make recommendations to improve the effectiveness of interventions. As properly fed, healthy, alert and active population contributes more effectively to economic development than one which is physically and mentally weakened by inadequate diet and poor health.

2. RATIONALE OF THE STUDY

Despite abundant agricultural resources, Ethiopia is one of the most food insecure and food aid dependent countries in the world. Food insecurity has been the primary concern for the successive governments of the country. The situation is aggravated by the low agricultural production and productivity, which is due to backward production technologies, poor infrastructure as well as unsuitable government policies and strategies. For policy responses, it is crucial to understand how different socio-economic groups especially the poorest segment of the population are affected by chronic hunger and food insecurity. This needs a thorough investigation of the problems associated with household food security.

The measurement and analysis of food insecurity is crucial for understanding peoples' situations of wellbeing and factors determining their food insecurity situations. To bring impact on the food security situation of rural poor, measuring the food insecurity status of the household at local level and identifying its covariates become vital to develop appropriate local level development interventions. Moreover, food security analysis at the household level could facilitate identification of the most appropriate strategies that could be taken either by the government or development partners or by the communities. Thus, this study has practical significance for designing a more targeted and effective food security related development intervention in the study area, and in other similar environments in the country.

3. RESEARCH METHODOLOGY

3.1. Description of the Study Area

Girar Jarso wereda is located in central Ethiopia, North Shewa zone is 112 Km away from Addis Ababa along the road to Bahirdar, with an area of 401.9 sq. kilometers. North Shewa zone is bounded by West Shewa zone of Oromia in the west and Amhara in the north and east direction. It is partly neighbored by East Shewa zone of Oromia in the east and southeast. Geographically, the wereda extends $9^{0}37'$ -$10^{0}00'$N latitudes and $38^{0}37'$-$38^{0}50'$E longitudes. The average annual temperature ranges from 15^{0}c -18^{0}c, while the average annual rainfall varies between 1200-1400 mm. The rainfall in the area is characterized by its bi-modal distribution pattern. Average land holding is estimated to be 3.2 hectare per household. According to the Zone Finance and Economic office report (2011), the district is divided in to 17 PAs with the population other than Fitche town closed to 76,921 (Male 39,387 & Female 37,534) with an average family sizes of 5. According to CSA (2008), the average population density of the woreda is 157 people per km^2.

Mixed farming is the mainstay of the household economy, intensively carried out by those who have land and livestock. The agricultural sector is rain fed and is characterized by low productivity due to low use of farm inputs, traditional farm practices, poor soil fertility, water logging and other related problems. The main crops grown include cereals (barley, wheat, maize, sorghum and teff), pulses (bean, pea, and lentil), fruits and vegetables (apple, cabbage, kale, onion). The livestock sub-sector is one of the components of the farming system. The major livestock species managed in the area includes cattle, small ruminants and equines. The sub-sector contributes to the subsistence requirement of the population in terms of milk, milk products and meat. The landless are engaged in sharecropping and other non-agricultural income generating activities like daily laboring. Agricultural products are consumed at home and partly sold to earn cash to meet other household needs, educate children, and contribute to social affairs. It also contributes a lot for crop production by providing draught power, manure, transportation services. Like elsewhere in the country, the production and productivity of this sub-sector is very low.

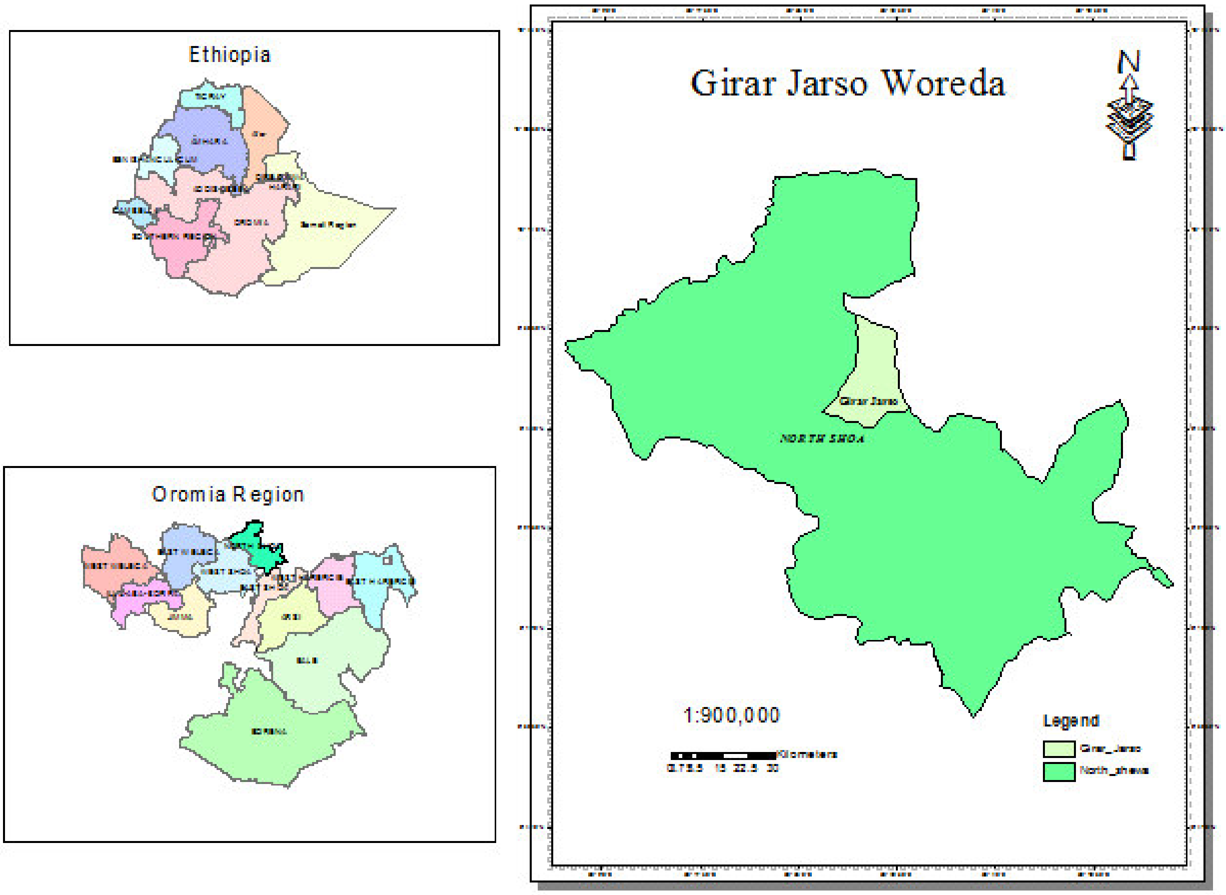

Fig. Location map of the study area

3.2 Source of data

The study gathered qualitative and quantitative data pertaining to social, demographic and economic aspects of households. A structured questionnaire was used to collect quantitative data through a household survey from four PAs (Torban Ashe, Weddesso Amba, Dire Doyu and Koticho). The survey covered a total of 120 randomly selected households. Data were collected on demographic characteristics, types and amount of food consumed by a household in a specific period (seven days recall), farm/non-farm income, livestock and oxen ownership and asset possession. Additional data on resource endowment, institutional factors such as access to credit, access to extension services were also gathered.

3.3 Method of Data Collection

For this study, survey respondents FGD participants and key informants were the primary data sources. A structured survey questionnaire was designed and pre-tested to collect the primary data. The household head and their spouses were the main respondent. Both quantitative and qualitative data were collected simultaneously during the fieldwork. The questionnaire tried to encompass both closed and open-ended types of questions to gather demographic and socio-economic informations, livelihood assets, volume of food items consumed with the recall period, crop and livestock production, access to services, etc. Government statistics such as the Central Statistical Agency and research reports by individuals or organizations were used in this study. Informations in relation to landholding size, the livestock owned and family size documents for comparison from the primary data were collected from secondary sources.

3.4 Sampling Procedure

Three stages sampling procedure were used to select 120 households in rural areas of Girar Jarso and generate the required data. At the first stage, Girar Jarso woreda was selected purposively. In the second stage, four PAs were selected randomly. Finally, a probability proportional to size (PPS) was employed to draw sample households from those four PAs. To determine the required sample size at 91% confidence level, with a 0.9 degree of variability and a 9% level of precision, a formula developed by Yamane (1967) was applied.

$$\text{Yamane (1967): } n = \frac{N}{1+N(e)^2}$$

Where: n is the sample size for the research use

N is the population size (total number of households in the selected kebeles)

e is the level of precision (= 0.09).

Accordingly; $n = \frac{4286}{1+4286(0.09)^2}$; n =120

The sample size in Torban Ashe, Weddesso Amba, Dire Doyu and Koticho PAs using the above formula respectively were found to be 40, 31, 22 and 27 households.

3.5 Method of Data Analysis

To achieve the stated objectives of the survey, data were first sorted out, edited and coded, organized, and analyzed using descriptive statistics, food security indices, and logit model with a software known as SPSS version 16.

3.5.1 Descriptive Statistics

Frequency distribution, percentage, means and inferential statistics (T-test and Chi-square tests) were used to assess the demographic and socioeconomic characteristics of farming households.

3.5.2 Food Security Indices

Household caloric acquisition was used to measure food security in the study area. To identify food secure and insecure households, volume of food items commonly consumed in Kg or liter in the area were obtained from respective households with seven days recall period. The data analysis started with the conversion of the weekly consumption data into kilocalorie using the nationally standardized food composition table manual. Household calorie availability was estimated using food nutrient composition in appendix 1.

The converted data were divided into household Adult Equivalent (AE). Following this, it was converted to Kcal/Day basis and it has been made ready to calculate Kcal/Day/AE. Daily per capita calorie consumption was estimated by dividing the estimated daily calorie supply to the household by the household size adjusted for adult equivalence using the equivalent scale weights as can be indicated in appendix 2.

Then after, the results obtained were compared with the minimum subsistence nutritional threshold (2100 Kcal per AE per Day). Household which consume below this minimum requirement were categorized as food insecure and those households which consume above the threshold were considered as food secure. The next step involved estimation of food insecurity status. The procedure of Foster et al. (1984) was used in the computation of incidence, depth and severity of food insecurity. The Foster-Greer-Thorbecke (FGT) measure is given as:

$$P_\alpha = \frac{1}{N}\sum_{i=1}^{q}\left(\frac{Z - Y_i}{Z}\right)^\alpha, \alpha \geq 0$$

Where: N is the number of sample households;

Y_i is the measure of per adult equivalent food calorie intake of the i[th] household;

Z is represents the cutoff point between food security and food insecurity households (2100Kcal);

q is the number of food-insecure households; and α is the weight attached to the severity of food insecurity;

α = "food insecurity aversion" parameter (the weight attached to the severity of the food insecured)

In FGT index, $Y_i \geq Z$ that the specified household is food secure.

According to Hoddinott (2001), using FGT family of indices, we compute the head count ratio, food insecurity gap and squared food insecurity gap. Head count ratio describes the percentage of sampled households whose per capita consumption is below the predetermined minimal nutritional requirement (2100kcal). FGT at (α = 0) becomes the ratio between number of food insecured with the total sample size.

Mathematically, $H = \frac{q}{N}$

The food insecurity gap, FGT (α = 1), measure how far the food insecurity of households, on average, are below subsistence level of energy. The food insecurity gap index measures the extent to which individual falls below the minimal nutritional threshold. It indicates the relative shortfall of the food insecured from the threshold. The food insecurity gap index H_1 mathematically be written as

$$H_1 = \frac{1}{N}\sum_{i=1}^{q}\left(\frac{Z-Y_i}{Z}\right)$$

This index characterizes the amount of resources that will be required to bring all the food insecurity of the households to this subsistence level. To put it differently, it will provide the possibility to estimate resources required to eliminate food insecurity through proper targeting. This measure is the mean proportionate food insecurity gap in the population. Finally, squared food insecurity gap H_2, FGT (α = 2), is mathematically expressed as

$$H_2 = \frac{1}{N}\sum_{i=1}^{q}\left(\frac{Z-Y_i}{Z}\right)^2$$

3.5.3 The Analytical Model

The last step involved identification of covariates that are assumed to have association with food security at a household level. As the dependent variable has a dichotomous nature (food secure or insecure households), a binary logistic regression was used where the estimated probabilities lie between logical limit 0 and 1 (Guajarati, 1995). Food security as a dependent variable, thus, assumes the value of Y= 1 if a household is food secure, 0 otherwise.

Regression models in which the dependent is dichotomous can be estimated by linear probability model (LPM), logit or probit. Although linear probability model is the simplest method, it is not logically attractive in that it assumes that the conditional probability increases linearly with the value of explanatory variables. Unlike linear probability, logit model guarantee that the estimated probabilities increases but never steps outside the 0 – 1 interval and the relationship between probability (P_i) and explanatory variable (X_i) is nonlinear (Gujarati, 1995). In order to test the hypothesis, a probabilistic model is specified with food security as a function of series of household characteristics as explanatory variables. The dependent variable in this case is dummy, which takes a value of zero or one depending on whether or not a household is food insecure. Thus, the main purpose of a qualitative choice model is to determine the probability that an individual with a given set of attribute will fall in one choice rather than the alternative.

Usually a choice has to be made between logit and probit models. But, as Amemiya (1981) has pointed, the statistical similarities between the two models make such a choice difficult. However, Maddala (1983) and Kementa (1986) and many authors tend to agree in that the logistic and cumulative normal functions are very close in the mid range, but the logistic function has slightly heavier tails than the cumulative normal distributions.

Pindyek and Rubinfeld (1981) also illustrated that the logistic and probit formulations are quite comparable. The main difference being that the former has slightly flatter tails, that is, the normal curve approaches the axis more quickly than the logistic curve. Therefore, the choice between the two is one of convenience and availability of computer programme. Thus, a logistic model was specified to identify the determinants of food insecurity and to assess their relative importance in determining the probability of being food insecure at household level. The analysis of the logistic regression model indicated that changing an independent variable alters the probability of a household being food insecure. Following Gujarati (1995), the functional form of logit model is specified as follows:

$$P_i = E(Y = \frac{1}{x_i}) = \frac{1}{1 + e^{-(\beta_0+\beta_i X_i)}}$$

Taking $\beta_0 + \beta_1 X_i$ to be Z_i, the probability that a given household is food insecure becomes $P_i = \frac{1}{1+e^{-Z_i}}$, while the probability for not food insecure is: $1 - P_i = \frac{1}{1+e^{Z_i}}$

Therefore the probability of food insecure to that of food secure can be written as $\frac{P_i}{1-P_i} = \frac{1+e^{Z_i}}{1+e^{-Z_i}}$

Finally, taking the natural log of equation, we obtain:-

$$L_i = \ln(\frac{P_i}{1-p}) = Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n$$

Where P_i = is a probability of being food insecure ranges from 0 to 1$\frac{P_i}{1-p}$

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

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

β_0 is an intercept

β_1, β_2 ------ β_n are slopes of the equation in the model
L_i = is log of the odds ratio, which is not only linear in Xi but also linear in the parameters.
X_i = is vector of relevant household characteristics
If the disturbance term (U_i) is introduced, the logit model becomes
$Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + U_i$

Prior to the estimation of the logistic regression model, the explanatory variables were checked for the existence of multicollinearity. Variance Inflation Factor (VIF) was used to measure the degree of linear relationships among the continuous explanatory variables. VIF shows how the variance of an estimator is inflated by the presence of multicollinearity (Gujarati, 2004). Each continuous explanatory variable were regressed on all the others and coefficient of determination (R^2) for each axillaries or subsidiary regression will be computed.

Following Gujarati (1995), VIF is defined as: VIF = $(\frac{1}{1-R^2})$

Where: X_i is the i^{th} quantitative explanatory variable regressed on the other quantitative explanatory variables.

R^2 is the coefficient of determination when the variable X_i regressed on the remaining explanatory variables.

A variable is said to be highly collinear, if R^2 exceeds 0.9 or VIF exceeds 10. As a rule of thumb, for the computed value of VIF, variables by far less than 10 were assumed to be free from the problem of multicollinearity (Gujarati, 1995). It is also evident that there might be interaction among dummy variables, which could lead to the problem of multicollinearity. To detect this problem, contingency coefficients were computed for each pair of dummy variables. The contingency coefficients are computed as follows:

$$C = \sqrt{\frac{\chi 2}{n + \chi 2}}$$

Where, C = contingency coefficient
$\chi 2$ = Chi-square test and
n = total sample size

The values of contingency coefficient range between 0 and 1, zero indicating no association between the variable and values close to 1 indicating a high degree of association, which means high degree of multicollinearity. As a rule of thumb, all dummy variables with the computed value of C between 0 and 1, but less than 0.75 (cut-off point) shows weak association and considered as free from the problem of multicollinearity. And a value above it indicates strong association of variables.

3.6 Hypothesis

The literature on the determinants of household food insecurity makes it clear that the choice of dependent and independent variables have been identified by different researchers, international and national development organizations. This section describes the variables used in the econometric analysis. Dietary intake is used as a proxy to measure household food security status. Household consume a variety of food, either from purchase or own production that were converted in to calories using ENHRI (Ethiopian Health and Nutrition Research Institute) food composition table for use in Ethiopia (1998).

After the analytical procedures are clearly delineated, it is necessary to identify the potential explanatory variables that would influence household food insecurity. Review of literatures, past research findings, experts and author's knowledge of the food insecurity situation of the study area were used to identify the potential determinants of household food insecurity (Bogale and Shimelis, 2009). Therefore, assigning the household food insecurity as the dependent variable, the following variables are selected to analyze whether they explain household's food insecurity or not.

Dependant variable: the dependant variable is Household Food Insecurity (HFINS*)* is a dichotomous dependent variable in the model taking value of 1 if a household is food insecure and 0 otherwise. Food security status of a household is identified by comparing total kilocalorie consumed in a household per adult equivalent per day with daily minimum requirement of 2100kcal and those getting above are food secured and food insecured otherwise.

$$HFS_i = \begin{cases} 1, \text{ Yi} < \text{R (Food insecured)} \\ 0, \text{ Yi} \geq \text{R (Food secured)} \end{cases}$$

HFS_i = household food security status of the i^{th} household, i = 1, 2, 3, 4. . . 120
Y_i = daily per capita calorie available
R = the minimum recommended nutritional threshold per AE per day (2100 kcal)

Independent variables: Household demographic and socio-economic characteristics such as household size, sex of household head, marital status of head, educational status of household head, dependency ratio, and access to credit, ownership of saving account, daily income per adult equivalent, and proportion of food expenditure are selected variables for the model analysis.

Age of the household head (AGEHH): Age matters in any occupation. Rural households mostly devote their live time or base their livelihoods on agriculture. The older the household head, the more experience he has in farming and weather forecasting. Moreover, older persons are more risk averters, and mostly they intensify and diversify their production activities. As a result, the chance for such household to be food insecure is less. In light of this, it is hypothesized that age of the household heads and food security are positively correlated (Beyene and Mequanent, 2010).

Family size (FMSZE): An increase in household size implies more mouth to be fed from the limited resources and especially in males dominant household the situation becomes more than this due to high possibility of accustoming to bad habits. As can be mentioned by Bogale and Shimelis (2009), the household size and status of food insecurity is expected to be related positively.

Sex of household head (SEX): it is a dummy variable taking a value of 1 if male and 0 otherwise. Household head is a person who economically supports or manages the household. It could be male or a female. There is no generally accepted relationship between sex of household head and level of food security. Households headed by female, according to the reviewed literatures, have higher probability of being food insecure (Tsegaye, 2009). However, in the study area, females actively engaged in various activities as compared to males. Consistent to Mitiku et al (2013), it was hypothesized that sex of household head and food security are positively related.

Education level of household head (EDU): Education level is important for gauging income earning potential of a household which has significant influence on consumption behavior of the household as it equips individuals with the necessary knowledge of how to make a living (Bogale and Shimelis, 2009). Education is a dummy variable taking a value of 1 if household head is literate and 0 otherwise. Educational level of household head and food insecurity are expected to be related negatively.

Dependency ratio (DEP): Dependency ratio is the ratio between economically inactive (age less than 15 and above 65) with active labor force (age between 15 and 65) with in a household. When a large household size corresponds with the availability of adequate adult labor, it can have a positive effect. But a household with more inactive productive labor force compared to the active age shows a high dependency ratio and it is more likely to be food insecure (Bigsten et al., 2002). Therefore, it is hypothesized that dependency ratio and food security are negatively associated.

Livestock ownership (TLU[1]): It is a continuous variable and measured in TLU (Tropical Livestock Unit). The rural households accumulate their wealth in terms of livestock. They are prominent sources of wealth to farm households and supply manure to improve soil fertility. Therefore, possession of large size of livestock increases the likelihood of the household to be food secure (Mitiku et al, 2013).

Total number of oxen (TOXEN): Oxen power is the most important means of land cultivation and basic farm assets in Ethiopia. It is a continuous variable measured in number. It allows effective utilization of land and labor resources where family labor could be spread over peak and slack periods to carry out both farm and non-farm activities (Haile et al., 2005). Households with relatively larger number of oxen can perform better on their farm and achieve sustainable food security. Thus, the number of oxen available to the household increases the probability of the household being food secure.

Cultivated land size (CLSZ): This variable represents the total landholding of the household measured in hectares. Total cultivated land owned by household is important resource for food production and is positively associated with food security status. Thus, it is expected that size of cultivated land will have positive impact on food security (Mitiku et al, 2013).

Total annual farm income (TOINC): One of the major determinants of household food insecurity is income of a household. As income determines the household's ability to secure food, it remains to be an important variable which explains the characteristics of food secure and food insecure households (Bogale and Shimelis, 2009).The the higher the level of total amount of income from different sources, the lesser would be the likelihood of household to become food insecure. Therefore, income was hypothesized to be negatively related with household food insecurity.

Total off farm income (TOFFI): Income earned from nonfarm activities is an important continuous explanatory variable that determines household food security in the study area. In this regard, households engaged in non-farm activities are better endowed with additional income and less likely to be food insecure. Therefore, non-farm income is expected to be positively associated with household food security status. As can be stated by Bogale and Shimelis (2009), income earned from any source improves the food security status of the household.

Owning saving account (SVACC): is a dummy variable taking a value of 0 if a household has bank account or

[1] Total herd size is measured in Tropical Livestock Unit (TLU), where 1 TLU is equivalent to 250kg of livestock. Total size of cattle, shoat, chicken, Donkey (young) Donkey (adult) and horse were computed into TLU using factor 0.7, 0.1, 0.013, 0.35, 0.7 and 1.1 respectively (Strock et al., 1991).

maintain credit and saving association and 1 otherwise. Owning saving account or maintaining credit and saving association is hypothesized to be positively related to food insecurity. Having a savings account was clearly disadvantageous in reducing the risk of being food insecured. As can be revealed by the findings of Lilian et al (2013), access to savings increases the ability of a household to deal with shocks which bring about abrupt changes in food production, prices and income, and so affect food security.
Access to credit (CRDT): is a dummy variable taking a value of 1 if household received credit and 0 otherwise. The possible explanation is that those households who were willing to participate in credit scheme and managed to earn higher amount became capable to improve their income position through performing different activities. Credit serves as a means to be involved in income generating activities and to reap derived benefit based on the amount and purpose of credit. It also normalizes consumption at hard time. Hence as can be hypothesized by Mitiku et al (2013), it was expected that credit will have a positive impact on food security.
Access to agricultural extension service (EXT): It is a dummy variable taking a value of "0" if the rural household has access to extension service and "1" otherwise. The provision of extension services to the rural house hold directly affects their knowledge, productivity and income; access to better crop production techniques and improved input that positively affect their food security status (Amaza et al., 2006). It was expected to influence household food insecurity status negatively.

4. RESULT AND DISCUSSION

Study results are presented in three categories as food security indices, descriptive and econometric model analysis of the survey data. Descriptive statistics such as mean, standard deviation, percentage and frequency distribution were employed and binary logistic, econometric model was used to identify determinants of food insecurity at household level. Status of household food insecurity, in terms of extent and severity, were computed by using an FGT index.

4.1 Construction of Food Security Indices

Though food security at the household level is best measured by direct survey of income, expenditure, and consumption and comparing it with the minimum subsistence requirement, in this study households' food or calorie acquisition per AE per day is used to identify the two groups. The households' food security status was measured by direct survey of consumption. Data on the available food for consumption, from home production, purchase and /or gift/loan/wage in kind for the seven days recall time before the survey day by the household was collected. Then the data were converted to kilocalorie and then divided to household size measured in AE. Following this, the amount of energy in kilocalorie available for the household is compared with the minimum subsistence requirement per adult per day (i.e. 2100 kcal). If the consumption/acquisition is less than the recommended amount then, the household is categorized as food insecure and if greater, as food secure.

The reason for use of this measure was that it produces a crude estimate of the amount of calorie available for consumption in the household. Moreover, it is not obvious to respondents how they could manipulate their answers. Since the questions were retrospective, than prospective, the possibility that individuals or households would change their behavior as a consequence of being observed is lessened (Hoddinott, 2001). Following the procedures specified in the methodology, FGT family of indices were also employed. The three FGT indices results; head count index, food insecurity gap and severity of food insecurity were found to be 0.375, 0.1095, 0.0419 respectively.

Table 1: Food insecurity indices of sampled rural households

Food insecurity indices	Food insecured			Food secured		
	Ratio	**%**	**No.**	**Ratio**	**%**	**No.**
Incidence of food insecurity (α = 1)	0.375	37.5	45	0.725	72.5	75
Depth of Food insecurity (α = 2)	0.1095	10.95				
Severity of food insecurity (α = 3)	0.0419	4.19				

Source: own computation, 2015

The results of the survey revealed that the head count ratio or incidence of food insecurity are 0.375 which implies 37.5 percent of the sampled households cannot meet the daily recommended caloric requirement. Out of 100 households about 38 cannot fulfill the minimal daily nutritional requirement.

To know how far the food insecure households are below the recommended daily caloric requirement, food insecurity gap was calculated. Food insecurity gap measures the aggregate food insecurity deficit of the food insecure population relative to the recommended caloric requirement i.e. it reflects total kcal deficit of all household below the subsistence energy requirement level. The calculated value for food insecurity gap was found to be 0.1095. This indicates that the woreda mobilizes and distributes resources that can meet 10.95 percent of caloric need of every food insecure households and distribute to each household to bring up to the recommended daily caloric requirement level, then theoretically food insecurity can be eliminated. This measure is the mean proportionate food insecurity gap in the population. Some people find it helpful to think of this measure as the cost of eliminating food insecurity (in terms of Kcal), because it shows how much would have to be transferred to the food insecured to bring their daily consumption up to the nutritional threshold. The minimum cost of eliminating food insecurity using targeted transfers is simply the sum of all the food insecurity gaps in a population; every gap is filled up to the line of demarcation. However this interpretation is only reasonable if the transfers could be made perfectly efficiently, for instance with lump sum transfers, which is implausible. Clearly this assumes that the policymaker has a lot of information; one should not be surprised to find that a government would need to spend far more than this in the name of food insecurity reduction.

To construct a measure of food insecurity that takes into account inequality among the food insecured, some researchers use the squared food insecurity gap index. Finally, to approach the most food insecure sample households, severity of food insecurity was calculated by assigning a higher weight. Index that measures the mean of squared proportional shortfalls from the cut off points is known as severity of food insecurity. The problem with this measure is that it is not easy to interpret. Thus, the survey result indicated that the severity of food insecurity becomes 0.0419. This is simply a weighted sum of food insecurity gaps (as a proportion of the daily nutritional threshold), where the weights are the proportionate food insecurity gaps themselves; food insecurity gaps of 0.034 implies there is a high degree of inequality among the food insecured households.

4.2 Descriptive Statistics

This sub section discusses the demographic characteristics of the respondent households. The household characteristics were compared to see the difference among food insecure and food secure groups. The variables discussed in this description are those which do have a relationship to the food security status of a household in the study area. Different aspects of a household like age group of the household, family size in AE, dependency ratio, TLU in AE, total farm income, total off farm income, total cultivated land size, number of oxen and owning saving account as continuous variables, and access to extension, access to credit, sex and educational level of the household head as dummy variables were given due consideration.

Table 2: Code, definitions and descriptive statistics of continuous variables included in the logit model

Variable Code	Variable type	Food secured (N = 75)		Food insecured (N = 45)		Total Sample (N = 120)		T- value
		Mean	Std dev	Mean	Std dev	Mean	Std dev	
FAMSZ	Continuous	4.3652	1.56212	4.4178	1.44565	4.384	1.5135	1.83
DPR	Continuous	24.3543	22.08477	29.7029	25.34863	26.36	23.40	1.215
AGE	Continuous	45.95	14.704	47.64	14.923	46.58	14.74	0.609
CLSZ	Continuous	3.1473	1.59769	1.6078	1.30231	2.57	1.665	-5.464***
TLU	Continuous	7.4287	5.90281	4.6842	3.13784	6.39	5.204	-2.881***
NOXEN	Continuous	2.11	1.361	1.53	1.160	1.89	1.314	-2.357**
TOFFI	Continuous	2.0306E3	3869.65	5.0611E2	885.20	1.4589E3	3186.01	-2.598**
TINC	Continuous	5.8068E3	3825.64	2.1036E3	1520.12	0.6250	0.04861	-6.198***

*** and ** significant at p<0.01 and P<0.05 respectively
Own Source, 2015

In Table 2, the basic characteristics of sample households in relation to the food insecurity status at household level were summarized. Possible explanations on factors supposed to have contribution on household food insecurity were also presented. It also shows summary statistics and scores of sample household groups on the continuous variables included in the model. Accordingly, family size in AE, dependency ratio and age of household head of food insecure households are higher than food secured households. On the other hand, TLU in AE, total farm income, total off farm income, total cultivated land size, number of oxen and owning saving TLU in AE are higher among food secured households than among food insecure households. The results revealed that food insecure and food secure household groups have statistically significant difference at less than 1% level of probability with respect to mean of the continuous variables such as cultivated land size (CLSZ), total annual income (TINC), and total number of livestock in (TLU), and at less than 5% level of probability with respect to mean of annual off-farm income (TOFFI) and number of oxen (NOXEN). Therefore, the results confirm the findings of the literature regarding the relationship between food security and determinants of food security.

Besides, as can be indicated on Table 3, categorical variables such as access to credit (CRDT) were also found to be statistically different for the two groups of households at less than 1 % level of probability. However, sex of the household head (SEX), education of the household head (EDUC), access to extension services (EXT) and Owning saving account (SVACC) were found to be statistically in significant.

Table 3: Code, definitions and descriptive statistics of dummy variables included in the logit model

Variable code	*Variables and their definitions*			*Food secured (N = 75)*		*Food insecured (N = 45)*		*Chi square test*
				No.	*%*	*No.*	*%*	
SEX	***1, if the household head is male; 0, otherwise***	***Dummy***	***Male***	***64***	***85.3***	*38*	***84.4***	***0.017***
			Female	***11***	***14.7***	*7*	***15.6***	
EDU	***1, if the household head is literate; 0, otherwise***	Dummy	***Literate***	***34***	***45.3***	*21*	***46.6***	***0.020***
			Illiterate	***41***	***54.6***	*24*	***53.4***	
CRDT	***1, if the household has an access; 0, otherwise***	Dummy	***Yes***	***13***	***17.3***	*18*	***40***	*7.542 ****
			No	***62***	***82.7***	*27*	***60***	
EXT	***1, if the household has an access; 0, otherwise***	Dummy	***Yes***	***54***	***72***	*32*	***71.2***	***0.011***
			No	***21***	***28***	*13*	***28.8***	
SVAC	***1, if the household has saving account; 0, otherwise***	Dummy	***Yes***	***28***	***37.3***	*17*	***37.7***	***0.002***
			No	***47***	***676.***	*28*	***66.3***	

*** Significant at $p<0.01$
Own Source, 2015

4.3 Econometric model Result

An econometric model, logistic regression, was employed to identify the determinants of household food insecurity. The variables included in the model were tested for the existence of multicollinearity, if any. Contingency coefficient and variance inflation factor were used for multicollinearity test of dummy and continuous variables respectively.

Contingency coefficient value ranges between 0 and 1, and as a rule of thumb variable with contingency coefficient below 0.75 shows weak association and value above it indicates strong association of variables. The contingency coefficient for the dummy variables included in the model was less than 0.75 that didn't suggest multicollinearity to be a serious concern.

Variance inflation factor (VFI) technique is used to detect the problem of multicollinearity for continuous explanatory variables (Guajarati, 1995). VIF shows how the variance of an estimator is inflated by the presence of multicollinearity (Gujarati, 2004). Each selected continuous variable is regressed on the other continuous explanatory variable, the coefficient of determination (R^2) being constructed in each case. If an approximate linear relationship exists among explanatory variables, it will result in a 'large' value for R^2 in at least one of the test represents. A variable is said to be highly collinear, if R^2 exceeds 0.9 or VIF exceeds 10 (Gujarati, 1995). With regard to variance inflation factor, each selected explanatory variable X_i was regressed on all other explanatory variables, the coefficient of determination R^2 constructed in each case was evaluated to detect whether multicollinearity is a serious problem. VIF is expressed as; $V=\frac{1}{1-R^2}$

The computational results of the variance inflation factor on Table 6 confirmed the non-existence of association between the variables and were included in the model. In total, 13 independent variables were used for estimation. To identify determinants of food insecurity among hypothesized explanatory variables that are supposed to have influence on Girar Jarso rural households, binary logit model were estimated using a statistical package known as SPSS version 16. Types, codes and definition of the variables and estimates of the logit model are presented on the following table.

In the binary logit model, twelve independent variables hypothesized to have influence on household food insecurity in the study area were included in the model, of which five were found to be statistically significant. The levels of statistical significance for the independent variables were and the sign of the significant parameters were as expected. The model output revealed that family size (FAMSZ), total annual farm income (TINC) and total off farm income (TOFFI) at less than 1 % level of probability, and number of oxen (NOXEN) and access to agricultural extension service (EXT) at less than 10% and 5% level of probability were statistically significant.

Table 4: The maximum likelihood estimates of the logit model

Variables	B	S.E.	Wald	df	Sig.	Exp(B)
FAMSZ	4.224	1.308	10.422	1	0.001***	68.295
DPR	0.034	0.031	1.198	1	0.274	1.034
AGE	0.029	0.047	0.388	1	0.533	1.030
EDU	-0.258	1.056	0.059	1	0.807	0.773
SEX	0.246	1.486	0.027	1	0.869	1.279
TLND	-1.197	0.774	2.390	1	0.122	0.302
CRDT	-2.456	1.802	1.857	1	0.173	0.086
TLU	-0.024	0.315	0.006	1	0.941	0.977
NOXEN	-1.205	0.729	2.732	1	0.098*	0.300
TOINC	-0.003	0.001	10.660	1	0.001***	0.997
EXT	-5.336	2.336	5.215	1	0.022**	0.005
TOFFI	-0.004	0.001	9.057	1	0.003***	0.996
SAVAC	0.305	1.164	0.069	1	0.793	1.357
Constant	0.826	3.189	0.067	1	0.796	2.284
Model Chi square					129.840(000***)	
- 2 Log likelihood					28.936	
Sensitivity[1]					97.3	
Specificity[2]					95.6	
Count R^2					96.7	
Sample size					120	

***, ** and* significant at p<0.01, P<0.05 and p<0.1respectively

Source: Model output 2015

The likelihood ratio has a chi – square distribution and it is used for assessing the significance of logistic regression. Model chi – square provides the usual significance test for a logistic model i.e. it tests the null hypothesis that none of the independents are linearly related to the log odds of the dependent. It is an overall model test which doesn't assure every independent is significant. The result is significant at less than one percent level of probability revealing that the null hypothesis that none of the independents are linearly related to the log odds of the dependent is rejected. Additionally, goodness of fit in logistic regression analysis is measured by count R^2 which works on the principle that if the predicted probability of the event is greater than 0.50 the event will occur otherwise the event will not occur. The model results show that the logistic regression model correctly predicted 96.7 % of the total sample households, 95.6 % food secured and 97.3 % food insecured groups This indicates that the model has estimated the food secure and food insecure correctly.

In light of the above summarized model results, possible explanations for each significant independent variable are given hereunder

Family size (FAMSZ)

Given the strong positive relationship between family size and food insecurity already noted in the descriptive part, it is not surprising that the estimated parameters are positive and significant. It appeared to be highly significant in determining household's food security status in the district. This variable is significant at 1% probability level and positively associated with the state of food security. The positive relationship indicates that the odds ratio in favor of the probability of being food secure decreases by a factor of 68.295 as family size increase by a unit, other things being constant. The possible reason is that with existing high rate of unemployment and less employment opportunity coupled with low wage rate payment, an additional family member shares the limited resources that lead the household to become food insecure. Households with many children could face food insecurity because of high dependency burden. This shows that those farmers with large economically non-active members in family tend to be food insecure than those with small family size. The findings of Tsegaye (2009), Bogale and Shimelis (2009) and Arega (2013) also revealed that Family size significantly determine household food insecurity.

Total annual farm income of household (TINC)

The coefficient of this variable was hypothesized to have negative influence on food insecurity. In agreement with the hypothesis, its coefficient came out to be negative and significant at less than 1 percent level of probability. The inverse relationship is an indicator of its influence to reduce food insecurity. The likely

[1] Sensitivity is the percent correctly predicted food insecured groups

[2] Specificity is the percent correctly predicted food secured groups

explanation is that those farmers who had an access to different income opportunities are less likely to become food insecure than those households who had no or little access. The odds ratio in favor of food insecurity decreases by a factor equal to 0.997 as the income increases by a unit. This result also confirms the findings of Bogale and Shimelis (2009), Mitiku et al, (2012) and Ahmed (2015).

Total off-farm income (TOFFI)

This variable represents the amount of income earned in cash or in kind during the year. In the areas like Girar Jarso district, where the farmers face crop failure and sales of livestock and livestock product is inadequate, income earned from off-farm activities is an important means of acquiring food. Accordingly, in the study area, the success of farm households and their family members in coping with food insecurity is highly determined by their ability to get access to off-farm job opportunities. The result suggests that households engaged in off-farm activities are endowed with additional income and less likely to be food insecure. Consistent with the hypothesis, off-farm income is negatively and significantly associated with farm households' food insecurity status at less than one percent level of probability. The odds ratio indicates that, other things being constant, the probability of the household to be food insecured decreases by a factor of 0.996 as the household earned one more unit of money from non-farm income per AE. The important role of non-farm income in contributing to household food security is consistent with the findings of Mitiku et al, (2012) and Beyene and Mequanent (2010).The econometric result gives important clues regarding variables, which should be considered and given emphasis during interventions in order to overcome the problem of food insecurity in the study area.

Number of Oxen (NOXEN)

Oxen are the main source of traction power among rural households in the study area. It is negatively and significantly associated at less than 10% with the probability of being food insecured. Households unable to possess a pair of oxen are either destitute or vulnerable (**Devereux et al, 2003**). Consistent with the findings of Mequanent and Esubalew (2015) and Tekle and Berhanu (2015), the odds ratio in favor of food insecurity decreases by a factor equal to 0.300 for each additional ox owned, provided that other things remaining constant. The possible justification was that households with more oxen have a better production capacity of households in subsistent agriculture of the area and less dependent on borrowing or hiring oxen.

Agricultural Extension Services (EXT)

The coefficient of this variable was hypothesized to have negative influence on food insecurity. In agreement with the hypothesis, its coefficient came out to be negative and significant at less than 10 percent level of probability. The inverse relationship is an indicator of its influence to attack food insecurity. The possible explanation is that those farmers who had access to modern inputs along with various packages of scientific agricultural practices are less likely to become food insecure than those households who had no or little access. The odds ratio in favor of food insecurity decreases by a factor equal to 0.005 as the agricultural extension services increases by one unit. This result also confirms the findings of Abebaw (2003).

5. CONCLUSION AND RECOMMENDATION

As a multidimensional concept with multifaceted consequences, an attempt has been made to measure the status and explore the determinants of food insecurity in Girar Jarso. The study applied a Cost of Basic Need approach to identify food secured and food insecured using the survey data. Accordingly, 37.5 % of rural households were food insecured, with a proportionate food insecurity gap and degree of inequality among food insecured households of 10.95% and 4.19% respectively. Then after, the socioeconomic characteristics of the two groups of sample households have been analyzed using descriptive statistics. The descriptive analysis examining the differences among food secured and food insecured households revealed that the former have higher family size and dependency ratio; possesses small amount of cultivated land, number of livestock, farm and off farm income; and are headed by illiterates than the later ones. The study also revealed that total cultivated land, number of livestock, total farm income, total off farm income and level of education of the household head exhibit statistically significant differences. However, there was no significant difference between the food secured and food insecured households in terms of the age, sex and education level of the household head, family size, dependency ratio, access to extension services and Owning saving account. Lastly, an effort has been made to identify determinants of rural household food insecurity with a binary logistic regression model. Accordingly, family size (FAMSZ), total annual farm income (TINC), total off farm income (TOFFI), number of oxen (NOXEN) and access to agricultural extension service (EXT) as the major determinants of household food insecurity assist policy makers to identify points for potential intervention to improve food security. Cognizant to the findings of this study, interventions that should be planned to achieve longer-term food security objectives are the following;

- Smallholder farming plays a great role in the struggle to eliminate food insecurity. Its contribution to the household food energy requirement and total income is significant. Hence, necessary effort should be made to improve the production and productivity of the sector. This can be done through timely provision of modern agricultural inputs along with packages of scientific agricultural practices. Improving production and productivity of agriculture needs strong tie of research and extension. Since smallholder agriculture needs to make use of a wide range of technologies and scientific agricultural practices across different farming systems and structures to meet a variety of changing demands from the public, researches that generate technologies to solve the specific problems of the rural households should be encouraged. The link between research and extension should also need to be revised.

- Rural households in the study area have very limited room for generation of income. Hence, for these households to enhance their welfare, they must have diversified access to income alternatives. Rural food insecurity can be improved through a comprehensive combination of interventions aiming at income diversification such as off-farm activities; trading, crafting, etc, commercialization and promoting education, among others. Development strategies should be able to identify income alternatives other than agriculture. In light of this, non-governmental organizations that are focusing only on agriculture should also channel their scarce resources to creation of other income generating activities which would greatly help to enable the households to secure their food through purchase.
- Better access to productive resources like farm oxen, have a paramount importance to enhance rural household food security. Possessing farm oxen helps in crop production by providing traction power and manure. From all livestock resources oxen are strategic asset especially for farming households; since they serve as a source of traction in the rural households. Therefore, concerned bodies should support the poor farmers by providing access to draught power.
- In a poor country like ours, food security can be achieved when people have access to sufficient food. Currently, there is not only lack of food to feed everyone, but also lack economic resources to produce or purchase food for many households. The food production is less than proportional to feed the rapidly growing number of mouths. As family size in AE and food insecurity are positively related, serious attention has to be given to limit the increasing population in the study area. This can be achieved through expansion of family planning services and creating awareness about family planning on rural households. Besides, it is very much important to provide incentives and expand women education in light of creating educated society.

REFERENCES

Abebaw, S. (2003). Dimensions and Determinants of Food Insecurity among Rural Households in Dire Dawa, A Thesis Presented to School of Graduate Studies of Haramaya University.

Ahmed, M. (2015). Determinants of Household Food Insecurity and Coping Strategies: The Case of Bule - Hora District, Borena Zone, Oromia, Ethiopia. Global Journal of Food Sciences and Technology. Vol. 3 (1): 143- 152.

Amaza, P.S., Umeh, J.C., Helsen, J. and Adejobi, A.O. (2006). Determinants and Measurement of Food Insecurityin Nigeria: Some Empirical Policy Guide. Contributed Poster Prepared for Presentation at the International Association of Agricultural Economics Conference, Gold Coast, Australia, August 12-18.

Amemiya, T. (1981). Quantitative Response Models: A Survey, Journal of Economics Literature. 19:1483-1536.

Amsalu, M., Bekabil, F. and Beyene, T. (2012). Empirical Analysis of the Determinants of Rural Household's Food Security in Southern Ethiopia: The Case of Shashemene District. Basic Research Journal of AgriculturalScience and Review. Vol 1(6): 132-138.

Anley, Y., A., Bogale and A., Haile - Gebriel. (2007). Adoption Decision and Use Intensity of Soil and Water Conservation Measures by Smallholders Subsistence Farmers in Dedo District, Western Ethiopia. In: Land Degradation and Development. Vol 18 (3): 289-302.

Arega, B. (2013). Determinants of Rural Household Food Security in Drought-Prone Areas of Ethiopia: Case study in Lay Gaint District, Amhara Region. A Thesis Submitted in accordance with the requirements for the Degree of Doctor of Philosophy in the Subject Geography at the University of South Africa.

Bigsten, A., Kebede, B., Shimelis, A. and Tadesse, M. (2002). Growth and Poverty Reduction in Ethiopia: Evidence from Household Panel Surveys. World Development 31 (1): 87-106.

Bogale, A. and A., Shimeles. (2009). Household level Determinants of Food Insecurity in Rural Areas of Dire Dawa, Eastern Ethiopia. African Journal of Food, Nutrition and Development, AJFAND. Vol (9):1914-1926.

CSA, (2008). Federal Democratic Republic of Ethiopia, Central Statistical Agency, Annual Statistical Abstract,Addis Ababa.

DARDO (District Agricultural and Rural Development Office), (2007). Girar Jarso District Agricultural and Rural Development Office Annual Report (Unpublished).1-14p.

Degefa, T. (2002). Household Seasonal Food Insecurity in Oromiya Zone, Ethiopia.
Devereux, S. and Sharp, K. (2003). Is Poverty Really Falling in Rural Ethiopia? A Paper to be Presented at the Conference Staying Poor: Chronic Poverty and Development Policy' at the University of Manchester, 7 to 9 April 2003.
EHNRI (Ethiopian Health and Nutrition Research Institute), (1997). Food Composition Table for Use in Ethiopia. Part III, from 1968-1997. A Research Project Sponsored by Government of Ethiopia through former ENI and EHNRI. Addis Abeba.
FAO, (1996). World Food Summit, Corporate Document Repository, FAO, Rome.
FAO, (2015). The State of Food Insecurity in the World. Meeting the 2015 International Hunger Targets: Taking Stock of Uneven Progress. Food and Agriculture Organization of the United Nations, Rome, 2015.
FDRE (Federal Democratic Republic of Ethiopia), (2001). Food Security Strategy. An Update. Addis Ababa,Ethiopia: 8-22.
Fekadu, B. and Mequanent, M. (2010). Determinants of Household Food Security among Rural Households of Central Ethiopia: An Empirical Analysis, Quarterly Journal of International Agriculture Vol 49 (4): 299-318.
FEWS NET, (2015). Ethiopia Food Security Outlook. Famine Early Warning Systems Network, April to September 2015.
Foster, J, Greer, J and Thorbecke, E., (1984). A Class of Decomposable Poverty Measures. Econometrica, Vol 52(3): 761- 766.
Fransen, S. and Kuschminder, K. (2009). Migration in Ethiopia: History, Current Trends and Future Prospects. Paper Series: Migration and Development, Country Profiles, Maastricht University.
Guajarati, D.N. (1995). Basic Econometrics. Third Edition. McGraw-Hill, New York. USA.
Gujarati, D.N. (2004). Basic Econometrics. Fourth Edition. McGraw-Hill, New York. USA.
Haile, K., Alemu, G. and Kudhlande, G. (2005). Causes of Household Food Insecurity in Koredegaga Peasant Association, Oromia Zone, Ethiopia: Working Paper.
Hoddinott, J. (2001). Methods for Rural Development Projects. Food Security in Practice, Vol1, IFPRI, Washington D.C.
Jemal, A. and kyung-Ryang, K. (2014). Determinants of Household Food Security in Rural Ethiopia: An Empirical Analysis, Journal of Rural Development. Vol 37(2): 129-157 129.
Jenny, C. (2003). Food Security in Sub-Saharan Africa. African Security Review Vol 12(1).
Kementa, P. (1986). Elements of Econometrics.2nd edition.
Lilian, K., Raphael, G. and Millicent, O. (2013). Household Food Security and Commercialization of Smallholder Farmers in Kenya, A Paper Prepared for the International Conference of the African Association of Agricultural Economists. Tegemeo Institute of Agricultural Policy and Development.
Maddala, G. S. (1983). Limited Dependent and Qualitative Variables in Econometrics, Cambridge University Press. New York.
Mequanent, M. and Esubalew, T. (2015). Analysis of Household Level Determinants of Food Security in Jimma Zone, Ethiopia. Journal of Economics and Sustainable Development Vol 6 (9):230-240.
Pindyek, R., Rubinfeld, S. and Daniel, L. (1981) Econometric Models and Economic forecasts 2nd Edition McGraw Hill Book Company.
Ramakrishna, G. and Demeke, A. (2002). An Empirical Analysis of Food Insecurity in Ethiopia: the Case of North Wello, Africa Development, 27 (1 & 2).
SIDA, (2015). ETHIOPIA Humanitarian Crises Analysis, January 2015.
Storck, H., Bezabih, E., Berhanu, A., Borowiecki, A., and Shimelis, W. (1991). Farming Systems Research and Farm Management Practices of Smallholders in Hararghe Highlands: Farming Systems and Resources Economics in the Tropics. Wssenshaftsver Lagvauk, Kiel, Germany. (11):41 - 48.
Tekle, L. and Berhanu, K. (2015). Determinants of Rural Household Food Security in Boloso Sore District of Wolaita Zone, Ethiopia. Asian Journal of Agricultural Extension, Economics & Sociology Vol 5(2): 57- 68.
The Economist, (2013). Global Food Security Index. An annual Measure of the State of Global Food Security. The Intelligence Unit.
Tsegaye, G. (2009). Determinants of food security in rural households of the Tigray region, a thesis submitted to School of graduate studies of Addis Ababa University in partial fulfillment of the requirements for the Degree of Master of Science in applied statistics, Addis Ababa University, Ethiopia.
USAID, (2015). Ethiopia Complex Emergency Fact Sheet No.1, Fiscal Year 2016, November 23, 2015.
USDA, (2015). United States Department of Agriculture International Food Security Assessment, 2015-2025, GFA- 26 June 2015, Economic Research Service
United Nation, (1974). The Universal Declaration on the Eradication of Hunger and Malnutrition Van Der
WFP, (2009). Food security and Vulnerability in Addis Ababa, Ethiopia.

WFP, (2011). Country Program Ethiopia. Agenda item 8. Rome, Italy.
World Bank, (2014). Ethiopia Poverty Assessment Report. Poverty Global Practice Africa Region, Document of theWorld Bank for Official Use Only, Aus 6744, January 2015.
Yamane, T. (1967). Statistics: An Introductory Analysis, 2nd ed., New York: Harper and Row, 1967.

APPENDICES

Appendix 1: Conversion factor of nutrient composition (Mean kcal/kg or lit) of food items

Food Items	Mean kcal/kg or lit
Milk	737
Meat	1970
Teff	3589
Wheat	3623
Bean	3514
Sorghum	3805
Vegetable	370
Oil	8964
Sugar	3850
Salt	1780
Coffee	1103
Tea	1190
Pepper	933

Appendix 2: Conversion Factors Used to Estimate Adult Equivalent

Age	Male	Female
0-10	0.6	0.6
10-13	0.9	0.8
14-17	1	0.75
18-50	1	0.75
>50	1	0.75

Appendix 3: Variance Inflation Factor (VIF) of continuous variables

Variables	Collinearity Statistics	
	Tolerance	VIF
AGE	0.802	1.247
DPR	0.908	1.101
CLSZ	0.299	3.339
TLU	0.393	2.545
NOXEN	0.454	2.203
TOINC	0.292	3.427
TOFFIC	0.872	1.147

Appendix 4: Contingency coefficient of dummy variables

Variables	EDU	SEX	CRDT	EXT	SAVAC
EDU	1				
SEX	0.105	1			
CRDT	0.008	0.226	1		
EXT	0.022	0.098	0.215	1	
SAVAC	0.116	0.084	0.093	0.142	1