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Status and Determinant of Food Insecurity in Girar Jarso Woreda of North Showa Zones, Oromia, Ethiopia

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Abstract: The main goal of this study was to look at food insecurity and its major determinant factors of households in Girar Jarso Woreda, North Shoa Zone, and Oromia Regional State, Ethiopia. In order to achieve this goal, demographic and socioeconomic data were collected from 110 randomly selected farm households in the Girar Jarso Woreda's as a special name Torban Ashe and Koticho Kebeles. Two kebeles were chosen using a purposive sampling method. A survey was done to collect primary data from sampled household in the study areas using a structured questionnaire to acquire qualitative and quantitative data on household demographic characteristics. Secondary data was gathered from a variety of sources, including Woreda and kebeles documents, as well as academic research publications, to supplement primary data. The collected data was analyzed using both descriptive and econometric models of analysis. The current household's food insecurity level was determined using the total kilocalorie consumption per adult equivalency per day. A bivariate analysis was used to examine the effect of each predictor variable on the household food insecurity status. Finally, the descriptive analysis revealed that approximately 28 household (25.45%) were food insecure, while 82 households (74.55%) were food secure. Furthermore, the logistic regression model estimates that six of the 13 variables in the logistic model were significant at various probability levels (1, 5, and 10). The age of the household head, the size of the household, the annual farm income, the size of the farm land, the adoption of technology, and the frequency with which the home receives extension services are all factors to consider. Generally, the direction of policy implication and governments has to emphasis on strengthening farmer's knowledge on adoption of technology by arranging farmer training, field visit and demonstration, and increasing awareness of effective family planning and impact of a high family size on food security.

Keywords: Food Insecurity, Logit, Ethiopia

1. Introduction

1.1. Background of the Study

Food insecurity is directly related to poverty at global, regional, national and local levels FAO [7].

At moderate degrees of severity, food insecurity is usually accompanied with an inability to eat a nutritious, balanced meal on a regular basis. As a result, modest levels of food insecurity can be used as a predictor of a variety of diet-related health issues in the population, such as micronutrient deficiencies and imbalanced diets. On the one hand, severe levels of food insecurity FAO, [7].

Agricultural areas of Eastern Amhara, Tigray, Central and Eastern Oromia, and Rift valley areas of SNNPR: obtained below average agricultural production in WFP [21] due to inadequate rainfall during both Belg and Kiremt seasons. This severely limits households' food availability from harvests. Livestock sales and agricultural labor opportunities are also down significantly, restricting household incomes and capacity to purchase. Early depletion of the insufficient harvest stocks and the decline in income from labor, coupled with the anticipated staple food price increase, particularly from January onward, will keep households from meeting their minimal basic food needs through at least March Ethiopian Health and Nutrition Research Institute, [6] as they remain in Crisis. Households in lowlands of the Abay river catchment and some households in the midland of central Oromia with somewhat better production are stressed in December, but will move to Crisis beginning in January Stamoulis and Zezza, [18]

The agriculture sector in Ethiopia typically supplies up to 85 percent of the country's food supplies and employs more than 80 percent of the labour force. With insecure sources of food and income as a result of the drought, vulnerable rural households face widespread hunger and malnutrition, huge economic losses and long-term environmental damage. In late WFP, [21] a Government-led multi-agency *meher* assessment found that 10.2 million people were food insecure, while 2 million required agricultural input support to resume food production. Malnutrition rates are staggering, with over one-third of Ethiopia's *Woreda* now officially classified as facing food insecurity and nutrition crisis EHNRI [6].

Ethiopia is one of the poorest countries in the world with a large portion of its population believed to be living below poverty line USAID. 41% of the Ethiopian population lives below the poverty line and more than 31 million people are undernourished USAID.

The degree of food insecurity problem is different from place to place due to variation of its determinants (causes), because the occurrence of food insecurity depends on the existing situation of a given place. As a result, the measure (program) that should be taken to combat this problem is also different from place to place. Therefore, we conducted this study on status and determinants of food insecurity in Grar Jarso district to provide relevant information to the concerned body.

1.2. Statement of the Problem

The problem of food insecurity greatly varies among households residing in the same country. In Ethiopia, some households frequently face the problem of food insecurity, even in areas where there are no aforementioned drivers of food insecurity. Although a number of efforts have been done to achieve food security at the household level in the rural areas of Ethiopia, it has remained as a challenging goal even today. In Ethiopia, the poor performance of food security at household level is associated with poor institutional forms and dependency on rain-fed agriculture, which is highly vulnerable to drought which leads to loss of rural household's lives and livelihoods in every three years Abduselam, [1].

For instance, study conducted by Frankenberg, [10] reviewed literature to seek an answer for the question "why does food insecurity persist in Ethiopia?" They found that macro-economic challenges like increasing food prices and unemployment determine the prospect of food security in the country. Therefore, according to them, there is an urgent need to transform access to agricultural technology by farmers and employment opportunity. However, interrelated causes of household food insecurity require an analysis at a household level.

Farm household endured seasonal food shortages almost every year, though the severity of the lack varied from year to year. Farm households that are food secure and those that are food insecure live next door to each other and may have a similar climatic and weather scenario, as well as cultural and land topography. Nonetheless, there are seasonal food shortages and one becomes reliant on food aid, while the other maintains food security and does not require assistance. Although drought is a major contributor to food crises, the variation in farm household consumption between good and bad years is not large enough to say that drought is the primary cause of famine or temporary food insecurity. Recent literature discovered that even in years of adequate rainfall and good harvest, households remain in need of food assistance. This clearly reflects that there are other factors which determine food insecurity status of households irrespective of adequate rainfall. This implies poverty and seasonal food insecurity are mainly determined by structural, socio-economic, cultural, demographic and other factors. Hence, the main question of this study was what factorial differences make the farm household food secure or food insecure even if they face similar natural factors like climate situation and land topography.

1.3. Objectives

1) To estimate the food insecurity gap and its severity among the target households.
2) To identify the major determinants of households food insecurity status in the study area.
3) To describe the relationship between food insecurity and its determinants.

2. Literature Review

2.1. Basic Concepts and Definition of Food Insecurity

The most commonly accepted definition of Food security is "access by all people at all times to enough food for an active and healthy life "Tilksew and Fikadu, [19] Food insecurity is a situation in which individuals have neither physical nor economical accesses to the nourishment they need. A household is said to be food insecure when its consumption falls to less than 80% of the daily minimum recommended allowance of caloric intake for an individual to be active and healthy. In particular, food insecurity includes low food intake, variable access to food, and vulnerability- a livelihood strategy that generates adequate food in good times but is not resilient against shocks. These outcomes correspond broadly to chronic, cyclical, and transitory food insecurity, and all are endemic in Ethiopia CSA, [5].

According to Mesfin, [17] food insecurity can be defined as 'the lack of capability to produce food and to provide access of enough food to all people at all times for an active and healthy life".

"There is food security when all people at all times have sufficient physical and economic access to safe and nutritious food to meet their dietary needs including food preferences, in order to live a healthy and active life" Mesfin, [17] When an individual or population lacks, or is potentially vulnerable due to the absence of, one or more factors outlined above, then it suffers from, or is at risk of, food insecurity.

2.2. The Type, Cause and Consequence of Food Insecurity

Food insecurity can be transitory (when it occurs in times

of crisis), seasonal or chronic (when it occurs on a continuing basis). A person can be vulnerable to hunger even if he or she is not actually hungry at a given point in time Guajarati, [13]. Chronic food insecurity means that a household runs a continually high risk of inability to meet the food needs of household members. In contrast, transitory food insecurity occurs when a household faces a temporary decline in security of its entitlement and the risk of failure to meet food needs is of a short duration. Transitory food-insecurity focuses on intra and tine-annual variations in household food access. It has been argued that this category can be further divided into cyclical and temporary food insecurity Food and Agricultural Organization, [8].

From similar source temporary food insecurity occurs for a limited time because of unforeseen and unpredictable circumstances. Cyclical or seasonal food insecurity occurs when there is a regular pattern in the periodicity of inadequate access to food; this may be due to logistical difficulties or prohibitive cost in storing food or borrowing. Chronic food insecurity is commonly perceived as results of overwhelming poverty indicated by a lack of assets. Both chronic and transitory problems of food insecurity are wide spread and several in Ethiopia.

2.3. Review of Empirical Evidences on Determinants of Food Insecurity in Ethiopia

A research on determinants of food insecurity among households in Addis Ababa city, Ethiopia by Fosters, [9] using descriptive statistics and Logit regression model shows that variables namely household size, age of household head, household head education, asset possession, access to credit service, and access to employment were found to be statistically significant as determinants of household food insecurity in the study area. Household size and age of household head were found to be positively related with probability of being food insecure whereas access to credit service, asset possession, and household head education and access to employment were negatively related with probability of being food insecure.

According to study in Girma, [12] on determinants of household's vulnerability to food insecurity in rural and urban households of Amhara regional state of Ethiopia through descriptive statistics and Logistic regression model, household size, household head education, annual per capita consumption, and access to employment were found to be statistically significant as determinants of household food insecurity in urban areas. Besides livestock ownerships, farm inputs and farm size, shocks such as drought and illness were the determinants of rural household food insecurity.

A study by Gujarati, [17] on factors influencing rural household food insecurity in case of Babile district East Hararghe zone, Ethiopia indicates that Educational status of the household head, annual farm income, use of irrigation scheme and, size of cultivated land associated negatively Whereas, insect and pest infestation has positive and significant association with household food insecurity.

According to Lemesa et al, [15] study on determinants of food security in rural households of the Tigray region by discriminate analysis with reference to a base group of food insecure households he conclude that an increase in land holding size, increase in oxen ownership, decrease in household size, decrease in distance to input sources, increase in fertilizer use, increase in educational level of household head, increase in livestock ownership and being male headed household increase the likelihood of a household to be classified into the group of food secure households in the study area.

The causes of the food insecurity situation vary widely across countries and from one sub region to another with in a country. But the principal problems include the following: prolonged droughts and unpredictable rainfall, uncertainty of overall crop prospects, civil insecurity, increasing prices of imported food commodities, continued humanitarian crises, and pockets of vulnerability due to localized crop production shortfalls, decimation and losses Africa Development Bank [2].

3. Research Methodology

3.1. Description of the Study Area

Girar Jarso *Woreda* is one of the districts of North Showa Zone, Oromia National Regional State. The *Woreda* lies along the highway to Amhara National Regional State in the Northwestern direction at a distance of 112 km from Addis Ababa. It shares border with Amhara Region in the North, Yaya Gullalle *Woreda* in the East, and Debre Libanos *Woreda* in the South and Degem *Woreda* in the West. The total area of the *Woreda* is about 42763 hectares. The altitude of the *Woreda* ranges from 1300 to 3419 meters above sea level. Astronomically the *Woreda* occupies 9035'-10000'N latitude and 38039'-38039'E longitude. According to Fiche Station meteorological data the average rainfall amount of the *Woreda* is about 1200mm, and maximum and minimum rainfall is about 1115mm and 651mm, respectively. Temperature of the *Woreda* ranges from a minimum of 11.5°C to a maximum of 35°C Girar Jarso Woreda Agricultural Office, [11].

Depending on the census results of 2008 the total population of the *Woreda* is 67298. The number of female and male population is 32836 and 34462, respectively giving sex ratio of 100 female to 105 males. The average population density of the *Woreda* is 157 persons per km^2 by Cochran, [4]. Girar Jarso *Woreda* consists of people with few ethnic groups, Oromo and Amhara. The majority of the people in the area belongs to Oromo ethnic group and speaks Afan Oromo while the rest belongs to the Amhara ethnic group and speaks Amharic (Girar Jarso *Woreda* Agricultural Office, [11]. According to data obtained, 75 percent of the household belongs to Oromo ethnic group while 25 percent belongs to Amhara. Commonly, people living in *dega* and *woina dega* areas speak Afan Oromo while Amharic is spoken by people living in *kola* areas. With regard to religion, almost all of the populations of the *Woreda* are followers of orthodox

Christianity.

According to Girar Jarso Woreda Agricultural Office [11], the land feature is characterized by flat land, mountains, sloppy to steep sloppy and gorges. About 36 percent of the land area is flat while the proportion of the total area that is considered as sloppy is about 33 percent. The remaining 31 percent is classified as mountainous and gorges. Agro-ecologically, the *Woreda* is categorized into three: *Dega, Woina Dega* and *Kolla* constituting 52%, 41% and 7% of the total area of the *Woreda* respectively. The types of soil in the study area are Vertisols 38%, Nitosols 38%, Cambisols 11%, and other type of soil is 13%.

Farming is the main livelihood strategy of the study area in which seasonal rainfall pattern determined the production activity. More than 90 percent of the population depends on subsistence farming as the livelihood strategy. In Girar Jarso *Woreda, Belg* crop production accounts 14% while *meher* crop production accounts about 86%. Hence, *meher* crop production is the major livelihood strategy that people engaged in Girar Jarso Woreda Agricultural Office, [11] Girar Jarso *Woreda* has poorly developed basic social service such as transport, communication, electric power, water supply and health services Girar Jarso Woreda Agricultural Office, [11]. Lack of water sources to access irrigation services causes the *Woreda* to depend on rain-fed agriculture. This cause low agricultural production and productivity to produce that would enhance food insecurity in the *Woreda*. This study is specifically focused in two kebeles of Girar Jarso Woreda called Torban Ashe and Koticho.

3.2. Sample Design

The sample size of this study was determined or calculated by using the following formulas of sample size determination which was developed by [4] The formula is given as,

$$n=\frac{m}{1+\frac{m-1}{N}}$$

Where:

$$m=\frac{z^2p(1-p)}{e^2}$$

n is sample size

e is the desired level of precision

P is estimated proportion of respondent household to be food secure

Z is the selected critical value of desired confidence level

N is the number of household

As the proportion of respondent household to be food insecure were not known initially, it was assumed that 50% of respondent household are food insecure and the rest food secure. Hence, 0.5 was used as p-value to obtain the sample size (n). Similarly, the level of precision and confidence of this study were 9% and 95% respectively. The total number of households in the two kebeles is 1745 (1131in Torban Ashe Kebeles and 614 in Koticho Kebeles). The sample size of this study was therefore determined as:

$$m=\frac{(1.96)^2 0.5(1-0.5)}{(0.09)^2}=118\; n=\frac{118}{1+\frac{118-1}{1745}}=110$$

Therefore, the numbers of sample households selected from two kebeles were 110. The sample was distributed to each kebeles based on the probability proportional to size sampling technique. As a result, numbers of sample households selected from each kebeles were:

From Torban Ashe Kebeles=$\left(\frac{110}{1745}\right)1131=71$

From Koticho Kebeles=$\left(\frac{110}{1745}\right)614=39$

3.3. Sampling Technique (Procedure)

The sampling unit for this study was rural households that are found in the two purposively selected kebeles of Girar Jarso *Woreda*. This study used both purposive and simple random sampling methods. The selection of the kebeles followed purposive sampling strategy, whereas the household selection within each kebeles was done by using simple random sampling. We applied two stage sampling technique to select the representative samples. At the first stage, two kebeles (Torban Ashe and Koticho) was selected purposively because of their proximity. At the second stage, total of 110 households was selected randomly using probability proportional to size sampling technique from each sample kebeles.

3.4. Data Type and Method of Data Collection

The data used in this study was collected from two kebeles (Torban Ashe and Koticho) of Girar Jarso district and, we used both primary and secondary types of data in this study.

3.4.1. Primary Data Method of Collection

To generate quantitative and qualitative information at household level, household survey was undertaken through structured questionnaires. The questionnaire was designed to gather qualitative and quantitative data pertaining to demographic, resource endowments, farm technology use, institutional factors and other aspects of households including food and non-food consumption and expenditures. The structured questionnaire was translated into the local language, '*Afan Oromo'* for the convenience of data collection during household survey**.**

3.4.2. Secondary Data Method of Collection

Secondary source of information was reviewed to supplement the primary sources of information. Various documents available at *Woreda* and *Kebeles* was reviewed and used to generate secondary source of information. Moreover, books, journal articles, different GOs and NGOs documents and publications, and academic research papers was reviewed to understand household food insecurity situation and supplement the findings.

3.5. Method of Data Analysis

As a general, to analyze the collected data we applied both descriptive statistics and econometrics analysis such as Foster, Greer and Thorbeck index of food insecurity and binary Logit regression.

3.5.1. Descriptive Statistic

Frequency distribution, percentage, standard deviation and mean were used to assess the association between food insecurity status and socioeconomic characteristics of farming households.

Food security measurement index

The procedure of Foster, [9] was used in the computation of incidence, depth and severity of food insecurity (the status of food insecurity for targeted households). The *Foster-Greer-Thorbeck (FGT)* measure is given as:

$$\mathrm{FGT}(\alpha) = \frac{1}{\mathrm{n}}\sum_{\mathrm{i}=1}^{\mathrm{q}}\left(\frac{\mathrm{c}-\mathrm{y_i}}{\mathrm{c}}\right)^{\alpha}$$

Where:

n is the number of sample households; y_i is the measure of per adult equivalent food calorie intake of the *ith* household; c represents the cut off between food security and food insecurity households (expressed here in terms of caloric requirements 2100kcal); q is the number of food-insecure households; and α *is* the weight attached to the severity of food insecurity. In FGT index, $y_i \geq c$ that the specified household is food secure. We computed the three most commonly employed indices: head count ratio, food insecurity gap and squared food insecurity gap. Head count ratio describes the percentage of sampled households whose per capita income or consumption is below the predetermined subsistence level of energy (2100kcal), means FGT (α=0)=q/n. The food insecurity gap, FGT (α=1), measure how far the food insecure households, on average, are below subsistence level of energy. Here, it means that, giving equal weight to severity of food insecurity among all the food insecure households will be equivalent to assuming that α=1. This index characterizes the amount of resources will be required to bring all the food insecure households to minimum subsistence level. Finally, squared food insecurity gap, FGT (α=2), it measures the severity of food insecurity among the food insecure households. It gives more weight to the average calorie shortfalls of the most food insecure of the food insecure households.

3.5.2. Econometric Model

In this study, the binary logit model was applied to estimate the effect of demographic and socio economic characteristics on household food insecurity status. In this model the dependent variable is household food insecurity which is dichotomous taking a value of 1 if the household is food insecure; 0 otherwise. Whereas, variables such as household size, household head age, sex, education level, dependency ratio, frequency of extension service, access to credit service, technology adoption, asset possession and participation in off farm activities was taken as independent variable. Identification of the food secure from the food insecure is done by comparing the total calorie consumption in the household per Adult Equivalent (AE) per day to the minimum level of subsistence requirement which is 2100 kcal/AE/day. A household below this threshold is said to be food insecure households, otherwise not. The functional form of Logit model is specified as follows [13]:

$$P(Y_i = 1) = \frac{1}{1+e^{-(\beta o+\beta_i X_i)}} \quad (1)$$

For simplicity, we write (1) as

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

Where: P (Yi=1) is the probability that a household being food insecure, Zi is the function of a vector of n explanatory variables). Equation (2) is the cumulative distribution function. If P (Yi=1) is the probability of being food insecure, then 1– P (Yi=1) represents the probability of being food secure and is expressed as:

$$1 - \mathrm{P}(\mathrm{Y_i} = 1) = \frac{1}{1+e^{\mathrm{Z_i}}} \quad (3)$$

Thus we can write

$$\frac{P(Y_i=1)}{1-\mathrm{P}(\mathrm{Y_i}=1)} = e^{Z_i} \quad (4)$$

Equation (4) simply is the odds ratio, the ratio of the probability that a household will be food insecure to the probability that it will be food secured. Taking the natural log of equation (4), we obtain

$$L_i = ln\frac{P(Yi=1)}{1-\mathrm{P}(\mathrm{Yi}=1)} = Z_i \quad (5)$$

Where, L_i is the natural logarithm of the odds ratio which is not only linear in the explanatory variables but in the parameters also.

Thus introducing the stochastic error term ui the logit model can be written as

$$L_i = ln\frac{P(Y_i = 1)}{1 - \mathrm{P}(\mathrm{Y_i} = 1)} = Z_i$$

$$Z = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n + u_i, \quad (6)$$

Where $\beta 0$ is an intercept and $\beta 1, \beta 2 \ldots, \beta n$ are slopes of the equation in the model, and X is vector of relevant household characteristics.

After this, it is possible to estimate the parameters of the model by maximum likelihood estimation (MLE).

Before the model analysis is started, whether the problem of multicollinearity exists between variables was thoroughly checked and detected. The reason is that the multicollinearity problem will strongly affect estimators. There are various indicators of multicollinearity and no single diagnostics will give us a complete handle over the collinearity problem Gujarati, [14]. Of these various indicators, the Variance Inflation Factor (VIF) for continuous explanatory variables

and contingency coefficients for dummy variables were used in this study. Variance Inflation Factor (VIF) was used to measure the degree of linear relationships among the continuous explanatory variables in which each continuous explanatory variable is regressed on all the other continuous explanatory variables and coefficients of determination for each auxiliary regression was computed.

Following [13] VIF is defined as:

$$VIF(X_i) = \frac{1}{1 - R^2}$$

Where:

X_i=the i^{th} quantitative explanatory variable regressed on the other quantitative explanatory Variables.

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

If the value of VIF exceeds 10, it is used as a signal for existence of strong multicollinearity between continuous explanatory variables Guarati, [14].

Similarly, there may also be an interaction among qualitative variables, which can lead to the problem of multicollinearity. To detect this problem, contingency coefficients were computed for each pair of qualitative variables.

The contingency coefficients are computed as follows:

$$C = \sqrt{\frac{x^2}{n + x^2}}$$

Where, C=coefficient of contingency, x^2=a Chi-square random variable and n=total sample size.

Contingency coefficient value ranges between 0 and 1, and as a rule of thumb a variable with contingency coefficient of below 0.75 shows weak association and value above it indicates a strong association of variables.

4. Result and Discussion

This analysis is based on data obtained from the questionnaire survey. The questionnaires of 110 households had been examined for incorrectness and missing data, were grouped (classified) into two groups, namely food secure and food insecure groups. The data presented in the following part will explain a distinction between the two groups of households. This chapter briefly presents the food insecurity status, relationship of predictor variables with the outcome variable for the households and also the econometric model analysis in the study area.

4.1. Food Insecurity Status of the Study Area

As a result, the household food security status was determined based on the amount of food consumed by the household within a specific time period in the past, i.e. the seven-day recalling method. The calorie number was calculated using information from the household's food consumption over the previous seven days. After that, the calorie intake of a single adult equivalent was calculated.

Different literatures differ on the required amount of calories per adult per day for an active and healthy life in order to distinguish food secure and food insecure households. However, in this study, a minimum threshold level of 2100 kcals per day was utilized to compare household energy consumption per adult per day. As a result, households with calorie consumption/acquisition below the threshold level were classified as food insecure, whereas those with higher calorie consumption/acquisition were classified as food secure.

According to the findings, 82 (74.55 percent) of the 110 households were determined to be food secure, whereas 28 (25.45 percent) were found to be food insecure. The minimum and maximum daily calories consumed by a single adult in food insecure households were 252 and 2088 kcals, respectively, while those consumed by food secure households were 2185 and 10803 kcals. As a result, the average calorie levels for food secure households were 3877.71 kcals and 1422.61 kcals for food insecure households. Consequently, the standard deviations for food insecure and food secure households were 482.639 and 1381.255 kcals, respectively.

Table 1. *Amounts of calorie consumed by an adult in a day.*

Calorie consumed per AE in (kcals)	Food secure (n=82)	Food insecure (n=28)	Total (n=110)
Minimum	2185	252	252
Maximum	10803	2088	10803
Mean	3877.71	1422.61	3252.77
Standard deviation	1381.255	482.61	1621.635

Source: Own survey result, 2017.

4.2. Food Insecurity Indices

The food insecurity indices applied in this study were head count ratio, food insecurity gap, and severity of food insecurity.

4.2.1. Head Count Ratio

The head count ratio shows the probability of households with daily energy deficits of 2100 kcals per adult equivalent. The research reveals that 82 and 28 households from the entire 110 sample households were food secure and food insecure, respectively, based on the threshold calorie requirement of 2100 kcal per day per adult. According to the findings, on average, 74.55 percent of households could fulfill the minimum daily energy requirement, while 25.45 percent consumed less than the minimum calorie requirement.

4.2.2. Food Insecurity Gap

The food insecurity gap measures the mean depth of food insecurity among the food insecure households. It is the mean proportion by which the food security status of the food insecure households falls below the minimum level of calorie requirement. The result of this study indicated that food insecure households are 8.21 percent far off from the minimum level of calorie requirement i.e. 2100 kcals. This

means each food insecure household needs 8.21 percent of the daily energy requirement to bring them up to the recommended daily caloric requirement level besides their kilo calorie consumption per adult equivalent per day.

4.2.3. Squared Food Insecurity Gap

The squared food insecurity gap is a measure for the severity of food insecurity among food-insecure households. It gives the average calorie deficits of the most food insecure of food-insecure households more weight. As a result, it calculates the squared proportionate deficiencies from the calorie intake minimum. It is difficult to comprehend. However, the severity of food insecurity, or relative kilocalorie deficiency, among food insecure households in Girar Jarso area is estimated to be around 3.94 percent.

Table 2. *Food insecurity indices.*

Measures of food insecurity status	Value
Incidence of food insecurity (head count ratio)	25.45%
Depth of food insecurity (food insecurity gap)	8.21%
Severity of food insecurity (squared food insecurity gap)	3.94%

Source: Own survey result, 2017.

4.3. Descriptive Statistics of Household Demographic Characteristics

The association between each explanatory variables and household food insecurity status is discussed in the next section in detail.

1. Age of the Household Head

The total sampled household heads ranged in age from 20 to 86 years old, and with a mean age of 47.07 years. Food secures household heads ranged in age from 20 to 86 years, with a mean age of 44.64 years, whereas food insecure household heads ranged in age from 29 to 80 years, with a mean age of 53.64 years. Furthermore, the t-test value was found to be -2.81. When compared independently with food insecurity status, it was significant at a probability level of less than 1%.

Table 3. *Descriptive statistics of age of the household head by food insecurity status.*

Age of the household head	Food secure (N=82)	Food insecure (N=28)	Total (N=110)
Mean	44.83	53.64	47.07
SD	14.60	13.50	14.78
Minimum	20	29	20
Maximum	86	80	86
t-value	-2.81		
p-value	0.0059***		

Note: ***Significant at 1% probability level of significance.
Source: Own survey result, 2017

2. Household Size in Adult Equivalents (AE)

Family size is one of the relevant variables that determine the food insecurity status at the household level. It was hypothesized that households with large family size is more susceptible to food insecurity problem. The mean family size was 5.08, 5.90, and 5.29 for food secure, food insecure and the total households respectively with a minimum of 1.64, 3.16, and 1.64 and maximum of 10.76, 9.56, and 10.76 respectively. The statistical test indicates that there is significant mean difference between food secure and food insecure with respect to family size at 5 percent probability level. Therefore, it can be concluded that family size is appropriate to differentiate between food secure and food insecure groups in the study area.

Table 4. *Descriptive statistics of household size of sample households' by food insecurity status.*

Household size (in AE)	Food secure (N=82)	Food insecure (N=28)	Total household (N=110)
Mean	5.08	5.90	5.29
SD	1.82	1.83	1.85
Min	1.64	3.16	1.64
Max	10.76	9.56	10.76
t-value	-2.03		
p-value	0.0443**		

Note: ** Significant at 5% probability level of significance.
Source: Own survey result, 2017

3. Sex of the Household Head

The head is responsible for the family member's food security status. As a principal person s/he has significant impact in the decision-making. The study found that among the 110 sample households, the number of male headed households and female headed households are found to be 85 and 25 in numbers and covers 77.27 percent and 22.73 percent respectively. Out of 82 foods secured households, 66 which account 80.49% is led by male whereas 16 accounting 19.51% are led by female. Out of 85 male-headed

households, 66 were food secure and 19 were food insecure. The Chi-square test was applied to determine the association between the sex of the household head and food insecurity status. The finding shows that, there is no significant difference on food insecurity status of the household in terms of household head sex.

Table 5. *Sex of households' head by food insecurity status.*

Sex of the household head	Food secure (N=82)		Food insecure (N=28)		Total household (N=110)	
	Number	Percent	Number	Percent	Number	Percent
Male	66	80.49	19	67.86	85	77.27
Female	16	19.51	9	32.14	25	22.73
Chi2	1.8961					
p-value	0.169					

Source: Own survey result, 2017

4. Educational Status of the Household Head

The educational status of the sampled household heads was categorized in to two groups as illiterate, and literate for descriptive analysis only. The results reflected that, out of 110 sample households, the number of illiterate household head and literate household head are found to be 69 and 41 in numbers and covers 62.73% and 37.27% respectively. And also out of 28 food insecure households, 19 which cover 67.86% and 9 which cover 32.14% are illiterate and literate respectively. The difference between food secure and food insecure households in terms of the educational status of household head is not statistically significant.

Table 6. *Descriptive statistics of educational status of household head by food insecurity status.*

Educational status of household head	Food secure (N=82)		Food insecure (N=28)		Total household (N=110)	
	Number	Percent	Number	Percent	Number	Percent
Illiterate	50	60.98	19	67.86	69	62.73
Literate	32	39.02	9	32.14	41	37.27
Chi2	0.4228					
p-value	0.516					

Source: Own survey result, 2017

5. Annual Farm Income

The average farm income of food secure households was about a 12,021.95 Birr per household per annul, while that of food insecure households was about a 4,803.57 Birr per household per annul. And also standard deviation of farm income distribution for food secure and food insecure households was 20121.36 Birr and 4,443.76 Birr respectively. The statistical analysis shows that there is a significant difference between the two groups in terms of their income at 10% probability level.

Table 7. *Descriptive statistics of annual farm income by food insecurity status.*

Annual income	Food secure (N=82)	Food insecure (N=28)	Total household (N=110)
Mean	12,021.95	4,803.57	10,184.55
SD	20,121.36	4,443.76	17,768.94
Minimum	0	0	0
Maximum	80,000	15,000	80,000
t-value	1.8773		
p-value	0.0632*		

Note: * Significant at 10% probability level of significance.
Source: Own survey result, 2017

6. Livestock Holding

In the study area, one household owns 5.50 TLU on average, with 0 TLU of minimum and 16.255 TLU of maximum livestock holding. The mean TLU of the food secure and food insecure households was 5.92 and 4.10 respectively. The t-test result demonstrates that the difference between the two sample household groups in terms of livestock holding is significant at 10% probability level in favor of the food secured.

Table 8. *Descriptive statistics of livestock holding (in TLU) by household food insecurity status.*

Livestock holding (in TLU)	Food secure (N=82)	Food insecure (N=28)	Total household (N=110)
Mean	5.92	4.10	5.50
SD	4.45	3.99	4.39
Minimum	0	0	0
Maximum	16.255	12.875	16.255
t-value	1.9710		
p-value	0.0513*		

Note: * Significant at 10% probability level of significance.
Source: Own survey result, 2017

7. Access to Credit

Credit serves as a means to be involved in income generating activities and to reap benefit based on the amount and purpose of credit. It also normalizes consumption at the hard time. The results reflected that from total sample household, proportion of 34.55% got credit service and 65.45% did not. The proportion of households that got credit service was 81.57% and 18.43% for food secure and insecure respectively. A chi-square test shows that there is no significant difference between the two groups in terms of access to credit.

Table 9. *Descriptive statistics of access to credit by household food insecurity status.*

Accesses to credit	Food secure (N=82)		Food insecure (N=28)		Total household (N=110)	
	Number	Percent	Number	Percent	Number	Percent
Yes	31	37.80	7	25	38	34.55
No	51	62.20	21	75	72	65.45
Chi2	1.5136					
p-value	0.219					

Source: Own survey result, 2017

8. Dependency Ratio

The mean dependency ratio was 0.5427, 0.6157 and 0.5956 for food secure, food insecure and total sample respectively with standard deviation of 0.5676, 0.6286, and 0.5815 respectively. The t-test statistics showed that there was no significant mean difference between food secure and food insecure group with respect to the dependency ratio. This implies that, it is not appropriate to differentiate food secure from food insecure groups based on dependency ratio in the study area.

Table 10. *Descriptive statistics of dependency ratio by household food insecurity status.*

Dependency ratio	Food secure (N=82)	Food insecure (N=28)	Total household (N=110)
Mean	0.5427	0.6157	0.5956
SD	0.5676	0.6286	0.5815
Minimum	0	0	0
Maximum	2.5	3	3
t-value	0.5248		
p-value	0.6008		

Source: Own survey result, 2017

9. Participation in off Farm Income Generating Activities

Participation in off farm income generating activities support the household's food security status by increasing the income of the households. The survey result reflected that the proportion of sample households who participate in off farm income generating activities was 78.04% and 21.96% for food secure and insecure respectively. In addition about 39.02% and 60.98% of the food secure households were found to have experience of participation in off farm employment and have no any experience respectively. On the hand, about 32.14% and 67.86% of the food insecure households had participated and had not participated respectively in off farm employment to get additional income so as to improve their calorie consumption. The difference between food secure and food insecure households in terms of participation in off farm income generating activities is not statistically significant.

Table 11. *Distribution of the respondents" participation in off farm income generating activities.*

Participation in off farm income generating works	Food secure (n=82)		Food insecure (n=40)		Total (n=141)	
	Number	Percent	Number	Percent	Number	Percent
Participant	32	39.02	9	32.14	41	37.27
Non-Participant	50	60.98	19	67.86	69	62.73
Chi2	0.4228					
p-value	0.516					

Source: Own survey result, 2017.

10. Household Land Holding Size in Hectares

The land holding of all the sample households ranges from 0 hectare to 5.5 hectares. The mean land size of food secure and food insecure households were 1.75 hectares and 1.69 hectares respectively with standard deviation of 1.29 hectares and 1.31 hectares respectively. The statistical test indicates that there is no significant mean difference between food secure and food insecure with respect to land holding size.

Table 12. *Descriptive statistics of Household's land holding size by household food insecurity status.*

Land size (in hec)	Food secure (n=82)	Food insecure (n=28)	Total (n=110)
Mean	1.75	1.69	1.73
SD	1.29	1.31	1.28
Minimum	0	0	0
Maximum	5.5	5	5.5
t-value	0.2097		
p-value	0.8343		

Source: Own survey result, 2017.

11. Market Distance

The minimum and maximum market distance for food secure households were 0.5 km, 12 km and that of for food insecure households were 1 km and 13 km respectively. And also, the average market distance was 3.60 km for food secure, 3.99 km for food insecure and 3.89 km for total sample households. The t-test statistics showed that there was no significant mean difference between food secure and food insecure group with respect to the market distance.

Table 13. *Descriptive statistics of market distance by household food insecurity status.*

Market distance (in km)	Food secure (n=82)	Food insecure (n=28)	Total (n=110)
Mean	3.60	3.99	3.89
SD	2.06	2.73	2.57
Minimum	0.5	1	0.5
Maximum	12	13	13
t-value	0.6901		
p-value	0.4916		

Source: Own survey result, 2017.

12. Frequency of Extension Services Received by Households per Annual

The study found that, for total sample one household visited 2.63 times per annual on average, with 0 of minimum and 20 of maximum frequency of visit a year. The mean frequency of visit for the food secure and food insecure households was 3.21 and 2.42 respectively. The t-test result demonstrates that the difference between the two sample household groups in terms of frequency of extension services received by households per annual is not statistically significant.

Table 14. *Distribution of frequency of extension services received by sample households per annual by food insecurity status.*

Frequency of extension services received by households per annual	Food secure (n=82)	Food insecure (n=28)	Total (n=110)
Mean	3.21	2.42	2.63
SD	4.74	2.57	3.26
Minimum	0	0	0
Maximum	20	16	20
t-value	-1.1050		
p-value	0.2716		

Source: Own survey result, 2017.

13. Technology Adoption

The survey result showed that, from total sample household, proportion of 77.27% were adopt farm technology like fertilizer utilization and raw planting, and 22.73% did not. From the total adopters of farm technology proportion of 78.82% and 21.18% covered by food secure and insecure households respectively. The chi-square test was applied to determine the association between technology adoption and food insecurity status. The finding indicates that there was a significant difference in terms of technology adoption between food secure and food insecure groups at 10 percent probability level of significance.

Table 15. *Distribution of technology adoption of sample households by food insecurity status.*

Technology adoption	Food secure (n=82)		Food insecure (n=28)		Total (n=110)	
	Number	Percent	Number	Percent	Number	Percent
Adopter	67	81.71	18	64.29	85	77.27
Non-adopter	15	18.29	10	37.71	25	22.73
Chi2	3.6073					
p-value	0.058*					

Note: * Significant at 10% probability level of significance.
Source: Own survey result, 2017.

4.4. Determinants of Household Food Insecurity

Multicollinearity problems were evaluated using the variance inflation factor (VIF) for continuous variables and contingency coefficients for dummy variables before introducing the variables into the model. As a rule of thumb, Variables with VIF values less than the cutoff value (10) are believed to have no multicollinearity problems, whereas those with VIF values greater than 10 are assumed to have a multicollinearity problem. Since the computational findings of the VIF for continuous variables in this research revealed the lack of correlation between the variables in the model.

Furthermore, the threshold for dummy variable contingency coefficients is 0.75 as a rule of thumb. The values below 0.75 indicate a weak relationship between variables, whereas those above 0.75 show a strong association. The dummy results in this investigation, on the other hand, were less than 0.75. As a result, this suggested that no multicollinearity problems had been identified.

After testing the degree of association of independent variables, all the explanatory variables were used for estimation. Binary logit model was applied to identify major determinants of food insecurity among hypothesized explanatory variables that are assumed to have influence on household's food insecurity status by using a statistical package known as STATA version 12. The result of maximum likelihood estimates of the model is presented in the table below.

Table 16. *The maximum likelihood estimates of the logit model.*

Variable	Coefficients	Std. Err	Odds ratio	Sign. Level
SEX	-0.3427	0.7140	0.7098	0.631
AGEHH	0.0415	0.0225	1.0424	0.065*
AE	0.3866	0.1944	1.4720	0.047**
DR	0.2050	0.5219	0.8146	0.694
EDU	-0.0044	0.1150	0.9955	0.969
TLU	-0.1239	0.0918	0.8834	0.177
AFRMI	-0.0025	0.001	0.9997	0.002***
OFFARMPAT	-0.7150	0.8401	0.4891	0.395
LANDS	-0.6630	0.3348	1.9406	0.048**
ACCTCR	-0.7	0.6781	0.4965	0.302
TECADOP	-2.4603	0.9343	0.0854	0.008***
FREXTSERV	-0.2589	0.1027	1.2955	0.012**
MKTDST	0.0692	0.1357	0.9310	0.610
CONSTANT	-1.9256	1.4894	0.1457	0.196
Dependent variable=Household food insecurity status		LR chi2 (13)=42.60		
Number of observation=110		Pseudo R^2=0.3413		
-2 Log likelihood=82.20				

*** Significant at less than 1% probability level; ** Significant at less than 5% probability level; * Significant at less than 10% probability level.
Source: Model output, 2017.

Out of 13 independent variables which was assumed to be significantly related with food insecurity status of the households the estimation revealed from binary logistic regression reflected that six variables were found statistically significant.

Based on the above model result possible explanation for each significant independent variable is given as follows:

Age of household head (AGEHH): The result of the model showed that age of household head is significant at less than 10 percent probability level and positively correlated with household food insecurity status. This result is against our prior expectation. The positive relationship implies that when household heads get older, the probability of household to be food insecure increase in the study area. Holding other variables constant at their mean value, the odds ratio in favor of food insecure will increase by a factor of 1.0424 as the age of household head increase by one year. This is possible because older household heads are less productive and they lead their life by remittance and gifts. They could not participate in other income generating activities Alemu, [3].

Household size (AE): This variable is significant at less than 5 percent probability level and in line with our expectation positively related with food insecurity status. The positive relationship indicates that the probability of being food insecure increase as household size increase. If the other variables held constant at their mean value, the odds ratio in favor of being a food insecure will increase by a factor of 1.4720 as household size increase by one AE. Large family size imposes more pressure on consumption and also in large household size there will be great share of dish, due to this households' with large adult equivalent are more exposure to food insecurity problem than smaller AE. This result confirms with our prior expectation and the findings Mequanent, [16].

Annual farm income (AFRMI): The likelihood estimate revealed that annual farm income is a significant determinant of food insecurity at less than 1 percent probability level of significance. In line with our hypothesis, the correlation between annual farm income and household food insecurity is negative, which is an increase in the annual farm income, makes the household to escape from the food insecurity problem. When the household earn more farm income, the probability of the household being food insecure will decreases. Holding other variables constant, the odds ratio in

favor of food insecurity will decrease by a factor of 0.9997 as the annual farm income increase by one Birr.

Farm land size of a household (LANDS): In line with our expectation Farm land size is found to negatively affect the probability of being food insecure at less than 5 percent level of significance. This means that, those households who have less farm land size are more likely to be food insecure than those who have a large of land size. This is possible because when the farm land owned by the household is less, the level of production and income become smaller and eventually the household faces food insecurity problem. If all other things are held constant, the odds ratio of 1.9406 for the farm land size implies that, the odds ratio in favor of being food insecure increases by a factor of 1.9406 as the farm land holding size decrease by one hectare.

Technology adoption (TECADOP): This variable is found to have negative influence on the food insecurity status at probability level of 1%. This means farmers who do not adopt farm technology like fertilizer, raw planting are more likely to be food insecure than farmers who adopt. The model result indicate that, other factors kept constant, the odd ratio in favor of being food insecure decrease by a factor of 0.0854 as a farmer uses or adopts farm technology. Poor farming systems and non-adoption of farm technology increases the likelihood of being food insecure by decreasing food availability and income.

Frequency of extension services received by households (FREXTSERV): The logit model analysis revealed that frequency of extension services received by households has a significant negative association with food insecurity status at a probability level of 5%. The negative relationship implies that when households get frequent extension service, probability of household to be food insecure decrease. The result indicates that, other things held constant, the odds ratio in favor of being food insecure decrease by a factor of 1.2955 as the frequency of extension services received by households increase by one unit.

5. Conclusion and Recommendations

5.1. Conclusion

Regarding the food insecurity status of the *Woreda the finding shows* that the majority of the households were food secure (74.55% of sample household) and small numbers of households were found food insecure (25.45% of sample household). And also in the study area each food insecure households needs 8.21% of the daily energy requirement to bring them up to the recommended daily caloric requirement level and the severity of food insecurity is 3.94%. According to descriptive statistics of the sample farm households, the averages of variables such as age of household head, household size, dependency ratio, and market distance were found higher with food insecure households than the food secure households. But the average of variables such as annual farm income, livestock holding and land holding size were found higher with food secure households than the food insecure households.

The finding of the research also indicates that six out of thirteen variables namely, age of household head, household size, annual farm income, farm land size, technology adoption, and frequency of extension services received by households were found to be statistically significant as determinants of household food insecurity in the study area. Annual farm income and technology adoption were significant at less than 1% probability level while household size, farm land size and frequency of extension service received by household were significant at less than 5% probability level. In addition, age of household head was significant at 10% probability level. Household size and age of household head were found to be positively related with probability of being food insecure whereas annual farm income, farm land size, technology adoption and frequency of extension service received by household were negatively related with probability of being food insecure.

5.2. Recommendations

Based on the results of this research, the following points are forwarded as recommendations in order to improve the food insecurity status of the district.

1) Given the positive relationship between household size and food poverty, special emphasis must be dedicated to limiting the study area's growing population. This can be accomplished by increasing household awareness about family planning.
2) Age has positive impact on food insecurity. This means older households are more likely to be food insecure. Therefore, capacity building with safety net programs and other incentives for old household heads should be given.
3) As extension is the main source of information for farm households about farming system. So, District's agricultural bureaus in collaboration with development agents should provide extension service frequently for the farm households to achieve increased agricultural productivity and farm income.
4) The model analysis demonstrated that, technology adoption is an essential determinant of household food insecurity. Therefore, emphasis has to be given towards strengthening farmer's knowledge on adoption of farm technology by arranging farmers training, field visit and demonstration. In this regard more demonstration sites for improved technologies should be organized to increase awareness of the farmers in the study area towards adoption of farm technology.
5) As the finding shows, small land size is cause for occurrence of food insecurity problem. But, Horizontal farm land expansion in the research area may not be possible due to land scarcity and increased population pressure. As a result, better soil and nutrient management will increase the land's quality is possible way to improve household's food security status.

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