ORIGINAL ARTICLE

DETERMINANTS OF HOUSEHOLD FOOD INSECURITY IN LAY GAYINT WOREDA, SOUTH GONDAR ZONE OF AMHARA REGION, ETHIOPIA

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ABSTRACT

Ethiopia lies within one of the most food insecure regions in the world. Amhara region is one of the largest regions in Ethiopia where nearly 50% of the woredas *(districts), including Lay Gayint* woreda*, are identified as food insecure. There are no detailed studies done using standard tools and methods to determine food security status of households and to identify the determinants of food insecurity in Lay Gayint* woreda*. This study is aimed at determining the food insecurity status of rural households and identify the determinants of food insecurity in the* woreda*. Data were collected from 379 randomly selected households of five* kebele*s located in three agro-ecological settings. Data were analyzed using Core Food Security Module (CFSM), descriptive statistics and logistic regression. The CFSM showed that about 85% of sampled respondents were food insecure while the logistic regression result revealed six major determinants of household food insecurity: having larger family size, being illiterate, having smaller size of cultivated land, being non-user of chemical fertilizer, being non-user of improved seed and having smaller livestock holding. Results indicated that development interventions aiming at increased income by increasing land productivity from supply and use of fertilizer and improved seed, as well as educating people on family planning will significantly contribute to the attainment of food security.*

Keywords: Core Food Security Module, food insecurity, Lay Gayint, farming, illiteracy, fertilizers

INTRODUCTION

Food insecurity is understood in terms of recurrent food crises and famine in the world. Food and Agriculture Organization's (FAO's) most recent estimates indicated that 842 million people (12 % of the global population) were unable to meet their dietary energy requirements in 2011–13. The vast majority of hungry people, 827 million (14.3%), live in developing regions. In the same referenced year, 226.4 million people (21.2%) in Africa: 3.7 million people (less than 5%) in Northern Africa and 222.7 million people (24.8%) in Sub-Saharan Africa were estimated to be unable to meet their dietary energy requirements (FAO et al., 2013). Most of the projected deterioration in food security occurs in Sub Saharan Africa (SSA), which is the only region projected to have an increase in the number of food insecure people over the next decade. The SSA food insecure population is projected to rise from about 254 million in 2013 (30 %) to 373 million (34 %) in 2023 (Meade et al., 2013).

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Ethiopia lies within one of the most food insecure regions in the world with a large number of population living at subsistence levels, depending on farm production which is highly vulnerable to severe draughts. The production volume of food crops as well as the per capita food production has shown tremendous fluctuations. The problem of food shortage has been the most dominant problem of the Ethiopian economy. Several reasons have been given by many authors and government officials for this persistent problem of food insecurity. Among these reasons, drought is mentioned frequently. In fact, the root cause of food insecurity and famine cannot be attributed solely to one particular reason alone; it is the cumulative effect of a number of factors. Hence, many authors impute problems of food insecurity and famine to poor economic policies that have inhibited the development of agriculture, and growing population pressures combined with depleting of the natural resource base, lack of incentives for the small-scale food producers and poor extension services for the small peasant households. In fact, recurrent drought years have significantly affected the country's subsistent agriculture based economy; changing transitory food shortages into chronic food shortages and abject poverty. Moreover, greatly increasing population pressure together with high livestock population might have caused the carrying capacity of the fragile environment in some areas to be approached or exceeded. As a result, food shortage and famine which previously were only the problems of the eastern part of the country are increasingly encroaching the areas which historically have been surplus producing and of high agricultural potential (FDRE, 2002; Gezahegn, 1995).

Amhara region is one of the largest regions in Ethiopia which comprises 129 rural and 38 urban *woreda*s. Among the existing rural *woreda*s of the region, 64 of them are identified as food insecure. Lay Gayint *woreda* is one of the food insecure *woreda*s. Food insecurity in Lay Gayint *woreda* is reflected by the fact that there is insufficient food production due to decreasing soil fertility, increasing scarcity of productive farmland, high rate of population growth and limited off-farm/non-farm economic activities. These conditions are exacerbated by climate variability (Lay Gayint Woreda Office of Agriculture, 2014).

The study *woreda* is classified as food insecure merely by its history of emergency food aid reception. There are no detailed studies done using standard tools and methods to determine food security status of households and identify the root causes of food insecurity. This study aimed to determine the food insecurity status and to identify the determinants of food insecurity in Lay Gayint *woreda*, South Gondar Zone, Ethiopia.

DETERMINANTS OF HOUSEHOLD FOOD INSECURITY

Different authors conducted empirical studies and identified various factors influencing household food insecurity. Genene (2006) using binary logit model identified sex, family size, dependency ratio, education, soil conservation measures, livestock owned and farm income as significant determinants. Using logistic model Guled (2006) identified age of the household head, number of oxen owned, sex of the household head, household size, total cropping land in hectare and remittance as significant factors. Abebaw (2003) used a binary logit model and has identified family size, annual income, amount of credit received, irrigation use, age of household head, status of education, cultivated land size, livestock ownership (TLU) and number of oxen owned as significant

determinants. Tesfaye (2005), using logistic model, identified family size, number of oxen owned, use of chemical fertilizer, size of cultivated land, farm credit use, total annual income per adult equivalent, food consumption expenditure, livestock owned and off-farm income per adult equivalent as significant factors. Mulugeta (2002) identified family size, number of oxen owned, use of fertilizer, food expenditure pattern, number of livestock owned, size of cultivated land, off-farm income and income per adult equivalent as significant determinants. Yilma (2005) used binary logit model and has identified family size, age of household head, use of chemical fertilizer, market distance, off-farm and non-farm income and total farm income as significant determinants of food insecurity. Dereje (2005), using binary logit model identified age of head of household, market distance, participation in ox fattening, off-farm/non-farm income, total livestock holding and crop income as significant factors.

STUDY AREA

Lay Gayint *woreda* is bordered in the north by Ebnat and Bugna, in the south by Tach Gayint and Simada, in the west by Estie and Farta *woreda*s and in the east by Meket *woreda* of North Wollo Zone. The absolute location of the *woreda* is 11°32'- 12° 16' N Latitude to 38° 12'- 38° 20' E Longitude. The administrative center is Nefas Mewcha; it is located on the way from Woreta to Woldia highway which is 226 kms away from Gondar city and 175 kms away from the regional capital city, Bahir Dar.

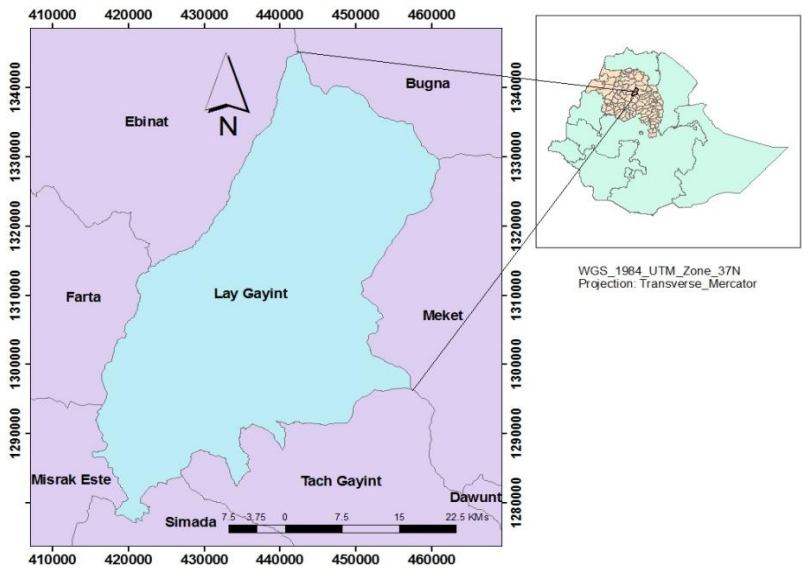

Figure 1: *Location map of Lay Gayint* woreda
Source: Girma & Ebrahim, 2015.

The elevation of the *woreda* ranges from 1,300 to 4,231 m above sea level. The topography of the *woreda* is characterized by 15 % plain, 10% mountain, 5% valley and 70% plateau. Agro-ecologically, the *woreda* is divided into three

zones, namely: *dega* (high altitude), *woina dega* (mid altitude) and *kolla* (low altitude) covering an area of 34.5%, 41.4% and 24.1% respectively. The mean annual temperature and rainfall of the *woreda* is 14^0C and 600 mm to 1400 mm respectively.

The population of the *woreda* is 208,249 (female 102,536). The rural population comprises 88.95%. The *woreda* covers about 1,548.56 km^2 with a wide variation of elevation. From the total area: 61% is cultivated land, 20.7% is grazing land, 7.3% is covered with forest and bushes, and 11% is settlement and wasteland. The major economic activity being run is mixed agriculture; crop and livestock production (Lay Gayint Woreda Office of Finance and Economic Development, 2014). Currently 45,154 individuals are under productive safety net program food aid support (Lay Gayint Woreda Office of Agriculture, 2014).

RESEARCH METHODS

Sampling

Lay Gayint *woreda* is divided into 29 rural *kebele*s. The *woreda* has three major agro-ecological zones. 10 of the *kebele*s fall in *dega*, 12 of them fall in *woina dega* and 7 of the *kebele*s fall in *kola* agro-ecologies. To account for the expected heterogeneity in the samples operating in different agro-ecologies, a stratified two-stage sampling procedure was used. In the first stage, the *woreda* was stratified into three agro-ecological zones using stratified sampling technique. Two *kebele*s from *dega*, two from *woina dega* and one *kebele* from *kolla* agro-ecological zones were selected proportionally using simple random sampling technique. The assumption was that in similar agro-ecological zones the households share similar opportunities and constraints. In the second stage, 379 household heads were drawn proportional to the size of the households in each *kebele*, by using systematic sampling technique.

The decision on how many respondents the study should have to embrace was determined by taking into account the following combination of factors: the level of confidence and the total population in the study area. Yamane (1967) as cited in Mersha (2013) provided a simplified formula; this was used to calculate sample size. After determining total sample size of the study area, as the number of households in each *kebele* is different, sampling with probability proportional to size method was employed to ensure equal representation of households.

Source of data and method of data collection

Data were collected from primary and secondary sources. Primary data were collected from the 379 sampled respondents through questionnaire survey while secondary data were collected from published and unpublished sources.

Definitions of variables and working hypothesis

The household food security status, which is the dependent variable for the logistic analysis, is a dichotomous variable. From the result of Household Core Food Security Module (HCFSM), the dependent variable has taken two values: Food secure and food insecure. The independent variables of the model are identified and explained below.

Gender of household head: Female-headed households have less labor force and farming experience than the male headed ones. A study conducted by Guled (2006) and Genene (2006) has indicated that the sex of the household head has a significant impact on food security status. Therefore, it was hypothesized that being female headed has positive correlation with household food insecurity. A dummy variable was used.

Age of household head: The livelihood base of rural households is agriculture. The older the household head, the more he/she has social network as well as the more experience on farming and weather forecasting. As a result, the chance for such households to be food insecure is low (Abebaw, 2003). Hence, being older was expected to have negative correlation with household food insecurity. Age was categorized into youth age, active labor age older than the youth age and above active labor age. Genene (2006) has made similar categorization.

Family size: This is an important variable which determines the food security status of the households. As family size increases, the number of mouths to be fed also increases. Hence, the expectation was having larger family size and households' food insecurity were positively related (Abebaw 2003; Genene, 2006, Gulled 2006). The average household size [5.17] was obtained from the sampled households and used to classify the variable.

Dependency ratio: The number of non-productive age groups, less than 15 and greater than 65 years of age, in relation to the number of productive age groups in a household, is an important variable that determine the food security status. Households with larger dependent members are more likely to be food insecure (Genene, 2006). Therefore, having larger dependent family members was hypothesized to have positively related with households' food insecurity. Dependency ratio was categorized into three by dividing its ordered value into three equal points. Genene (2006) has used similar categorization.

Level of education of the household head: As agriculture is a dynamic business, agricultural production technologies are always coming with better knowledge. An illiterate household is expected to be less eager to accept improved technologies and practices. As a result, being illiterate was hypothesized to have positive correlation with household food insecurity (Abebaw, 2003; Genene, 2006). A dummy variable was used.

Size of cultivated land: The base of most of the farmers' livelihood is the cultivated farmland they have. Thus, households who have smaller farm landholdings were expected to have high probability to be food insecure than those with larger size of cultivated land (Abebaw, 2003; Mulugeta 2002). Thus, smaller cultivated land holding was hypothesized to positively correlate with household food insecurity. The average cultivated land size holding obtained from sampled households was 0.93 hectare and this was used to classify the variable.

Soil fertility status: Fertility of soil and productivity of land are directly related. Households having cultivated land with poor soil fertility are more likely to be food insecure than those with good fertile cultivated land. Therefore, it was expected that the poor soil fertility status has positive correlation with food

insecurity. Soil fertility was categorized into three categories. Ayalew (2003) has used a similar classification.

Use of chemical fertilizer: Using chemical fertilizer improves yield per unit area. Thus it was expected that those households who do not use chemical fertilizer are more likely to be food insecure (Tesfaye, 2005). This covariate is assumed to have binary values and being non-user of chemical fertilizer was expected to have positive influence on household food insecurity.

Use of improved seeds: Use of improved seeds increases agricultural productivity per unit area of land. Hence, it was expected that households who do not use improved seeds are more likely to be food insecure. This variable has two values and being non-user of improved seeds was expected to have positive influence on household food insecurity.

Soil conservation measures: Practicing soil conservation techniques increases crop production through maintaining soil nutrients and moisture. The lack of practicing any of the soil conservation measures was expected to increase the probability of being food insecure. This was a dummy variable and lack of practicing soil conservation practices was hypothesized to have positive influence on household food insecurity.

Access to irrigation land: This was a dummy variable. Availability of irrigated land helps households to produce more than one crop per year. Thus, the lack of access to irrigable land was expected to positively affect households' food insecurity.

Livestock holding: Livestock is perceived as saving and mostly used as an indicator of wealth status. Livestock is used for draft power, source of manure, source of income from sale of milk, butter and live animals. Thus, it was hypothesized that smaller livestock holding was positively associated with household food in security (Abebaw, 2003). This was a dummy variable. The average livestock holding obtained from sampled households was 2.88 TLU and this was used to classify the variable.

Grazing land: Households with grazing land are expected to feed their animals better in that their animals' performance would enable them to get better output either in the form of product like butter, milk, and meat or efficiency in plowing of draught animals. This was a covariate with binary values and lack of access to grazing land was expected to influence households' food insecurity positively.

Off-farm/non-farm income: Income earned from off-farm/non-farm activities is an important variable which determines households food security. Households who are not engaged in off-farm/non-farm activities have no additional income and are more likely to be food insecure. Therefore, this variable was assumed to have two values and having no off-farm/non-farm income was expected to positively associate with households' food insecurity (Tesfaye, 2005).

Contact with extension agents: The existence of significant relationship between a farmer and an extension agent for technical advice that could enhance the information flow and the technological (knowledge) transfer from the exten-

sion agent to the farmer is considered to be an important variable. A dummy variable was used to see if there is significant relationship between the extension agent and the household. The number of contacts expected to happen between the extension agent and the farmer was set at least once in a quarter as a standard (with the consultation of the Lay Gayint woreda office of agriculture) and used to classify respondents. Households who do not have significant relationship with extension agents are more likely to be food insecure. Thus, the lack of significant contact with extension agents was hypothesized to correlate positively with households' food insecurity.

Household's attitude of dependency on food aid: Oxfam GB (2004) reported that some households in Amhara and Tigray regions of Ethiopia depleted their livestock resources in order to become poor and qualify for food aid. In this study, the variable took two values and having dependency attitude on food aid was hypothesized to influence households' food insecurity positively.

Perceived land tenure security: Ensuring land tenure security enhances farmers' confidence to invest on land that improves its productivity. The Ethiopian government tried to address the problem of tenure insecurity through issuing certificates of land use rights to farmers. Perceived land tenure security was assumed to have binary values and the lack of confidence on land tenure security was expected to positively associate with household food insecurity.

METHODS OF DATA ANALYSIS

Descriptive statistics, Core food Security Module and binary logistic regression model were employed to analyze the data using SPSS-Version 16.

Measuring food security status: To measure the extent of food security status of the households over selected 12 months (April 2014 to March 2015) the Core Food Security Module (CFSM) was employed. The CFSM actually consists of two measures, a scale measure based on Rasch item-response theory and the CFSM categorical measure. The categorical measure is used to estimate the prevalence of household food insecurity and hunger.

The set of food security questions included in the CFSM are combined into a single overall measure called the food security scale. This continuous linear scale value is used to measure food insecurity in a household. In developing the food security scale, a set of ten questions for households with no children and eighteen questions for households with children were used to calculate the household food security scale and then to estimate the prevalence of food insecurity (National Research Council, 2006).

According to Opsomer et al. (2002), the model which was used to create food security scale can be written in terms of the log of the odds ratio expressed as the difference between the severity of the household's food insecurity and the level of food insecurity (difficulty) the household experienced.

It is expressed as:

$$\Pr(I_{ij} = 1/\theta_i, \alpha_j) = \frac{\text{Exp}^{(\theta_i \alpha_j)}}{1+\text{Exp}^{(\theta_i \alpha_j)}} \quad \text{or} \quad \frac{e^{(\theta_i \alpha_j)}}{1+e^{(\theta_i \alpha_j)}}$$

Where,

I_{ij} - Is random variable that gives the dichotomous answer of person i to item j

θ_i - The i^{th}individual's ability parameter for i=1… n

α_j - The j^{th} item's difficulty parameter for j=1… m

e - The base of natural logarithms

Pr - Probability

Independent sample t-test was also employed to compare means of the two food security groups: food secure and food insecure households.

Measuring determinants of food insecurity: In order to identify the determinants of households' food insecurity, a dichotomous dependent variable, household food security status, was represented in the model by taking the value of 0 if a household is food secure and 1 otherwise. To set a breakeven point for food secure and insecure groups, categorization of food security status of households was made according to the number of affirmed items based on responses to all eighteen items or questions. Categorization of a household into food secure and insecure groups was done based on the Household Core Food Security Module (HCFSM).

A binary logistic regression model was used where the estimated probabilities lie between logical limit 0 and 1 (Fekadu et al., 2010; Gujarati, 1995). Food security as a dependent variable, thus, assumed the value of Y= 0 if a household is food secure, 1 otherwise. Following Gujarati (1995), the functional form of logistic regression model was specified as follows:

$$\pi(x) = e(y = 1/x) = 1/1 + e^{-(\beta 0 + \beta i x i)} \qquad (1)$$

For ease of exposition, we write (1) as,

$$\pi(x) = 1/1 + e^{-zi} \quad (2)$$

Where $\pi(x)$ is a probability of being food insecure ranging from 0 to 1 and $Z_i$is a function of n explanatory variables (x_i) which is also expressed as:

$$Z_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_n x_n + U_i \qquad (3)$$

In other words, the probability for a household to be food secure can be expressed as,

$$1 - \pi(x) = 1/1 + e^{zi} \quad (4)$$

Thus,

$$\pi(x)/\ 1 - \pi(x) = (1 + e^{zi}/1 + e^{-zi}) = e^{zi} (5)$$

Then, the expression $\pi(x)/(1-\pi(x))$represents the odds ratio in favor of food insecurity. It means the ratio of the probability that a household would be food insecure to the probability that it would be food secure.

RESULTS

Food security status of the respondents

The Core Food Security Module result showed that 85% and 15% of the sampled respondents were food insecure and food-secure respectively (Table 1). The significance of the food security status values were tested by independent t -test and found significant (at p<1%). The *woreda* is considered as food insecure by the government based on the criteria set for differentiating food secure

and food insecure *woreda*s in order to implement the Productive Safety Net Program (PSNP) in Ethiopia. The result of this study supported the government's consideration about the *woreda*.

Joint research conducted by Yohannes and Peter (2000) as cited in Masfield (2001), came up with similar findings in low potential areas of Amhara Region. According to their study results, only 15% of farming households were able to fulfill their basic needs from agricultural activities. Approximately 30% were able to fulfill basic needs from farm and off-farm activities while about 70% of the households were not able to generate sufficient resource from any means to secure household food requirement.

Table 1: *Percentage distribution of household food security status (N=379)*

Categories	Count	Percentage	Mean	S.D	t-Value	P- Value
Food Secure	57	15	1.779	0.41		
Food Insecure	322	85	6.118	1.38		
Total	379	100	5.465	2.01	-23.61	.000

Source: Household survey, April–March, 2015.

Determinants of food insecurity

Socio-demographic characteristics: A total of 379 rural household heads were asked and completed the survey questionnaire. Among these participants, 323 (85.2%) were males while the majority age group 299 (78.9%) were aged between 31 and 64 with the mean age of 46.2 years. 228 (60.2%) and 151 (39.8%) of the respondents were having a family size of 1-5 and 6-9 members respectively; the mean family size of the sampled households was founded to be 5.17. 200 (52.8%), 173 (45.6%) and 6 (1.6%) of the respondents had a dependency ratio (the ratio of non-productive age group to the productive age group) of 0-1,1.01-2 and 2.01-3 respectively with the mean dependency ratio of 0.90. About half 202 (53.3%) of the respondents were illiterate (Table 2).

Farming system and farm characteristics: Among the total of 379 participants, nearly half 198 (52.2%) of them hold 0-0.93 hectares of land and the fertility status of about half 180 (47.5%) of them was poor while nearly two-third 239 (63.1%) of the sampled households practiced different soil conservation measures. The average size of land holding was 0.93 hectares. Only 7 (1.8%) of the sampled households had access to irrigation water. About half of the 197 (52%) respondents possessed 0-2.88 livestock in Tropical Livestock Unit (TLU) with the mean value of 2.88. Only 12 (3.2%) of the respondents have grazing land (Table 3).

Table 2: *Socio-Demographic characteristics of the sampled households*

Variables	Frequency	Percentage
Gender of the Household Head		
Female	56	14.8
Male	323	85.2
Age of the Household Head		
22-30	43	11.3
31-64	299	78.9
65-85	37	9.8
Family Size		
1-5	228	60.2
6-9	151	39.8
Dependency Ratio		
0-1	200	52.8
1.01-2	173	45.6
2.01-3	6	1.6
Level of Education of the Household Head		
Illiterate	202	53.3
Literate	177	46.7

Source: Household survey, April–March, 2015.

Access to service and use of agricultural inputs: Among the total of 379 respondents, nearly half 194 (51.2%) of them applied chemical fertilizer while only 37 (9.8%) of them used improved seed. 233 (61.5%) of the respondents had no significant relationship (do not meet at least once in a quarter and discuss on issues relevant to improve household's production and income) with extension agents (Figure 2).

Table 3: *Farming system and farm characteristics of the respondents*

Variables	Frequency	Percentage
Size of Cultivated Land		
0-0.93	198	52.2
0.94-2.25	181	47.8
Soil Fertility Status		
Poor	180	47.5
Medium	187	49.3
Good	12	3.2
Soil Conservation Measure		
Do not Practice	140	36.9
Practice	239	63.1
Access to Irrigation		
Have No Access	372	98.2
Have Access	7	1.8
Livestock Holding		
0-2.88	197	52.0
2.89-9.08	182	48.0
Grazing Land		
Have No Land	367	96.8
Have Land	12	3.2

Source: Household survey, April–March, 2015.

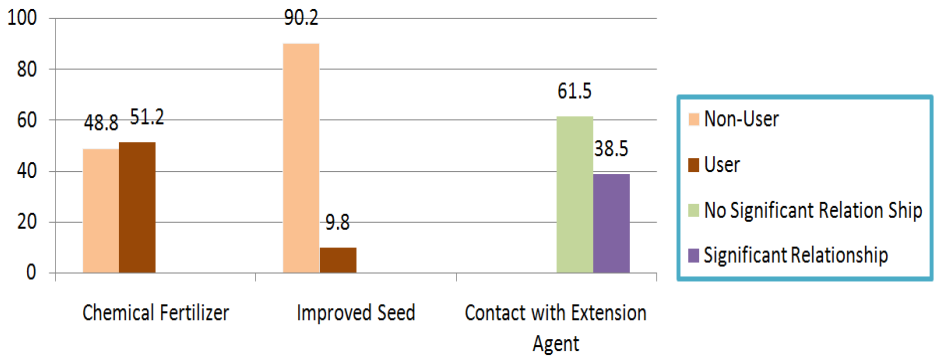

Figure 2: *Access to service and inputs*
Note: Percent of Households [N= 379]
Source: Household survey, April–March, 2015.

Off-farm/Non-farm income: About three-fourth 286(75.5%) of the total respondents got no income from off-farm and non-farm activities (Figure 3).

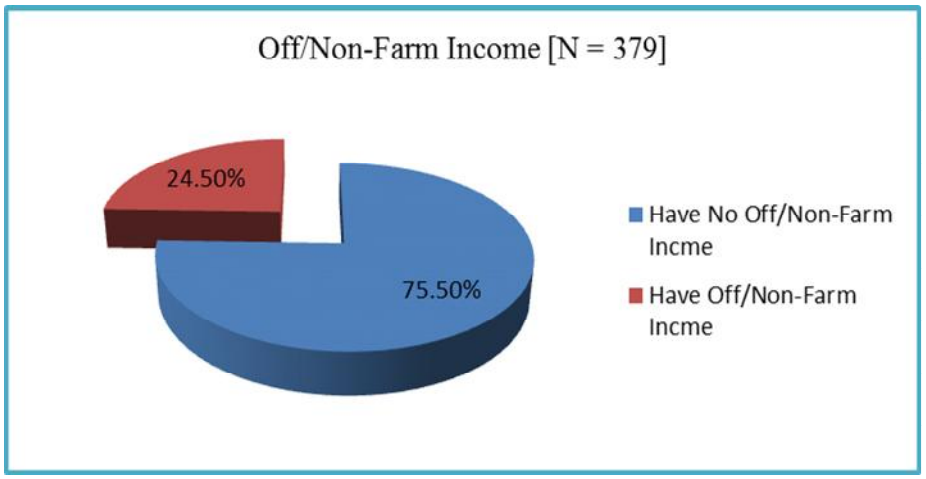

Figure 3: *Off/Non-Farm activity*
Source: Household survey, April–March, 2015.

Households' perception and attitude: More than two-third (255, 67.3%) of the total respondents had dependency syndrome on food aid while nearly half (187, 49.3%) of them were not confident (they are not sure if their cultivated land will exist long with them) (Table 4).

Table 4: *Households' perception and attitude*

Variables	Frequency	Percentage
Attitude towards Food Aid		
Have Dependency Attitude	255	67.3
Have No Dependency Attitude	124	32.7
Perceived Land Tenure Security		
Not Confident	187	49.3
Confident	192	50.7

Source: Household survey, April–March, 2015.

Logistic regression result
Based on the results of the logistic regression analysis, a model containing twelve selected predictor variables were included in the regression with a condition that any variable whose bivariate test has a p-value less than 0.25 (Hosmer-Lemeshow, 1989). The list of predictor variables that were included in the logistic regression model were: sex of household head, family size, education of the household head, size of cultivated land, use of chemical fertilizer, use of improved seed, soil conservation practice, livestock holding, off-farm/ non-farm income, contact with extension agent, attitude towards food aid, and perceived land tenure security. Using the stepwise (Likelihood Ratio) method,

seven out of twelve predictor variables were selected and had a significant joint impact in determining household food insecurity. The result of logistic regression is summarized in Table 5.

Table 5: *The maximum likelihood estimates of the binary logistic regression model*

Variables	Food Security Status		OR (95%) CI		
	Secure	Insecure	Crude	Adjusted	P-Value
HHH_Sex					
Female	3(5.3%)	53(16.5%)	3.55 (1.07,11.77)	1.14 (0.02,1.01)	0.051*
Male (ref)	54(94.7%)	269(83.5%)			
Family_Size					
1-5 (ref)	42(73.7%)	186(57.8%)			
6-9	15(26.3%)	136(42.2%)	2.05 (1.09,3.84)	4.43 (1.76,11.19)	0.002***
HHH_Edu					
Illiterate	11(19.3)	191(59.3%)	6.10 (3.05,12.21)	4.27 (1.67, 10.98)	0.003***
Literate (ref)	46(80.7)	131(40.7%)			
Size_Cultland					
0-0.93	12(21.1%)	186(57.8%)	5.13 (2.61,10.06)	11.29 (3.17, 40.19)	0.000***
0.94-2.25 (ref)	45(78.9%)	136(42.2%)			
Che_Fertilizer					
Non –User	3(5.3%)	182(56.5%)	23.40 (7.17,76.40)	7.24 (1.91, 27.44)	0.004***
User (ref)	54(94.7%)	140(43.5%)			
Imp_Seed					
Non-User	30(52.6%)	312(96.9%)	28.08 (12.41,63.54)	41.74 (9.98, 174.47)	0.000***
User (ref)	27(47.4%)	10(3.1%)			
LS_Holding					
0-2.88	3(5.3%)	194(60.2%)	27.28 (8.35,89.12)	12.70 (3.22, 50.03)	0.000***
2.89-9.08 (ref)	54(94.7%)	128(39.8%)			

Notes: Model-2LL = 143.282, Chi-square = 177.65, df = 7, p =0.000
Hosmor–Lemeshow test: Chi-square = 13.575, p = 0.094
Classification Accuracy: 93.9%
Sensitivity: 75.4%
Specificity: 97.2%
Sample Size: 379 ***, **, * Significant at 1%, 5% and 10% respectively

DISCUSSION

The result of logistic regression had revealed seven variables: sex, family size, level of education of the household head, size of cultivated land, use of chemical fertilizer, use of improved seed and livestock holding had shown a significant joint impact. Each of the variables is discussed below.

Gender: The overall food insecure households in the study population were 85.0%. The proportion of female headed households in the food insecure category (16.5%) was more than three-fold the proportion of female headed households in the food secure category (5.3%). Sex of the household head was not found significant at 5% significant level.

Family size: The proportion of households, having family size of between 6 and 9, in the food insecure category (42.2%) was more than the proportion of households in the food secure category (26.3%). This variable was significant (atp<1%), indicating that this variable was the cause of food insecurity and having larger family size was positively related with household food insecurity in the study area. The odds ratio in favor of food insecurity for the variable family size with family size between 6 and 9 was 4.43 which implies, households who have larger family (> sample mean) were nearly five times more likely to be food insecure compared to those who have smaller family size (≤ the sample mean). The possible explanation for such association is that an increase in family size decreases the cultivated land and possessed livestock per capita and in return also decreases the availability of enough food for a household. It also exerts influence on household demand on non-food items, which impacts food security status of households. As expected, this variable showed positive (as expected) and significant influence on household food security status. This finding was in agreement to some research evidences (Abebaw, 2003; Alem, 2007; Mesfin, 2014; Mulugeta, 2002; Tilaye, 2004).

Household education: The proportion of illiterate household heads in the food insecure category (59.3%) was three-fold the proportion of households in the food secure category (19.3%). The model result indicated that education of the household head was significant (at p< 1%) and, as expected being illiterate positively influenced household food insecurity. The odds ratio for this variable is 4.27 implying households who are illiterate were four times more likely to be food insecure compared to those who are literate. This could be due to the fact that education equips individuals with the necessary knowledge of how to make a living. Educated farmers tend to use modern agricultural technologies, use agricultural extension advice and information and diversify their source of income than illiterate farmers. This result is inconsistent with the findings of other similar studies on food security (Asrat et al., 2004; Genene, 2006; Teshome, 2010).

Size of cultivated land: The proportion of households, having farmland size of between 0 and 0.93 hectares, in the food insecure category (57.8%) was almost three–fold the proportion of households in the food secure category (21.1%). The result indicated that size of cultivated land, as a basic input in farming, was significant (at <1%) and having smaller size of cultivated land positively associated with household food insecurity as was hypothesized. The odds ratio for this variable was 11.29 implying that households who have smaller size of

cultivated land (≤ sample mean) are eleven times more likely to be food insecure relative to those with larger (> sample mean) size of cultivated land. The possible reason could be households with larger farm size had better chance to produce more, to diversify the crops they produce and to get larger volume of crop residues. This result is supported by the findings of Abebaw (2003) and Fekadu (2010).

Use of chemical fertilizer: The proportion of households who do not use chemical fertilizer in the food insecure category (56.5%) was more than ten times the proportion of households in the food secure category (5.3%). The model result indicated that this variable was significant (at p<1%) and being non-user of chemical fertilizer was found to have a positive (as expected) impact on household food insecurity. The odds ratio for this variable was 7.24 implying that households who do not use chemical fertilizer are seven times more likely to be food insecure when compared to those who used chemical fertilizer. The explanation for this could be the use of chemical fertilizer and other technological inputs help farmers to increase productivity per unit area and boost production. This result is consistent with the findings of Fekadu (2010).

Use of improved seed: The proportion of households who do not use improved seed, in the food insecure category (96.9%) was nearly double the proportion of households in the food secure category (52.6%). The model result indicated that this variable was significant (at p<1%) and being non-user of improved seed was found to have a positive effect (as expected) on household food insecurity. The odds ratio for this variable was 41.74 which implies, households who do not use improved seed are forty-two times more likely to be food insecure relative to those who use improved seed. The explanation for this could be use of improved seed and other technological inputs help farmers to increase productivity per unit area. Farmers can enhance their production by using high yielding varieties and other complementary farm technologies and practices. This result is consistent with the findings of Tefera (2009).

Livestock holding: The proportion of households who have livestock between 0-2.88 TLU (≤ sample mean), in the food insecure category (60.2%) was nearly twelve times the proportion of households in the food secure category (5.3%). Livestock holding had a significant impact (at p<1%) and having smaller livestock holding had positive (as hypothesized) impact on the household food insecurity in the study area. The odds ratio for this variable was 12.70 implying that households who have smaller (≤ sample mean) livestock holding were nearly thirteen times more likely to be food insecure in relation to those who have larger (> sample mean) livestock holding. The possible explanation for this result could be farmers who have larger number of livestock (ox, cow, heifer, calf, donkey, goat, sheep and chicken) enjoy better food security status as livestock is an important source of food, income and draft power source. It also enables to earn off-farm/non-farm income. This result is similar to the findings of Mulugeta (2002) and Genene (2006).

CONCLUSIONS

This research presented important information, justification and findings concerning status of food insecurity and major factors associated with food insecurity in Lay Gayint *woreda*. The output of this study revealed that only 15%

of the sampled households were food secure. The result obtained looks too small despite the effort which has been exerted to ensure food security. Hence, there is a need to find a different (new) pathway (model) that leads to fast eradication of food insecurity.

Family size, education, size of cultivated land, use of chemical fertilizer, use of improved seeds and livestock holding had significant relationship with food insecurity. Hence, to improve the situation and minimize their effect on food insecurity it is recommended giving due attention to limit the growing population, strengthening adult education program for rural households (in addition to the formal education program), enhancing land productivity (by the development and use of improved technologies and practices), diversifying income from off-farm/non-farm activities and exert the necessary effort to improve production and productivity of the livestock sector (by facilitating credit, provision of improved breeds, introduction of artificial insemination, training and support on proper livestock management, forage development, adequate veterinary service and establishing fair and sustainable marketing system).

REFERENCES

Abebaw, S. (2003). Dimensions and Determinants of Food Security among Rural Household in Dire Dawa, Eastern Ethiopia. *Journal of Tropical Science, 47*(2),16-80. doi:10.1002/ts.199

Alem, S. (2007). *Determinants of Food Insecurity in Rural Households in Tehuludere Woreda, South Wollo Zone of the Amhara Region* (Master's thesis). Addis Ababa University. Retrieved from https://eidmon.files.wordpress.com/2012/11/alem-shumiye.pdf

Ayalew, Y. (2003). *Identification and Intensity of Food Insecurity and Coping Strategies of Rural Households in North Showa: The Case of Lalomama Woreda* (Master's thesis). Alamaya University.

Dereje, K. (2005). *Analysis of Gender Based Household Food Security in Kurfa Chale Woreda of Oromia, Ethiopia* (Master's thesis). Alamaya University.

FAO, IFAD & WFP (2013). *The State of Food Insecurity in the World. The multiple dimensions of food security*. Rome: FAO.

FDRE [Federal Democratic Republic of Ethiopia]. (2002). *National Food Security Strategy* (Government Document). Addis Ababa.

Fekadu, B., & Mekuannent, M. (2010). Determinants of Food Security among Rural Households of Central Ethiopia. *Quarterly Journal of International Agriculture, 49*, 299-318.

Genene, T. (2006). *Farmers' Perceptions of Land Degradation and Determinants of Household Food Security Status at Middle Catchments of Bilate Watershed* (Master's thesis). Addis Ababa University.

Gezahegn K. (1995). Agricultural Marketing Policies and Food Security in Ethiopia. In D. Mulat, A. Wolday, S. Ehui & Z. Tesfaye (Eds.), *Food Security, Nutrition and Poverty Alleviation in Ethiopia: Problems and Prospects Proceedings of the Inaugural and First Annual Conference of the Agricultural Economics Society of Ethiopia*. Addis Ababa.

Girma Zewdie & Ebrahim Esa. (2015). Land Use and Land Cover Dynamics: Driving Forces and Impacts in Lay Gayint Woreda of Amhara National Regional State, Ethiopia. *Ethiopian Renaissance Journal of Social and Sciences and the Humanities, 2*(1), 57-71.

Gujarati, D. N. (1995). *Econometrics*. New York: McGraw-Hill Inc.

Guled, A. (2006). *Food Insecurity and Copping Strategies of Agro-pastoral Household in Awbare Woreda, Somali Region, Ethiopia* (Master's thesis). Addis Ababa University.

Hosmer, D.W., & Lemeshow, S. (1989). *Applied Logistic Regression*. New York: Wiley.

Lay Gayint Woreda Office of Agriculture. (2014). *Annual Report* (Unpublished office document). Nefas Mewcha.

Lay Gayint Woreda Office of Finance and Economic Development. (2014). *Basic Socio-Economic data* (Unpublished document). Nefas Mewcha.

Masfield, A. (2001). Chronic Food Insecurity in Ethiopia: Looking through a Livelihood lens. In Yared Amare (Ed.), *Food security and sustainable livelihoods in Ethiopia. Proceedings of the Symposium of the Forum for Social Studies, 10-11 March 2000*. (pp. 37-59). Addis Ababa: Forum for Social Studies. Retrieved from http://repository.forcedmigration.org/pdf/?pid=fmo:2792

Meade, B., & Stacey, R. (2013). *International Food Security Assessment: 2013-2023*. U.S. Department of Agriculture, Economic Research Service, GFA-24. Retrieved from http://www.ers.usda.gov/topics/international-markets-trade/global-food-security.aspx

Mersha, A. (2013). *Farmers' Vulnerability to Drought and their Coping Strategies: In the Case of Lay Gayint Woreda, Amhara Regional State* (Master's thesis). University of Gondar.

Mesfin Welderufael. (2014). Determinants of Households Vulnerability to Food Insecurity in Ethiopia: Econometric analysis of Rural and Urban Households. *Journal of Economics and Sustainable Development, 5*(24), 70-79. Retrieved from http://www.iiste.org/Journals/index.php/JEDS/article/view/17506

Mulugeta, T. (2002). *Determinants of Household Food Security in Eastern Oromia, Ethiopia: The case of Boke District of Western Hararghe Zone* (Master's thesis). Addis Ababa University.

National Research Council. (2006). *Food Security and Hunger in the United States: An Assessment of the Measure*. Washington, DC: The National Academies Press, 2006. Retrieved from http://www.nap.edu/catalog/11578

Opsomer, J.D., Jensen, H.H., & Pan, S. (2002). *An evaluation of the USDA food security measure with generalized linear mixed models*. Retrieved from http://lib.dr.iastate.edu/card_workingpapers/320/

Oxfam Great Britain. (2004). *Food Aid Impact Research: A case study in Atsbi and Wonberta Woredas*. Retrieved from http://iiste.org/Journals/index.php/JEDS/article/download/21904/22245

Paulos Asrat, Kassa Belay & Hamito Desta. (2004). *Determinants of farmers' willingness to pay for soil conservation practices in the southern highlands of Ethiopia*. Retrieved from http://www.researchgate.net/publication/229570849_Determinantsof_farmers%27_willingness_to_pay_for_

Tefera, M. (2009). *Determinants of Household Food Security in Farta District, South Gondar Zone* (Master's thesis). Addis Ababa University.

Tesfaye, K. (2005). *Household Food Insecurity in Dodota-Sire District, Arsi Zone: Coping strategies and policy options* (Master's thesis). Addis Ababa University.

Teshome, T. (2010). Food Security Situation in Ethiopia: The Case of Amhara National Regional State. *Ryukoku journal of economic studies 50*(1/2), 55-

74. Retrieved from http://repo.lib.ryukoku.ac.jp/jspui/bitstream/10519/1033/2/r-kz-rn_050_01 _005. pdf

Tilaye, T. (2004). *Food Insecurity: Extent, Determinants and Household Copping Mechanisms in Gera keya Woreda, Amhara* (Master's thesis). Addis Ababa University.

Yilma, M. (2005). *Measuring Rural Household Food Security Status and Its Determinants in the Benishangul Gumuz Region, Ethiopia: The Case of Assosa Woreda* (Master's thesis). Addis Ababa University.