ORIGINAL ARTICLE

DETERMINANTS OF FOOD INSECURITY AMONG RURAL HOUSEHOLDS IN DEBARK *WOREDA*, NORTHWEST ETHIOPIA

Belete Debebe[1]

ABSTRACT

Ethiopia is one of the food deficit countries in sub-Saharan Africa. The food deficit is especially manifested in Amhara region. Many woredas in the region are only able to produce food that could meet their food requirements for less than six months of the year. This food insecurity is a key development challenge. Thus, the objective of this study was to examine the extent of the food insecurity and identify its determinants in Debark woreda. The food insecurity was assessed using the calorie intake. A total of 200 farming households' were randomly selected using systematic sampling technique. Primary data were collected using a structured questionnaire. Data were analyzed using descriptive and inferential statistics. The findings revealed that the proportion of food insecure households was more than the food secured households. The chi-square statistic revealed a significant association between food insecure and secure households. Similarly, the t-test revealed a significant mean difference between food insecure and secure households with respect to age of household heads, TLU and cultivated land size. Moreover, the model output revealed seven out of twelve explanatory variables: age of household heads, educational level, TLU, cultivated land size, access to credit, applying chemical fertilizer and improved seeds were found to be statistically significant determinants of household food insecurity. In conclusion, the determinants of food insecurity are complex and call for multifaceted interventions. Such efforts should include resettling food insecure households where better land resources are available, strengthening informal education and skill training centers to farming households, enhancing and expanding rural credit service.

Keywords: *food insecurity, food security, prevalence, determinant, odds ratio, binary logit*

STATEMENT OF THE PROBLEM

It is an unquestionable fact that food is a fundamental right that affects human ability to survive, to thrive and to learn (Morduch, 1995). Optimal physical, cognitive and emotional development and function in human being require access to adequate quantity and quality of food at all stages of life (Cook & Frank, 2008). Given the numerous negative outcomes associated with poverty and hunger, food insecurity is a serious threat to the well-being of human beings.

Food insecurity is a condition that exists when people experience limited or

1.Lecturer at the department of Population Studies, College of Social Sciences and Humanities, University of Gondar, email:belebete@yahoo.com/ beleaman2005@gmail.com.

uncertain physical and economic access to safe, sufficient and nutritious food to meet their dietary needs or food preferences for a productive, healthy and active life (Seligman, Laraia, & Kushel, 2010; Mazumdar, 2012; Keino, Plasqui, & van den Borne, 2014). This may be due to lack of access to water and resources, insufficient purchasing power, inappropriate distribution of wealth, or inadequate utilization of resources at household level (Carlson et al., 1999). Globally, food insecurity continues to be a cause for concern and is still a major problem undermining people's health, productivity, and often their very survival. Efforts to overcome the development challenges posed by food insecurity necessarily begin with identifying the causes at household level (Smith & Subandor, 2007). According to FAO (2012) estimate globally about 870 million people (one in eight people) suffered from chronic hunger of which 98% were found in developing countries. Food insecurity occurs in most countries at varying degrees, 75% of the food insecure people live in the rural parts of the developing countries, out of which two thirds of them live in Bangladesh, China, Democratic Republic of Congo, Ethiopia, India, Indonesia and Pakistan (Keatinge et al., 2011 and Khush et al., 2012).

Ethiopia is one of sub-Saharan Africa countries where about 26% of its population lives below the poverty line (MoFED, 2013) and suffers from the lowest average per capita kilocalorie intake of 1,982 (Ramanaiah & Gowri, 2011). Close to a quarter of its population is malnourished, making food insecurity chronic and pervasive (Strintzos & Mulugeta, 2009). The country had also been faced with many droughts and more people had died of famine than any other problems, particularly in the epidemic periods of 1960s, 1970s, 1980s, 1990s and 2000s (Berhanu, 2001; Endalew, Muche & Tadesse, 2015).

In Ethiopia, most food shortages have been geographically concentrated along two broad belts (Degefa, 2002). The first belt consists of the mixed farming production system area of the central and northern highlands. The second belt is made up of the low-lying agro-pastoral lands ranging from Wollo in the North, through Hararghe and Bale to Sidamo and Gamo Gofa in the South. The Amhara National Regional State belongs to the first drought prone belt which is characterized by rugged terrain, highly degraded soil, climate variability, population pressure, deforestation and overgrazing (Ramakrishna & Assefa, 2002). Different studies revealed a mix of factors affecting household food insecurity in Amhara region: demographic, labour and market accessibility, differences in resource availability, topography, and others (Amare, 1999; Berhanu, 2001; Ramakrishna & Assefa, 2002; Workneh, 2004; Tilaye, 2004; Alemu, 2007; Fekadu, 2008; Temesgen, 2010; Frehiwot, 2007; and Arega, 2012).

Debark *woreda*, where this study was conducted, is one of the chronically food insecure *woredas* in North Gondar Zone, Amhara Region. The agricultural practice in the *woreda* has been highly challenged by rugged terrain, recurrent drought, frost, erratic, late onset and early offset rainfall distribution, and pest which lead to frequent crop failure and animal death and/or quality loss. Due to these challenges farming households in the *woreda* could not fulfill the food requirement and create additional asset to

their family. The various complex and interrelated determinants of rural household food insecurity were not studied in detail in the rural areas of Debark *woreda*. Therefore, this study attempts to fill the gap by identifying and analyzing those determinants that are responsible for variation in household food insecurity thereby to guide policy makers, to develop appropriate interventions and to integrate efforts to combat food insecurity in the *woreda*. The objective of this study is thus to examine the prevalence (extent) of the food insecurity and to identify its determinants among the rural households of Debark *woreda*, Northwest Ethiopia.

METHODS AND MATERIALS

Description of the study area

This study was conducted in Debark *woreda*, North Gondar Zone of Amhara National Regional State. The study area shares border with Dabat *woreda* in the South, Tigray region in the northwest, Addi-Arkay *woreda* in the north and Jan-Amora *woreda* in the east. The *woreda* is mainly *dega* in terms of agro-ecology with an elevation ranging from 500 m to 4620 m above sea level. According to the data obtained from the Woreda Agriculture Office, the topography of the *woreda* is characterized by rugged topography. The mean annual rainfall and temperature of Debark *woreda* ranges from 400 mm to 1200 mm and 18^0 C to 29^0 C. Based on the 2007 census the *woreda* has a total population of 159,193; of whom 80,274 are men and 78,919 women; 138, 354 (87%) and 20,839 (13%) are rural and urban inhabitants, respectively (CSA, 2010). The *woreda* is organized into 28 rural and 3 urban *kebele*s. Mixed farming system is the main source of livelihood of the population in the *woreda*. Frost, poor infrastructure and low institutional supports are thought to be the major problems of crop production in the *woreda*. Moreover, as the *woreda* is one of the nine drought-prone and chronically food insecure areas of the North Gondar zone it has been included in the productive safety net programme (BoFED, 2007).

Sampling technique and sample size

The study employed a household based cross-sectional survey. The population of study is the set of entire households residing in rural areas of

Table 1: *Sample household allocation to each selected* kebele

Study *woreda*	Study *kebele*	Total households in each *kebele*	Selected sample households from each *kebele*
Debark rural *kebele*	Loma	686	29
	Segi	1385	58
	Adisge-Milegebsa	1230	52
	Adebabay-Tsion	1441	61
Total number of households		4742	Desired sample size taken = 200

Source: author's field survey, 2015.

Debark *woreda*. A two stage random sampling technique was used to select the desired sample. At the beginning, from the total of 28 rural *kebele*s, 4 *kebele*s were selected using simple random sampling technique. At the second stage, the entire households in each selected *kebele*s were listed to take 200 sample households by using systematic sampling technique proportional to size in each selected *kebele* (see Table 1).

METHODS OF DATA COLLECTION

The study used primary data obtained from household survey. The heads of household were the main respondents. To generate primary data, household survey was employed, asking the respective households directly regarding food insecurity issues. Prior to disseminating the questionnaire, pilot tests were undertaken and revision was then made. Four enumerators were recruited based on their educational level and prior experience in data collection. Then training was given to them on the contents of the questionnaire and the procedures to follow while conducting the survey.

Secondary data relevant to the research work were collected from relevant regional, zonal and *woreda* office of the Agriculture, and Food Security and Disaster Prevention and Preparedness Office. Various texts and research findings dealing with food insecurity and related matters on Ethiopia and other countries as well as published documents of CSA were consulted.

Data editing, coding and verification were undertaken for the 200 sample households. The data were also checked for inconsistencies, missing data and reasonableness. The quantitative data were then entered and analyzed using SPSS version 20 software program. The data were analyzed using both descriptive and inferential statistics. Accordingly, frequency distribution, percentage, mean and standard deviation were used to describe the household characteristics. Moreover, bivariate (chi-square and t-test) statistics were used to see whether there was an association or difference between household food insecurity situation and the different independent variables. A multivariate statistical analysis, binary logit model, was used to identify the determinants of household food insecurity among the rural households surveyed.

For this study the Logit model was employed. The logistic function was used because it represents a close approximation to the cumulative normal distribution and is simpler to work with. Moreover, as Train (1986) pointed out, a logistic distribution has got advantage over others in the analysis of dichotomous outcome variable in that it is extremely flexible and easier model from a mathematical point of view and lends itself to a meaningful interpretation and relatively inexpensive to estimate.

Following Pindyck and Rubinfeld (1981) the cumulative logistic probability

$$P_i = F(Z_i) = F[\alpha + \sum(\beta_i X_i)] = \left[\frac{1}{1+e^{-[\alpha+\sum(\beta i Xi)]}}\right]$$

function is specified as:

Where:

e: represents the base of natural logarithms (2.718)
x_i: represents the i^{th} explanatory variable
P_i: the probability that a household is being food insecure given x_i,
α and β_i: regression parameters to be estimated

Interpretation of the coefficients could be understandable if the logistic model can be written in terms of the odds and log of odds (Hosmer & Lemeshow, 1989). The odds ratio is the probability that a household would be food secure (P_i) to the probability of a household being food insecure (1 - P_i).

$$1 - P = \frac{P_i}{1+e^{-zi}}$$

And putting them using natural logarithm:

$$Z_i = L_n \left[\frac{P_i}{1-P_i}\right] = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n$$

Where:

Z_i: represents is a function of explanatory variables xi
a: intercept
β's: the slope parameters in the model

VARIABLES SPECIFICATION

The household food insecurity is a dichotomous dependent variable in the model taking a value of 1 if a household is food insecure and 0 otherwise.

The independent variables in the model expected to have association with food insecurity were selected based on available literature and during exploratory data collection before the survey work started. The variables include various socio-economic, demographic and institutional factors: household size, age of the household head, sex of the household head, marital status, educational level, farm size, extension service, and access to farm credit, off-farm activities, application of chemical fertilizer, livestock ownership in TLU, application of improved seeds and so on.

Food insecurity at household level is best measured by direct surveys of expenditure, income, consumption, and by comparing it with the minimum subsistence requirement. However, in this study the total household caloric consumption per adult equivalent was taken to compute proxy indicators of food insecurity. To identify food secure and insecure households, food items consumed by the households were collected from available sources (home production, purchase and/or gift/loan/wage in kinds), for seven days. Then the data were converted into kilocalorie using FAO's food composition table prepared for the Ethiopian context (EHNRI, 1998) and then divided by households per adult equivalent (AE). Next the results were compared with the minimum requirements (2100 Kcal) per day per adult equivalent (MOFED, 2008). Accordingly, households whose caloric consumption is less

Table 2: *Description of variables in the model*

Variable	Exp. Sign	Type of variable	Definition
Dependent variable:			
Household food insecurity (HHFIN)		Dummy	1 if the household is food insecure (< 2,100 Kcal/AE/ day) and 0 otherwise.
Independent variable:			
Age of household head (AGE_HH)	-	Continuous	Age of the household head in years
Sex of household head (SEX_HH)	-	Dummy	1 if the household head is male and 0 otherwise
Marital status of household head (MAR_STA_HH)	-	Dummy	1 if the household head is married and 0 otherwise
Educational level of HH head (EDU_STA_HH)	-	Dummy	1 if the household head is literate and 0 otherwise
Household/Family size (HHSIZE)	+	Continuous	Family size in adult equivalent
Access to credit (ACCREDIT)	-	Dummy	1 if the household received credit and 0 otherwise
Livestock ownership (LIVSTO)	-	Continuous	Livestock holding of the household in TLU
Agricultural extension service (EXTSER)	-	Dummy	1 if the household has access to credit or 0 otherwise
Size of cultivated land (CULTLAND)	-	Continuous	Cultivated land holding of the household in hectare
Participation in off-farm activities (OFFFARM)	-	Dummy	1 if the household participates in off farm activities; and 0 otherwise
Application of chemical fertilizer (CHEMFERT)	-	Dummy	1 if the household applied fertilizer and 0 otherwise
Application of improved seed (IMPRSEED)	-	Dummy	1 if the household used improved seeds and 0 otherwise

Source: author's field survey, 2015.

than 2100 Kcal/day/AE are said to be food insecure and those households whose per capita kilocalorie is greater than or equal to 2100 Kcal/day/AE are set to be food secure. Once the unit is categorized as food secure and insecure households, the next step was the identification of the determinant factors that affect household food insecurity in the study area using household survey.

RESULTS AND DISCUSSION

Table 3 presents the prevalence (extent) of food insecurity in the study area. The sample data was based on responses from household heads. A total of

200 households from four *kebele*s were interviewed with a response rate of 100%. Food insecure and secure households were identified based on calorie intake extracted from the pattern of food consumption of each household. According to MoFED's (2008) cut-off value (2100 Kcal), the survey result revealed that 143 (71.5%) and 57 (28.5%) of the sampled households were categorized as food insecure and secure, respectively.

The descriptive statistics for continuous and discrete variables were presented separately for the sake of understanding. Table 4 reveals distribution of household food insecurity characteristics based on continuous variables. The result showed that the mean per capita kcal available for the household per adult equivalent per day for the entire sample size was found to be 1870.47 kcal with a standard deviation of 739.37 kcal. The survey also indicated that the mean value of the energy available for food insecure and secure households was 1,466.8 kcal/day/ AE and 2,883.1 kcal/day/AE, respectively.

Age of household was considered as one of the potential variables that would have high contribution for food insecurity. As can be seen from Table 4, the average age of the sample household heads was 48.7 years whereas the minimum was 20 years and the maximum was found to be 75 years. The mean age of food insecure household heads was 45.74 years with a standard deviation of 11.78 while the mean age of food secure household heads was found out to be 56.2 years with a standard deviation of 8.98. The independent sample t-test revealed a significant difference between the

Table 3: *Prevalence (extent) of household food insecurity in the sample households*

Food security status	Frequency	Percent
Food secure households	57	28.5
Food insecure households	143	71.5
Total	200	100.00

Source: author's field survey, 2015.

mean age of food insecure and secure households at ($t= -6757$, $p<0.01$).

As it is shown in Table 4, the mean household size of the sample households was 5.56 persons, with 1 and 11 being the minimum and the maximum, respectively. When we compare the mean household size between food insecure and secure households, the result revealed that the mean household sizes for food insecure and secure households was 5.43 and 5.88, respectively. The independent sample t-test revealed there is no significant difference between the mean household sizes of the food insecure and secure households at ($t= -1.367$, $p>0.1$).

Farmland is one of the most important assets for rural households. The cultivated land holding of the sample households varies from 0.25 ha to 6

Table 4: Household food insecurity status based on continuous variables

Variables	Total (N=200)		Food Insecure (N= 143)	Food Secure (N = 57)	t-value
	Min (Max)	Mean (SD)	Mean (SD)	Mean (SD)	
Age	20 (75)	48.7 (12)	45.74 (11.8)	56.2 (8.98)	-6.757*
Household size	1 (11)	5.56 (2.1)	5.43 (1.99)	5.88 (2.25)	-1.367
TLU	0 (13.13)	4.98 (3.23)	3.65 (2.62)	8.3 (1.99)	-13.563**
Cultivated land (ha)	0.25 (6)	1.46 (1.12)	1.45 (1.17)	1.48 (0.98)	-0.215*
Food energy required	860.9 (3932.3)	1870.5 (739.4)	1466.8 (341.3)	2883.1 (432.8)	-24.472

Source: author's field survey, 2015.
Note: *and ** significant at 1% and 5%, respectively.

hectares. The mean household cultivated land size was 1.46 hectare while the mean household cultivated land size for food insecure and secure households were 1.45 and 1.48 hectare, respectively. The independent sample t-test revealed a significant difference the mean cultivated land size between food insecure and secure households at ($t= -0.215$, $p<0.01$).

In this study livestock owned by households was measured in Tropical Livestock Unit (TLU). The mean TLU of all the households was 4.98 with a standard deviation of 3.23. Correspondingly, the mean TLU of food insecure households was 3.65 with a standard deviation of 2.62 while the mean TLU for food secure households was 8.3 with a standard deviation of 1.99 (see Table 4). The independent sample t-test showed a significant mean difference in TLU between food insecure and secure households at ($t= -13.563$, $p<0.01$).

Table 5 indicates household food insecurity characteristics based on discrete variables. According to the survey result, 80.5% of the sample households were male headed and the rest (19.5%) were female headed. As can be seen in Table 5, male and female headed food insecure households accounted 84% and 16%, respectively and. The chi-square result also indicated a significant association between the two groups in terms of sex of household heads as shown by ($c^2=3.73$, $p<0.1$).

Regarding the marital status of the household heads the study found out that the majority (79.5%) of the sample households were married while others (20.5%) were unmarried. When we compare the marital status of food insecure and secure households 83% and 70% were married, respectively. When independently observed the chi-square result showed a significant association between household food insecurity and marital status at ($c^2 =4.253$, $p<0.05$).

Similarly, the educational level of the sampled household heads was

assessed. The result (Table 5) indicated that 71.5% were illiterate while the remaining 28.5% were literate. The survey result also indicated that 32.9% of the food insecure and 17.6% of the food secure households were literate. The chi-square result also revealed a statistically significant association between household food insecurity and educational level at (c^2=4.696,

Table 5: Household food insecurity characteristics based on discrete variables

Variables	Overall (N=200)		Food insecure (N=143)		Food secure (N=57)		c^2
	No	%	No	%	No	%	
Sex of respondents							
Male	161	80.5	120	84	41	72	3.73***
Female	39	19.5	23	16	16	28	
Educational level							
Illiterate	143	71.5	96	67.1	47	82.4	4.696**
Literate	57	28.5	47	32.9	10	17.6	
Marital Status							
Unmarried	41	20.5	24	16.8	17	29.8	
Married	159	79.5	119	83.2	40	70.2	4.253**
Access to agricultural extension service							
User	149	74.5	102	71.3	47	82.5	2.656
Not-user	51	25.5	41	28.7	10	17.5	
Access to credit service							
Access	64	32	53	37.1	11	19.3	5.911**
Not access	136	68	90	62.9	46	80.7	
Participation in off -farm activities							
Participating	62	32	53	37	11	19.3	4.86**
Not-participating	138	68	90	63	46	80.7	
Applying chemical fertilizer							
User	61	30.5	25	17.5	42	74	5.271**
Non- user	139	69.5	118	82.5	15	16	
Applying improved seeds							
Applying	53	26.5	7	4.9	46	80.7	8.27**
Not-applying	147	73.5	136	95.1	11	19.3	

$p<0.05$).

Besides, in the study area, agricultural extension personnel who were trained in agricultural fields were assigned at rural *kebele*s. The extension program requires farmers to use package of chemical fertilizer, farm credit etc. The result revealed that 74.5% of the sample farming households have been users of agricultural extension services while 25.5% of them did not use extension services. When we compared food insecure and secure households' about 71.3% and 82.4% households got support from extension agents however the result of chi-square showed no significant relationship between household food insecurity and access to agricultural extension service at (c^2=2.656p>0.1).

In addition, the availability of agricultural credit to subsistence farmers who have little or no capital is an important component of small farm development programs. However, the farm credit is related with chemical fertilizer distributed through service cooperatives. But very few of the farmers have had access to Amhara Credit and Saving Institution. In line with this, of the total households, 32% of them had access to farm credit while 68% did not have access to farm credit. The chi-square result showed a significant association between household food insecurity and access to farm credit at (c^2 =5.911, p<0.01).

Moreover, in areas like Debark where drought-induced famine and food insecurity chronically persist and widespread, livestock and crop production alone is not enough to fulfill the households food security. Hence, with such limited conditions off-farm activities are needed as alternatives to address the situation of food insecurity. However, the result showed that the majority (68%) of the households did not participate in off-farm activities. When we compared food insecure and secure households about 37% and 19.3% of the sample households engaged in off-farm activities, respectively. The result from chi-square showed a significant association between household food insecurity and engaging in off-farm activities at (c^2 =4.86, p<0.01).

Furthermore, appropriate application of modern farm inputs: chemical fertilizers, improved seeds and herbicides increases crop productivity. The importance of modern farm inputs becomes more significant in highly eroded soils and fragile environments like Debark *woreda* to enhance the overall agricultural production. In this regard, households were asked whether they used modern farm inputs since last year (2014). About 69.5% of the sample households reported that they did not use chemical fertilizers. As fertilizer usage decreases the household becomes more food insecure. Consistently, the chi-square analysis also indicated a significant association between household food insecurity and application of chemical fertilizer at (c^2 =5.271, p<0.01).

Concerning the use of improved seeds, it was found out that very few improved varieties are available in the study area. The survey result revealed 73.5% of the sample households did not use improved seeds whereas 26.5% of the sample households used improved seeds. When we compare the two groups, 80.7% and 4.9% of food secure and insecure households used improved seeds, respectively while 19.3% and 95.1% of food secure and insecure household did not use improved seeds, respectively. The chi-square result showed a statistically significant

association between household food insecurity and use of improved crop varieties at (c^2 =8.27, p<0.01).

In order to analyze the determinants of household food insecurity the logistic regression model was estimated using enter method of Maximum Likelihood Estimation, which is available in SPSS version 20. A total of 12 explanatory (8 discrete and 4 continuous) variables were included in the model analysis on the basis of theoretical explanations and the results of various empirical studies. (see Table 6)

Model result from the model (-2Log likelihood = 24.277) and goodness-of-fit statistics (x2 = 214.768, p = 0.000) showed that the likelihood ratio for all explanatory variables are different from zero and the model fits the data very well. The model result shows the logistic regression model correctly predicts 98% of the sample households. The sensitivity (correctly predicted food insecure) was 99.3% of the sample households and specificity (correctly predicted food secure) of the logit model was 94.7% (see Table 6). This indicated that the model has estimated both groups very well. The result and interpretation of the significant explanatory variables in the model are presented below.

Model result from the model (-2Log likelihood = 24.277) and goodness-of-fit statistics (x2 = 214.768, p = 0.000) showed that the likelihood ratio for all explanatory variables are different from zero and the model fits the data very well. The model result shows the logistic regression model correctly predicts 98% of the sample households. The sensitivity (correctly predicted food insecure) was 99.3% of the sample households and specificity (correctly predicted food secure) of the logit model was 94.7% (see Table 6). This indicated that the model has estimated both groups very well. The result and interpretation of the significant explanatory variables in the model are presented below.

The maximum likelihood estimates of the logit model showed that seven variables: AGE_HH, EDUC_HHH, TLU, CULT_LAND, ACC_CREDIT, CHEM_FERT and ACC_IMP_SEED were found to be significant determinants which influence household food insecurity in the study area, and all the variables get the expected direction (sign).

The result of the logit model revealed that the coefficient of age of the household head was hypothesized to have negative influence on household food insecurity. The sign of the coefficient of change in age of the household heads showed a negative relationship with food insecurity and is statistically significant at (p<0.05). This means that an increase in the age of the household heads decreases the probability for the households to become food insecure. The result of the model revealed that keeping other factors remain constant, the odds ratio in favor of food insecurity decreased by a factor of 0.861 when the age of the household head increased by one year. The possible explanation is that as the household head gets older, he/ she could have more experience in farming operation, climatic knowledge, and use better planning than the younger ones. Hence, they can have better chance of not being food insecure. This finding is consistent with the

Table 6: *The maximum likelihood estimates of the logit model*

Variables	B	SE	Wald	Sig.	Exp (B)
SEX_HHH (1) (Categorical)	1.191	1.860	.410	.522	3.290
AGE_HHH	-.149	.073	4.191	.041**	0.861
EDUC_HHH (1) (Categorical)	-3.822	2.680	2.034	.054*	0.022
MARSTA(1) (Categorical)	-2.043	6.241	3.724	.124	.056
HH_SIZE	.658	.514	1.640	.200	1.931
TLU	-1.632	.665	6.011	.014**	0.196
LAND_CULT	-1.351	.738	3.348	.067*	0.860
AGR_EXT_SERV (1) (Categorical)	.042	1.633	.001	.980	1.043
OFF_FARM_ACTIVITY (1) (Categorical)	1.435	1.637	.768	.381	4.198
ACCESS_CREDIT (1) (Categorical)	-.184	2.882	.004	.049**	0.202
CHEM_FERTILIZER (1) (Categorical)	-3.632	2.108	5.139	.008***	0.190
ACC_IMP_SEED (1) (Categorical)	-4.085	2.970	2.690	.017**	0.011
CONSTANT	12.969	6.732	3.712	.054*	
Number of observation (sample size): 200					
Pearson chi-square: 214.768					
-2Log likelihood: 24.8					
Pseudo R^2 94.4%					
Correct prediction (Count R^2) 98%					
Specificity: 94.7%					
Sensitivity: 99.3%					
Note: *, ** and *** significant at 10%, 5% and 1% probability level, respectively					

Source: Model Output (2015).

findings of Bogale and Shimelis (2009), Benjamin, Asogwa and Joseph, Umeh (2012) and Meseret (2012) which revealed that household food insecurity decreases when age of the household heads increase.

As hypothesized, education equips individuals with the necessary knowledge as to how to make a living and to quickly adopt new technology. This is because as agriculture is a dynamic occupation, the conservation practices and agricultural production technologies are always coming up with better knowledge. The model results show that education had a negative and significant influence on household food insecurity at (-3.822: p=0.054). The possible justification for this finding was that literate farming

household heads are more willing to implement agricultural extension advice, to use modern agricultural technologies, and to diversify their source of income than the illiterate ones. This finding is in line with prior research findings of Amsalu et al. (2012), Gezemu (2012), and Amsalu and Wendimu (2014) who stated that education changes the attitude of individuals and also improves the productivity of households.

Similarly, total livestock units (TLU), a measurement of household livestock ownership which was negatively related with household food insecurity and statistically significant at ($p<0.05$). The negative sign of slope coefficient indicated that when livestock owned increases by one TLU, the probability of a household to become food insecure, ceteris paribus, decreases by a factor of 0.196. The possible reason is that livestock in rural area are considered as liquid asset and a means of hedging risk against food insecurity. The finding of the present study is consistent with prior research findings of Shiferaw et al. (2003), Meseret (2012) and Mesefin (2014), who indicated that, besides its contribution to the subsistence need and nutritional requirement, livestock provides manure and serves as accumulation of wealth which can be disposed during times of need, especially when food stock in the household deteriorates.

In agreement with a priori hypothesis, the relationship between cultivated land size and household food insecurity is negative and the coefficient is statistically significant at ($p<0.1$). The negative sign of slope coefficient indicates that when cultivated land size increases by one unit, the probability of a household to become food insecure, ceteris paribus, decreases by a factor of 0.860. The possible explanation is that households who had larger cultivated land size had relatively better chance to produce more, to diversify the crop they produce and to be food secure than household heads who had not. This result is consistent with the findings of Shiferaw et al. (2003), Bogale and Shimelis (2009), Amsalu et al. (2012), Mesefin (2014), Amsalu and Wendimu (2014). The results of their studies indicated that households with small cultivated land size are more likely to be food insecure and vice versa.

The other significant predictor of household food insecurity was access to credit. It was found out that access to credit has a negative and statistically significant influence on household food insecurity. The negative relationship indicates that households who have access to credit have a lower probability of being food insecure. The result implies that access to credit is an important source of investment, a means of income generation which enables them to perform different activities and to normalize consumption at hard times. This result is in conformity with the findings of Ayantoye et al. (2011), Gezemu (2012), Abimbola, Adepoju and Kayode, Adejare (2013), Amsalu and Wendimu (2014), which showed that a household which has access to credit is less likely to be food insecure.

Consistent with the hypothesis, application of chemical fertilizer has a negative and significant influence on household food insecurity at ($p<0.01$). This can be justified by the fact that those households who used chemical fertilizer were less likely to be food insecure than their counterparts. This

finding is also supported by the findings of Bezabih (2000), Fekadu and Mequanent (2010), Yishihake, Fishseha, and Solomon (2015), which indicated that the use of chemical fertilizer has been perceived as a factor of improving productivity, and hence households are less likely to be food insecure.

The model also revealed that application of improved seed has a negative and statistically significant influence on household food insecurity at ($p<0.05$). The negative sign implies that the likelihood of food insecurity decreases as the households' use of improved seeds increases. The likely explanation is that households who used improved seeds have a chance of getting high production which in turn would enable them to become food secure. This finding is also in consonance with the findings of Avadogo, Reardon, Pietola (1998), Asfaw and Shiferaw (2010). The results of their studies revealed that application ot improved seeds augmented agricultural productivity by boosting overall production and this in turn decreases the likelihood of household to become food insecure.

CONCLUSIONS AND IMPLICATIONS

The aim of this study was to examine the extent of household food insecurity and identifying its determinants among rural households in Debark *woreda*, Northwest Ethiopia. The study employed a household based cross-sectional survey. The population for this study is the set of entire households residing in rural area of Debark *woreda*. A total of 200 farming households were randomly selected using systematic sampling technique. To identify food secure and insecure households, food items consumed by the households from available sources during the last seven days before the survey day were collected. Then, household survey was employed to ask the respective households directly regarding food insecurity issues. Data were analyzed using both descriptive and inferential statistics.

The result of this study showed 71.5% and 28.5% of the farming households were found to be food insecure and food secure, respectively. The result of chi-square and t-test statistics revealed there are statistically significant associations and/or differences between household food insecurity and household demographic and socio-economic characteristics. Furthermore, the binary logit model output revealed age of household heads, education level, TLU, cultivated land size, access to farm credit, applying chemical fertilizer and improved seed were found to be statistically significant with the hypothesized sign in determining household food insecurity. Thus, the finding indicates the determinants of household food insecurity are complex and call for multifaceted interventions.

Based on the finding the following suggestions are made in an attempt to address household food insecurity in the study *woreda*: strengthening informal education and skill training centers to farming households in order to give due attention to improve household food security and upgrade their production potential. In addition, enhancing and expanding rural credit service can help farming households in solving capital problem to

buy modern farm inputs, farm oxen, start off-farm activities, and further enhancing use of technologies. Moreover, due to population pressure and the emerging of new farming households every year, land fragmentation continued in the *woreda*. Hence, an attempt can be made to increase the size of landholding of farming households in the short run possibly by resettling farming households to other parts of the region, where better land resources available. Similarly, the introduction and use of different varieties of improved seeds could contribute to augmenting agricultural production and improving the food security situation of farming households. Thus, due attention should be given by the relevant actors.

LIMITATIONS OF THE STUDY

The study used a 7 day recall method in assessing the various sources of food used by the households. Hence, the data obtained could be affected by the memory of the respondents since the time period between their experiences and the survey period could be relatively long. Therefore, these issues must be taken into account when analyzing the household food insecurity situation in the study area.

ACKNOWLEDGEMENTS

The author would like to thank all the participants in this study for providing the necessary information during data collection. This study could not have been completed without the guidance and moral support of several people. The author is grateful for all the support received from all of them.

REFERENCES

Adepoju, Abimbola O., & Adejare, Kayode A. (2013). Food Insecurity Status of Rural Households during the Post-Planting Season in Nigeria. *Journal of Agriculture*, *4*(1), 16-35.

Alem Shumiye. (2007). *Determinants of Food Insecurity in Rural Households in Tehuldre Woreda, South Wollo of the Amhara Region* (Master's thesis). Addis Ababa University.

Amsalu Mitiku, Bekabil Fufa & Beyene Tadese. (2012). Analysis of Factors Determining Household Food Security in Pastoral Area Oromia Region, Moyale District, Ethiopia. *International Journal of Agricultural Science, Research and Technology*, *2*(3), 105-110.

Amsalu Mitik & Wendimu Legesse. (2014). The Determinants of Rural Households' Vulnerability to Food Insecurity in Jimma Zone, Southwestern Ethiopia. *J. Biol. Chem. Research*, *31*(1), 62-72.

Arega Bazezew. (2012). Determining Food Security Indicators at Household Level in Drought Prone Areas of the Amhara Region of Ethiopia: The Case of Lay Gayint District. *Ethiopian Journal of Environmental Studies and Management*, *5*(4), 422-434.

Asfaw Solomon & Shiferaw Bekele. (2010). *Agricultural Technology Adoption and Rural Poverty: Application of Endogenous Switching Regression for Selected East African Countries* (AEASA) Conference, Cape Town, South *Africa.*

Ayaleneh Bogale & Abebaw Shimelis. (2009). Household Level Determinants of Food Insecurity in Rural Areas of Dire Dawa, Eastern Ethiopia. *African Journal of Food Agriculture Nutrition and Development, 9*(9), 1914-1926.

Ayantoye, K., Yusuf, S., Omonona, B. & Amao, J. (2011). Food Insecurity Dynamics and its Correlates among Rural Households in South Western Nigeria. *International Journal of Agricultural Economics and Rural Development, 4*(1), 43-55.

Bazabih Emana. (2000). *The Role of New Varieties and Chemical Fertilizer under Risk: The Case of Small Holders in Eastern Oromia, Ethiopia* (Doctoral dissertation). University of Hannover.

Benjamin C. Asogwa & Umeh, Joseph C. (2012). *Food Insecurity Determinants among Rural Farm Households in Nigeria. International Conference on Ecology, Agriculture and Chemical Engineering (ICEACS) December 18-19, Phuket (Thailand).*

Berhanu Gezu (2001). *Food Insecurity in Ethiopia: The Impact of Socio-political Forces*. Working Paper No. 102. Research Center on Development and International Relations (DIR), Aalborg University, Denmark.

Birara Endalew, Mequanenet Muchie & Samuel Tadesse. (2015). Assessment of Food Security Situation in Ethiopia: Review. *Asian J. Agric. Res.*, 1-14.

Carlson, S.J., Andrews, M.S., & Biekel, G.W. (1999). Measuring Food Insecurity and Hunger in the United States: Development of a National Benchmark Measure and Prevalence Estimate. *J Nutr, 129* (2S Suppl), 510S-516S.

Central Statistical Agency (2010). *The 2007 Population and Housing Census of Ethiopia*. National Statistical Summary Report. Addis Ababa, Ethiopia: Population Census Commission.

Cook, J.T., & Frank D. A. (2008). Food Security, Poverty and Human Development in the United States. *Annals of the New York Academy of Sciences, 1136*, 193-209.

Degefa Tolossa (2002). Household Seasonal Food Insecurity in Oromia Zone: Causes. *OSSREA Research Report No.* 26, Addis Ababa: Organization for Science Research in Eastern and Southern Africa, 2-9.

EHNRI (Ethiopian Health and Nutrition Research Institute). (1998). Food Composition Table for use in Ethiopia. Part III and IV. Addis Ababa. 6, 41-46.

EHNRI. (1998). Food Composition Table for use in Ethiopia. Part III, from 1968-1997. *Ethiopian Health and Nutrition Research Institute* (pp. 1-34). Addis Ababa: Government of Ethiopia.

Fekadu Beyene & Mequanent Muche. (2010). Determinants of Food Security among Rural Households of Central Ethiopia: An Empirical Analysis. *Journal of International Agriculture, 49*(4), 299-318.

Food and Agricultural Organization (2012). *The State of Food Insecurity in the World: Food and Agriculture Organization of the United Nations*. Rome.

Frehiwot Fantaw. (2007). *Food Insecurity and its Determinants in Rural Households in Amhara Region.* School of Graduate Studies,

Faculty of Business and Economics, Department of Economics, Addis Ababa University.

Girma Gezemu. (2012). Determinants of Food Insecurity among Households in Addis Ababa City, Ethiopia. *Interdisciplinary Description of Complex System*, *10*(2), 159-173.

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

Keatinge, J.D.H., Yang, R.Y., Hughes, J.d'A., Easdown, W.J., & Holmer, R. (2011). The Importance of Vegetables in Ensuring Both Food and Nutritional Security in Attainment of the Millennium Development Goals. *Food Security, 3*(4), 491-501.

Keino, S., Plasqui, G., van den Borne, Bart. (2014). Household Food Insecurity Access: A Predictor of Overweight and Underweight among Kenyan Women. *Agric. Food Secur*, *3*(2), 1-8.

Khush, G. S., Lee, S., Cho, J.I., & Jeon, J. S. (2012). Biofortification of Crops for Reducing Malnutrition. *Plant Biotechnology Reports, 6*, 195-202.

Mazumdar, S. (2012). Assessing Vulnerability to Chronic Under-Nutrition among Under-Five Children in Egypt: Contextual Determinants of an Individual Consequence. *International Journal of Population Research*, *2012*. doi: 10.1155/2012/939541

Meseret, M. (2012). Household Food Security Status and Coping Strategies in Humbo Wereda, SNNPRS, Ethiopia. *International Journal of Sciences: Basic and Applied Research*, *6*(1), 64-82.

Mesfin, W. (2014). Determinants of Household Vulnerability to Food Insecurity in Ethiopia: Econometric Analysis of Rural and Urban Households. *Journal of Economics and Sustainable Development*, *5* (24), 70-79.

Ministry of Finance and Economic Development (2013). Development and Poverty in Ethiopia, 1995/96-2010/11. Addis Ababa, Ethiopia: MoFED, Federal Democratic Republic of Ethiopia.

Ministry of Finance and Economic Development (2008). Dynamics of Growth and Poverty in Ethiopia (1995/96-2004/05). Addis Ababa, Ethiopia: MoFED, Federal Democratic Republic of Ethiopia.

Morduch, J. (1995). Income Smoothing and Consumption Smoothing. *Journals of Economic Perspectives*, *9*, 103-114.

Pindyck, S. and Rubinfeld, L. (1981). *Econometric Models and Economic Forecasts* (2nd ed.). New York: McGrew-Hill.

Ramakrishna, G. and Assefa, D. (2002). An Empirical Analysis of Food Insecurity in Ethiopia: The Case of North Wollo. *African Development*, *27*(1&2), 127-143.

Ramanaiah, M. & Gowri, C. (2011). A Review of Ethiopian Micro Finance Institutions and Their Role in Poverty Reduction: A Case Study of Amhara Credit and Saving Institution. *African Journal of Business Management*, *5*(20), 8117-8124.

Savadogo, K., Reardon, T., & Pietola, K. (1998). Adoption of Improved Land Use Technologies to Increase Food Security in Burkina Faso: Relating Animal Traction, Productivity, and Non-Farm Income. *Agric Sys, 58(3), 441-464.*

Seligman, H. Laraia, B. & Kushel, M. (2010). Food Insecurity is Associated with Chronic Disease among Low-income NHANES Participants. *J*

Nutr, *140*(2), 304-10.

Shiferaw, F., Richard, R.L., & Christy, G. (2003). Determinants of Food Security in Southern Ethiopia. A Selected Paper Presented at the 2003 American Agricultural Economics Association Meetings in Montreal, Canada. *Agricultural Economics*, *33*, 351-363.

Smith, Lisa C., & Ali Subandor (2007). *Measuring Food Security Using Household Expenditure Surveys*. Washington D.C.: International Food Policy Research Institute.

Strintzos, M. and Mulugeta Berhanu (2009). Ethiopia Shifting Paradigms: Famine Prevention. In A. Sagro & A. Naerstad (Eds.) *Good or Bad Aid for Agricultural and Rural Development? Case Studies and Overview of Support for Agriculture and Rural Development* (pp. 23-36). Rome: More and Better Campaign.

Temesgen, T. (2010). Food Security Situation in Ethiopia. The Case of Amhara National Regional State. *Journal of Economic Studies*, *50* (1&2), 55-74

Tilaye, T. (2006). Food Insecurity: Extent, Determinants and Household Coping Mechanisms in Gera Keya Woreda, Amhara Region. In A. Ermias, T. Akalu & A. Alemayehu (Eds.), *Proceedings of the 1st Annual Regional Conference on Completed Crop Research Activities*. Bahir Dar: Amhara Regional Agricultural Research Institute.

Train, K (1986). *Qualitative Choice Analysis: Theory, Econometrics and an Application to Automobile Demand*. Cambridge: The MIT Press.

Workneh Negatu (2004). *Reasons for Food Insecurity of Farm Households in South Wollo, Ethiopia: Explanations at Grassroots*. Collaborative Research Program, Basis, Department of Agriculture and Applied Economics, University Wisconsin Madison.

Yared, A. (1999). *Household Resources, Strategies and Food Security in Ethiopia. A Study of Amhara Households in Wogda, Northern Showa*. Addis Ababa: AAU Press.

Yishihake, E., Fisseha, A., Fisseha, A., & Solomon, T. (2015). Determinants of Food Insecurity and Coping Mechanisms among Rural Farm Households: The Case of Shasogo and East Badewacho Districts, Hadiya Zone, South Nations, Nationalities People Region, Ethiopia. *International Journal of Science and Research*, *5*(11), 1155-1161.