Journal of Poverty, Investment and Development
ISSN 2422-846X An International Peer-reviewed Journal
Vol.32, 2017

Determinants of Rural Household Food Security in Wolaita Zone: The Case of Humbo Woreda

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Abstract
Among sub-Saharan Africa, Ethiopia remains one of the poorest and most food insecure countries of the world. Therefore, this study attempted to address the determinants of rural household food security in Wolaita zone, the case of Humbo Woreda, South Ethiopia with the objectives of assessing rural households' food security status and identifying the determinants of rural household food security in the study area. For this study a total of 120 households were selected from five rural kebeles by using systematic random sampling technique. Primary and secondary data sources were collected for this study. The data were analyzed using descriptive statistics and econometric regression models. Multiple linear regression model was applied to identify determinants of rural household food security. The survey result shows that from the total sample respondents 38.3% and 61.7% was food secure and insecure, respectively. The average and squared food insecurity gap among the food insecure households were found as 31.1% and 14.17% respectively. The model result shows out of 13 explanatory variables, about 6 variables had statistically significant relationship with household food security. Family size was negatively related with food security while the other variables (farm size, total livestock owned, and educational status of household head, use of credit and use of inputs) were positively related with household food security. Therefore, more attention should be given to limit the increasing population through awareness creation and provision of education about the use and benefits of family planning to both rural men and women to enhance household food security and also strengthen adult learning programme for those illiterate households. Attention should be given to credit advancing institutions such as microfinance and should make the loan available in time to the farmers and create awareness about repayment and how to use it and more attention should be given to livestock production and their management; strengthen animal health services through extension services. Furthermore, agricultural sector should be given close attention by providing improved agricultural inputs to rural farm households on time.
Keywords: Food security, Kilocalorie, Multiple Linear regression models, Humbo.

1. INTRODUCTION

1.1 Background of the study

In sub-Saharan Africa and Southern and Western Asia, the trend in hunger reduction can be accelerated to meet the MDG hunger target. While the MDG hunger target seems to be within reach globally, there is not enough time to achieve the World Food Summit (WFS) target of halving the number of undernourished people by 2015 (FAO, 2014). Despite the progress in developing regions as a whole, large differences remain across regions. In general, in Africa, there has been insufficient progress towards international hunger targets, especially in the sub-Saharan region, where more than one in four people remain undernourished, the highest prevalence of any region in the world. Nevertheless, the prevalence of undernourishment in sub-Saharan Africa has declined from 33.3 % in 1990–92 to 23.8% in 2012–14 (FAO, 2014). The SSA region is still challenged with rapid population growth which affects the ability of countries to assure stable supply of, and access to food. The population in the region has grown annually by 2.7 percent increasing from 507 million in 1990 to about 936 million in 2013 (FAO, 2015).

Among sub-Saharan Africa, Ethiopia remains one of the poorest and most food insecure countries of the world whereas Ethiopia reduced the proportion of its population living below the poverty line from 38.7% in 2004/5 to 29.6 % in 2010/11 but most of its population get below the minimum levels of dietary energy consumption compared with other sub-Saharan and developing countries (EU, 2014). Similarly WFP (2014) reported that the country economy has shown fast real GDP growth of about 11% per annum during the past eight years between 2004 and 2012, but the poverty level in Ethiopia made it to be ranked 173 out of 186 countries in human development index. In addition, EU, (2014) reported that Ethiopia is a low-income country with a per capita GDP of USD 409 in 2012. This is less than one third of the average USD 1258 for Sub Saharan Africa countries (World Bank, 2012).

In Ethiopia, the seriousness of food shortage varies from one area to another, depending on the state of natural resources and extent of development of food shortages. This condition was due to series of successive droughts, "poor and erratic" rainfall, global high food and fuel prices and global financial crisis (Tekel and Berhanu, 2015). To beat this situation, the government's Productive Safety Net Programme (PSNP) provides 8.3 million chronically food insecure households with reliable cash and/or food transfers during lean months. The PSNP, as part of the government's strategy for food security and the eradication of extreme poverty, represented

a key departure away from annual emergency food aid appeals towards a planned approach to food security and drought risk management (WFP, 2014).

The Southern Nations, Nationalities and Peoples Regional State (SNNPRS) is also one of the food insecure areas in Ethiopia. Report on regional disaster prevention and preparedness activities to regional agricultural bureau indicated that population number and area of the region facing food insecurity is increasing from time to time. And 1.5 million people in 64 Woreda of the region are vulnerable to chronic and transitory food insecurity. Many households are only able to produce sufficient food to meet their food requirements for less than six months of the year (DPPC, 2012).

Wolaita zone represents one of the major food deficits and famine-prone part of Ethiopia (Almaz B. *et al.,* 2015). Similarly Yeshak *et al.,* (2014) reported that the rural population in the Zone is frequently and increasingly vulnerable to droughts and famine. The SNNPRS livelihood profile 2005 shows that Wolaita Zone is characterized by chronic poverty and food insecurity (Almaz *et al.,* 2015).

The study area Humbo Woreda is one of the highly food insecure and one of the least self sufficient Woreda in Wolaita Zones in Southern Nation Nationalities and Peoples Regional State (SNNPRS) of Ethiopia (SNNPRFSD, 2012). The Woreda mainly depends on small scale subsistence agriculture to derive its livelihood. According to woreda agricultural office, it is reported that about 44.1% households have been benefited from safety net program since 2004 (HWAO, 2014). The aim of the program was to provide security against abrupt income changes and to improve availability and access to food to rural households (World Bank, 2010).

While the problems of food security have big diversity and multiple dimensions, which range from the global, regional, country, household to the individual level, so far in the study area little demand driven study was undertaken to elicit these problems. More attention was given to the country level. Moreover, the complex and interrelated causes of household food security problem were not studied in detail at individual household level. Given these all efforts, the question of how the different factors affect the food security situation reminded unanswered in the Woreda. Hence, it becomes very important to undertake research to identify factors determining rural household food security in study area. Therefore the main objective of this study is to identify the determinants of rural household food security in Humbo Woreda, with specific objectives: i) to evaluate the food security status of the rural household in the study area. ii) To identify the determinants of rural household food security in the study area

2 Statement of the Problem

According to FAO (2014) 11.3% of the global population (805 million) was unable to meet their dietary energy requirements in 2012–14. In developing countries 791 million of people lives in hungry that makes 13.5% of the overall population remain chronically underfed. Achieving food security for all people at all times remains a huge challenge for several developing countries including Ethiopia. MoFED (2013) reported that among the varieties of shocks Ethiopian households face, food insecurity and food price shocks are the most common ones.

On the other extreme it seems a paradox to hear that Ethiopia is one among the seven fastest growing country in the world while it is also being reported that in Human Development Index (HDI) Ethiopia is at the lower level. Thus it is wise to analyze areas where Ethiopia is performing good or bad. This enables the country target and prioritizes areas which need immediate intervention. "….. an accurate assessment of food insecurity, in terms of identifying who the food insecure are as well their number, location and the underlying causes of food insecurity will enable stakeholders to design appropriate interventions" (WFP, 2014: 22).

To overcome food security problem, Ethiopian government in collaboration with international donors have been formulating and implementing different strategies such as increasing the level and stability of production, increasing food reserve, and distribution of subsidize basic food items, increase job creation opportunity, increase private sector investment, improvement of wage for government employee, improving income, productive assets, and other market and non-market transfer and strengthening disaster prevention and preparedness capabilities through adequate early warning systems to attain food self sufficiency and reduce food aid dependency. But still food insecurity remains the main problem in the country and the need for food aid is increasing (Bogale *et al.,* 2014).

Similar to other food insecure areas of the country, Wolaita zone is well known for its fertility, population pressure and food insecurity. A rise in the rural population, particularly in the last 30 years, has resulted in an increased number of land claimants, some of which have used forests, steep mountain land or grazing land to establish their homesteads. Many others among the rural youth are landless. During times of food stress, the term "green famine" is often used to describe the situation (Adugna and Wagayehu, 2011). According to Wolaita Zone Food Security Department report (2013), 180,800 people received food aid apart from 319,006 safety-net beneficiaries in the year.

The study area (Humbo Woreda) is also known to be one of the areas with highest level of environmental degradation in the region. The rate of soil erosion has generally increased through time while the intensity of deforestation has shifted towards lowlands in recent times and the area is experiencing erratic rain

fall. Rural households in the study area face continuous food shortage and from the total population of the woreda about 44.1% (67,051 people) have been benefited from safety net program since 2004 (HWAO, 2014). According to Humbo Woreda Agricultural Office (2015) report food productions of major food item in the area have not been sufficient to satisfy the food demand of the increasing population and currently 15,550 people were benefited food aid due to climate change (Illino) and 38,765 people benefited from safety net programme. These indicate that the rural poor to depend on food aid for their survival. These problems exposed many people to vulnerable condition. Therefore, relief assistance is common and provided frequently in the area from government and non government organizations. Furthermore, the SNNPRS food security department in 2012 categorized Humbo woreda as primary hot spot woreda affected by food security problem in the zone.

Currently, many governmental and nongovernmental organizations are working in this area to ensure sustainable food security and to avoid seasonal food shortage at all levels. In spite of all these efforts, most rural households of the area are facing food shortage. In addition, the analyses of determinants of food security of rural households by the household's level remain a long-standing challenge. This study, therefore, attempted to fill the gap by conducting household level food security study.

Thus, evaluating the status of rural household food security and identifying determinants of rural household food security is the main drive of this study to guide policy decisions, devise appropriate interventions and integrated efforts to improve household food security in the study area.

3. METHODOLOGY

3.1 Descriptions of the Study Area

Humbo Woreda is one of 12 Woreda in the Wolaita zone (135 in SNNRP). The Woreda is located at a distance of 408 km (to the south) from Addis Ababa. It is 18 km to the Southern of Sodo town, the seat of Wolaita zone administration. The woreda has 40 rural kebele administrative. The total land coverage of the Woreda is 86,646 hector out of which 38,488.15 h/r (44.42%) is used to crops production, and the rest 48,157.85 h/r (55.58%) of the land is used for grazing, forest, degraded and small portion of land for other communal purposes (HWAO, 2014).

The total population of the Woreda is estimated to be 153,286 out of which 77,351 (50.5%) are male and 75,936 (49.5%) are female. The total number of household heads in the Woreda is 32,682 out of which 28,812 (88.16%) are men and 3,870 (11.84%) are women. The average household size is 4.88 (WZFED, 2014).

The *Woreda* is classified into two agro ecological zones, among them large proportion is Kola (low altitude) which is about 70% of the area; the rest 30% is described as Waina-Dega (mid-altitude). Agriculture is the main source of livelihoods of the people. However, the agricultural system is still traditional and is often characterized by low productivity. Farmers grow a variety of crops in the two seasons. Major crops grown in the *Woreda* include cereals, pulses and cash crops like, fruits, and root crops. Maize is the dominant cereal crops grown in the area (HWAO, 2014).

There are two agricultural production seasons; *meher* (long rainy season) and *belg* (short rainy season). The *meher* rains start in June and extends up to mid September, while the *belg* rainy season lasts from March to May. The *belg* season contributes the highest share to the annual crop production; and above 90% of the farmers operates in this season. However, the area is known for its low productivity due to erratic rainfall and prevalence of pests. As a result, income from non-farm and off-farm activities is the second most important source of livelihood in the *Woreda*. Especially, trading plays an important role in generating income for both non-farm and off-farm activities. Apart from trading, income from daily labor and seasonal workforce movement during harvest time is another source of income (HWAO, 2014).

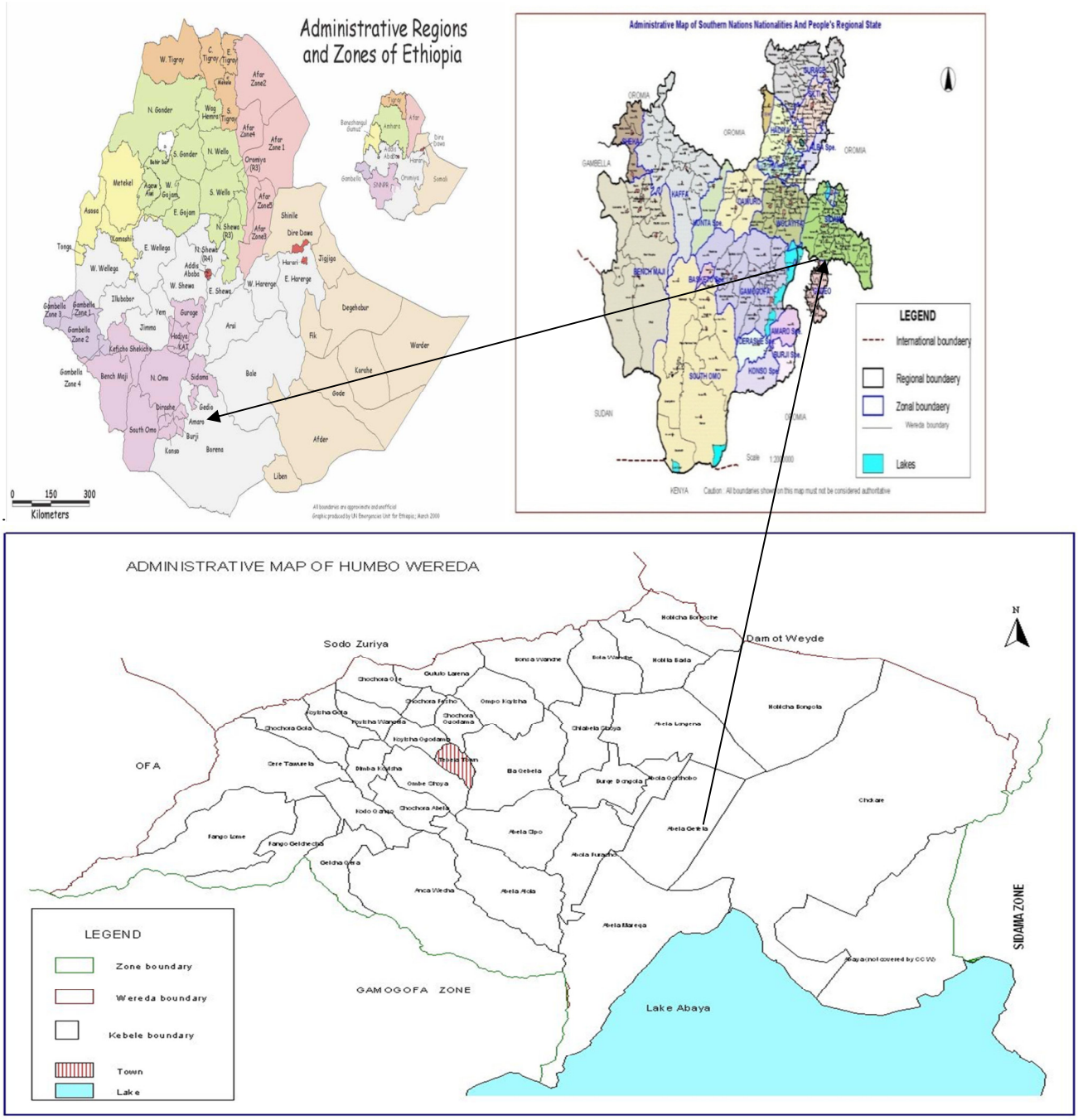

Figure 1: Map of the study area
Source: (WZFED, 2015)

3.2 Sampling Technique

$$n = \frac{N}{1 + N(e)^2}$$

The number of sample households was determined based on the Yamane (1967) formula /Where n is the sample size, N is the population size and e is the level of precision/. Multi-stage sampling technique was used to generate the required primary data. At the first stage, Humbo Woreda was selected purposively because the woreda has faced by food deficit (shortage) in every year and the population is supported by safety net program and food aid is common in the area (HWAO, 2014). In the second stage, five kebeles were selected by stratified sampling techniques because the woreda has two agro-ecological zone namely lowland (Kola) and midland (woyinadega). The woreda has totally forty kebeles out of which 28(70%)

kebeles are lowland and 12(30%) kebeles are midland. Therefore, from the total, 5 selected kebeles (3 kebeles from lowland and 2 kebeles from midland) were selected by using random sampling techniques. In the third stage a total of 120 respondents were selected from the five kebeles using systematic random sampling techniques. The number of sample household chosen from each kebele was proportional based on the total number of households in each kebele.

Table 1: Sample size of kebeles

Name of the sample Kebeles	Total HHs in the sample Kebeles				Sample size**
	Male	Female	Total	%*	
Abela Faracho	762	85	947	22.6	27
Abela Shoya	735	66	801	19.2	23
Demba Koyisha	492	87	579	13.8	17
Shochora Ogodama	673	99	772	18.4	22
Abaya Chokare	1020	63	1083	25.8	31
Total	3782	400	4182	100	120

* Percentage= (Total population in individual KA/Total population of all sample KAs) X 100
**Sample size= (PercentageX120/ 100)
Source: own survey, 2016

3.3 Methods of Data Collection and Analysis

This research employed both primary and secondary data. Primary data were collected using survey research methods. Conceptual generalization was used to analyze qualitative data; whereas descriptive statistics and multiple linear regression models were used to analyze quantitative data.

3.3.1 Type and method of data collection

Both qualitative and quantitative types of data were collected from primary and secondary sources. Primary data was gathered using structured questionnaire, key informant interview and focus group discussions. To complement the primary data, secondary data were collected from published and unpublished documents. Also related literatures were reviewed. The data were collected in the month of January 2016 year was the recall time for the collected data.

3.3.2 Methods of data analysis

In this study, descriptive statistics and econometric models were used to analyze the data collected from sample households. The quantitative types of data were analyzed using percentage, frequency, minimum, maximum and average. Information generated through key informant interviews and focus group discussions were qualitatively analyzed. After computing the descriptive statistics, multiple linear regression models were used to identify determinants of rural household food security. The data analysis was conducted using STAT version 12.

3.4 Measurements of food security status of sampled household

There are different methods of food security measurement widely used in most food security studies. In this study calorie intake is used as a direct proxy for physical food consumption as it is also the main proxy to tackle progress in mitigating food poverty in Ethiopia (MoFED, 2006). To measure the food security status of sampled household, Physical food consumption data were synthesized as follows. Using a structured questionnaire, respondents were asked to report food items consumed, in kind and amount purchased or otherwise, by their families in the two weeks preceding the survey. Converting the data into calories adjusted for household age and sex composition involved a series of steps. First, different units of local measurement were converted into a common measure for each food item. Second, the acquisition of each food item was converted to calories using the food composition table which was compiled by the Ethiopian Health and Nutrition Research Institute (EHNRI, 1997). Third, all food calories were added up and then converted into daily amounts. Finally, the aggregate food calories were adjusted in adult equivalent units per household to make a meaningful analysis of intra-household calorie intake. To get the household daily per capita calorie intake, the household per capita calorie intake was divided by 14 day. Fourth stage is comparison of the per capita per day calorie consumption with the standard requirement of 2200 kcal per capita per day calorie consumption which is set by (MoFED, 2013). The same Author expresses the 2200 kcal food poverty line as a calorie requirement that is only sufficient to an individual to walk and perform light tasks. Thus, those households beyond the estimated calorie requirement level (≥2200 kcal per person per day) were deemed to be food secure and otherwise food insecure.

3.4.1 Food insecurity index of sample household

In this section food insecurity gap, the severity index, and the head count ratio of food insecurity were calculated based on the recommended daily calorie requirement. The head count ratio (H) measures the percentage of the population of the households that are food insecure or secure. The food insecurity gap measures the extent to which poor households are food insecure. Finally, the squared food insecurity gap measures severity of food

insecurity among the food insecure households (Tekel and Berhanu, 2015). The implicit form of the model is as follows:

The food insecurity gap (P) measures the extent to which poor households are food insecure. This is given as:

$$\text{Food Insecurity Gap} = \frac{1}{M}\sum_{i=1}^{m} Gi$$

Where

M= the number of food insecure households

G_i = Per capita calorie intake deficiency intake for a household.

$$Gi = \frac{R - Y}{R}$$

Where, Y = Daily per capita calorie intake of i^{th} households.

R= the recommended per capita daily calorie intake

Therefore, Total Food Insecurity Gap (P), which indicates the depth of food insecurity among the food insecure households, is expressed as:

$$\text{Food Insecurity Gap } (P) = \frac{1}{M}\sum_{i=1}^{m} \frac{RI - Y}{R}$$

Finally, the squared food insecurity gap (L), which indicates severity of food insecurity among the Food Insecure Households, is given as:

$$\text{Food Severity Index } (L) = \frac{1}{M}\sum_{i=1}^{P} P^2$$

The head count ratio (H) measures the percentage of the population of the households that are food insecure/secure. From the above findings, the head count ratio could be calculated as:

$$\text{Head count index } (Hin) = \frac{M}{N}$$

Where

H_{in} is Incidence of Food Insecurity

M = Number of food insecure households and

N = the total sample size.

$$\text{Head count index } (Hs) = \frac{S}{N}$$

Where

Hs = Incidence of Food Security

S= Food secure household

N= total sample households

3.4.1 Model specification to identify determinates of household food security status

In this study, econometric model analysis was used to estimate relationships among demographic, economic, institutional and natural variables. Explanatory variables included selected socio-economic and biophysical factors that were assumed to influence food security of rural households in the study area. Changes in the dependent variable are explained by reference to changes in the explanatory variables. In the current study, the influences of different determinant factors on food security were quantified using Ordinary Least Squares (OLS). This was done by estimating the slope coefficients. The available kilocalories of each sample household were used as the dependent variable. The household food security determinants have been done following the regression technique in linear form. Because a linear regression model different from the logistic regression model is that the outcome variable in linear regression is continuous. Multiple regression analysis is more amenable to ceteris paribus analysis because it allows us to *explicitly* control for many other factors which simultaneously affect the dependent variable. This is important both for testing economic theories and for evaluating policy effects when we must rely on non experimental data (Gujarati, 2004).

Furthermore, multiple regression models can accommodate many explanatory variables that may be correlated; I hope to infer causality in cases where simple regression analysis would be misleading. Naturally, if we add more factors to the model that are useful for explaining *y*, then more of the variation in *y* can be explained. Thus, multiple regression analysis can be used to build better models for predicting the dependent variable. An additional advantage of multiple regression analysis is that it can incorporate fairly general

functional form relationships. In the simple regression model, only one function of a single explanatory variable can appear in the equation. Finally multiple regression models allows for much more flexibility (Wooldridge, 2002). In the same reason multiple regression analysis has been applied by a number of other researchers in food security studies such as Hoddinott and Yisehac (2002) and Frongillo and Jung Lee (1994) and E. Kaloi (2005) among others.

Following (Gujarati, 2004) multiple regression model was applied to identify the determinants of rural household food security.

$$Yi = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3,\ldots + \beta nXn + Ui \quad (1)$$

Where

Yi = is available kilocalories of the each sample household

$X_1, x_2\ldots, x_n$ = the explanatory variables

B_0 = the intercept

$B_1, B_{2\ldots} B_n$ = the coefficient of the parameters (slops)

U_i = the error terms

The existence of multicolinearity problems was checked before entering the selected variables in to the model in terms of variance inflation factor (VIF) for continuous and contingency coefficients for dummy and discrete variables, respectively. The reason for this is that the existence of multicolinearity affects seriously the parameter estimates. If multicolinearity turns out to be significant, the simultaneous presence of two variables was attenuate or reinforces the individual effects of these variables. However, omitting significant interaction terms incorrectly is leads to a specification bias. In a nut shell, the coefficients of the interaction of the variable indicate whether or not one of the two associated variables should be eliminated from model analysis (Kothari, 1990). Each selected continuous explanatory variables (X_j) is regressed with all the other continuous explanatory variables, the coefficient of determination (R_j^2) being constructed in each case. If an approximate linear relationship exists among the explanatory variables then this should show up as a large value for R_j^2 in at least one of the test regressions. A popular measure of multicolinearity associated with the VIF (X_j) is defined as:

$$VIF(Xj) = \left(1 - R_j^2\right) - 1$$

Where, R_j^2 is the coefficient of multiple determinations when the variable X_j is regressed on the other explanatory variable. A rise in the value of R_j^2 that is an increase in the degree of multi-co linearity does indeed lead to an increase in the variances and the standard errors of the OLS estimators. As a rule of the thumb, when the variables having VIF values less than the cut off value (10) is believed to have no multi-co linearity problems and those with VIF of above 10 is assumed to have a multi-co linearity problem (Gujarati, 1995).

Similarly, there may also be interaction between two qualitative variables, which can lead to the problem of high degree of association between two variables. To detect this problem, contingency coefficients was computed from the survey data. The contingency coefficients are compute as follows:

$$C = \sqrt{\frac{X^2}{N + X^2}}$$

Where

C= coefficient of contingency

X^2= chi-square random variable

N= total sample size

The problem of heteroskedasticity was checked before entering the selected variables in to the model in terms of two common ways to test for heteroskedasticity: the Breusch-Pagan test and a special case of the White test. Both of these statistics involve regressing the *squared* OLS residuals on either the independent variables (BP) or the fitted and squared fitted values (White).

Heteroskedasticity does not cause bias or inconsistency in the OLS estimators, but the usual standard errors and test statistics are no longer valid. We showed how to compute heteroskedasticity-robust standard errors and *t* statistics, something that is routinely done by many regression packages (Wooldridge, 2002). In this study endogeneity problem was also checked. Regressions in the presence of correlations between the error term and any of the repressors may result a biased estimate. The same holds true if there is reverse causality between the regressors and the dependent variable. In the food security literatures endogeneity is widely recognized.

3.5 Definitions of Variables and Hypothesis

3.5 .1 Dependent variable of the study

The dependent variable for this study is the available kilocalories of the sample household. It was hypothesized to be a function of the following variables.

3.4.2 Independent variables of the study

Different variables were affect food security status of rural households in the study area and they are listed below:

Age of household head: is a continuous explanatory variable measured by year. Older people have relatively richer experiences of the social and physical environments and greater experience of farming activities. Older household heads are expected to have better access to land than younger heads, because younger men either have to wait for land redistribution, or have to share land with their families (Haile *et al*., 2005). Thus, it is hypothesized that age of the household heads and household food security would be positively correlated.

Sex of household head: It is dummy variable and household head is a person who economically supports or manages the household. It could be male or female. Male headed households have more access to agricultural technologies, more labor power and farm land as compared to female headed households. Whereas, women farmers may need a long adjustment period to diversify their income sources fully and become food secure (Christina *et al*., 2001). Hence, it is hypothesize that male headed households are more likely to be food secured than female headed households.

Educational status of household head: is dummy variable and an important determinant of household food security status in that; educated households have a better chance of adopting soil conservation measures which in turn increases crop production (Million and Kassa, 2004). Moreover, educated household head has the capacity to innovate and to adopt timely technology and has better understanding of the cash crops that can help them to have a better income than the non-educated households (Fekadu, 2008). Thus, education status is hypothesized to have a positive effect on household food security.

Family size: is a continuous variable; it refers to the total number of household members who lived and eat with household at least for six months. It is an important variable which determines the state of household food security and expected to have negative effect on household food security (Mequanent, 2009). According to reviewed literatures, increasing family size tends to exert more pressure on consumption than the labor it contributes to production (Tsegay, 2009). Thus, family size is hypothesized to have a negative effect on household food security.

Total farm size: is a continuous explanatory variable and an important determinant of household food security. Farm size is the total area of land cultivated to food and cash crop by households, measured in hectares. Positive relationship has been established between farm size and improvement in households' income and food security (Jayne *et al*., 2005). Therefore, expected of a household with a larger farm size to be more food secure than a household with a smaller farm size.

Off-farm income: A dummy variable whether the household head works in off farm income or not. According to the data this study uses, off farm income is a situation by which the household earns income through participating in an activity out of his own farm. This could be in food for work or in a farm other than own farm. Holden *et.al* (2004) found that off farm activity has positive welfare implications. Hence, it is anticipated that households participate in off-farm activities have positive effect on food security than Non participant households.

Pest and disease: is dummy variable and one of the factors affecting production and reducing yield. FSB (Federal Security Coordination Bureau) (2007) reported that among the major challenges, pests and disease, plays grate role of food security in Ethiopia. Hence, it is expected that households affected by pest and disease have negative linkage with household food security than not affected households.

Dependency ratio: is a continuous variable and is measured as total household size divided by the number of individuals working to support the household. Due to the scarcity of resources, an increase in household size especially the non-working members put pressure on consumption than production (Aschalew, 2006, Ojogho, 2010). Therefore; it is hypothesized that dependency ratio would be negative related with household food security.

Total Livestock owned (TLU): is a continuous variable and is important source of livelihood. It contributes as source of transport, nutrition, and income. It also serves as a means of coping mechanism during shortage of food (Almaz *et al.,* 2015). The types of animal reared in the study area include cattle, sheep, goat, donkey and chicken. Therefore, it is expected a household with a larger number of livestock owned to be more food secure than a household with a smaller number of livestock owned.

Use of inputs: is dummy variable and refers to use of chemical fertilizer, improved seed, pesticide and herbicide. A household who could have used farm inputs hypothesized to have positive relation with food security status because he/she produce more (Mequanent *et al.*, 2014). Thus, it is hypothesized that household who used farm inputs would have a positive relation with household food security than non users.

Uses of Credit: Credit is dummy variable and gives the household an opportunity to be involved in income generating activities so that derived revenue increases and purchasing power of the household to escape from risk of food insecurity advances. Moreover, it helps to smooth consumption when household face with temporary food problem (Tekel and Berhanu, 2015). Thus, it is hypothesized that household who use credit would have positive relation with household food security than non users.

Frequency of extension contact: is continuous variable and the effort to disseminate new agricultural technologies are mainly successful if there is smooth and frequent contact between development agent and the rural household. Here, the extension contact between a farmer and development agent has the potential force to accelerate effective dissemination of adequate agricultural information that, in turn, enhances farmers' decision to adopt agricultural technologies (Kidane *et al,* 2005). Therefore, it is hypothesized that households having frequent extension contact would have positive relation with household food security than have no frequent extension contact.

Use of irrigation: is dummy variable and plays key role in production supplementing water during dry time. It is highly related with production of crops and livestock. Improvements in access to irrigation water serve a powerful tool to diversity food livelihoods and reduce vulnerability for small holder producers (Geberemedhin and Peden, 2008). Thus, it is hypothesized that households using irrigation would have positive relation with food security than non users.

Table 2: Variable definitions, measurement and hypothesis

Variable code	Description and measurements	Hypothesized sign
KILOCALORIE	The available kilocalorie of the sample household and measured in calorie.	
AGEHHH	Age of the household head (in years)	+
SEXHHH	Is a dummy variable taking the value 1 if the house hold head is male, 0 otherwise	+
FAMILYSIZE	Is the number of the households members	-
EDUCATIONSHHH	Is a dummy variable taking the value of 1 if the household is literate, 0 otherwise	+
USESOFCREDIT	Is the dummy variable taking the value 1 if the household uses credit, 0 otherwise	+
FRQEXNCONT	Number of time extension agent visited/advised farmer (number) per a year.	+
OFFARMINCOME	Is dummy variable taking the value 1 if the household participate on off farm income, 0 otherwise	+
TOTALLIVESTOCK	Total livestock owned by the farm household (TLU).	+
FARMSIZE	Total farm size of household (in hectare).	+
DEPENDACYRTIO	is measured total household size divided by the number of individuals working to support the household (in number)	-
PESTDESEASE	Is a dummy variable taking the value of 1 if the household is not affected by pest and disease, 0 otherwise	+
USEIRRIGATION	Is a dummy variable taking the value of 1 if the household is uses irrigation, 0 otherwise	+
USEOFINOUT	Is dummy variable taking the value 1 if the household uses inputs, 0 otherwise	+

4 RESULTS AND DISCUSSION

This chapter discusses the analytical results of the study. The first section of this chapter presents the descriptive results of the study. It is followed by the discussion of the econometric model results.

4.1 Descriptive Statistics

In this study, the descriptive analysis was addressed through description of characteristics of the sample households in terms of the major variables which include demographic characteristics (age of household heads, sex of household heads, family size, educational level of household heads and dependency ratio), institutional factors (credit access, extension service, use of farm input), economic factors (livestock ownership, off-farm income and total farm size) and natural factors (pest and disease and accesses to irrigation).

4.1.1 Household food security status of sample households

The result revealed that from the total sample households 61.7% and 38.3% of households were found food insecure and food secure, respectively. The mean calorie available for food insecure and secure households was 1,520.39 and 3,139.39 Kcal/AE/day, respectively. The mean calorie intake of all sample households was 2,141 kcal. The minimum and maximum energy intake for food insecure households was 381.15 and 2,192.60 Kcal, respectively. The minimum and maximum calorie intake of food secure households was 2,289.30 and 5,910.60 Kcal, respectively. The survey results show that the study area could be regarded as food insecure given the fact that only 38.3% of the households were able to meet the recommended calorie intake of 2,200 Kcal per person per a day. The t value (13.724) confirmed that there is significant mean difference between food insecure and

secure households (Table 3).

Table 3: Calorie intake of sample households by food security status

Calorie available per AE/kcal/	Food secure (N=46)	Food insecure (N=74)	Total (N=120)
Minimum	2289.30	381.15	381.15
Maximum	5910.60	2192.60	5910.60
Mean	3139.39	1520.39	2141.00
Standard deviation	793.24	500.27	1008.11
t-value = 13.724	p-value = 0.000***		

***significant at <1 probability level

Source: Own survey result (2016).

Food insecurity index of sample household

In this section food insecurity incidence, depth and severity were presented. The results revealed that the head count ratio or incidence of food insecurity was 0.617. This implies that 61.7% of the sampled households are not able to meet the daily recommended caloric requirement. On the other hand on average only 38.3% could meet the minimum threshold daily energy requirement. Food insecurity gap provides the possibility to estimate resources required to eliminate food insecurity through proper targeting. The food insecurity gap index (p) result of the study is 31.1% implying that food insecure household's calorie consumption fall by 31%, on average, below the minimum kilocalorie requirement i.e. 2200 kcals for active and healthy life. This implies that if it is possible to mobilize resources that can meet 31.1% of calorie requirement of every food insecure households and distribute to the recommended daily caloric requirements level, then theoretically food insecure can be eliminated (Table 4). The severity of food insecurity is measured as a weighted average of the square distance below minimum requirement. As the survey result indicated, the severity of food insecurity is 14.2% (Table 4).

Table 4: Food security index

Type	Result	Percentage
Incidence Food insecurity (Head count ratio)	0.617	61.7
Food insecurity gap index	0.31	31
Food severity Index	0.142	14.2

Source: Own survey result, 2016

4.1.2 Descriptive statistics for continuous variables

As table 5 depicted, 92.83 % of the sample respondent's age were found under the age group of 34-64 years. The maximum and minimum age of the sample respondents were 76 and 25 years, respectively. Moreover, the average age of sample respondents was 47.6 years. Thus, majority of the household's age found that they were considered as economically active age group; and not faced labor shortage in the study area. The average family size of sampled household was 4.13 and the maximum and minimum family size was 8.7 and 1.65 respectively. However, the majority of sample households (nearly 50%) have greater than 4 family sizes. The total dependency ratio is measured as total household size divided by the number of individuals working to support the household. The maximum dependency ratio of sampled households was 0.75 and an average dependency ratio was 0.41. About 70% of the household's dependency ratio falls under less than 0.5.

Livestock is an important source of livelihood in the study area. It contributes as source of transport, nutrition, and income. It also serves as a means of coping mechanism during shortage of food. The types of animal reared in the study area include cattle, sheep, goat, donkey and chicken. The average size of livestock holding is about 2.52 TLU varying from the minimum 0 to the maximum of 9.97 TLU. Among the total sample households, about 64.16% possess 0-3 TLU. During the focus group discussions most of the respondents noted that the study area is characterized by very small and highly fragmented landholdings because of higher density of population. The average farm size of sample households is about 0.97 ha, which is below the national average of 1.53 ha. The minimum and maximum farm size is 0.13ha and 3 ha respectively. Among the total sample households, about 78.33% possess less than one ha. In this study, it is a number of times extension agent's visited and advised farmer per a year. The maximum extension contact in the sample households is 36 times per a year. The average contact of DA's with sample households is about 16.7 times per a year (Table 5).

Table 5: Socio-economic characteristics of variables

Variables	Categories	frequency	percentage	Average	Max (Min)
Age of household heads	25-34	9	7.50	47.57	76 (25)
	35-44	51	42.50		
	45-64	52	43.33		
	65 and above	8	6.67		
	Total	**120**	**100**		
Family size	0-2	9	7.50	4.13	8.7 (1.67)
	2.01-4.0	52	43.33		
	4.01-6.0	48	40.00		
	Above 6	11	9.17		
	Total	**120**	**100**		
Dependency ratio	0-0.5	85	70.83	0.41	0.75 (0.00)
	0.51-1.0	35	29.17		
	Total	**120**	**100**		
Total livestock unit (TLU)	0-1	46	38.33	2.52	9.97 (0.00)
	1.01-3	31	25.83		
	3.01-5	28	24.33		
	5.01-7	12	10.00		
	7.01-9.97	3	2.51		
	Total	**120**	**120**		
Farm size in ha	< 0.5	36	30.00	0.97	3 (0.13)
	0.5-1.0	58	48.33		
	1.01-2	23	19.17		
	Above 2	3	2.50		
	Total	**120**	**100**		
Frequency of extension contacts	0	16	13.3	16.7	36 (0.00)
	12	54	45.0		
	24	37	30.8		
	36	13	10.9		
	Total	**120**	**100**		

Source: Own survey, 2016

4.1.3 Descriptive statistics for discrete variables

As shown in table 6, the total of 120 sample households was used to collect relevant data pertaining to the objectives of this research. Responses were collected from the household heads; of the total households, 97(80.83%) were male headed and females headed constitute about 23(19.17%). During women focus group discussion, the female headed households strongly mentioned that they faced a great challenge during cropping season due to shortage of labor; because of this, they give their farm land for share crops or rented out as a solution. Education is an important factor that helps farm community to get access to agricultural information. It largely influences the adoption of new technologies and improved techniques of production. The results reflected that from the total sample, about 22.7% are illiterate and 78.3% households are literate. Access to credit serves as a means to increase household income generating activities so that derived revenue increases and purchasing power of the household to escape from risk of food insecurity advances in the study area. The survey result revealed that, from the total sample households about 38(31.67%) is users and 82(68.33%) is non-users of credit access. Chemical fertilizers and improved seeds, among others of agricultural inputs, play significant role in increasing productivity and boosting agricultural production in the study area. From the total sample households about 92(76.67%) and 28(23.33%) were found to be users and non-users of agricultural inputs respectively.

Similarly irrigation plays key role in production supplementing water during dry time. It is highly related with production of crops and livestock. Improvements in access to irrigation water serve a powerful tool to diversity food livelihoods and reduce vulnerability for small holder producers. From the total sample households interviewed, 19(15.83%) and 101(84.17%) is found to be user and non-user of irrigation respectively. In the other hand, from the households interviewed, 49(40.83%) and 71(59.17%) households were found to be affected and non-affected by pest and disease respectively. Off-farm income often serves as an additional source to buy food items and agricultural inputs, as well as to cover school fees and costs for cloths and for asset building in the study area. The study result revealed that 69 (57.5%) and 51(42.5%) is participant and non-participate in off farm income activity respectively. However, on the FGD and KIs discussion the sample households strongly mentioned that during food shortage time the off-farm income used as a means of cope the challenges.

Table 6: Descriptive statistics for discrete variables

Variables	**Categories**	**Total sampled household (N=120)**	
		Frequency	percentage
SEXHH	Male	97	80.83
	Female	23	19.17
EDUSTAHH	Illiterate	27	22.5
	Literate	93	77.5
CREDITACCESS	User	38	31.67
	Non user	82	68.33
USEAGRINPUT	User	92	76.67
	None user	28	23.33
USEIRRIGN	User	19	15.83
	None user	101	81.17
PESTADISE	Yes	49	40.83
	No	71	59.17
OFFFARMICOM	Yes	69	57.5
	No	51	42.5

*** Significant at less than 1%.

Source: - Own survey, 2016

4.1.4 General food security situation of sample household

As indicated in the table 7, from the total respondent's more than 56 % mentioned that strongly disagree and disagree on the availability of food to feed their family members throughout the year. This implies that the majority of respondents in the study area have no enough physical availability of food throughout the year. Similarly, more than 60% of sample households reported that strongly disagree and disagree on the accessibility of good physical and economic access to food for their family members through the year.

The results revealed that from the total sample households less than 10% mentioned that agree and strongly agree on the adequacy of food that is nutritious and safe, and produced in environmentally sustainable ways trough the year for their family members. This implies that more than 90% of the respondents have no adequate food for their family members. And the result shows that from the total sample households about 89% are reported that agree and strongly agree on the availability of food and access to food are unstable. This shows that in the study area there is no food stability throughout the year for their family members. Similarly, 89% of respondents are reported that strongly disagree and disagree on the utilization of healthy diet for all their family members throughout the year (Table 7).

Table 7: General food security situation of the sample household

Variables	Categories	frequency	percentage
Availability (there is enough food available in your farm land to feed the family members throughout the year)	Strongly disagree	27	22.5
	disagree	41	34.2
	neutral	6	5
	agree	45	37.5
	Strongly agree	1	0.8
	Total	**120**	**100**
Accessibility (all family members in your farm land have good physical and economic access to food through the year)	Strongly disagree	30	25
	disagree	43	35.8
	neutral	5	4.2
	agree	37	30.8
	Strongly agree	5	4.2
	Total	**120**	**100**
Adequacy (all family members in your farm land have access to food that is nutritious and safe, and produced in environmentally sustainable ways)	Strongly disagree	57	47.5
	disagree	47	39.2
	neutral	4	3.3
	agree	10	8.2
	Strongly agree	1	0.8
	Total	**120**	**100**
Stability (There are periods where all family members in your farm land are food insecure b/c availability of food or access to food is unstable)	Strongly disagree	2	1.7
	disagree	5	4.2
	neutral	6	5
	agree	53	44.1
	Strongly agree	54	45
	Total	**120**	**100**
Utilization (in your farm land all family members use their food in ways that amount to a healthy diet)	Strongly disagree	60	50
	disagree	47	39.2
	neutral	5	4.2
	agree	6	5
	Strongly agree	2	1.6
	Total	**120**	**100**

Source: - Own survey, 2016

4.2 Econometric Analysis

Attempts were made to identify factors responsible for the determination of household food security among the sample households. Occurrence of strong multicolinearity problems was checked for the continuous explanatory variables prior to estimation of the model using VIF and contingency coefficient. The result showed that there was no strong multicolinearity problems among the explanatory variables included in the model (appendix 4).

The model result shows that the coefficient of determination i.e. the adjusted R^2 values are 0.745. This implies that about 74.5% of the variation in the dependant variable is explained by the variation of the independent variables, indicating relatively high explanatory power of the model (Table 8). The econometric results using OLS were almost indicating that the homoscedasticity assumption was not violated (Appendix 6). In appendix 7 indicated that the model has no omitted variables. The endogeneity test result shows that there is no endogeneity problem and thus instrumental variable regression is not employed (Appendix 9). As the result signified, the chi square distribution is suggesting that the linear regression model as the basis of analysis which means that the model is correctly specified (Appendix 8).

The value of F is statistically significant indicating that the explanatory variables included in the model jointly influenced the dependent variable (Table 8).

4.2.1 Determinants of rural household food security

The result indicated that, out of the 13 hypothesized variables which were included in the multiple linear regression models six variables were found to be significant to affect the household food security. These are education status of household head, family size, credit access, total livestock owned, use of inputs and farm size (Table 8).

Family size:

Family size was statistically significant at 1% probability level and had a negative coefficient of 0.057, which implies that for every increase in an individual in a household, food security decreases by 0.057 kilocalories per day (table 8). Larger family size has a negative impact on household kilocalorie availability. That means when the size of family members increase the household was less likely to be food secure. A study by Tekel and Berhanu, (2015) also found a strong negative relationship between family size and household caloric consumption per adult equivalent.

Total Farm Size

The study result shows that farm size is positively related with food security and statistically significant at 10% probability level. The coefficient of the variable implies that increasing one hectares of farm size, increases kilocalorie availability of the households by a factor of 0.041 (Table 8). That is, households with larger farm sizes tend to be more food secure than those with smaller sizes, and vice versa. This is possibly because that the size of landholding is a proxy for a host of factors including wealth, access to credit, capacity to beer risk and income. Larger farms are associated with greater wealth and income and increased availability of capital, which increase the probability of investment in purchase of farm inputs that increase food production and ensuring food security. One could observe that greater efficiencies in the use of farm resources are associated with the large farms than the smallholding farms. They pointed out that the smallness of holdings deters the use of modern inputs due to lack of purchasing power in the hands of small farmers (Tekel and Berhanu, 2015). On the contrary, Altieri (2008:6-8) stated that there is inverse relationship between farm size and production indicating that as the farm land size is smaller the household tends to be more productive. This is due to the fact that the household invests more for land improvement.

Total Livestock owned (TLU)

This variable is positively related with kilocalorie availability of households and statistically significant at 1% probability level. The coefficient of the variable implies that increase in one unit of TLU in households, increases caloric consumption by 0.0498 (Table 8). Livestock is important source of livelihood. The household with a larger number of livestock has more kilocalorie consumption than a household with a smaller number of livestock. This study agrees with (Almaz *et al.,* 2015).

Educational status of household heads

As the model result indicate that education positively and significantly influences the household caloric consumption and statistically significant at 10% probability level which is the same with the hypothesized effect. The positive coefficient of 0.061 implying each yearly an increase in education increased food security of the households by 0.061(Table 8). This is implies that an educated household head is more sensitive to adopt technology to increase the output generated from farm activities. This study is in line with the previous study (Mequanent, 2014).

Use of Credit Service

Use of credit service was significant at 10% probability level and had a positive coefficient of 0.051 implying household head that use credit service increased food security by 0.051 kilocalories consumption (Table 8). The result conform prior expectation. This shows that when household get credit, they involve different income generating activities which help to improve household food security. Thus lack of credit access worsened food

insecurity as they have no means to increase their income. Thus, once we knew that credit access improves food security, at least for those who accessed it, outreaching the scope of microfinance's and local saving mechanisms to rural farm household's should be put in policy interventions. The findings coincide with similar study conducted by (Hiwot, 2014).

Use of Agricultural Input

Use of agricultural inputs in this study is very important determinants and positively related with household food security. It is statistically significant at 1% probability level. The coefficient 0.0955 implies that the households that use more inputs tended to increase food security by0.0955 caloric consumption (Table 9). The findings coincide with similar study conducted by (Teshome, 2014). On the other hand, farm inputs are highly expensive in price; as a result, the farmers invest their income for farm input by ignoring other expenditures and sold their crop produce to purchase those farm inputs for his/her land when their cash income is not enough to purchase farm inputs (Genene, 2006).

Table 8: Determinants of rural household food security model result

Variables	Coefficient	Std. Err.	t	P>t
SEXHHH	0.0105189	0.0328072	0.32	0.749
AGEHHH	0.0008437	0.0012938	0.65	0.516
FAMILYSIZE	-0.0573075	0.0092337	-6.21	0.000***
DEPRTIO	0.0002683	0.0100865	0.03	0.979
FARMSIZE	0.0414921	0.0243772	1.70	0.092*
TOTALLIVESTOCK	0.0498153	0.0083988	5.93	0.000***
EDUCSHHH	0.061024	0.0340102	1.79	0.076*
CREDITACCESS	0.0505379	0.0285471	1.77	0.080*
USEOFINPUT	0.0955402	0.0271979	3.51	0.001***
USEIRRIGTION	0.0384664	0.0345846	1.11	0.269
PESTDESEASE	0.0265176	0.0257588	1.03	0.306
OFFARMINCOME	0.0067649	0.024037	0.28	0.779
FRQEXNCONT	-0.0007236	0.0013076	-0.55	0.581
Constant	0.8479381	0.0875018	9.69	0.000
Number of obs = 120				
F(13, 106) =23.83				
Prob > F = 0.0000				
R-squared = 0.7451				
Adj R-squared = 0.7138				
Root MSE = .12458				

* and *** significant at less than 10% and 1% probability, respectively.

Source: Own survey, 2016

5 CONCLUSION AND RECOMMENDATIONS

On the basis of the findings of the results presented in the preceding chapters, this chapter attempts to draw general conclusions and recommendations.

5.1 Conclusion

This study attempted to address the potential determinant of rural household food security in the study area. The study was conducted using descriptive statistics and multiple linear regression models to identify factors determining household food security and asses' food security status of rural households in *Humbo Woreda.* Based on the result the study area was found to be chronically food insecure; and it was found that 61.7% of the total households were food insecure. These households could not cover the required minimum daily calorie which is dominated by subsistence agriculture. Food shortage in the area is common and occurs every year and their own production was not covering yearly consumption requirement of rural households while only 38.3% of the household were food secure. The food insecurity gap of the study area is 31.1% implying that food insecure household's calorie consumption fall by 31%, on average, below the minimum kilocalorie requirement. The severity of food insecurity gap among food insecure households was 14.6%.

Generally, in the study area majority of the respondents have no enough availability of food and less accessibility to good physical and economic access to food for their family members throughout the year. Similarly, more than 89% of the sample households have no adequate, stability and utilization of food for their family members throughout the year.

The multiple linear regression model result revealed that from the total thirteen (13) independent variables, six variables significantly influence household food security in the study area. These are family size, farm size, total livestock owned, and educational status of the household head, use of credit and use of inputs.

In the study area family size negatively influences household food security. This implies that an additional increase in household family size decreases the kilocalories consumption of the households. On the other hand, farm size, total livestock owned, and educational status of the household head, use of credit and use of inputs positively influence household food security. This means that a unit increase in these variables increases the kilocalories consumption of the households in the study area.

5.2 Recommendations

Based on the findings discussed above, the following recommendations are very crucial to enhance improved food security at household level. The possible areas of intervention include:

- Family size has significant association with the state of household food security. More attention should be given by health organization to limit the increasing population through awareness creation, informing the households that having more household size aggravate the problem of obtaining adequate food for healthy and active life and provision of education about the use and importance of family planning to both rural men and women.
- Farm size is a critically scarce resource which influences the state of rural food security in the study area. Proper attention should be given to agricultural sector to increase food production through intensive agriculture and promote biophysical conservation activities (soil and water conservation activities) that are essential to maintain the productivity of arable land and improve the fertility of soils.
- Total livestock owned is important and critical factors for agricultural production and a means of cope during food shortage in the study area. Government and nongovernmental organization should give more attention to livestock production and their management; strengthen animal health services through extension services.
- Educational status is one of the determinant factors of rural household food security. The education sector in collaborated with the concerned organizations should give more attention to adult learning programme for those illiterate households which already set as national adult learning program.
- Credit is a one of income generating activity which influences the state of rural household food security. Government should give attention to credit advancing institutions such as microfinance and should make the loan available in time to the farmers and create awareness about repayment and how to use it. This will help distribution of loan in time and it encourages farmers to utilize the loan for a given objectives as intended.
- Use of inputs (chemical fertilizer and improved seed) was one of the factors affecting rural household food security. Agricultural sector should be given close attention by providing improved agricultural inputs to rural farm households on time. Woreda experts and extension agents should also be strengthened and expanded to initiate farmers to use recommended rate of agricultural inputs to increase agricultural production.

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