ORIGINAL ARTICLE

Identifying the Status and Determinants of Food insecurity in North Central Ethiopia: A case Study from *Borena* District, Ethiopia

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Abstract

Currently, food insecurity is a global concern particularly in the developing nations like Ethiopia despite there is governmental efforts. Thus, the main purpose of this study was to identify the status and determinants of rural households' food security in Borena district, north central Ethiopia. The study followed the positivism world view with a cross sectional study design. The study used multistage sampling procedure which involves a combination of purposive and random sampling techniques to select 358 sample household heads. Household sample survey was the main means that was used to acquire primary data. To identify the status of food insecurity and its determinants, Dietary Energy Supply indicator and Binary logistic regressions model were respectively employed. The results showed that about 71.7% of the respondents were food unsecured households. A binary logistic regression model which was used in the study confirmed that education, cultivated farm size, improved seeds, urban linkages and access to health extension workers positively determined the food security while family size (population pressure) negatively determined the food security status of the households in the study area. Thus, the stakeholders (government bodies, non-governmental organizations, humanitarian agents and community leaders) need to intervene on regularly consumed nutritious foods. Policy reformers and designers should also work hard to reform and design policies on improvements in rural households' education, size of cultivated land, access to health extension workers, improved seeds and rural- urban linkage in order to alleviate their food security constraints.

Keywords: Food security, Dietary Energy Supply, Logistic regression model, urban linkages

Introduction

Despite the government efforts to secure food insecurity, it is a global concern particularly in the developing nations like Ethiopia. Along with increasing world population, the adverse impacts of climate change on agricultural production and food insecurity remained major global problem for millions of people around the world (IFPRI, 2016). The estimated number of people in the world who are affected by food insecurity rose to 815 million in 2016; from 777 million in 2015 and 775 million in 2014 (FAO, IFAD, UNICEF, WFP

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& WHO, 2017). Furthermore, more than one-fifth (22.7 %) people of these live in Sub-Saharan African (SSA) countries where one-out of-three people is severely food unsecured (Pinstrup-Andersen & Pandya-Lorch, 2001).

Concomitant with population growth in SSA countries, the number of food insecure people increased from 175 million in 1990-92 to 220 million in 2014-16 though the prevalence of food insecure people was estimated to decrease from 33% to 23% in the periods of 1990-92 to 2014-16 (FAO, IFAD & WFP, 2015). The failure of the SSA countries to self-sufficiency in food requirement has been attributed to recurrent climatic shocks (like drought and water scarcity), chronic resource degradation, lack of responsible governance, ineffective policies, widespread epidemics, technological stagnation and violent conflicts (Degefa, 2005).

In fact, food security is multidimensional in its nature making accurate measurement and policy targeting quite challenging (Jacobs, 2009). Maxwell et al. (2013) pointed out that measuring food insecurity is relatively complex, and often it requires the use of many different indicators. These indicators are supposed to probe different dimensions of food security because neither one indicator captures different aspects of food security, nor a set of indicators apprehend particular features of food security. Thus, in light of the multidimensionality of food security at household level, various scholars used different food security assessment models based on their intent and insight. For instance, Messay (2012) and Guyu (2014 & 2016) used the average amount of grains available (NGA) in each household from their own production, and other sources were used to analyze the availability of food, and they were taken as a proxy indicator of food insecurity. Coates et.al (2007) also suggested using Household Food Insecurity Access Scale (HFIAS) as a proxy measure of food insecurity. Swindale et al., (2006) contemplated that Household Dietary Diversity Score (HDDS) should be used as an indicator to measure household-level food security using food group consumption in the previous 24 hours. There are other some researchers who advise to use Dietary Energy Supply (DES) as a proxy indicator of food security by emphasizing, and analyzing the killocaloric content of the food the households' consumed.

The author of this article followed the latter claim at which the food security status of the target households is determined based on DES because:

1. DES takes into account the killocalory content of consumed food in a day rather than the physical and economic access to food,
2. DES is a comprehensive measure than the other indicators. That is, it enables researchers to see the wide-range effect of the daily consumed food,
3. DES indicator overwhelmingly produces more acceptable, and more preferable output than the other indicators.

Despite the government's claim of two-digit economic growth over the past two-decades, the majority of rural Ethiopians continue to suffer from chronic food insecurity, and from abject poverty. In this regard, Guyu (2014) stated that the Ethiopian two-digit economic growth rate did not bring economic growth and food security. Thus, almost close to 30 percent of the population is expected to be food unsecured each year, earning less than 1.5 dollars per day (FAO, IFAD & WFP, 2014). Moreover, although huge resources have been invested in agricultural research and extension packages to alleviate food deficiencies in Ethiopia, they could not ensure food security among the citizens (FAO, 2010).

Moreover, international development organizations reported that Ethiopians are frequently affected by food insecurity. For example, UNICEF (2014) reported that in 2014 about 10%

of Ethiopians were chronically food unsecured, and 2.7 million people required emergency food aid. In the same way, FAO (2015) also estimated that 32% of Ethiopians were food unsecured in 2015, and 10.2 million people were in need of emergency food aid by the end of 2015. Recently, more than half of southern Ethiopian's livelihoods have been reliant on emergency food aid (Cochrane, 2017). According to the Household Consumption & Expenditure Survey (HCES) which was carried out in 2011, the proportions of households who were in food unsecurity were about 42.5% in Amhara region. It is one of the regions of Ethiopia in which most of its rural inhabitants often suffered from food shortage in almost every year (Teshome, 2010). Concomitantly, as Borena district (the study area) is among the drought-prone areas of Amhara region (ARAB & EARO, 2000), its population do not have access to sufficient amount of subsistence food all year round due to natural and human-induced catastrophes. As a result, for a long period of time, most of its dwellers' food requirements have been substantiated by humanitarian aid, and by NGOs' interventions in which food aid is not last long solution. Such persisting food insecurity gaps and the reasons why such a population have been food unsecure are the researcher's main rationale of conducting this study. Moreover, to the best of the researcher's knowledge, there were no previous empirical research works that attempt to examine the food insecurity status, and its determinants in the study area. Therefore, the main purpose of this study was to identify the status and determinants of food insecurity in Borena district, north-central Ethiopia.

Materials and Methods

The Study Area Descriptions

The study area, Borena district, is located in South Wollo zone in Amhara Region (Figure 1). It is about 467 kilometers North of Addis Ababa and 284 kilometers South-East of Bahir Dar town (Regional Capital). The district is found between 100 34' 2" to 100 53'16"N Latitudes and 380 27'39" to 380 55'49" E Longitudes (CSA, 2008). The area is bordered by Mehal Sayint district at the north, Wogidi district at the south, Legambo district at the east and the Abay River at the west. The study area consists of Mekane-selam town (having 5 urban kebeles) and Borena district (having 35 rural kebeles). In an aggregated manner, in 2013, the total estimated population of the study area was 180,073 of whom 89,198 were men and 90,875 were women. Moreover, 12,916 (7.2 %) and 167,157 (92.8%) of the population were urban and rural inhabitants respectively (CSA, 2013).

The district is characterized by different landscape features such as: mountains (10%), rugged land (40%), flat land (20%) and valley (30%) (BDAO, 2016). Likewise, its altitude ranges from 500 meters above sea level which is located at the bottom of the canyon of Abay to 3200 meters above the sea level that found at the northeast corner of the district. As a result, it is characterized by four agro-climatic conditions such as Woinadega (47%), Dega (20%), Kolla (32%) and Wurch (1%) (BDAO, 2016).

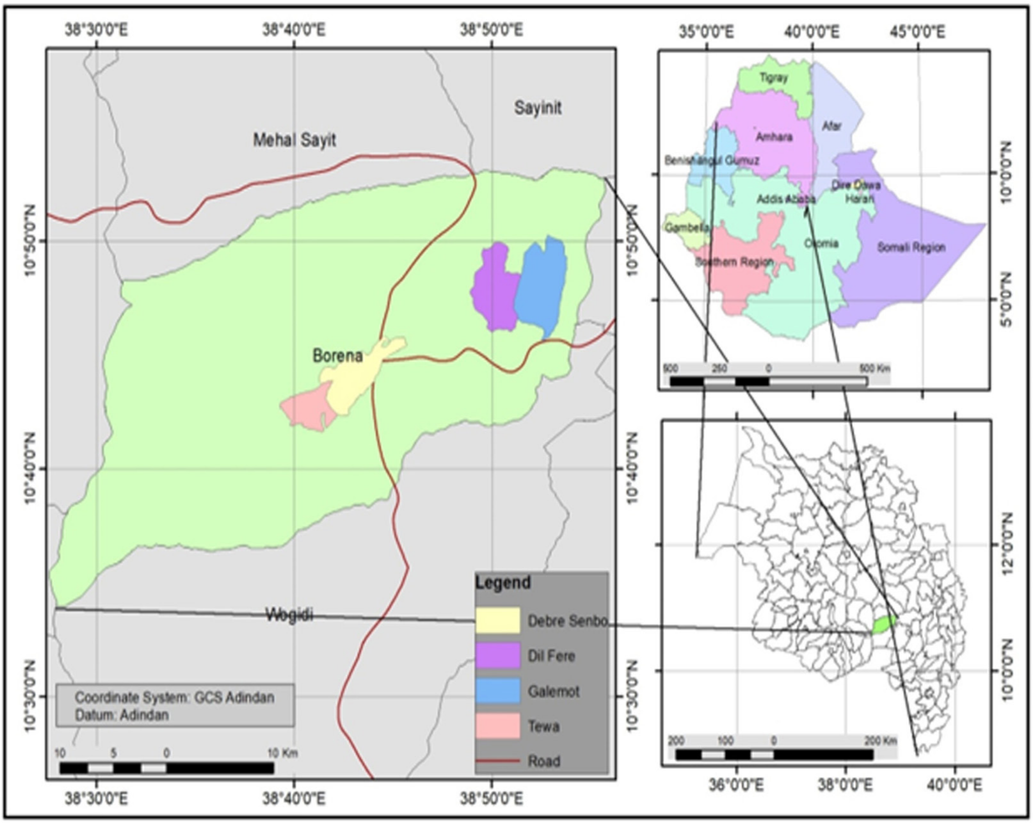

Figure 1: Location map of the study area (Source: Produced based on CSA data)

Land Use

According to the data obtained from BDAO (2016), 40.72% of the district's land was arable, 8.56% of the land was used for grazing, 18.98% of the districts' land was covered with different bushes and forests, and 5.62% of the land is used for settlements and road construction purposes. Unfortunately, more than one-fourth (26.12%) of the land is not suitable for cultivation or other agricultural production activities.

Economic Activities

Like other rural areas of Ethiopia, almost all of the rural households' economic activity is largely depended on agriculture (crop production and livestock rearing). Some of the most common crops grown in the study area are: teff, wheat, barely, vetch, bean, pea, maize, lentil, sorghum, nug, flax and chickpea. Besides to these crops, vegetables like cabbage, carrot, potato, tomato, and beet-root are also cultivated in the study area. Despite these facts, crop productivity has been threatened by a number of natural factors such as inadequate rainfall, sometimes excess rain and floods, snowfall, weeds, frost and crop pests, and human induced factors, like small and fragmented land size, traditional farming practices, continuous plowing and low adoption of practices of modern agricultural inputs (BDAO, 2016).

In addition to crop and vegetable productions, most common animals domesticated by the rural dweller households are: cattle, pack animals (mule, horse and donkey), shoats (sheep and goats) and poultry. According to Save the Children report on BDLP (2015), in 2015, the district had 84,342 cattle, 11,591 pack animals and 175,201 shoats. As can be seen in table below, oxen and cows constitute 59.6% and 16.7 % of the total cattle percentage respectively while heifer shared 12.1 % of the cattle. Similarly, 9.5 % of the cattle were bulls, and the rest 2.2 % of the cattle were calves. Moreover, three quarters (75%) of the pack animals in the district were donkeys. This may be because of the economic and transportation importance of the animal.

Table 1: Livestock Resources or Assets of Borena district

Livestock Groups	**Livestock types**	**Number**	**Percent**
Cattle	Cows	14,090	16.7
	Oxen	50,252	59.6
	Heifer	10,180	12.1
	Bull	8,000	9.5
	Calves	1,820	2.2
	Subtotal	84,342	100
Pack animals	Mule	1,403	12.1
	Horse	1497	12.9
	Donkey	8,091	75
	Subtotal	11,591	100
Shoats	Sheep and Goats	175,201	100

Source: BDAO (2016)

Temperature and Rainfall

According to the data which was found from BDAO (2016), the area receives an average annual rainfall of 6000-8500 millimeter. Its mean monthly temperature is 22^0c which ranges from a minimum of 13^0c to a maximum of 27. 20 c. Moreover, according to the computed data collected from Mekane-selam metrological station (2000-2016), the study area's mean annual temperature was 17.34 0c while mean annual rainfall was about 7000 millimeter. In addition, as can be seen in Figure 2 below, the average temperature trend showed an increment during 2000-2004, but it declined in 2002. Thus, from 2004 to 2005, there was a sharp decline in average temperature, but then after it continuously increased afterward (though forming a zigzag line to some extent). This result is somewhat similar to the global as well as national temperature changes due to global warming. The figure also depicts that in the study area, though the average rainfall showed some variation between 2000 -2010, it continuously declined up to 2022.

$$PCI_{annual} = \frac{\sum_{i=1}^{12} P^2 i}{\left(\sum_{i=1}^{12} Pi\right)^2}$$

$$Z = \frac{(Xi - \mu i)}{s} * 100$$

Figure 2: Average temperature and rainfall; Source: Prepared based on raw data obtained from Mekane-selam meteorological station (2000-2022).

Methods

This study followed the positivism world view in which the investigator tried to collect, and to analyze quantitative data in a cross sectional research design where the required data was drawn merely from primary sources.

Sampling Procedures and Sample Size Determination

Multistage sampling method which involves purposive and random sampling techniques was employed to select 358 sample households. In the first stage, Borena district was purposively selected as the district is one of the drought-prone districts of South Wollo zone of ANRS (ARAB & EARO, 2000) in which most of the rural household faced persistent food shortage. In the second stage, four rural kebeles out of the total 34 rural kebeles in the study area were randomly selected due to homogeneity on food security status of rural households where sample households were randomly selected out of the total 5082 household heads. Thirdly, the sample size was determined based on the table provided by Krejice & Morgan representative (1970), and based on Raosoft on-line sample size calculator within 5% marginal error and 95% confidence level. Both the table and the online sample size calculator indicated that to the average 358 household heads represents 5082 total household heads (those who reside in four selected kebeles). Then, the number of samples derived from each selected kebeles which could be included in the sample were determined by probability proportional to size principle. Hence, the amounts of samples drawn from each selected kebeles were determined. At the fourth stage, systematic random sampling technique by taking kebele records as a sampling frame was employed to select the required sample size from each selected kebeles. The distribution of total household heads and the sample size by kebeles are given in Table 1 below.

Selected kebeles	Total Number of Household Heads	Selected Sample Household Heads
Debr Senbo	1249	88
Dilfrie	1164	82
Tewa	1363	96
Galemot	1306	92
Total	5082	358

Methods of Data Collection and Instruments

For this study, quantitative data were collected from sample respondents using structured questionnaire as the main instrument employed where targeting randomly selected HHs. The study used eight development experts who were regular agricultural workers, and who are familiar with the study kebeles as data collectors. The development experts were recommended by the district's food security expert, and they had the necessary experience and knowledge in data collections which are related to food security. The data collectors were given a day training on the questionnaire, and on the possible issues that can be raised in the field data collection process. The Amharic version of the questionnaire was used for training in order to avoid language confusion while data were being collected from the samples in each selected kebeles. Furthermore, supervision was made two times by the main researcher to ensure the reliability of data collection.

Method of Data Analyses

To identify the food security status of the study subjects, Dietary Energy Supply (DES) method of determining the status of food insecurity was employed while binary logistic regressions model was used to analyze the determinants of food insecurity.

Model Characteristics

The overall model's fitness produced by binary logistic regression was checked by various statistical methods and techniques: Hosmer-Lemeshow test was used to test the suitability of fit (R2L) of the data. Accordingly, the Hosmer-Lemeshow test produced by the model was 10.78 (p=0.219). This implies that the model adequately fitted the data as the p-value is greater than 0.05. The Nagelkere Pseudo R2 statistic was 0.525 which showed that 52.5% of the variation in food insecurity was explained by the predictors or explanatory variables in the model. Regarding the importance of the predictor variables in the model, as can be seen in Table 1.3, -2, Likelihood ratio and Wald statistics were in harmony implying that each predictor was useful to the model. Moreover, the logistic regression model which was prepared based on the classification table value, predicted about 81.8% of the total variation in the food security status of the surveyed households (i.e., 68.8% of the food secured and 88.9% of the food insecured). Subsequently, before running stepwise binary logistic regression, multi-collinearity was also tested using VIF to see the relation among explanatory variables. The result indicated that all the independent variables have a VIF value of less than 6 (see annex III). These indicated that there was no serious problem of multi-collinearity among predictors. Then, to select the most important factors that determine the food insecurity situation of a household, first, the regression analysis was run using the forward stepwise likelihood ratio (Forward-LR) method. Consequently, among sixteen predictor variables which were entered in the model, six of them were found to be significant variables at various levels of significance.

Table 3: Test of the model: ANOVA

Model-1	Sum of Squares	Mean Square	F	Sig.
Regression	26.026	1.627	1.627	
Residual	48.178	.141	.141	
Total	74.204			

Source: Model output (2018)

As indicated in Table 3, the overall significance of regression model for food availability variation was found to be statistically significant with F ratio =11.513 and □ = 0.000. This indicated that at least one explanatory variable is different from zero, and it determines variations in the dependent variable. That is, daily per capita food available.

A re-run of the binary logistic regression using the enter method showed that there was no significant difference in the type of significant variables. This showed that the probability of households who are being food insecure was generally related to the predictors in the model so that we can proceed to present, and to interpret the result. Finally, the model points out the following variables as statistically significant determinants of food insecurity (labled as 1) in the study area.

Dependent and Independent Variables
Dependent Variable:

Food security status of households (labeled as 1 if food insecure and 0 otherwise)

Independent Variables:

X1: sex of the HHH (1: Male, 2: Female)
X2: Educational level of the HHH (1: illiterate, 2: read and write, 3: primary education (1-
4), 4 primary education (5-8), 5: secondary education, 6: above secondary).
X3: Household size
X4: Age Dependency Ratio (ADR)
X5: Access to health extension workers (1: Yes, 0: No)
X6: Average production in quintal per household
X7: Livestock possession (TLU) per household
X8: Cultivated land per household in hectare
X9: Proximity to market in KM.
X10: Adoption of improved seeds in 2008 E.C (1: Yes, 0: No)
X11: Faced animal production risk in 2008 E.C (1: Yes, 0: No)
X12: Wealth status based on cultivated land size and herding (1: Poor, 2: Medium, 3: Better off)
X13: having brothers or sisters in the town (1: Yes, 0: No)
X14: Extravagantness of food grain (1: Yes, 0: No)
X15: Savings (1: Yes, 0: No)
X16: Access to credit services (1: Yes, 0: No)

$$P(y) = f(\beta 0 + \beta 1\ X1 + \beta 2\ X2 + \beta 3\ X3 + \ldots\ldots\ldots\ \beta 16\ X16)$$

Where, P (y): the probability of a household to be food insecure,
X1, X2, X3…. X16: explanatory variables as listed above,
β1, β2, β3…. β16: estimated regression coefficients associated with the explanatory variables (X1, X2, X3….. X16) respectively and β0: constant or random error.

Results and Discussions

There was a consensus on the claim that food insecurity is one of the big challenges for the sustainable development of any country particularly of developing nations like Ethiopia. Thus, investigating the status and determinants of food insecurity seems to be appropriate to understand the food security status, and to suggest possible mechanisms of mitigating these challenges. As noted in the methodology section of this study, DES method and the binary logistic regression model were employed to look into the status of food security, and to the main determinants of food insecurity respectively in the study area. In doing so, based on a thorough investigation of related literatures and preliminary study, the researcher used the following independent variables as the main proxy predictors of food insecurity in the study area.

Food Security Status

As elucidated in the methodology section, the food security status of the households can be addressed by assessing the sample households' per capita dietary calorie consumption. In fact, probing the food security status of farm households using daily dietary calorie per capita analysis is one of the most difficult tasks in any food security study. In this regard, Messay (2012) argues that measuring food security using dietary caloric amount is too complex, and often it requires a data set which depicts the type and amount of individual's daily food intake which is converted into calorie equivalent. The computation requires four steps: firstly, calculate the Net Grain Available (NGA) per household per year using the HFBM formula as presented below:

NGA = (GP + Gpu + GBR+ GA/RM + MP +DP) - (GS+ PHL+ GR +GGO)

Where,

NGA: Net grain available/year/household
GP : Total grain produced/year/household
GPu: Total grain purchase/year/household
GBR: Total grain borrow/year/household
GA/RM: Quantity of grain/food aid/remitted/year/household
MP: Meat, meat based products and poultry (kilogram/household/year)
DP: Dairy and dairy based products (little/household/year)
PHL: Post harvest losses in quintal/year/household
GR: Quantity of grain reserved for seed in next harvest in quintal/year/household
GS: Amount of grain sold in quintal/year/household
GGO: Grain given to others in quintal per year

Secondly, the amount of NGA for each food grain or item is changed into kilocalorie using the Food Composition Table (see Appendix II). For instance, the amount of kilocalorie in a certain household x who have 4.25 quintals of teff per year is computed as 4.25 *161. 2 (the amount of kilocalorie of 100 grams of teff) divided by 0.001. Thirdly, the result is divided by the total number of the households' sizes as measured in adult equivalent. Fourthly, by dividing the result that we get in step three by the number of days in a year (365), and by comparing the available dietary supply of each household with 2100killocalori/ADE/day.

If the calculated value is greater or equal to the WHO's recommended kilocalorie intake (2100kilocalori/day/ADE), the household will be categorized as food secure otherwise it is labeled as food insecure. As an evidence, a well-known food security scholar, Devereux (2006) classified households' food security/ insecurity status based on kill caloric consumption per day per person as follows: households who consumed on average more than 2100 kilocalorie per day per person are classified as food secured whereas those who consumed less than 2100 kilocalories per day were classified as food insecure.

The analysis using kilocalorie as shown below in table 3, revealed that 70.7 and 29.3% of the sample households were found to be food insecure and secure respectively. This might be attributed to, in part, the frequent environmental catastrophe and drought occurrence, and in part due to the human-induced problems like small and fragmented land, population pressure, inadequate farm inputs, poor infrastructures and administrations, and to less opportunities of participating in the non-agricultural activities.

The above finding was consistent with some research findings which were conducted in different parts of Ethiopia. For instance, More than 75% of Degefa 's surveyed case study villages of Erenssa and Garbi community of Oromiya zone, Wollo, were neither food self-sufficient nor food secure (Degefa, 2005), 69.2% of Alem's (2007) study households were food insecure in Tehulederie district of South Wollo zone, Ethiopia, 75.3% of (Tesfahun et al., 2015) study subjects were food insecure in Sayint district of South Wollo zone, Ethiopia, 71.8% of the study subjects of Guyu (2016) in Belo-Jingafoy district of Benishangul-Gumuz region of Ethiopia were food insecure, 65.3% of the sample households of Zewdie et.al (2017) study in East Gojam zone of Amhara region, Ethiopia were food insecure, 70.62% of Ermias's (2018) study subjects in Kindo-Diday district of Southern Ethiopia were food insecure, 64.7% of the sample households of Mequanent & Esubalew (2015) were food insecure in Jimma zone, Ethiopia, 72% of Guyu & Muluneh's (2018) study households were food insecure which analyzed using head count ratio analysis and 79.1% of Alem meta &Singh (2018) study subjects were food insecure in Teleyayen sub-watershed areas of South Wollo zone, Ethiopia.

The present study finding was also in line with some studies in Africa, and in other developing countries of the world. For instance, a study conducted in the Singida region of Tanzania showed that 67.7% of the study subjects were food insecure (Kingu, 2015). Moreover, 75% of the rural households in the dry savanna region of Nigeria were food insecure (Bamire, 2010).

Determinants of Food Security

Educational level of the household head: Households which were headed by literate household heads were in a better position to achieve food security than their counterparts. Concomitant with this claim, the binary logistic regression result revealed that the effect of the educational level of household on food insecurity was negative (B = -2.191), and it was statistically significant at $p<0.01$. This indicated that, Ceteris Paribus, when the household head's educational level increases from illiterate to able to read and write, the odds ratio of being food insecure decreased by a factor of 0.112. This might be due to the fact that households which are being led by educated heads are adopting coping strategies, and searching for other means of getting livelihood like diversification. A similar finding was reported by (Kidane et al., 2005; Tilksew & Fekadu (2014); Worku et al. (2015), and Guyu & Muluneh (2018).

Household size: the binary logistic regression model revealed that the effect of household size on food insecurity was positive (B = 1.23), and it was statistically significant at $p<0.01$. This implied that an increment of the household size by one member increased the odds ratio of being food insecure by a factor of 3.42 provided that the other factors remain constant. This result is in line with the theory of Malthus (1798) who argued that a large population lowers agricultural productivity and food security, but it is in contrary to the theory of Boserup (1965) who contended that large family size would increase agricultural productivity through intensification. The finding of this study was also similar to various earlier research findings which were conducted in different parts of Ethiopia. For instance, Kidane et al. (2005), Alem (2007), Messay (2012), Tesfahun et.al (2015), Worku et al. (2015), Guyu (2016), Ermias (2018) and Guyu & Muluneh (2018) that found out statistically significant and positive relationship between household size and food insecurity. The possible reason why the large family size is associated with food insecurity is that in an area, like ours, where there is a land scarcity or limited access to adequate cultivated land, large family size coupled with recurrent environmental catastrophe leads to decreased agricultural production which could be a source of food insecurity.

Cultivated farm size: different literatures revealed that cultivated farm size has a statistically significant positive influence on household food security at various levels of significance. For example, Alem (2007), Tilksew & Fekadu (2014), Mequanent & Esubalew (2015), Furgasa & Degefa (2016), Ermias (2018) and Guyu & Muluneh (2018) confirmed that farm size had a statistically positive influence on the food security status of a household. In line with this general literature, the present study disclosed that cultivated land size has a statistically significant negative effect ($P<0.01$) on household food insecurity. The binary logistic regression analysis indicated that, all other variables in the model being constant, a one-unit increase in cultivated farm size was associated with a decrease in the food insecurity status of a household by a factor of 0.186. This might be attributed to the fact that scarcity of cultivated farmland is common in the study area where food insecurity seems to be inevitable. Moreover, literatures conducted in Ethiopia showed that there was a negative association between access to and cultivation of farmland, and food insecurity (Degefa, 2005). This is also true for Nigeria (Omotesho et al., 2006); for Ghana (Aidoo et al., 2013) and for Nepal (Joshi & Joshi, 2017).

Use of improved seeds: The binary logistic regression result showed that the adoption of agricultural inputs, particularly improved seeds has a statistically significant ($p< 0.1$) influence on the food security level of rural households. Holding all other variables constant, the odds ratio of being food insecure decreased by a factor of 0.498 in favor of rural people who cultivated their land with improved seeds. The possible explanation is that households who used improved seeds produced more aggregate output thereby less likely to be food insecure than those who cultivated their land without improved seeds. Thus, the role of using modern agricultural inputs like improved seeds to augment agricultural yield, and consequently to attain food security goes in line with the concept of Boserup's (1965) theory of agrarian change under population pressure. She argues that population growth is neither the cause nor the result of agricultural change. However, the intensive use of land took the lion's share of the change. This finding also goes in line with some contemporary studies which conducted in Ethiopia showing a statistically significant and positive relationship between adoption of modern agricultural input and the probability of being food secure (Kidane et al., 2005; Ermias, 2011; Tilksew & Fekadu, 2014; Furgasa & Degefa, 2016).

Urban linkages: One of the ways by which urban linkages can be related to food security is through the provision of information. Rural households who have close relatives like brothers or sisters in the nearby town may access timely information on how households can address their food needs. Folks living in towns have better capacity and awareness of addressing food needs. The transmission of such knowledge, therefore, can help rural households to address their food needs. In addition, rural households who have relatives in towns can receive remittance which helps rural people address food needs. The binary logistic regression model which was used in this study showed that having brothers/ sisters or other relatives in the town has a statistically significant ($p < 0.01$) impact on food security. The binary logistic regression analysis revealed that citrus paribus, the likelihood of being food insecure decreased by a factor of 0.395 with rural households who have brothers or sisters in the urban areas than their counterparts.

Access to health extension workers: literatures that are related to health indicated that rural households' should be healthy enough to achieve their life necessities well. To this effect, the role of health extension workers is undeniable. The binary logistic regression result confirmed that those households who have access to health extension workers have a statistically significant ($p < 0.01$) effect on their food security status. The probability of being food insecure decreased by a factor of 0.146 in favor of those households who have access to health extension workers than their counterparts, keeping all other factors remain constant. It can, thus, be concluded that easy access to health extension workers leads to the realization of preventive and primary health in the household which in turn boosts the food security status of people.

Table 4: Results of binary logistic regression showing parameters estimating the effects of determinants.

Variables	β	S.E.	Wald	Sig.	Exp (β)
Gender of the Household head	0.074	0.498	0.022	0.883	1.076
Educational level of Household head	-2.191	0.574	14.548***	0.000	0.112
Household size	1.230	0.179	47.412***	0.000	3.420
Age dependency Ratio	0.001	0.003	0.074	0.786	1.001
Access to health extension workers	-1.923	0.547	12.384***	0.000	0.146
Average production per quintal per year	-0.050	0.031	2.561	0.110	0.951
Total animal possession in TLU****	-0.090	0.138	0.425	0.514	0.914
Farm size cultivated in 2016/17 in hectare	-1.680	0.674	6.217**	0.013	0.186
Proximity to the nearest market in Km	0.037	0.028	1.723	0.189	1.038
Improved seeds use in 2016/17	-0.697	0.398	3.070*	0.080	0.498
Animal production risk in 2016/17	0.489	0.440	1.237	0.266	1.631
Wealth status of the household	0.159	0.548	0.085	0.771	1.173
Urban linkages	-0.930	0.339	7.504***	0.006	0.395
Extravagantness	0.024	0.500	0.002	0.961	1.025
Savings	0.479	0.422	1.288	0.256	1.614
Access to credit services	0.114	0.371	0.094	0.759	1.121
Constant	2.593	1.090	5.658	0.017	13.372
Model Prediction success (%)	Food secure				68.8
	Food insecure				88.9
	Over all case predicted				81.8
-2 Log-likelihood ratio for the model	268.637				
H-L model test (df = 8)	Chi-square = 10.7.8 (p = 0.219)				
Nagelkere Pseudo R2	0.525				

Source: Model Output (2016); Note: *, ** and *** are significant at less than 0.1%, 0.05% and 0.01% significant level, respectively. **** see annex IV, the conversion of TLU

Conclusions

The author of this article comes out with the following concluding remarks:

The majorities of rural households are food insecure, and they were suffering from dietary deficiency: The use of DES indicators in this study showed that most households are food insecure, and they consumed less nutritious food. The results of the study indicated that 70.7% of the sample respondents were food insecure. This implies that the target population did not have the habit and capacity of consuming nutritious food in a day.

Among other factors, food insecurity is highly influenced by having larger household size and education. As a result, the binary logistic regression model revealed that some of the socioeconomic institutional and agricultural input related variables were statistically significant predictors of food insecurity. The model result displayed that better education lowers food insecurity while large family size aggravates food insecurity. This might be due to better educated person's ability to speculate the occurrences of food insecurity ahead of time, and they might engage in mitigating activities. In the same way, large family size and limiting cultivated farmland aggravated food insecurity.

Limitations of the Study

This study used a cross-sectional research design which doesn't capture the seasonality of data. Therefore, future research should focus on analyzing the status of food security by generating data that can capture the seasonality. Moreover, measuring the food security status of the house hold using DES is too complex, and often it requires a data set which depicts the type and amount of individual's daily food intake which is converted into calorie equivalent. However, the unavailability of calorie equivalent for some type/form of locally consumed food items in the society makes it more problematic. In addition, there is also a variation in the calorie equivalent of the form of food consumed. For instance, food is prepared in the form of roasted grain, bread or enjera. The quantity of calorie requirement also varies with sex, age and working conditions of an individual. In spite of all the above problems, the author tried his best in compromising with the scientific standards, and he come up with an acceptable findings and conclusions. Thus, future researches should focus on handling the above challenges which are contemplated with the scientific standards.

Recommendations

Based on the major findings and concluding remarks of this article, the author suggested the following as recommendations for the concerned bodies:

To the stakeholders (government bodies, non-governmental organizations, humanitarian agents and community leaders) need to intervene on regularly consumed nutritious foods. Policy reformers and designers should also work hard to design on improvements in rural households' education, size of cultivated land, access to health extension workers, improved seeds, urban leakage and family planning in order to alleviate their food security constraints.

Ethical Consideration

As the author follows all the principles of the research ethics, the ethical approval is assured.

Conflict of Interest: The author declares that there is no conflict of interests regarding the publication of this paper

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Appendix I. Average calorie composition of major food items consumed in the study area

S/N	**Description of major food kinds in the area**	**kcal/100gram**
Teff	pure Teff flour + water (enjera) Teff flour + wheat flour (enjera) Teff flour + sorghum flour (enjera)	161.20
Wheat	wheat flour + water (enjera) wheat flour + maize flour+ water (enjera) wheat bread porridge (genfo) boiled wheat (nifro) and roasted wheat (kollo) split boiled maize with salt (qinche)	170.18
Barely	barely flour + water (enjera) barley flour + water (bread) whole roasted barley (kollo) roasted barely flour + salt + water (besso)	226.27
Maize	cooked maize flour with salt and water (porridge) cooked maize flour with meager salt and water (bread) cooked maize flour, fermented (enjera) boiled maize only (nifro)	127.83
Chick Pea	Sauce: split chick pea + shallot + chili + oil + garlic + salt Roasted chick pea + salt (kollo)	227.00
Lentil	Sauce or “Misir wot”:split or whole lentil + butter + shallot + chili + salt Sauce or “Misir wot”: split or whole lentil + chili + shallot + oil + salt	93.50
Vetch	“Shiro wot” : powdered vetch + chili + shallot + oil + salt boiled vetch (Nifro)	71.5
Bean	“kik wot” or Sauce: split broad bean +butter + chili “kik wot” or Sauce: split broad bean +oil+ Shallot + chili+ garlic + ginger +salt “Shiro wot” or sauce: Bean powdered + pen powdered + salt +chili + water. Roasted bean (Ashuk) or boiled bean (Nifro)	75.00
Pea	“Shiro wot” or sauce: pen powdered + salt +chili + water. Roasted pea (Ashuk) or boiled pea (Nifro)	138.00
	Overall average calorie supply (kcal/100 gram)	147.18

Annex II: Tables showing sample size determination

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	246
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	351
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	181	1200	291	6000	361
45	40	180	118	400	196	1300	297	7000	364
50	44	190	123	420	201	1400	302	8000	367
55	48	200	127	440	205	1500	306	9000	368
60	52	210	132	460	210	1600	310	10000	373
65	56	220	136	480	214	1700	313	15000	375
70	59	230	140	500	217	1800	317	20000	377
75	63	240	144	550	225	1900	320	30000	379
80	66	250	148	600	234	2000	322	40000	380
85	70	260	152	650	242	2200	327	50000	381
90	73	270	155	700	248	2400	331	75000	382
95	76	270	159	750	256	2600	335	100000	384

Note: “N” Population; “s” sample size
Source: Krejcie, R. & Morgan, D.(1970)

Annex III: Variance Inflation Factors (VIF) of Binary Logistic Regression Model

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	0.602	0.115		5.237	0		
Household head Sex	-0.022	0.061	-0.02	-0.366	0.714	0.617	1.621
Household head education level	-0.157	0.052	-0.154	-3.034	0.003	0.74	1.35
Household Size	0.143	0.016	0.479	8.8	0	0.642	1.558
ADR	6.72	0	0.009	0.197	0.844	0.817	1.224
Cultivated farm size	-0.189	0.082	-0.235	-2.315	0.021	0.185	5.395
Livestock ownership in TLU	-0.013	0.019	-0.052	-0.701	0.484	0.344	2.908
Proximity to market in Km	0.006	0.003	0.091	2.037	0.042	0.949	1.054
access to credit services	0.015	0.052	0.016	0.286	0.775	0.576	1.737
Savings	0.065	0.057	0.064	1.137	0.256	0.605	1.653
Brother or sister in urban Town	-0.14	0.044	-0.146	-3.188	0.002	0.912	1.097
animal production risk	0.003	0.06	0.003	0.057	0.955	0.823	1.215
Adoption of improved seeds	-0.024	0.049	-0.024	-0.482	0.63	0.759	1.318
Access to health extension workers	-0.19	0.052	-0.176	-3.668	0	0.826	1.21
Average production per year	-0.01	0.004	-0.149	-2.555	0.011	0.557	1.796
Extravagantness	0.001	0.063	0	0.01	0.992	0.859	1.164
wealth status of the household	0.051	0.069	0.081	0.745	0.457	0.162	6.186

Model Summary

Model	R	R square	Adjusted R Square	Std. Error of the Estimate
1	.592a	.351	.320	.376

a. Predictors: (Constant), wealth status of the household, Brother or sister in urban town, Proximity to market in Km, ADR, Extravagantness, Household head educational level, Adoption of improved seeds in 2008EC, Access to credit services, Animal production risk in 2015/16?, Access to health extension workers, Household Size, Average production per quintal per year, Household head gender, savings, Animal possession in TLU, Farm size cultivated in 2008 in hectare.

b. Dependent Variable: Food security status

ANOVA[a]

Model-1	Sum of Squares	Df	Mean Square	F	Sig.
Regression	26.026	16	1.627	11.513	.000b
Residual	48.178	341	.141		
Total	74.204	357			

a. **Dependent variable: Food security status**

Annex IV: Conversion factors for tropical livestock units

Animal	Livestock units	Animal	Livestock units
Calf	0.25	Mule	1.1
Heifer	0.75	Donkey (Adult)	0.70
Bull	0.75	Donkey (young)	0.35
Cow	1.0	Sheep &Goat (Adult)	0.13
Ox	1.0	Sheep &Goat (young)	0.06
Horse	1.1	Chicken	0.013

Source: Storck et al., 1996 cited in Adugna, 2008, Yenesew et al, 2015