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Agriculture is the most important sector in the Ethiopian economy, contributing the lion's share of the GDP. Nearly 80% of the population live in the rural areas and derive their livelihoods directly or indirectly from agriculture. Given its importance, the performance of the sector is therefore reflected in the performance of the whole economy. With this background, the Journal of Agriculture and Development aims to stimulate research and thinking on agriculture and development studies in Ethiopia. The articles contained in the journal reflect the views of their authors and do not necessarily coincide with those of the Editorial Committee, Institute of Agriculture and Development Studies, JADS or of SMU.

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Institute of Agriculture and Development Studies (IADS),

St. Mary's University

P.O. Box 18490 (Addis Ababa, Ethiopia)

E-mail: sgs@smuc.edu.et

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Analysis of Rural Households' Vulnerability to Food Insecurity in Ethiopia

Tsige Zeray[1] and Sisay Debebe[2]

Abstract

This study analyzes rural households' vulnerability to food insecurity in Ethiopia, using a sample data of 3115 rural households from the Ethiopian Socio-economic Survey (ESS). Calorie method was employed to determine food insecurity and vulnerability. In addition to descriptive statistics, GLS and the Logit models were used to analyze the data. The Results indicates that 63% (1961 out of 3115) were found to be food insecure whereas, the rest 37.05% of the households were found to be food secure. Furthermore, the estimated logit model result revealed that rainfall shock, death of livestock positively and significantly influenced current food insecurity status of household. , Furthermore, age of household head, education level of the household head, annual household farm income, participation in off- farm activity, access to credit and remittance negatively affected the extent of households' food insecurity. General least squares regression results indicate that total land holding (ha) of the household head has a significantly positive correlation with calorie intake and households' access to credit significantly increased expectation of food consumption. Empirical findings also showed that rainfall shocks (environmental shocks) have larger impact on vulnerability to food insecurity. Based on the intensity of their vulnerability, households were grouped into highly vulnerable-food secure (18.4 percent), and low vulnerable-food secure (45.84 percent). Overall, about 54.4 percent of households were categorized as vulnerable to food insecurity.

Key words*:* Vulnerability as expected poverty, Vulnerability to food insecurity, Food insecurity, Ethiopia

[1]College of Business and Economics, Department of Economics, Addis Ababa University
[2]Development Studies, St. Mary's University, Ethiopia Corresponding Author's email:sisaydebebe2000@gmail.com

Motivation of the Study

According to the latest FAO estimates, roughly 770 million people (10%) of the world's population were affected by acute food insecurity in 2017. Values range from 1.4 percent in Northern America and Europe to around 30 percent in Africa at the regional level. The prevalence of undernourishment has been on the rise at the global level, driven by trends observed in Africa and Latin America of severe food insecurity (FAO, 2018).

In 2016, Africa had the greatest rate of acute food insecurity, with 27.4% of the population, over four times that of any other area. Food insecurity is on the rise in the region, particularly in Sub-Saharan Africa, with an increase of nearly three percentage points from 2014 to 2016. In Latin America, food insecurity increased over the three-year period, rising from 4.7 percent to 6.4 percent. Between 2014 and 2016, the prevalence of severe food insecurity in Asia decreased slightly, from 7.7% to 7.0 percent overall, driven mainly by the reduction observed in Central Asia and Southern Asia, (FAO, 2017).

Nearly 33 million Ethiopians suffer from chronic malnutrition and food insecurity, with dry land areas accounting for the majority of the food-insecure population. According to the report of the ministry of agriculture and rural development (MoARD, 2009), arid and semiarid rangelands of Ethiopia comprise nearly 13% of the population, while these areas constitute about 63% of the country's landmass (Bezu, 2018). Prolonged drought, conflict, and political instability are the main causes of food insecurity in Ethiopia's dry lands, as are crop disease, flooding, the long-term effects of previous bad seasons, desert locusts, low household income, and the cost of nutritious foods and knowledge about nutritious food factors, (FAO, 2018).

Globally, the world is not on track to achieve targets for any of the nutrition indicators by 2030.With the COVID-19 pandemic and related containment measures, the obstacles have increased. In 2020, about 12% of the world's population was extremely food insecure, accounting for 928 million people that is 148 million more than in 2019 (FAO, 2021). The state of food insecurity and nutrition of the world in 2021 showed that it is projected that between 720 and 811 million people in the world faced hunger in 2020. Considering the middle of the projected range (768 million), around 118 million more people were facing hunger in 2020 than in 2019 or as many as 161 million more, considering the upper bound of the range. More than half of the world's undernourished are found in Asia (418 million) and more than one-third in Africa (282 million). Compared with 2019, about 46 million more people in Africa, 57 million more in Asia, and about 14 million more in Latin America and the Caribbean were affected by hunger in 2020. And almost all low- and middle-income countries were affected by pandemic induced economic downturns, and the increase in their number of undernourished was more than five times greater than the highest increase in undernourishment in the last two decades. When those countries were also affected by other drivers, particularly climate-related disasters, conflict, or a combination, the largest increase in undernourishment was seen in Africa, followed by Asia, (FAO, 2021).

Ethiopia has already faced one of the worst food crises over the last recent years: the compounding impacts of conflicts, desert locusts, the effects of the coronavirus disease 2019 (COVID-19) pandemic, natural hazards, and the poor macroeconomic context continue to threaten the food security and livelihoods of millions of Ethiopians, limiting their capacity to cope with future shocks and stressors (FAO, 2021). According to the Food Security Information Network, Ethiopia was the most food-insecure country in the area, with 8.1 million people

in need of immediate assistance, followed by Sudan with 6.2 million and South Sudan with 6.1 million. The situation is particularly severe in the region's dry land areas, where extended dry weather and flash floods have harmed pastoral and agro-pastoral livelihoods by creating lower-than-average crop production, grazing, and limited water sources for both, resulting in chronic and acute food insecurity. As a result, these regions have become heavily dependent on external food aid, (FSIN, 2020). Hence, the General objective of the study is to assess the vulnerability of food insecurity and its determinants among households in rural areas of Ethiopia.

Research Methodology

In the analysis, different models were used with the view of addressing the objectives set forth in the present study. To attain the first objective that is related to the current food security status of the households in the study area, the first step taken was distinguishing the food secure and food insecure. In order to classify into two groups, a demarcation point or line is required. The government of Ethiopia has set the minimum acceptable weighted average food requirement per adult equivalent (AE) per day at 2200 kcal (MoFED, 2002).

The determination of the adult equivalent takes into account the age and sex of each household member (Gassmann *et al.,* 2006). Hence, for this study 2200 kcal per adult equivalent (AE) per day is employed as a cut-off value between food-secure and food-insecure households. To estimate vulnerability to food insecurity, the study applied Capaldo *et al.,* (2010) methods in which estimated following three-step: first, a model of food consumption measured in kilocalorie, whereby the latter is a function of a number of household characteristics is estimated. In the second step, a model of the residuals that explains their variability is estimated. with residual variance. Lastly, the

estimate of variance of the residuals is used to calculate the probabilities that kilocalorie consumption, which is assumed normally distributed, may be lower than an acceptable threshold. Estimation procedures and variables used are detailed subsequently.

Models of Food insecurity and Vulnerability Analysis

Logistic regression model was used to measuring determinants of food insecurity. An empirical model for the determinants of rural household food insecurity can be specified using logistic regression model. An empirical model for the determinants of rural household food insecurity can be specified as follow:

$$\text{Li} = \beta 0 + \beta 1 AGE + \beta 2\text{SEX} + \beta 3 EDUC + \beta 4\text{FS} + \beta 5\text{LS} + \beta 6\text{DRM} + \beta 7\text{FI} + \beta 8\text{OFI} + \beta 9\text{CREDIT} + \beta 10\text{IRR} + \beta 11\text{LV} + \beta 12\text{FER} + \beta 13\text{AID} + \beta 14\text{RAIN} + \beta 15\text{DA} + \text{Ui}$$

Where age, sex, education, family size, land size, distance from markets, farm income, off farm income, credit use, irrigation use, livestock use, fertilizer use, remittance and aid, rain falls shocks, death of livestock are explanatory variables.

Following (Capaldo *et a*l., 2010), a three step process and then Generalized Least Square (GLS) methods were used for determinants of vulnerability to insecurity.

For a generic household, let Ch indicate kilocalorie consumption and *Xh* be a vector of observable household characteristics such as household size, location, educational attainment of the household head, etc. that serve as explanatory variables of per capita kilocalorie consumption. Assuming linear dependence between the dependent and independent variables, each household's calorie consumption can be expressed as follows:

$$C_h = X_h^{'}\beta = \beta_1 x_{h1} + ... + \beta_2 x_{h2} + ... + \beta_j x_{hj} \quad (1)$$

Where, β is a vector of parameters that are the same for all households.

Considering all households in one multivariate equation, we have:

$$C = X\beta = \begin{bmatrix} \beta_1 x_{11} + ... + \beta_2 x_{12} + ... + \beta_j x_{1j} \\ . \quad . \quad . \\ \beta_1 x_{h1} + ... + \beta_2 x_{h2} + ... + \beta_j x_{hj} \\ . \quad . \quad . \\ \beta_1 x_{H1} + ... + \beta_2 x_{H2} + ... + \beta_j x_{Hj} \end{bmatrix}$$

Where $C = [c_1 ... c_h .... c_H]$ and $X = [X_1^{'} ..... X_h^{'} ..... X_H^{'}]$

The first step of three step generalized least square (GLS) procedure consists of estimating the multivariate equation and obtaining estimates **b**ˆ of the parameters that explain calorie consumption. But for the residual component,

$$u = [u_1 ..... u_h ..... u_H]$$

$$C = X\hat{\beta} + u \quad (3)$$

As a second step, dependence on the same explanatory variables through a set of parameters γ estimated using equation:

$$u = X\hat{\gamma} + \varepsilon \quad (4) \quad (2)$$

Where ε is the vector of residuals of this second estimation, showing all the desirable properties of residuals that u does not have. From the deterministic part of equation (4) and after correcting again for heteroskedasticity, one can derive a consistent estimate of the household variance of food consumption Table 1 below summarizes the definition of variables, measurement and

hypothesis.

Table 1. Expected hypothesis of dependent variable with independent variables

Independent variables	Data type	Expected sign	References
Sex	Dummy variable	+,-	Baten and Khan (2010)
Education level	Continuous variable	+,-	Sisha (2018), Mesfin (2014)
Age	Continuous	+ ,-	Baten and Khan (2010)
Family size	Continuous	+	(Stephen and Samuel 2013; Muche *et al.,* 2014), Ayele *et al.* (2018),Mesfin (2014)
Land size	Continuous	-	(Kwadwo *et al*., 2013; Seid & Biruk, 2018)
Distance from road	Dummy variable	+	(Fekede *et al*., 2016; Getachew *et al*., 2018; Girum, 2016)
Farm income	Dummy variable	-	(Ejigayhu, 2011)
Off farm income	Dummy variable	-	(Indris & Adam, 2013)
Credit use	Dummy variable	-	Sishay (2018)
Irrigation use	Dummy variable	-	(Shishay, 2014; Teklay *et al*., 2013)
Livestock use	Dummy variable	-	
Fertilizer use	Dummy variable	-	Teklay *et.al*.,2013), Foster 1992).
Access to remittance	Dummy variable	-	(Okyere *et al*., 2013; Mesfin 2014)
Rain falls shock	Dummy variable	+	(Demeke 2011)
Death of animals	Dummy variable	+	Tagese and Berhanu (2015) and Teklay *et al*. (2013)

Results and Discussion

Descriptive statistics results

General descriptions of socio-demographic and economic characteristics of sample households were made. Based on a calorie requirement of 2200 kcal per day per person, out of the 3115 sample rural households in the study area 1154 (37.05%) and 1961 (62.95%) were found to be food secure and food insecure, respectively.

Mean acquired kilocalorie per day per adult equivalent for food insecure households is (1612.42) kilocalorie which is below the minimum required level (2200 kilocalorie). This shows, on average, food insecurity is far below the minimum threshold by 587.58 kilocalories. The mean acquired kilocalorie per day per adult equivalent for food secure households is 3547.95 kilocalories. This seems far above the minimum required level 2200 kilocalories but with high standard deviation of 1431.04. value. Hence it is rational to expect that there might be possibility for the food security to fall in to food insecurity or there will be high vulnerability to food insecurity in view of the fact that the mass of the households' occupation is farming where risk and uncertainty are common features.

For this study, 3115 sampled household head - 73.52% male and the rest, 26.48% female were used This indicates that male headed households were owners of major livelihood assets as usual. The majority of the households (47.06%) reported to have a size of 4–6 members followed by 0-3 (30.95%) and only 22.06% and 0.65% of the households are 7- 10 and 10+sized households, respectively. It is also observed that the computed mean household size for the study is about 4.85 with an average age of 44 years. When the educational status of the study participants is considered, it was found out that 69.85 % of the

respondents are literate, while the remaining 30.15% are categorized as illiterate. The percentage distribution of the household heads by educational status reveals that 65.11% of the respondents are at primary level of education. The secondary and college levels account for about 3.34%and 1.42% of the respondents, respectively.

More than half (72.1%) of sample households owned less than 0.25 hectare of farm land, 7.39% owned 0.25–0.5 hectare, about 18.91% owned half to one hectare, and 1.34% owned 1–2 hectares. On average, land holding size per household was found to be 0.18 hectare, which appears very small. Moreover, 58.05% of households market distance from their residence was greater than 10 km followed by distance between 5 and 10 km (19.04%) and less than 5 km (30.18%). Regarding the income earning from farming activities, 32.2% of the households were earning between 7000-1000 Birr per year followed by (30.68%), earning 20000–40000 Birr per year, (20.37%) greater than 40000 Birr per year, and (16.55%)10000-20000 Birr per year. Besides, the majority (65.30%) of the households was not engaged in any type of off-farm and non-farm activities and the rest (34.70%) were earning a positive income from off-farm and non-farm activities. Furthermore, the findings of the study showed that 75.83% of the sampled households had no access to credit service, implying that the majority of the households did not receive any type of credit from formal and informal sources. As to households' access to remittance and aid, only 13.07% of the households had obtained remittance and aid from different sources. In addition, the study showed that 21.51% of the sampled households had access to irrigation; about 10.63% of the sample farmers reported to use fertilizer; and 56.05% farmers had livestock. From the total sample, 53.03% have experienced rainfall shock and 26.77% have also experienced death of livestock.

Table 2. Summary Statistics for Continuous variables

Variable	Variable label	Mean	Std. Dev.
Acquired kilocalorie	Acquired kilocalorie per adult equivalent	2809.06	1492.01
Age	Age of the household head in years	44.36	15.35
Education	Level of education in numbers of years	3.01	2.07
Total family size	Number of Family size	4.85	2.33
Total land holding	Total cultivated land holding	0.18	0.31
Distance to the markets	Distance to the market (km)	15.83	12.77
Farm income	Total annual income in birr	25837.69	19140.46
Livestock TLU	Livestock owned (Tropical Livestock Unit)	3.78	2.29

Source: own computation based on ESS (2018) data

Table 3: Summary Statistics for categorical variables

Variable	Variable label	Frequency (N)	Percentage (%)
Sex	Dummy of sex of household sex (1=male)	825	26.48
Off-farm Activity	Dummy for participation to off farm activity (Yes=1)	1081	34.70
Use of credit	Dummy for receiving credit (Yes=1)	753	24.17
Use of fertilizer	Dummy for use to fertilizer (Yes=1)	331	10.63
Use of irrigation	Dummy for use to irrigation (Yes=1)	670	21.51
Death of livestock	Dummy for death of livestock (Yes=1)	834	26.77
Remittance and aid	Dummy for aid (yes=1)	407	13.07
Rainfall shock	Dummy for rain fall shock (Yes=1)	1652	53.03

Source: own computation based on ESS (2018) data

Econometrics Model Results

Determinants of households' food insecurity

Table 3 presents the results of logit model. Before interpreting the significant variables, it is essential to determine the statistical validity of the model. Our model fitted the data reasonably well [Wald Chi-squared = 2013.10 P= 0.000)]. Thus, the hypothesis that all coefficient of independent variables are jointly equal to zero was rejected. The logit model result revealed that a total of 15 explanatory variables were considered in the econometric model, out of which, 8 variables were found to significantly influence the food insecurity status of the household.

The log likelihood estimates of the logit regression model indicate that age of household head, education level of the household head, annual household farm income, participation in off- farm activity, access to credit and remittance negatively and significantly influenced food insecurity whereas, death of livestock, and rainfall shock positively and significantly influenced current food insecurity status of household with different level of significance.

Age of household head was one of the factors which negatively and significantly influenced the food insecurity of household ($P<0.01$). Accordingly, as age of household head increases, the probability to food insecurity also increases. This means that the older household family was less likely to be food secure than the young household head family. The model outcome indicated that age of household head increases by 1, the probability of food insecurity decreases by 0.3 percent.

The results of the logit model revealed that **land size,** measured by hectare, in the household negatively and significantly affected household food insecurity

(P<0.01). The possible explanation is that most of farm households with a large number of land size can produce different products and can engage in different agricultural activity and have income by renting and by sharing their land to different people to obtain income. This decreases household vulnerability to food insecurity. Thus, a unit change in the discrete variable leads to 15.4%.

Household engagement in **off- farm income** is another important factor which was negatively related to the dependent variable. The marginal effect result indicates that a discrete change in dummy variable from 0 to 1, decreases the probability of being food insecure by 40.5 percent, and this is significant (P<0.01). This implies that the farmer who is engaged in off- farm activities like trading and others is less capable of considering the issue of food insecurity.

Household a**ccess to credit** is another important factor which was negatively related to the dependent variable. The marginal effect result indicates that a discrete change in dummy variable from 0 to 1, decreases the probability of being food insecure by 27.5 percent, which is significant (P<0.01). This implies that using credit has less probability to directly involve in different activities to expand household ability to obtain income. The results of the logit model revealed that **farm income** of household which is measured by the annual income obtained by the household has negatively and significantly affected household food insecurity(P<0.01). The possible explanation is that most farm households with huge annual income can buy food and survive, so their vulnerability to food insecurity will be minimized. As seen in the table below a unit change in annual household farm income leads to 0.1% change in food insecurity.

Households who have **remittance and aid** from different government and non-governmental supporters were another factor which were negatively related to

the food insecurity. The marginal effect result indicates that a discrete change in dummy variable from 0 to 1, decreases the probability of being food insecure by 1.08 percent, which is significant (P<0.01).

Rainfall shock is an important factor which was positively related to food insecurity. The marginal effect result indicates that a discrete change in dummy variable from 0 to 1 increases, the probability of being food insecure by 1.22 percent, which is significant (P<0.01). This implies that the households that faced more rainfall shock are highly vulnerable to food insecurity because rainfall is the major input in our production system, especially in rural areas where more people depend on agriculture.

Education level of the household was one of the factors which negatively and significantly influenced the food insecurity of household (P<0.01). Accordingly, as education level of household head increases, the probability to food insecurity decreases. This means, the more educated household was less likely to food insecurity than the illiterate household. The model outcome indicated that as education level of a household head increases by 1, the probability of food insecurity decreases by 0.9 percent.

Existence of d**eath of livestock** is also another important factor which was positively related to the food insecurity. The marginal effect result indicates that a discrete change in dummy variable from 0 to 1, increase the probability of being food insecure by 1.10 percent which is significant (P<0.01). This implies that, the households facing frequent death of livestock is highly vulnerable to food insecurity because livestock by themselves are food and they are among the assets in which the households use in many of their activity.

Table 4: Determinant of food insecurity

Food security	Coef.	St.Err.	Mfx
Sex of Household head	-.067	.128	-0.016
Age of household head	.012***	.004	0.003
Education level of household head	.037*	.02	0.009
Total family number	-.001	.025	-0.000
Total land owned	6.618***	.27	1.541
DRMD	-.004	.004	-0.001
Annual farm income	0.01***	0.0	0.001
Off farm income	1.747***	.117	0.405
Access to credit	1.145***	.127	0.275
Total livestock owned	-.004	.017	-0.001
Remittance	.449***	.169	0.108
Death of livestock	-.488***	.132	-0.110
Rain fall shock	-.523***	.116	-0.122
Irrigation	.112	.144	0.026
Fertilizer	.141	.186	0.033
Constant	-3.161***	.297	
Pseudo r-squared	0.490		
Chi-square	2013.096		
Akaike crit. (AIC)	2123.752		

*Note: *** p<.01, ** p<.05, * p<.1*

Source: Own computation based on ESS (2018) data

Vulnerability to food insecurity

A household is then considered highly vulnerable to food insecurity if its vulnerability level exceeds some threshold, in our case this is, following,

Chaudhuri (2003), 0.5. Based on this, a vulnerability profile for rural Ethiopia is estimated.

Any operationally useful assessment of households' vulnerability status depends essentially on the choice of vulnerability threshold, that is, the minimum level of vulnerability above which all households are defined to be vulnerable. In the vulnerability estimation, each estimate takes values in the interval [0 1]. The extremes of the interval represent two opposite certainties: when, vh=1 household will consume in the future, with certainty, at least the minimum amount of calories prescribed by the threshold; when, vh=0 household will consume less calories in the future than prescribed by the threshold.

Determinants of vulnerability to food insecurity

The binary logistic regression model is employed to examine the association of each factor with vulnerability to food insecurity. To analyze the factors that determine vulnerability to food insecurity, households were classified into two categories, as low vulnerable and highly vulnerable, using the threshold chosen (0.5) variable. Thus, the dependent variable in this case, vulnerability, is a dummy variable, which takes a value zero or one depending on whether or not a household vulnerability index is less than or greater than the chosen threshold.

In widely used economic literature for estimating binary choice models, the linear probability, logit and probit are the possible alternative models and have been widely used for a binary response variable. A linear probability model is plagued by several problems such as non-normality of the disturbance term (ui), hetroscedaciticity of ui, possibility of predicted *y hat* lying outside the range (0-1), and generally lower R^2 values (Gujirati, 2003). As a result, hypothesis testing and constructing confidence interval become inaccurate and misleading.

Moreover, the predicted values (y hat) lie outside 0-1 range and violate the basic idea of probability. The shortcomings of linear probability model suggest that nonlinear specifications may be more appropriate. For this reason, in the studies involving qualitative factors, usually a choice has to be made between logit and probit models. According to Amemiaya (1981), the statistical similarities between the two models make the choice between them difficult. However, Maddala (1989) and Kmenta (1986) reported that many authors tend to agree on the logistic model since the cumulative normal functions are very close to the mid-range, but the logistic function has slightly heavier tails than the cumulative normal functions. It is also argued that the logit and probit formulations are quite comparable; the main difference being that the former has slightly fatter tails; that is, the normal curve approaches the axes faster than the logistic curve. What is more, a logistic distribution (logit) has advantages over the other in the analysis of dichotomous outcome variable, in that it is an extremely flexible and easily usable model from mathematical point of view and results in a meaningful interpretation.

Table 5: GLS regression: The expected value and variance of log per adult equivalent

Vulnerability	Log kilocalorie consumption per adult equivalent per day	Variance of kilo calorie consumption
Sex of household head	0.0237	-0.00938
	(0.031)	(0.048)
Age of household head	-0.067	0.047
	(0.0068)	(0.020)
Education level of household head	0.028	0.019
	(0.237)	(0.0207)
	(0.016)	(0.044)
Total family size	.002	.025
	(0.206)	(0.028)
Total land owned	6.637	3.27
	(0.0116)***	(0.0116)**
DRMD	-2.104	.004
	(0.347)	(0.16)
Annual farm income	0.0087	0.0054
	(0.126)***	(0.016)*
Off Farm income	1.724	0.0116
	(0.047)	(0.047)
Access to credit	1.136	0.0126
	(0.067)***	(0.004)*
Remittance	.383	0.0154
	(0.547)**	(0.047)
Death Livestock	-.485	0.0132
	(0.47)***	(0.037)**
Rainfall shock	-.00507	-0.0116
	(0.567)***	(0.0851)*
Irrigation	-0.0185	-0.0018
	(0.030)	(0.031)
Fertilizer	.14	.184
	(0.047)	(0.047
Total livestock owned	-.003	.017
Constant	-2.852***	291

Source: Own computation based on ESS (2018) data

Column (1) of Table 5 above shows that consumption expenditure which is used as a proxy variable for income has a positive and significant correlation with the level of calorie consumption among the households. The result is also in agreement with those of other previous studies from Nigeria (Aromolaran, 2004; Agboola *et al*., 2004) who found income has a positive and significant relationship with calorie consumption.

The results further show that total land holding in hectare of household head has a significantly positive correlation with calorie intake. This is probably because land in rural areas is often highly needed for adequate nutrition intake. Moreover, the capacity to access sufficient calories increase with land holding is growing diminished overtime. So dependent land size of the household will economically be active and contribute to the family's food consumption level. The higher land ownership, the higher expected food consumption will be.

Possibly, the puzzling result is the correlation of death livestock, rainfall shock, and level of food consumption. The level of food consumption was strong and negatively correlated with drought shock. This seems counter intuitive; nevertheless, this could possibly be due to well-established relief assistance in the country and high calorie content in the food items like oil and wheat provided by relief assistance.

Households' access to credit significantly increases expectation of food consumption. It is well-known that families with good access to credit can participate in any activity by taking credit from credit source to increase their annual income. No evidence is found on gender of the household head to be associated with expected food consumption.

Table 6. Vulnerability and food security status of households

Vulnerability	Food security						χ^2 test
	Food secure		Food insecure		Total		
	N	%	N	%	N	%	
Low-vulnerable	1766	45.84	195	9.76	1961	100.00	45.41
High –vulnerable	212	18.4	942	26	1154	100.00	***
Total	407	64.24	2708	35.76	3115		

Source: Own computation based on ESS (2018) data

Vulnerability to food insecurity was computed as a probability to fall, or stay, below a given food security threshold in the next period. Because vulnerability is linked to the uncertainty of events, everyone is vulnerable to food insecurity, but some are more so than others. Using the method specified in the methodology part of this thesis, vulnerability index for each household is estimated. Following the regression analysis, the vulnerability indicator is computed using predicted kilocalorie consumption and its variance for each household. After computing vulnerability index for each household, those with vulnerability index greater or equal to 0.5 are grouped as less vulnerable group and households with vulnerability index greater than 0.5 are grouped as low vulnerable group.

Conclusions and Recommendations

Conclusions

Food insecurity and poverty are two major issues that most Ethiopians are facing today. Various studies have revealed that improving the rural poor's livelihood is critical to reversing the prevalence of these issues. To be effective, improvement projects for the welfare of rural communities must be backed up

by empirical evidence that provides essential information on household food security to relevant entities.

The problem of food insecurity is extensive in the study area. Among the sampled households in rural areas of Ethiopia 62.95% were found to be food insecure (1961 out of 3115) where as

37.05% of the households were found to be food secure. Mean acquired kilocalorie per day per adult equivalent for food insecure households is (1612.42) kilocalorie which is below the minimum required level (2200 kilocalorie). This implies that, on average, the food insecurity is far below the minimum threshold by 587.58 kilocalories.

In addition, the estimated logit model results revealed that age of household head, education level of the household head, farm income, off- farm activity, access to credit and remittance, and aid negatively and significantly influenced food insecurity, whereas death of livestock, and rainfall shock positively and significantly influenced the current food insecurity status of household with different level of significance.

This study has also examined the determinants of vulnerability to food insecurity using logistic regression. Most of the findings in the descriptive analysis are consistent with the results of logistic regression model. From the logistic regression model, it is found that factors such as land ownership, livestock ownership, off- farm income and use of irrigation significantly reduce the likelihood of vulnerability to food insecurity. Rainfall shock and larger family size positively affects the probability of vulnerability to food insecurity.

Recommendations

As a result, urgent actions aimed at reducing and/or eliminating food insecurity in rural households in the study area should address the following:

- Comprehensive human capital development policy is a key factor that can be used to mitigate high level of vulnerability to food insecurity among rural households.
- There is a need for an international policy regarding the adoption of mitigation strategies to control climate change and the main cause of agricultural and rainfall shocks, and this strategy should be integrated into the development planning. The creation of awareness about effective family planning and the effects of big family size on food security, as well as the creation of awareness and capacity building for elder households by guaranteeing the availability and transmission of accurate information, should be emphasized.
- Improving rural households' access to credit allows them to purchase various inputs to improve their production of consumption items, reducing and/or eliminating food insecurity and improving their overall well-being.
- Construction of irrigation schemes is important because it allows households to produce more than once a year by reducing water stress and the risk of crop failure, hence reducing and/or eliminating food insecurity.
- Enhancing households' farm income-earning prospects by providing sufficient input to enhance agricultural production and productivity, and improving households' technical skills and understanding of how to employ off-farm and non-farm income to improve their food security situation.

Generally, as a policy implication, the government should exhaustively work on promoting irrigation, facilitating credit availability and subsidizing farmers to reverse the problem of food insecurity and to enhance households coping capacity to food shortage and/or insecurity.

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