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Research Article

ANALYSIS OF FOOD INSECURITY AND COPING STRATEGIES AMONG RURAL HOUSEHOLDS: EVIDENCE FROM WESTERN ETHIOPIA

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A B S T R A C T

The continuing evolution of food security as an operational concept in the public policy has reflected the wider recognition of the complexities of the technical and policy issues involved. An understanding of its major causes is important for interventions aiming to reduce food crisis. The current study was designed to analyze food insecurity status of rural households, to identify determinants of food insecurity status among rural households, and to identify rural households' coping strategies against food insecurity. The analysis was based on cross sectional data gathered from randomly selected households while both descriptive statistics and econometric analysis were used for the analysis of data. The results from descriptive statistics show that the majority (57.3%) of total surveyed households were food insecure. The binary log it model outputs show that six variables were significant determinants of household food insecurity status. Accordingly, age of household head, family size and dependency ratio were positive and significant determinant while education level of household head, seed type used for production and size of cultivated land were found to be negative and significant determinant of food insecurity status. Furthermore, results show that households use different coping strategies such as borrowing food or cash from relatives or neighbors, reduce number of meals, reduce meal size, sale of livestock than usual and sale of fire wood and charcoal against food insecurity. The results generally suggest the need to improve agricultural technologies enhancing land productivity. Finally, limiting population size through integrated health and education services and giving priority to old aged headed households in interventions, introduction of water harvesting technologies to practice intensified agriculture are also suggested to improve food insecurity status of households.

INTRODUCTION

Food security is originated as a concept in the mid-1970s in the discussion of international food problem at a time of global food crisis with particular emphasis of food supply. The continuing evolution of food security as an operational concept in the public policy has reflected the wider recognition of the complexities of the technical and policy issues involved. Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life. Household food security is the application of this concept to the family level, with individuals and within households as the focus of concern. In another way, food insecurity exists when people do not have adequate physical, social and/or economic access to food (FAO, 2003).

Food security is one of the urgent and emerging development challenges of the 21st century (Jonathan, 2010). It is a growing concern worldwide. According to the State of Food Insecurity report of United Nations Food and Agriculture Organizations, nearly one billion people are estimated to be undernourished, of which developing nations account for 98% (FAO, 2010). Ethiopia is one of the poorest countries in the world with the worst scenario of poverty and food insecurity. Nearly a quarter of the population in Ethiopia is undernourished where the largest proportion suffers from chronic hunger (FAO, 2006).

Based on duration, food security analysts have identified two types of food insecurity, which are chronic and transitory (FAO, 2008). Chronic food insecurity is long-term or persistent, and occurs when people are unable to meet their minimum food requirements over a sustained period of time. Contrarily, transitory food insecurity is short-term and temporary, and occurs when there is a sudden drop in the ability to produce or access enough food to maintain a good nutritional status. While chronic food insecurity results from extended periods of poverty, lack of assets and inadequate

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access to productive or financial resources, transitory food insecurity is caused by short-term shocks and fluctuations in food availability and food access, including year-to-year variations in domestic food production, food prices and household incomes. There is also a concept of seasonal food insecurity which falls between chronic and transitory food insecurity (FAO, 2008). It occurs when there is a cyclical pattern of inadequate availability and access to food. This is associated with seasonal fluctuations in the climate, cropping patterns, work opportunities and disease.

Ethiopia is one of the most food-insecure and famine affected countries and its large portion of population has been affected by chronic and transitory food insecurity (ADB, 2014). Food security situation in Ethiopia is highly linked to recurring food shortage and famine in the country, which are associated to recurrent drought. According to FAO (2010), more than 41 percent of the Ethiopian population lives below the poverty line and above 31 million people are undernourished. The concentrations of food insecurity and malnutrition are prevalent in rural areas, with a population of six to seven million chronically food insecure and up to 13 million seasonally food insecure (EATA, 2010). This figure is very high and needs to be addressed through targeted interventions. Macro-economic challenges like increasing food prices and unemployment determine the prospect of food security in the country. This needs an urgent transformation of access to agricultural technology by farmers and employment opportunity of youth (Lemesa *et al*., 2017). However, interrelated causes of household food insecurity require an analysis at a household level. The problems of food security in Ethiopia have been 'confined' to certain parts of the country mainly the Northern, Eastern and Southern referred to as famine prone areas (Getachew *et al*., 2018; Furgasa and Degefa, 2017; Guyu, 2016; Dagiye *et al*., 2013 and Devereux, 2000). Moreover, a study by Wondu (2020) confirmed that more than two-thirds of the households were classified as food insecure (had insufficient access to adequate food) in west Oromia. Households with insufficient access to food often face other challenges related to food insecurity including poor health and a decline in productivity. The gravity of food insecurity, and its many rippling effects, has led much of the development agenda to search for specific areas for intervention given limited resources and growing populations in many developing countries (IFPRI, 2009).

LaloAssabi, the district which was selected for this study, is found in West Wollega zone which can be observed as having evergreen environment and abundant natural resource. However, in the long-run, the natural resources particularly land has become scare because of growing number of population of the area and also large number of people who moved to the area through settlements. The acidity and degradation of land from time to time is also another concern which declines the productivity of land. The report by United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA) disclosed that the aid operations in West Wollega zone are intermittently restricted by ongoing hostilities between the Ethiopian defense force and undefined armed group, with clashes taking place in a number of woredas. This report cited that LaloAssabi is among the woredas where these clashes ongoing and the situation remain unpredictable. Furthermore, there is limited partner presence with reduced capabilities, including sectoral coordination (UN, 2019). These unpredictable conditions are very dangerous to freely operate agricultural activities to afford suitable consumption.

Internal displacement is also another challenge in *LaloAssabi* district which needs further policy simulation. According to the recent report of United Nations, more than thirty-seven thousand persons of West Wollega zone were re-displaced from Benishangul Gumuz region and are currently sheltered in seven wored as including *LaloAssabi*. These internally displaced persons (IDPs) have not received humanitarian assistance for almost one year, and they urgently require food, shelter and health service considering increased exposure to COVID-19 due to overcrowding and gender-based violence (UN, 2020). These natural and man-made factors will have direct, indirect or combined effect on the food insecurity status of the households in the study district. As far as there is increasing concern of food insecurity, the nature, determinants and status of food security at the household level in this area is not well documented. Therefore, this research is designed to examine food insecurity status, assess determinants of food insecurity and identify different coping mechanism during food crises.

MATERIALS AND METHODS

The study area

The study has been conducted in western Ethiopia by taking sample data from rural households of *Lalo Assabi* district. This district was chosen due to the fact that the district is suffering from both natural and man-made factors of food insecurity

Sampling and sample size

In order to get relevant information for the study, two-stage random sampling was employed. At first stage, five rural *kebeles* were selected by simple random sampling. At the second stage, 267 households were proportionally selected by systematic random sampling from each selected *kebeles.* Sample size determination formula for proportions proposed by Cochran (1977) was used to determine number of units included in the sample.

Method of data analysis

The study used descriptive statistics, mean comparison (t-test) and chi-square test to characterize sampled households based on potential variables along with food insecurity status. Similarly, Binary logistic model was used to assess potential factors that influence households' food insecurity in the study area. Binary logistic regression describes the relationship between a dichotomous response variable and a set of explanatory variables (*M*cCullagh and Nelder, 1980). The logistic regression model has become the statistical model of choice (Agresti, 2007). We consider first the case where the response y_i is binary, assuming only two values that are coded as one or zero.

$$y_i = \begin{cases} 1, & if the i^{th} household is food insecure \\ 0, & if the i^{th} household is food secure \end{cases} \quad 1$$

We view y_i as a realization of a random variable Y_i (food insecurity status) that can take the values one and zero with probabilities π_i and $1 - \pi_i$, respectively. The distribution of Y_i is called Bernoulli distribution with parameter π_i and this can be written in compact form as:

$$\Pr(Y_i = y_i) = \pi_i^{y_i}(1 - \pi_i)^{1-y_i} \quad 2$$

Suppose we have $X_{n*(k+1)}$single level binary logistic regression data matrix with k predictor variables of food insecurity status and $\beta_{(k+1)*1}$vector of coefficients, then a binary logistic which fits this condition is defined as:

$$\pi_i = \frac{\exp\{\boldsymbol{x_i'\beta}\}}{1+\exp\{\boldsymbol{x_i'\beta}\}} \quad 3$$

While the left-hand-side is in the familiar probability scale, the right-hand-side is a non-linear function of the predictors. The logistic regression function can be expressed in terms of odds ratio.

$$\frac{\pi_i}{1-\pi_i} = \exp\{\boldsymbol{x_i'\beta}\} \quad 4$$

This expression defines a multiplicative model for the odds. For instance, if we were to change the j^{th} predictor by one unit while holding all other variables constant, we would multiply the odds by $\exp\{\boldsymbol{\beta_j}\}$. Following some algebraic manipulation, the following intrinsically linear function is produced.

$$ln\left[\frac{\pi_i}{1-\pi_i}\right] = \boldsymbol{x_i'\beta} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_K X_K \quad 5$$

Estimation: Maximum likelihood

Logistic regression uses a maximum likelihood estimation technique to estimate parameters in the model. Maximum likelihood function yields the best solution for the binary logistic model and log likelihood function are given in Equations (6) and (7), respectively.

$$L(\beta) = \prod_{i=1}^{n}(\pi_i)^{y_i}(1-\pi_i)^{1-y_i} \quad 6$$

$$\ln \mathrm{L}(\beta) = \sum_{i=1}^{n} yiln(\pi_i) + (1-y_i)\ln(1-\pi_i) \quad 7$$

The estimation of parameters requires the maximization of the likelihood function or equivalently the maximization of natural logarithm of the likelihood function.

Test of Goodness-of-fit Test

Hosmer and Lemeshow Test: The well fitted models show non-significance on the Hosmer and Lemeshow goodness-of fit test. This desirable outcome of non-significance indicates that the model prediction does not significantly differ from the observed (Hosmer and Lemeshow, 1989).

Omnibus test: Interpreted as a test of the capability of all predictors in the model jointly to predict the response variable. It tests if the model with the predictors is significantly different from the model with only the intercept. A finding of significance of Omnibus test corresponds to concluding that there is adequate fit of the model.

Variables of the study

Dependent variable: Food insecurity status is a response variable and its computation is started by converting weekly (seven days) consumption data which will be obtained from survey into standard kilocalorie using the nationally standardized food composition manual (EHNRI, 1997).The converted data is further changed into household adult equivalent (AE). Following this, the amount of energy in kcal for sampled households was recorded. Next, kcal of each sample household were compared with the minimum subsistence requirement per AE per day. The government of Ethiopia has set the minimum subsistence food requirement per AE per day at 2200 kcal (MoFED, 2013). Households who consume below this minimum requirement were grouped as food insecure whereas those who consume above or equal the threshold were grouped as food secure. Thus, the response variable (food insecurity status) is a dichotomous (food insecure and food secure). Here, we are interested in estimating the probability that a household is food insecure, given the proposed explanatory variables. The main grain crops got high emphasis to get information on food insecurity.

Independent variables: Based on the literature review and practical experiences, explanatory variables which have logical and justifiable rational in determining food insecurity status of a rural farm household were identified.

Table 1 Hypothesized explanatory variables and their definitions

No.	Explanatory Variables	Definition
1	Sex of household head	Dummy variable coded as 1 for male and 0 otherwise
2	Age of household head	Continuous variable measured in years
3	Education of household head	Continuous variable representing year of schooling
4	Family size	Continuous variable measured in numbers
5	Dependency ratio	Variable representing proportion of working member
6	Cooperative membership	Dummy variable coded as 1 if member and 0 otherwise
7	Access to credit	Dummy variable coded as 1 if having access and 0 if not
8	Access to transportation	Dummy variable coded as 1 if having access and 0 if not
9	Distance to the market	Continuous variable measured in minutes
10	Access to market information	Dummy variable coded as 1 if having access and 0 if not
11	Seed type used	Dummy variable coded as 1 if using improved and 0 if not
12	Use of fertilizer	Dummy variable coded as 1 if using fertilizer and 0 if not
13	Size of cultivated land	Continuous variable measured in hectare
14	Livestock ownership	Continuous variable measured in TLU

RESULTS AND DISCUSSION

Descriptive Results

Food Insecurity Status of Households: The households' food insecurity status can be measured by direct survey of income, expenditure and consumption. In this study, households' food or calorie acquisition/consumption per adult per day is used to identify the food insecure and food secure households. The calorie consumed by the household is compared with the minimum recommended calorie of 2200 kcal per adult per day. If the consumption/acquisition is less than the recommended amount, then the household is categorized as food insecure and if greater than or equal to the recommended amount, the households is categorized as food secure. The households' food insecurity status was measured by direct survey of consumption. Data on the available food for consumption, from home production, purchase and /gift/loan/wage in kind for the previous seven days before the survey day by the household was collected. Then the data were converted in to kilocalorie and then divided to household size measured in AE.

The calorie intake result is calculated by using the standard food composition table prepared by Ethiopian Health and Nutrition Research Institution [EHNRI].

The food insecurity status of rural households that had been determined using descriptive analysis is presented in Figure below. This study has been conducted on 267 rural households in *LaloAssabi* district to estimate food insecurity status, principal factors influencing food insecurity and households' coping mechanisms during food shortage. The result of the household daily minimum requirement revealed that from the total sample households, 153 (57.3%) households were found to be food insecure and were failing to fulfill the minimum recommended daily calorie (2,200 kcal/AE/day) as mentioned under methodology part.

The result further depicted that only 114 (42.7%) of them were food secure and were able to get the daily minimum requirement. It can be observed from this result that majority of the households in the study area were not getting the minimum daily food requirements for their livelihood. As it has been explained under literature, there are different factor which make this result happen. Land degradation, political instability in Western Ethiopia and internal displacement were among the fundamental reasons which influence the households to mislead their livelihood strategies.

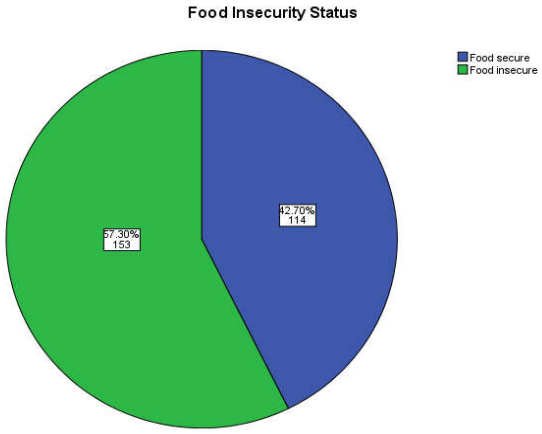

Fig 1 Food Insecurity Status of Sampled Households

Source: Author's computation (2020)

Results presented in Table 2 shows that the mean per capita calorie intake of the sample household was 2191.75 kcal, which is lower than the minimum calorie requirement of 2200 kcal. The average and maximum calorie intake of food insecure households were below the minimum energy required for an individual to live a healthy life.

There is statistically significant mean difference between food secure and food insecure households at five percent significance level. Thus, the study area could be classified as food insecure given the fact that majority (57.3%) of the surveyed households were not getting the minimum daily energy requirement for an individual to live healthy life.

Demographic Characteristics of Households along Food Insecurity Status

Sex of the household heads: According to the survey results presented in Table 3, from the total sampled households, male headed households accounted for 88.80% while female headed households accounted for 11.20%. The proportion of male headed households was 90.20% of total sampled food insecure households. In addition to this, male headed households accounted for 86.80% of the total food secure households. Whereas, the proportion of female headed households out of total sampled food insecure households and food secure female headed households were 9.80% and 13.2%, respectively. There is no statistically significant proportion difference between food insecure and food secure households in terms of sex. Thus, the result shows that there is no great disparity of food insecurity status due to sex difference among the household heads.

Age of the Household Heads: Age is an important demographic characteristics of the household assumed to bring food insecurity difference among the sampled rural households.The average age of the sampled household heads was 43.40 with standard deviation 13.99 years for food insecure households. The average age of food secure household heads was 41.19 years with standard deviation 11.42. Mean comparison suggested that there is no significant difference between food insecure and food secure households based on their age as indicated by t-value 1.376 (Table 4).

Family Size: The following Table 4 shows that the mean of food insecure sampled households' family size in AE is 4.96 with standard deviation 1.24. The mean of family size in AE of food secure households is 3.45 with standard deviation 1.05. The result from mean comparison on this variable indicates that there is significant difference between food insecure and food secure household at five percent significant level as indicated by t = 10.23.

Dependence Ratio: The result in Table 4 shows that the mean dependency ratio was 0.94 with standard deviation 0.78 for food insecure households and 1.03 with standard deviation 0.86 for food secure households.

Table 2 Energy available per AE per day among sampled households

Variable	Category	Min	Max	Mean	St. dev.	Mean difference	t
Energy available per AE (Kcal)	Food Insecure (N=153)	1357.01	2177.50	1819.94	197.66	2191.75	69.59**
	Food Secure (N=114)	2211.79	3711.39	2691.94	361.26		

Source: Author's computation (2021)
Note: ** significant at 5 percent level of significance

Table 3 Food Insecurity Status by Sex

Variable	Food insecurity status				Total		χ^2
Sex of household head	Food Insecure (N = 153)		Food Secure (N = 114)				
	Freq.	%	Freq.	%	Freq.	%	
Male	138	90.2	99	86.8	237	88.8	
Female	15	9.8	15	13.2	30	11.2	0.737
Total	153	100	114	100	267	100	

Source: Author's computation (2021)

The result further depicts that there is statistically insignificant mean difference of dependency ratio between food insecure and food secure households at five percent significance level. Thus, the result shows that food insecure households had high dependency burden than food secure to small extent which may increase vulnerability of households to food insecurity.

Non-farm income: Non-farm income is very important for the wellbeing of the households in that it helps the households to access food when income from agriculture is inadequate to enable households to access food throughout the year.

Table 4 Food Insecurity Status by Age, Family Size and Dependency Ratio of Household Heads

Variables	Food Insecurity Status	N	Mean	Std. Dev.	Mean difference	t
Age of household head	Food Insecure	153	43.40	13.993	2.206	1.376
	Food Secure	114	41.19	11.416		
Adult Equivalent	Food Insecure	153	4.96	1.24	1.47	10.23**
	Food Secure	114	3.45	1.05		
Dependency Ratio	Food Insecure	153	1.03	0.86	-0.09	-0.897
	Food Secure	114	0.94	0.78		

Source: Author's computation (2021)
Note: **Significant at 5 percent significant level

Table 5 Food Insecurity status by economic factors

Variables	Food Insecurity Status	N	Mean	Std. Dev.	Mean difference	t
Size of cultivated land (Hectare)	Food Insecure	153	1.55	0.83	-0.11	-1.02
	Food Secure	114	1.66	0.89		
Number of Oxen (Number)	Food Insecure	153	2.88	1.49	0.005	0.03
	Food Secure	114	2.88	1.43		
Livestock Ownership (TLU)	Food Insecure	153	3.40	2.44	-0.38	-1.09
	Food Secure	114	3.75	3.01		
Non-farm income (ETB)	Food Insecure	153	2631.58	416.59	1765.81	1.95**
	Food Secure	114	4397.39	10118.90		

Source: Author's computation (2021)
Note: **Significant at 5 percent significant level

Economic factors/Resource ownership

Size of cultivated land: Based on the finding of this study, Table 5 presented that the average size of cultivated land of food insecure households is found to be 1.55 hectare with standard deviation 0.84. The result further show that the mean cultivated land of food secure households is 1.66 hectare with standard deviation 0.89. There is no statistically significant difference between food insecure and food secure households in their mean size of cultivated land at less than one percent significance level. The result shows that both food insecure and food secure households were relying on very small pieces of land to meet their food requirement and the difference may be that of effective implementation of agricultural technologies on this piece of land.

Number of Oxen: In the study area, oxen is the most important traction power for the production of crops. As a result, it was hypothesized that the number of oxen owned is negatively related with the food insecurity status of households in the study area. That is, the more the number of oxen owned the less the probability of the household to become food insecure. The survey results presented in Table 5 shows that the mean number of Oxen owned by both foods insecure and food secure households is found to be about 3 Oxen. The result also confirms that there is no significant mean difference between food insecure and food secure households at five percent significant level in terms of oxen ownership.

Livestock ownership: From Table 5, one can observe that the mean livestock holding was 3.40 TLU with standard deviation 2.44 for food insecure households while it was 3.75 with standard deviation 3.01 for food secure household. The test for the equality of the means in livestock holding between food insecure and food secure households shows that there is no statistically significant mean difference five percent significant level as indicated by t = -1.09.

Table 5 shows that food insecure households have generated very low non-farm average income of about Birr 2631.58 with standard deviation 416.59 while their counterparts generated an average of Birr 4397.39 with standard deviation 10118.90. The t-test shows that there is statistically significant difference in the mean of non-farm income between food insecure and food secure households at five percent significance level.

Human capital

Education level of household head: The educational level of the household head is an important human capital which is expected to affect food insecurity status of households negatively. That is, the more the educational level of the household head, the more the possibility of household to diversify their livelihood so that the less possibility the household to become food insecure. However, the result suggests that there is no significant difference between mean years of education of food insecure and food secure households based on the sampled data at 5 percent significant level. The result depicted that the average years of education of food insecure and food secure households were 3.22 and 4.18 with standard deviation 3.23 and 3.55, respectively (Table 6).

Table 6 Food Insecurity Status by Education Level of HHs

Variable	Food Insecurity Status	N	Mean	Std. Dev.	Mean difference	t
Year of education of HH	Food Insecure	153	3.22	3.226	-2.303	-0.960
	Food Secure	114	4.18	3.551		

Source: Author's computation (2021)

Institutional factors

Distance to the nearest market: Good infrastructure is essential for food security by ensuring low food price and efficient market that can respond to changes in demand. It allows information transfer between producers and traders, and

gives farmers access to new technologies (FAO, 2009). As a result, it was hypothesized that the distance of the household's residence from the nearest market center is negatively related with food insecurity status and households nearest to the market center have less probability of becoming food insecure. Result presented in Table 7 shows that food insecure households are expected to walk 0.78 hour with standard deviation 0.40 to arrive at the nearest market whereas food secure households are expected to walk 0.72 hours with standard deviation 0.38 to arrive at the nearest market. The survey result also indicated that there no statistical significant mean difference between the food insecure households and food secure households at five percent significance level.

Table 7 Food Security Status by market distance (in hour) of HHs

Variable	Food Insecurity Status	N	Mean	Std. Dev.	Mean difference	t
Distance to the nearest market (in hour)	Food Insecure	153	0.78	0.40	1.03	0.05
	Food Secure	114	0.72	0.38		

Source: Author's computation (2021)

Econometric Results

The econometric analysis was made using binarylogistic regression model. This model was used to see the relative influence of household's demographic, socio-economic, human capital and institutional variables on food insecurity status. Identification of the descriptive statistics is not enough to stimulate policy actions unless the relative influence of each factor is known for priority based intervention. Before discussing about the econometric model results, the model specification and data fitting should be made.

Test of goodness-of-fit of the model: Hosmer and Lemeshow test was used to test the goodness-of-fit of the model to handle numerical problems. This test shows insignificance (P = 0.251) and concludes that the model is well fitted and the model prediction does not significantly differ from the observed. The finding of the significance of omnibus test (P = 0.000) corresponds to concluding that there is adequate fit of the model. This means that at least one of the predictors is significantly related to the response variable (Table 8).

Table 8 Goodness-of-fit of the model

Omnibus Test	Chi-square	d.f	P
Step	135.194	14	0.000
Block	135.194	14	0.000
Model	135.194	14	0.000
Hosmer and Lemeshow	10.207	8	0.251

Source: Author's computation (2021)

Model Summary: The -2 Log Likelihood statistic measures how poorly the model predicts the food insecurity status of the sampled households such that the smaller the statistic the better the model. The usual R^2 (in OLS) statistic cannot be exactly computed for logistic regression models, so Cox and Snell R^2 as well as Nagelkerke R^2 are computed instead (Pseudo R^2). Larger pseudo R^2 statistics indicate that more of the variation is explained by the model, to a maximum of 1 (Table 9).

Table 9 Model Summary

Step	-2 Log likelihood	Cox & Snell R^2	Nagelkerke R^2
1	1423.650[a]	0.152	0.224

Source: Author's computation (2021)

The classification table: The classification table showed that 40.4% of food secure households were correctly classified whereas 81.0% of food insecure households were correctly classified. About 72.4% correct predictions of overall sampled households is modeled by using binary logistic regression model. The overall percent of cases that are correctly predicted has increased from 68.7% for the null model (model without predictor) to 72.4% for the full model (model with predictors) (Table 10).

Table 10 Classification Table

Observed		Predicted		
		Food Insecurity Status		Percentage Correct
		Food Insecure	Food Secure	
Food Insecurity Status	Food Insecure	124	29	81.0
	Food Secure	68	46	40.4
	Overall percentage			72.4
	The cut off value			0.50

Source: Author's computation (2021)

Odds ratio of model with no predictor: The intercept-only model is ln (odds) = 0.294. If we exponentiate both sides of this expression, we find that our predicted odds [Exp(B)] = 1.342. That is, the predicted odd of food insecure households is 1.342. Since 153 of our subjects were food insecure households and 114 were food secure, our observed odds are 153/114 = 1.342 (Table 11).

Table 11 Model with no predictor

		B	S.E.	Wald	df	P	Odd Ratio
Step 0	Constant	0.294	0.124	5.656	1	0.017	1.342

Source: Author's computation (2021)

Determinants of food insecurity

Odds ratio of model with predictors: This statistic is used to interpret significant predictor variables. A total of fourteen predictor variables were included in the binary logistic model while six of them are fond to be statistically significant. These variables were age of household head, education level of household head, family size, dependency ratio, seed type for production and cultivated land (Table 12). The odds ratios and coefficients of logistic regression and possible statistical interpretations and discussion of the results were given here.

Age of household head: Age of the household headis found to be positive and significant determinant of food insecurity. This means that, an increase in the age of the household head increases the likelihood for the household to be food insecure. One possible reason may be that older household heads have larger number of family size as Polygamy is a common practice. This opens up a chance for bearing children even at latter ages. The other possible reason is that a household who headed by older aged head face a family labor shortage since old children become independent having their own household. And due to this the household would be composed of young aged children with large family size. The result confirmed that the odds ratio for age of household head indicates that one-year increase in age of household head is associated with increase in the odds of being food insecure by a factor 0.996 keeping other things constant. The possible reason for such result might be the old age bearing of children so that the family number increases while the head of the household was getting older and older.

Education of household head: Education level of household head negatively and significantly influenced food insecurity status of rural households. As indicated by the reported P-value (0.026), the odd ratio of this variable confirmed that as year of education increases by one year, food insecurity status decreases by a factor of 0.879 being other things remain constant. This is because spending more years in formal education makes rural households to diversify source of their income and become wise in the choice of which crops to produce to be food secure. Hence, educational level of households is considered as an important factor to participate actively in the eradication of poverty. Similar findings were found in Mebratu (2018) who discussed that literate households have more chance to apply their knowledge towards the food security as compared to illiterate households. Similarly, Okyere *et al*. (2013) found negative and significant association between education level of household head and food insecurity.

Family size:This study found out that the family size (AE) positively and significantly affected food insecurity status. Rural households with large family size, having children of non-productive age, could face the probability of food insecurity because of high dependency ratio than farm households with small family size. Therefore, this agrees with the expectation that household size with high dependency ratio had role to play in affecting the probability of households to become food insecure. The odds ratio of 3.293for family size implies that, other things being constant, the odds ratio in favor of being food insecure increases by a factor of 3.293as family size increase by one person. The possible explanation can be those households with many children could face food insecurity because of high dependency burden. Several empirical studies (Ayalew, 2003; Mulugeta, 2002; Tesfaye, 2005and Yilma, 2005) showed that the family size was significant in determining the probability of household's food security status.

Dependency ratio: Dependency is burden to every household, it is also a catalyst for food insecurity. This variable is found to have positive influence on the food insecurity status of rural households. It is found that dependence ratio and food insecurity have positive relationship. The positive sign shows that the probability of becoming food insecure is high for households where productive members are less than unproductive members. The odds ratio of 0.994implied that, other variables remaining constant, the odds ratio in favor of being food insecure increased by factor of 0.994as the dependent age group (<15 and >65) increases by one person. The possible explanation could be that those households with many dependent family members could be food insecure because of high dependency burden. This shows that those households with large economically non-active members tend to be food insecure than those households with economically active household members. This result is also in line with the result by Dereje (2008), Indris (2012) and Saadiq (2012).

Seed type for production: Seed type used for crop production is another important determinant of food insecurity. This variable is negatively and significantly influenced food insecurity status. The odd of this variable indicates that the household who uses improved seed for production is 0.364 times less likely to be food insecure than those households who use traditional type of seed. The possible explanation of this result could be that if the households use improved seed for crop production, they are more likely to earn more outputs than their counterpart who use traditional seed. This will improve the livelihood of households by securing their life standard.

Table 12 Coefficients and odds ratio of binary logistic regression

Variables	β	$SE(\beta)$	Wald	P-value	Odd ratio
Sex of household head (1 = Male)	0.255	0.458	0.309	0.579	1.290
Age of household head (Year)	0.034	0.021	2.747	0.097***	0.966
Education of household head (Year)	-0.128	0.058	4.981	0.026**	0.879
Family size (AE)	1.192	0.160	55.731	0.000*	3.293
Dependency ratio	0.006	0.002	6.163	0.013**	0.994
Cooperative membership (1 = Yes)	-0.386	0.422	0.839	0.360	0.679
Access to credit (1 = Yes)	0.506	0.423	1.433	0.231	1.658
Access to transport (1 = Yes)	-0.382	0.446	0.735	0.391	0.682
Distance to nearest market (Hour)	-0.005	0.006	0.907	0.341	0.995
Access to market information (1 = Yes)	-0.580	0.651	0.794	0.373	0.560
Seed type for production (1 = Improved)	-1.012	0.439	5.306	0.021**	0.364
Using fertilizer (1 = Yes)	0.365	0.401	0.828	0.363	1.440
Size of cultivated land (Hectare)	-0.387	0.218	3.156	0.076***	0.679
Livestock ownership (TLU)	-0.048	0.062	0.600	0.439	0.953
Constant	-0.818	1.312	0.389	0.533	0.441
N = 267				***Significance levels: (*) 1%, (**) 5% and (***) 10%***	

Source: Author's computation (2021)

Size of cultivated land: Size of cultivated land negatively and significantly influenced food insecurity status of the respondent households. This implies that the household who got more hectares of cropping land would be in a position to cope with food insecurity, this means households with large cultivated land produce more for household consumption and for sale and have better chance to be food secure than those having relatively small size of cultivated land. The reason may be that, the rural households who got more hectare of cropping land planted with crops, the probability of getting enough harvest for home consumption increases. The odds ratio of 0.679 implied that, other things being constant, the probability of being food insecure decreased by factor of 0.679 as total land holding increased by one hectare. Similar result is observed in Beyene and Meche (2010) who indicated negative association between farm land size and food insecurity.

Household Coping Mechanisms

Households adopt and develop diversified coping strategies and sequential responses through which people used at times of decline in crop production. As illustrated in the Table 13, rural households in the study area use alternative copingmechanisms such as: sale of more livestock than usual, borrowing of food, reducing frequency of meal, selling charcoal and relying on food aid.The first most important coping mechanism and the most common strategy used and practiced during crop failure by the large number of surveyed households is sale of livestock which was used by about 88.9% and 79.8% of food insecure and food secure households, respectively. The second, and third most important coping

strategies used by large number of households were borrow grain or cash from relatives or neighbors and selling fire wood or charcoal which were about 68.0% and 66.7% of food insecure, respectively and about 58.8%, and 47.1% of food secure households, respectively. Reducing frequency of meal and relying on food aid were also among the copingmechanisms used during minor and major crop failures in the study area.

Table 13 Coping mechanism during minor or major crop failures

Coping Mechanisms	Food Insecure	Food Secure
	%	%
Sale of Livestock	88.9	79.8
Borrow grain or cash from relative or neighbors	68.0	58.8
Reducing frequency of meal	45.8	37.7
Selling fire wood or charcoal	66.7	47.1
Relying on food aid	51.6	45.6

Source: Author's computation (2021)

Table 14 presents the coping mechanisms used by rural households in the study district during severe food crisis. They use different coping mechanisms such as sale of small animals, sale of draft animals, consume wild foods, reduce size and frequency of meal, borrow cash or food from relatives, sale of farm and household equipment, distress migration, sale of fire wood or charcoal, withdraw children from school and postponing wedding or ceremonies.

The first top four best strategies to cope severe food crises in the study area were sale of small animals, sale of draft animals, reduce size and frequency of meal and borrow Cash or food from relatives. Accordingly, 87.7%, 65.8%, 35.9% and 41.2% of food insecure households, respectively used the above mentioned top four coping mechanisms while 81.7%, 49.7%, 47.4% and 32.5% of the food secure households used the aforementioned top four best strategies during severe food crisis. Nowadays, distress migration to find work is also practiced as the coping mechanisms during food crisis in the study area.

Table 14 Mostly used coping mechanism during severe food crisis

Mechanisms	Food Insecure	Food Secure
	%	%
Sale of small animals	87.7	81.7
Sale of draft animal	65.8	49.7
Consume wild foods	34.6	38.6
Reduce size and frequency of meal	35.9	47.4
Borrow cash or food from relatives	41.2	32.5
Sale of farm equipment	38.6	36.8
Sale of household equipment	9.8	5.3
Distress migration to find work	22.2	28.9
Sale of fire wood or charcoal	26.1	39.5
Withdraw children from school	30.7	27.2
Postponing wedding or ceremonies	32.7	22.8

Source: Author's computation (2021)

Conclusion and Policy Implication

CONCLUSION

This study was undertaken in *LaloAssabi* district of Western Ethiopia with the objectives to measure the food insecurity status of the rural households, identifying the determinants of food insecurity among the rural households and identifying households' coping strategies during crop failure and severe food crisis. To achieve these objectives, the study relied more on primary data which werecollected by conducting household survey from randomly selected households from five randomly selected kebeles of the district. Households' demographic, socioeconomic, human capital and institutional data which were deemed to be relevant were collected, organized, analyzed and interpreted to come up with the results.

Data were analyzed using both descriptive statistics and econometric method. The descriptive statistics were used to study the demographic, socio-economic, human capital and institutional factors in relation to food insecurity status of households. The econometric method in which logit model was specified and estimated was used to analyze the determinants of food insecurity status among the rural households. The sampled households were classified into food insecure and food secure groups based on kilo-calories (kcal) actually consumed by the households during the previous seven days of survey data either through production, purchase, gift or other means. Total amount of foodcommodity consumed by each household during the seven days were converted into equivalent daily kilo calories (kcal) per adult equivalent (AE) and then compared with recommended daily kcal per adult equivalent. Total daily food energy per adult equivalent of less than 2200 kcal was considered as food insecure and 2200 kcal and above as food secure. Accordingly, 57.3% of sampled households were living on total daily food energy level per adult equivalent of less than the minimum recommended requirement.

Binary logit model was employed to study the relations between the probability of households being food insecure and household's socio-economic and other characteristics. The result revealed six significant variables out of the hypothesized variables. Among those significant variables, education level of household head, type of seed used for production and size of cultivated land negatively and significantly affected food insecurity status while age of household head, family size and dependency ratio positively and significantly influenced food insecurity status. In addition to this, the coping strategies practiced by most of the rural households during major and or minor crop failure were sale of livestock, borrow grain or cash from relatives or neighbors, reducing frequency and size of the meal, sale of charcoal and rely on the food aid. The study also assessed coping mechanisms during severe food crisis and identified sale of small animals, sale of draft animals, consume wild foods, reduce size and frequency of meal, borrow cash or grain from relatives and distress migration to find work as the most commonly practiced mechanisms in the study district.

Policy implication

The result of this study shows that 57.3% of the surveyed households were unable to getthe minimum daily energy requirement. In order to improve households' food security situation in the district, the following may be the major recommendable areas ofintervention.

- Age of the household head had positive impact on food insecurity. This means old household heads are more likely to be food insecure. Therefore, capacity building for older household heads should be given more priority. In addition, interventions intended to help rural households have to give priority to old aged household heads.
- Education level of household head have negative influence on the food insecurity status of rural

households. This indicated that better educated households were more likely to be food secure than those who do not have access to better education. Therefore, concerned authority should give attention on the coverage of access to education in the rural areas.

- Large family size is a problem for the household if the non-productive members are high. Awareness creation should be the first task to tackle this problem. Therefore, organizations working on the health stream need to create strategic approach for the utilizations of family planning facilities.
- Seed type used for production is found to have negative impact on the food insecurity status. That is, households who use improved seed for production of crops were more likely to be food secure than those households who do not use improved version. Hence, development agents should work on giving trainings and awareness creation for rural households regarding the effective utilization of the improved seed and other agricultural mechanization.
- Cultivated land is important economic factor that negatively affects households' food insecurity status in the study area. However, with an increase in population size of the district, cultivated land is becoming in short supply and the farmers are producing crop on small plot of land with lack of technologies and low productivities. Improved agricultural technologies that enhance the productivity of land per unit area should be developed and training of rural households on land management should be given a due emphasis.
- Borrowing of food or cash, sale of more livestock than usual, reduce number of meal, reduce size of meal and sale of firewood and charcoal are the most important coping strategies used by rural households during either crop failure or food crisis. Therefore, the regional government, zonal and district administration should have to give technical skill training and provide some credit for the rural households in order to increase the income of the household and reduce the food insecurity status. In addition to this district administration should also link rural food insecure households with international and local NGOs which are implementing in the district.

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