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Full Length Research Paper

Emperical analysis of the determinants of rural households food security in Southern Ethiopia: The case of Shashemene District

Amsalu Mitiku[1], Bekabil Fufa[2] and Beyene Tadese[3]

[1]Department of Agricultural Economics and Extension, Jimma University, Jimma, Oromia Regional State, Ethiopia, P.O.Box 307.
[2,] School of Agricultural Economics and Agribusiness, University of Haramaya, P.O.Box 138 Dire dawa Ethiopia.
[3]School of Agricultural Economics and Agribusiness, University of Haramaya, P.O.Box 138 Dire dawa Ethiopia.

Corresponding authors:amse2001@gmail.com or fayoo@yahoo.com

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This study examined the status and determinants of rural households' food security in Shashemene district of Oromia regional state, in Ethiopia. Both primary data and secondary were used for the study. The study was based on the survey of a total of 100 households randomly selected using a three-stage sampling technique. Analytical tools used include descriptive statistics, Foster-Greer-Thorbecke (FGT) and logit model. The findings from head count ratio computed by FGT model revealed that about 36 and 64 % households in Shashemene district were food insecure and food secure respectively. The depth of food insecurity and severity were 12.38 and 7.35-%, respectively. Logit model analysis result showed that factors such as, family size, cultivated land size, total farm income, off-farm income and livestock ownership of households were significant influence household food security status. The findings suggest the following set of policy recommendation. Identifying and understanding factors those are responsible for household food security is important to combat food security problems at the household level. The study findings also suggest that in selecting priority intervention areas, the food security strategy should consider statistically significant variables as the most important areas.

Keywords: Head Count Ratio; Food insecurity and rural households

INTRODUCTION

Ethiopia is one of the poorest countries in the world. The proportion of the total population living in poverty is 44 % and its per capita income is about US$ 160. This is less than Sub-Saharan African countries average of US$ 500 (World Bank, 2007). Based on the Human Development Index, Ethiopia is ranked 170th out of 177 countries (UNDP, 2007). Like many other developing countries, agriculture provides a lion's share of the economic activity, accounts for half of the Gross Domestic Product (GDP), 60 % of the exports, and 80 % of the national employment (CSA, 2008a). In Ethiopia, the seriousness of food shortage problem varies from one area to another, depending on the state of the natural resources and the extent of development of food shortage (Webb *et al*., 1994). It is roughly estimated that 15 million rural peoples were food insecurity in 2006. Of these about 8.29 million peoples were chronically food insecurity while the remaining 6.71 million were acute food insecurity people (FSB, 2007).

The same source indicated that a number of factors aggravated the growing problem of food security in this country. Among the major challenges of food security in Ethiopia are backward agriculture, unstable weather, recurrent drought, pests and disease, population pressure, weak institutional capacity, and inadequate infrastructures and social services. Moreover, food insecurity is one of the defining features of rural poverty affecting millions of people particularly in moisture- deficit and pastoral areas (FDRE, 2001). While the problem of food insecurity have big diversity and multiple dimensions, which range from the global, regional, country, local, household to individual level. So far there is a little research undertaken to elicit these problems. More attention is only given to the country level.

Moreover, the various, complex and interrelated cause of household food insecurity and local responses during crisis situation are not studied in detail, especially at a household level. Therefore, this study attempts to fill the gap by conducting an empirical research on identifying, analyzing, and understanding those elements that are responsible for variation in household food security that are needed to guide policy decisions, device appropriate interventions and integrated efforts to combat food insecurity. Hence**,** the objectives of this study are:

1. To assess the extent of rural household's food insecurity, and
2. To identify the major determinants of rural household's food security in the study area.

RESEARCH METHODOLOGY

Description of the study area

The study was conducted in Shashemene district of Oromia Regional States, Ethiopia. Shashemene is found in West Arsi Zone and located 255 km south of the capital Addis Ababa and 25 km north of Awassa, the regional capital of southern nation nationalities and people regional state (CSA, 2008b).

Sampling Procedure

In this study the farming households are actually responsible for making day to day decisions on farm activities. Thus, households were the basic sampling unit. Three-stage sampling techniques were used to generate the required primary data. At the first stage, Shashemene district, where Horn of Africa Regional Office (HARO) project intervention, was selected purposively. In the second stage, four kebeles were selected randomly. Finally, a probability proportional to sample size (PPS) sampling procedure was employed and 100 sample households were selected using systematic random sampling from the list of farmers.

Methods of Data Analysis

Data collected were analyzed using descriptive statistic, food security model, and logit model:

(i) Descriptive statistics

Frequency distribution, percentage and mean were used to assess the socioeconomic characteristics of farming households.

(ii) Food security index

The procedure of Foster *et al*. (1984) was used in the computation of incidence, depth and severity of food insecurity. The *Foster-Greer-Thorbecke (FGT)* measure is given as:

$$FGT(\sim)=\left(\frac{1}{n}\right)\sum_{i=1}^{q}\left[\frac{(c-y_i)}{c}\right]^{\sim} \qquad (1)$$

Where:

n is the number of sample households; *yi* is the measure of per adult equivalent food calorie intake of the i^{th} household; *c* represents the cut off between food security and food insecurity households (expressed here in terms of caloric requirements 2100kcal); *q* is the number of food-insecure households; and ~ is the weight attached to the severity of food insecurity. In FGT index, $y_i \geq c$ that the specified household is food secure.

Within this FGT index, we compute the three most commonly employed indices: head count ratio, food insecurity gap and squared food insecurity gap (Hoddinott, 2001). Head count ratio describes the percentage of sampled households whose per capita income or consumption is below the predetermined subsistence level of energy (2100kcal), means FGT (α=0) =.q/n. The food insecurity gap, FGT (α=1), measure how far the food insecurity of households, on average, are below subsistence level of energy. Here, it means that, giving equal weight to severity of food insecurity among all the food insecure households will be equivalent to assuming that ~ = 1. This index characterizes the amount of resources will be required to bring all the food insecurity of the households to this subsistence level. To put it differently, it will provide the possibility to estimate resources required to eliminate food insecurity through proper targeting. Finally, squared food insecurity gap, FGT (α=2), is a measure closely related to severity of food insecurity gap but giving those further away from the subsistence level a higher weight in aggregation than those closer to the subsistence level.

(ii) Specification of the model

The binary logit model was applied to estimate the effects of explanatory variables on household food security status. In this model the dependent variable is household food security (HFS) that is dichotomous taking a value of 1 if the household is food secure; 0 otherwise. The information, which identifies the food secure from the food insecure, was obtained by comparing the total food calorie available for consumption in the household per Adult Equivalent (AE) to the minimum level of subsistence requirement per AE (2100 kcal) (EHNRI,

1998). A household beyond this threshold is said to be food secure households, otherwise not. The cumulative logistic probability model is specified as follows (Gujarati, 1995): Estimable form is

$L_i = Ln[P_i/(1 - P_i)] = \alpha_o + \alpha_1.X_1 + \alpha_2.X_2 + \alpha_3.X_3 + \alpha_4.X_4 + \alpha_5.X_5 + \alpha_6.X_6 + \alpha_7.X_7 + \alpha_8.X_8 + \alpha_9.X_9 + \alpha_{10}X_{10} + \alpha_{11}.X_{11} + \alpha_{12}.X_{12} + \varepsilon_i$ (2)

Where:

L_i = logit means log of the odds ratio, which is not only linear in X_i but also linear in the parameters. It shows how log odd in favor of food security change as the respective independent variable change by a unit

X_i = the individual i i = 1, 2, …., 12; are independent variables

Pi = the probability that an individual is being food secure and

(1-Pi) = the probability that a household will not be food secure households:

α_o= intercept or constant term, that implies the combined impact of these fixed factors on household food security

X_1 = Number of family size (number)

X_2= Dependence ratio

X_3 = Age households in ayear)

X_4 = Distance to markets (killo meter)

X_5= Size of cultivated land (hectare)

X_6= Total livestock holding (in Tropical Livestock Unit (TLU[1])

X_7 = Total farm income (Birr),

X_8= Total off-farm income or non farm income (Birr)

X_9 = Amount of food aid obtained by the households (Birr)

X_{10}= Gender of the households(male = 1; female = 0)

X_{11}= Education level the households (Literate = 1; illiterate = 0)

X_{12}= Access to credit service (yes= 1; 0= no)

ε_i = error term

The parameters were estimated by maximum likelihood technique by latest STATA software packages version 10. Before model analysis was commenced, to check the problem of the multicollinearity the Variance Inflation Factor (VIF) for continuous explanatory variables and Contingency Coefficients (C) for dummy variables were used in this study. Following Gujarati (1995), VIF is defined as:

$$VIF(X_i) = \frac{1}{1 - R^2} \qquad (3)$$

Where:

X_i = the i[th] quantitative explanatory variable regressed on the other quantitative explanatory variables.

R^2_i = the coefficient of determination when the variable X_i regressed on the remaining explanatory variables. If the value of VIF exceeds 10, it is used as a signal for existence of strong multicollinearity between continuous explanatory variables. Contingency Coefficients were computed for each pair of qualitative variables. The C is computed as follows:

$$C = \sqrt{\frac{i^2}{n + i^2}} \qquad (4)$$

Where,

C= Contingency Coefficient,

χ^2 = a Chi-square random variable and

n = total sample size.

Contingency Coefficient value ranges between 0 and 1, and as a rule of thumb variable with Contingency Coefficient below 0.75 shows weak association and a value above it indicates strong association of variables.

The model is based on the following hypotheses:

1. Household income, livestock and land size were factors that have positive influence on food security
2. Household size is demand factor, which influence food security negatively
3. Education is a proxy variable of attitudes of households and expected to influence food security positively
4. Sex and age are demographic variables and expected to influence food security positively
5. Access to adequate credit and market information are institutional factors that have positive influence on food security
6. Distance to the market is institutional factors that have negative influence on food security

RESULTS AND DISCUSSION

Demographic and Socio-economic Characteristics of the Households

The distribution of the socioeconomic characteristics of the households is shown in Table 1. The result indicated that 73 % of the responding households were male headed, while 27 % are female headed. Categorization of household based on education exhibited that 68.75 % households are literate, while 31.25 are illiterate.

The survey result showed that the mean age households are 44 years. The mean age of food secure and food insecure households were 47 and 41 years, respectively. The mean family size of households is 6.84.

The mean family size of food secure and food insecurity households were 6.33 and 7.73, respectively. The farm size cultivated by the respondents was 0.99ha with the range of 0-5.25 hectare, this shows that the farmers are operating on small scale production. The

[1] Calf = 0.25; Weaned Calf= 0.34; Heifer = 0.75; Cow and Ox = 1.00; Horse and Mule = 1.10; donkey (adult) = 0.70; Donkey (Young) = 0.35; Sheep and Goat (adult) = 0.13= Sheep and Goat (young) = 0.06

Table 1: Distribution of household food security status by sex and education level

		Food insecurity (36)	Food security (64)	χ^2	Tot. (100)
Sex	Female	30.56	25	3.56*	27
	Male	69.44	75		73
Education	Illiterate	33.33	31.25	0.23	32
	Literate	66.67	68.75		68

***, ** and * significant at 1, 5 and 10 % probability level

Table 2. Distribution of households' food security status by mean family size, dependence ratio, age, land size, crop yield, number of livestock and total annual income.

	Food insecurity (N=36)	Food secure (N=64)	P-value	Tot. (N=100)
Family size	7.73	6.33	0.03	6.84
Age	41	47	0.03	44
Land size	0.66	1.17	0.02	0.99
Crop yield per ha	83000	186000	0.001	269000
Livestock holding	3.35	5.6	0.02	4.16
Annual Income	363.29	745.33	0.0	606.41

***, ** and * significant at 1, 5 and 10 % probability level

Table 3. Household food security status by household annual income sources in $

Income source	Food insecure (N=36)	Food secure (N=64)		Total (N=100)
Crop income	27.45	52.48	0.07*	79.93
Livestock	1.39	3.81	0.06*	5.21
Off-farm/ non farm	0.69	4.03	0.01**	4.72
Total	29.54	60.60	0.0***	90.13

***, ** and *** implies significant at 1, 5 and 10% level, respectively.

mean farm land size for food insecure and food secure households were 0.66 and 1.71 hectare respectively. The annual total crop production of households was 269,000 kg from 93.82 ha. About 186,000 and 83,000 kg of food crops were produced by food secure and food insecurity households. Livestock provide milk, meat, traction power, income and transport. Moreover, they are sold for cash as a coping mechanism during food shortage. Livestock owned by the sample households include cattle, sheep and goat, equine and poultry. The average livestock owned by the sample respondents Shashemene were 7.31 TLU (Table 2).

Table 3 shows the result of the household annual Income per Adult Equivalent (AE) and sources of income. Household income has a paramount importance in achieving household food security for all segments of rural population. It is important to buy food and non-food items. The finding revealed that the major income sources for the households include crops, livestock and their products and off-farm activities. It was observed from the survey that crop production was the most important source of income followed by livestock production and off-farm activities, respectively. The mean annual income per Adult Equivalent (AE) of sample households was $90.13. The mean annual income per Adult Equivalent (AE) of food secure and food insecurity household were 29.54 and $60.60, respectively. Finally, the finding also revealed that the average market distance of food secure and food insecurity households were 14.9 and 18.17 km, respectively. This implies, proximity to market center creates access to additional income by providing off-farm employment opportunities and easy access to inputs and transportation. It was, therefore, expected that households nearer to market center have better chance to improve household food security than who do not have proximity to market centers.

Extent of households food insecurity

Table 4 presents the summary of the household incidence, depth and severity of food insecurity. The three FGT measures used are head count index, food

Table 4. Summary of incidence and severity of food insecurity in Shashemene

Type	Percentage
Incidence food insecurity	36
Depth food insecurity	12.38
Severity food insecurity	7.35

Table 5. The maximum likelihood estimates of the Logit model

Variables	Coefficients	Odds Ratio	P-value
Sex (Male headed household)	0.423	1.5265	0.528
Age of household	0.0498	1.0511	0.0640
Family size of household	-0.2218	0.8011	0.0530*
Dependency ratio of household	-0.639	0.5278	0.207
Education level of household	0.8218	2.2746	0.23
Total farm income of household	0.0002	1.0003	0.0520*
Total off-farm income	0.0035	1.0035	0.0640*
Total cultivated land size	0.4631	1.589***	0.295
Livestock holding	0.2165	1.2417	0.0260**
Access to credit	0.6192	1.8574	0.297
Market distance	0.0005	1.0005	0.991
Amount of food aid	0.0009	1.0009	0.268
Constant	-3.0485		0.164
Pearson Chi-square		80***	
Log.hood		-39.6	
R^2		79%	
Sensitivity		84.38%	
Specificity		69.44%	

***, **, * significant at 1, 5 and 10 % respectively
Source: Model output

insecurity gap and severity of food insecurity. The results revealed that the head count ratio or incidence of food insecurity was 0.36. This implies that 36 % of the sampled farmers are not able to meet the daily recommended caloric requirement. To know how far the food insecurity households are below the recommended daily caloric requirement, food insecurity gap was calculated. Food insecurity gap provides the possibility to estimate resources required to eliminate food insecurity through proper targeting. The calculated values for food insecurity gap were found to be 12.38 %. These values shows that if it is possible to mobilize resources that can meet 12.38 % of caloric requirement of every food insecure households and distribute to each household to bring up to the recommended daily caloric requirement level, then theoretically food insecurity can be eliminated. On the other hand, to approach the most food insecurity sample households, severity of food insecurity was calculated by assigning a higher weight, α=2. The survey result indicated that the severity of food insecurity is 7.35% in the study area.

The Determinants of household food security

Table 5 shows the result of the determinant of household food security. Logit model was employed to assess determinants of food security. Before fitting the models, it was important to check whether there exists serious problem of multicollinearity among the hypothesized explanatory variables. The values of VIF for each of the continuous variables were found to be less than ten and hence, there was no a multicollinearity problem among all the hypothesized continuous variables included in the model. The result of C revealed that there was no a serious problem of association among discrete explanatory variables as the contingency coefficients did not exceed 0.75. Therefore, all the hypothesized dummy variables were included in the logistic regression model.

The likelihood ratio has a Chi-square distribution and it is used for assessing the significance of logistic regression. Model Chi-square provides the usual significance test for a logistic model. It tests the null hypothesis that none of the independent variables are linearly related to the log odds of the dependent. It is an overall model test which doesn't assure every independent variable is significant. The result is significant at less than 1 % probability level revealing that the null hypothesis that none of the independent variables are linearly related to the log odds ratio of the dependent variables is rejected. In addition, goodness of fit in logistic regression analysis is measured by count R^2 which indicates the number of sample observations correctly predicted by the model. The count R^2 is

interpreted based on the principle that if the predicted probability of the event is less than 0.50, the event will not occur, and if it is greater than 0.50, the event will occur (Maddala, 1981). Hence, the model results showed that the logistic regression model correctly predicted 79 % of sample households. The sensitivity and specificity analysis showed 84.38 % and 69.44 %, respectively. Thus, the model fits the data very well. The discussion and interpretation of the significant explanatory variables in the model in the study area are presented as below.

Family size in AE (FSIZE)

This variable was significant at 5 % probability level and negatively related with the food security. The result indicated that smaller household size tends to be food secure as compared to larger family size. The possible explanation is as family size increases, the amount of food for consumption in one's household increases thereby that additional household member shares the limited food resources. Other things being constant, the odds ratio in favor of being food secure decreases by a factor of 0.8011 as family size increase by one adult equivalent.

Total Size of Cultivated Land (Lsize)

The model result reveals that this variable has a significant at 1 % level and positive influence on the food security status of the household. The implication is that the probabilities of being food secure increases with farm size. This is possibly because that the size of land holding is a proxy for a host of factors including wealth, access to credit, capacity to beer risk and income. Larger farms are associated with greater wealth and income and increased availability of capital, which increase the probability of investment in purchase of farm inputs that increase food production and insuring food security. The odds ratio of 1.589 for total farm size implies that, other things kept constant, the odds ratio in favor of being food secure increase by a factor of 1.589 as the total farm size increases by one hectare.

Livestock size (TLU)

Livestock are important source of income, food and draft power for crop cultivation. Livestock size is positively and significantly associated with the probability of being food secure in the study area. This indicates that households with more livestock produce more milk, milk products and meat for direct consumption. Besides, livestock enables the farm households to have better chance to earn more income from selling livestock which enables them by increasing purchasing power of stable food during food shortage and could invest in purchasing of farm inputs that increase food production, and able in ensuring household food security. The result indicates that, other things held constant, the odds ratio in favor of being food secure increases by a factor of 1.2417 as the total livestock holding increase by one TLU.

Total annual farm income per AE (TOTFARIN)

This variable was hypothesized to have positive influence on food security. In agreement with the hypothesis, its coefficient came out to be positive and significant at 10 % probability level. The probable explanation is that those farmers who have better access to different types of farm income are less likely to become food insecurity than those households who have little access. The odds ratio in favor of food security increases by a factor of 1.0003 as the farm income increases by one Birr, keeping other factor constant.

Total off-farm income (TOFFIN)

This represents the amount of off-farm income of the farmer or any of the household members earned in the year. As expected the availability of off-farm income was positively and significantly associated with household food security status. The result showed that the probabilities of the household to be food secure increases by factor of 1.0035 as the household earned more off-farm (non farm income). The result suggests that households engaged in off-farm activities are endowed with additional income and less likely to be in food insecurity.

CONCLUSION

The study revealed that 36 % of the households were not able to meet the daily recommended caloric requirement and 12 % the households were below poverty line while 7.35 % sample households were most food insecurity households groups in the study area. Further, the study has shown as the major factors affecting food security of rural households were family size, total cultivated land size of household head, annual farm income, total cultivated land size, total off-farm income and livestock holding. Study also indicated, annual farm income, off-farm income have a significant and positive influence on the state of household food security while family size and food security were negatively related. Based on the findings and conclusion of the study, the following policy recommendations are forwarded.

1) Proper attention should be given to limit the increasing population. This could be achieved by proper awareness creation about practicing family planning
2) activities through integrated health and

education services.

3) Total off-farm income have a significant and positive influence on the state of households food security, therefore, concerned stakeholders should identify the different possible types of off-farm activities and support with the necessary knowledge and skills of the various types of off-farm activities that could improve their food security status.

4) Annual farm income has a positive influence on food security. Therefore, household's total farm income should be improved through promotion of: better livestock management practices, improved crop varieties with full management practices, small scale irrigation schemes, commercialization and diversification of farm products (value addition and strengthening market linkages).

5) Farm households with larger livestock holdings are more food secured than farmers with less livestock holdings. Therefore, farmers should be encouraged to engage in livestock husbandry through providing with improved livestock production technologies (health service, improved breeds and feeds) to improve production and productivity of the sector, this will ultimately increase food security status.

6) Shortage of cultivated land size was found to be significantly affecting households' food security in the study area due to population pressure, constant drought and severe decline in soil fertility. Therefore, proper attention should be given to increase food production and productivity of the farmers through improving better access and availability to improved agricultural technologies; promoting the provision and use of chemical fertilizer; promoting physical and biological conservation measures that enable the households to maintain their food security status; promoting strategy such as crop diversity, timely and low cost supply of inputs like fertilizer, improved seed, agrochemicals, further development of micro-irrigation should be promoted to increase production and productivity

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