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HOUSEHOLD LEVEL DETERMINANTS OF FOOD INSECURITY IN RURAL AREAS OF DIRE DAWA, EASTERN ETHIOPIA

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ABSTRACT

Even though the struggle to achieve food security at the household level in the rural areas of Ethiopia dates back a long period, it has remained as a challenging goal even today. Making their living on marginal, moisture stressed, heavily degraded and less productive land, households in rural areas of Dire Dawa face persistent food shortages. The design and implementation of effective measures to reduce household food insecurity in the region depends on in-depth understanding of its covariates. This study seeks to address these issues by assessing location specific socio-economic factors that influence food insecurity of households in rural areas of Dire Dawa Administrative region. The analysis is based on survey data gathered from randomly selected 115 sample rural households in the study area. A binary logit model was used to identify the factors influencing household level food insecurity. A total of thirteen explanatory variables were included in the empirical model. The empirical results estimated using the survey data to identify the determinants of food insecurity among rural households in the study area revealed mixed impressions. Among variables considered**,** family size, annual income, amount of credit received, access to irrigation, age of household head, farm size, and livestock owned showed theoretically consistent and statistically significant effect. However, estimated coefficients of number of oxen owned and dependency ratio showed theoretically inconsistent and statistically insignificant effect on the probability of household to be food insecure.. Estimated coefficients of sex of household head, total off-farm income, education of household head and amount of food aid received were not found to be statistically significant in determining household food insecurity in the study area. The findings imply that improvement in food security situation needs to build assets, improve the functioning of rural financial markets and promote family planning. These areas could provide entry points for policy intervention to reduce hunger and augment household and community livelihood opportunities.

Key words: Food Insecurity, Binary Logit, Ethiopia

INTRODUCTION

Even though developing countries have achieved relatively faster agricultural growth during the last four decades, the progress has been dominated by significant gains in Asia [1]. Agricultural growth in sub-Saharan Africa averaged nearly 3 percent over the past 25 years. This is partly attributed to their agro-climatic potential, poor infrastructure and the dismantling of public agricultural institutions for research, extension, credit and marketing [2]. To counter these years of neglect and concerned about global food security, the United Nations, heads of states and Government and international and regional organizations, called for urgent action [3]. A number of initiatives have emerged or are emerging to address this important challenge [4]. Such initiatives include the Alliance for an African Green Revolution and a proposed Global Fund for Smallholder Agriculture [5]. The reason for such initiatives also includes ensuring sustainability of agricultural growth in countries experiencing it.

Despite the above efforts, deepening food crises in several developing countries specially those in sub-Saharan Africa (SSA) is still the concern of many researchers, planners, donors and international development agencies, who have given high priority to the study of food systems and the problem of food security [6]. Despite the availability of resources and the efforts made by governments in most of these countries, food insecurity and declining food production per capita remained among the most crucial issues. The attainment of an increase in food grain production above the population growth is still a challenge for most SSA countries [7].

With a population projected to reach 80 million in 2010 and about 45 percent living below the poverty line and most vulnerable to food insecurity, ensuring food security remains a key issue for the Government of Ethiopia [8]. In order to combat threats of famine and pervasive poverty and thereby ensure food security for its population, the government strategy has rested on increasing the availability of food grains through significant investments in agricultural technologies (high yielding varieties of seeds, fertilizer), services (extension, credit, inputs), and rural infrastructure (roads, markets). The impacts of these policies, however, have been shadowed as there are still millions of people who experience extreme hunger in the country.

Food security is the condition in which all have access to sufficient food to live healthy and productive lives [9]. Food security is dependent on agricultural production, food imports and donations, employment opportunities and income earnings, intra-household decision-making and resource allocation, health care utilization and caring practices [10]. It is a multi-dimensional development issue that needs cross-sectoral integrated approaches. However, because there are concerns that such approaches can be too costly, too complicated or take too long to show results, institutions may not invest their scarce resources in implementing them. Moreover, household food security issues cannot be seen in isolation from broader factors such as physical, policy and social environment [11]. The physical factors play a large role in determining the type of activities that can be undertaken by rural households. Government policies, on the other hand, have a strong effect on the design and

implementation of household food security interventions. Likewise, the presence of social conflict expressed in terms of mistrust of other social groups or even outright violence, is also an important factor in the design and implementation of interventions in a given region.

Making their living on marginal and moisture stressed, and heavily degraded and less productive land, households in rural areas of Dire Dawa are facing unrelenting food shortages. On top of ever decreasing land holding size and increasing population, recurrent drought and resource (land, water, forest, rangeland) degradation in the study area have made the food security situation worse. Realizing this issue, many governmental and non-governmental organizations are intervening at least to lessen the adverse effects of the food problem, but there is yet little success. Cognizant of these facts, this study was designed to identify location specific factors that contributed to household food insecurity, and through that make recommendations to improve the effectiveness of interventions.

METHODOLOGY

Source of data

A two-stage random sampling procedure was used to select 115 rural households in rural areas Dire Dawa. At the first stage, 5 peasant associations (PAs) were selected randomly. In the second stage, probability proportional to size sampling technique was employed to draw sample households from the selected sample PAs. A structured survey questionnaire was designed and pre-tested to collect the primary data. The household head was the main respondent. The questionnaire tried to encompass information on demographic characteristics, crop and livestock production, farming systems and productive resources, land use, access to services, as well as coping strategies employed by the households during time of food shortage [12].

The analytical model

Food security at the household level is best measured by direct survey of income, expenditure and consumption and comparing it with the minimum subsistence requirement [13]. The government of Ethiopia has set the minimum acceptable weighted average food requirement per adult equivalent (AE) per day at 2100 kcal [8, 14, 15]. The determination of the adult equivalent takes into account the age and sex of each household member [16]. Hence, for this study 2100 kcal per adult equivalent per day is employed as a cut-off value between food-secure and food-insecure households. Thus, those households who have energy per AE below the minimum subsistence requirement (2100 kcal) are deemed to be food insecure, and those who managed to attain the 2100 kcal per AE per day are considered to be food secure households.

Once the groups are categorized as food-secure and food-insecure, the next step is to identify the socio-economic factors that are correlated with food-insecurity. It is hypothesized that some farm and household characteristics such as household size,

land size and level of agricultural production have got relative importance in determining whether a household is food secure or not.

A variety of statistical models can be used to establish the relationship between these household characteristics and food insecurity. Conventionally, linear regression analysis is widely used in most economic and social investigation because of availability of simple computer packages, as well as ease of interpreting the results. However, results derived from linear regression analysis may lead to fairly unreasonable estimates when the dependent variable is dichotomous. Therefore, the use of the logit or probit models is recommended as a panacea of the drawback of the linear regression model [17]. Which model to choose between logit and probit is, however, difficult for they are similar in most applications, the only difference being that the logistic distribution has slightly fatter tails. This means that there is no binding reason to choose one over the other but for its comparative mathematical and interpretational simplicity many researchers tend to choose the logit model [18]. Therefore, this study employed the logit model following the footstep of these researchers. The dependent variable in this case, food insecurity, was a binary variable which took a value one if a household was found to be food insecure, zero otherwise.

The cumulative logistic probability model can be econometrically specified as [19]:

$$P_i = F(Z_i) = \frac{1}{1+e^{-(\alpha+\sum \beta_i X_i)}} \quad (1)$$

Where P_i is the probability that an individual is being food insecure given X_i
X_i represents the i^{th} explanatory variables
α & β_i are regression parameters to be estimated.
e is the base of the natural logarithm

For ease of interpretation of the coefficients, a logistic model could be written in terms of the odds and log of odd. The odds ratio is the ratio of the probability that an individual or household would be food insecure (P_i) to the probability of a household would not be food insecure (1- P_i). That is,

$$\left(\frac{P_i}{1-P_i}\right) = e^{Z_i} \quad (2)$$

and taking the natural logarithm of equation (2) yields:

$$\ln\left(\frac{P_i}{1-P_i}\right) = Z_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_m X_m \quad (3)$$

If the disturbance term U_i is taken into account, the logit model becomes:

$$Z_i = \alpha + \sum_{i=1}^{m} \beta_i X_i + U_i \quad (4)$$

The parameters of the model, α and β, can be estimated using the maximum likelihood (ML) method [19, 20].

Variables and working hypothesis

Review of literature, past research findings, experts and authors' knowledge of the food insecurity situation of the study area were used to identify the potential determinants of household food insecurity. Therefore, the following variables were selected to analyze whether they explain a household's food insecurity or not.

As family size increases, obviously the number of mouths to feed from the available food increases. Hence, it is hypothesized that family size and food insecurity are positively related. Age of household head also matters for household food security. Rural households mostly devote their lifetime or base their livelihoods on agriculture. The older the household head, the more experience s/he has in farming and weather forecasting. Moreover, older persons are more risk averters, and mostly they tend to diversify their production activities. As a result, the chance for such a household to be food insecure is less. Moreover, in a household where productive age groups are higher than the non-productive age groups, the probability of a household to be in shortage of food would be less, provided that the area provides good working atmosphere and production potential. Since male-headed households are in a better position to pull more labor force than the female-headed ones, sex of the household head is an important determinant of food insecurity in the study area.

Education equips individuals with the necessary knowledge of how to make a living. Literate individuals are keen to get information and use it**.** Hence, it is supposed that households who have had at least primary education or informal education are the ones to be more likely to benefit from agricultural technologies and thus become food secure.

Ownership of assets such as cultivated land and livestock as well as access to irrigation decreases the likelihood that the household will be food insecure. As income determines the household's ability to secure food, it remains to be an important variable which explains the characteristics of food secure and food insecure households. Income earned from any source improves the food security status of the household. Households which manage to secure larger income from any source have better access to the food they need than those households which do not. Credit may also serve as an important source of income. Those households which receive the credit they requested have better possibility to spend on activities they wish. Either they purchase agricultural input (improved seed and/or fertilizer) or they purchase livestock for resale after they fattened them.

EMPIRICAL RESULTS

Table 1 below shows summary statistics and scores of sample household groups on the continuous and dummy variables included in the model. The results revealed that food insecure and food secure household groups have statistically significant difference with respect to mean of the variables such as family size (FASZ), total annual income (TINC), annual off-farm income (TOFFI), age of household head (AGE), dependency ratio (DPR), and amount of credit received (AMDT). Categorical variables such as education of the household head (EDUC) and access to irrigation (IRGN) were also found to be statistically different for the two groups of households (Table 1).

In order to identify the most important factors which determine household food insecurity from the hypothesized potential variables, binary logit model was estimated by employing SPSS Version 10.0 statistical package.

Since the likelihood ratio test statistics exceeds the chi-square critical value by 13 degrees of freedom, the hypothesis that all coefficients of the model except the intercept are equal to zero is rejected. Another measure of goodness of fit used in logistic regression analysis is the count R^2, which indicates the number of sample observations which are correctly predicted by the model. The count R^2 is based on the principle that if the estimated probability of the event is less than 0.5, the event will not occur and if it is greater than 0.5, the event will occur [20]. In other words, the i^{th} observation is grouped as food insecure if the computed probability is greater than or equal to 0.5, and as otherwise food secure . The model results showed that the logistic regression model correctly predicted 97.4 percent of the sample households. The sensitivity (correctly predicted food insecure) and the specificity (correctly predicted food secure) are found to be 98.9 percent and 92.9 percent, respectively (Table 2).

Out of the thirteen variables hypothesized to influence household food insecurity, seven were found to be statistically significant. The maximum likelihood estimates of the logistic regression model showed that family size, annual household income, amount of credit received, irrigation use, age of the household head, cultivated land size and total livestock owned measured in Tropical Livestock Unit (1 TLU = 250 kg live weight of livestock) were important factors identified to influence household food insecurity in the study area.

DISCUSSION

Family size is found to be highly significant to determine household food insecurity in the study area. This household factor revealed a positive relationship with food insecurity indicating that the odds ratio in favor of the probability of being food insecure increases with an increase in the family size. More specifically, the odds ratio in favor of food insecurity, *cetris paribus*, increases by a factor of 49.77 as the family

size increases by one member. The likely explanation is that in an area where households depend on less productive agricultural land, increasing household size results in increased demand for food. This demand, however, cannot be matched with the existing food supply so ultimately end up with food insecurity.

The amount of household income was hypothesized to have negative influence on food insecurity. In agreement with the hypothesis, its coefficient came out to be negative and statistically significant. Households that have access to better income opportunities are less likely to become food insecure than those households who had no or little access. The odds ratio in favor of food insecurity decreases by a factor of 0.995 as income increases by one unit.

The sign of the coefficient of age of the household head shows a negative relationship with food insecurity which is statistically significant. This means that an increase in the age of the household head decreases the likelihood for the household to become food insecure. This is possible because as rural households acquire more and more experience in farming operations, accumulate wealth and use better planning, they have better chances to become food secure. This result agrees with the prior expectation. The odds ratio, keeping other factors unchanged, in favor of food insecurity decreases by a factor of 0.744 when age of the household head increases by one year.

Cultivated land size was hypothesized to influence food insecurity negatively. The results of the logit model indicated that sample households which had larger farm size had less risk of being food insecure. This is confirmed by statistically significant negative coefficient of the variable. The possible justification is that farm households which had larger farm size had better chance to produce more, to diversify the crop they produce and also have got larger volume of crop residues.

The result of the logit model showed that amount of credit received has a significant and negative influence on food insecurity in the study area. This result is completely in agreement with the prior expectation. This might be due to the fact that households which have the opportunity to receive credit would build their capacity to produce more through purchase and use of agricultural inputs. It would also be possible for the households to spend the credit on some other income generating activities so that the income from these activities position households on a better status to escape vulnerability to food insecurity.

Use of irrigation showed a statistically significant and negative relationship with food insecurity. The negative relationship indicates that using irrigation reduces the risk of food insecurity among the sample households. This can be justified by the fact that in moisture stressed areas like the rural areas of Dire Dawa, getting access to irrigation would improve the situation and help to boost agricultural output. It is important to note that by definition, odds ratio implies the ratio of the probability of occurrence to the probability of non-occurrence. In this case, it is the ratio of the probability of being food insecure to the probability of being food secure. Here, odds ratio with

respect to irrigation variable was zero. This means that the probability of a household to be food insecurity is zero if a household has access and uses irrigation.

The relationship between the amount of livestock holding in tropical livestock unit and food insecurity turned out to be negative and statistically significant. This is an indication that ownership of livestock acts as a hedge against food insecurity in the study area. Livestock, besides its direct contribution to subsistence need and nutritional requirement, is a vital input into crop production by providing manure and serves to accumulate wealth that can be disposed during times of need, especially when food stock in the household deteriorates. The odds ratio in favor of food insecurity decreases by a factor of 0.704 when the amount of livestock owned by a household rises by one TLU.

CONCLUSION AND RECOMMENDATION

A number of studies have sought to examine the extent and determinants of food security and poverty in rural Ethiopia [21, 22, 23]. Socio-economic variables such as asset holding (mainly cultivated land, farm income and livestock holding) and access to services like credit are found to be important correlates which affect household food security favourably. While controlling for all other variables, households with better access to irrigation are found to have significantly higher wellbeing and so more likely to be food secure. However, among demographic variables considered in this study only household size was found to have a negative and statistically significant effect on household food security. Contrary to usual expectation, the coefficient of education level of the household head was not statistically significant. This may imply that education of household head has not yet enhanced households' capabilities to adopt better production technologies, accept technical advice from extension workers and diversifying their source of income than the illiterate ones which would have reduced the risk of food insecurity among households. The results also suggest that both food secure and food insecure households have the same access to food aid resources. Thus, food aid targeting should be a concern during intervention. The statistically insignificant coefficient for oxen ownership clearly points out to the difference in livelihood activities between the highlands of Ethiopia and the study area. As stated elsewhere in this paper, the rural areas of Dire Dawa are largely moisture stressed and drought prone where cultivation of crop is rudimentary. Therefore, it is the number of total livestock which is dominated by cows and goats that makes a difference rather than owning oxen for plowing.

Table 1: Code, definitions and descriptive statistics of variables included in the logit model

Variable code	Variable type	Variable definition	Food insecure (N = 87)		Food secure (N = 28)		Overall sample (N = 115)		t- (chi-square) value
			Mean	SD	Mean	SD	Mean	SD	
FASZ	Continuous	Family size in number	7.08	1.67	4.50	1.48	6.45	1.96	7.784***
DPR	Continuous	Dependency ratio	1.35	0.84	0.92	0.64	1.23	0.82	2.888**
CLSZ	Continuous	Cultivated land size	0.74	0.33	0.85	0.43	0.77	0.36	-1.489
TLU	Continuous	Total livestock holding in TLU	4.80	4.47	5.677	6.06	5.01	4.89	-0.824
OXEN	Continuous	Number of oxen owned	0.41	0.62	0.50	0.64	0.43	0.62	-0.635
AMDT	Continuous	Amount of credit received	68.70	97.99	115.07	118.27	79.98	104.67	-1.877*
TOFFI	Continuous	Total off farm income earned	168.80	195.41	416.89	284.87	229.21	243.85	-4.295***
FAID	Continuous	Food aid obtained	340.44	261.35	322.96	247.83	336.19	257.17	0.312
AGE	Continuous	Age of household head in years	41.07	8.66	32.21	7.38	39.89	8.60	2.877**
TINC	Continuous	Total annual household income	1554.72	633.69	2230.12	738.86	1719	719	-4.349***
EDUC	Dummy#	1, if the household head is literate; 0, otherwise	26.40 (23)		42.90 (12)		30.40 (35)		2.794*
SEX	Dummy	1, if the household head is male; 0, otherwise	88.50 (77)		85.70 (24)		87.83 (101)		0.154
IRGN	Dummy	1, if the household used irrigation; 0, otherwise	4.60 (4)		78.60 (22)		22.60 (26)		30.27***

Note: SD: Standard Duration; # Mean for dummy variables indicates percent with value 1 and numbers in the parenthesis represent frequency distribution;
***, ** and * is significant at 1%, 5% and 10% probability level, respectively.

Table 2: The maximum likelihood estimates of the logit model

Variables	Estimated Coefficient	Odds ratio	Wald Statistics
Constant	20.361		4.064**
FASZ	3.907	49.770	8.401***
DPR	-0.583	0.558	0.135
CLSZ	-7.455	0.001	3.556*
TLU	-0.350	0.704	2.738*
OXEN	2.811	16.630	1.813
AMDT	-0.021	0.979	4.794**
TOFFI	-0.004	0.996	1.273
FAID	0.003	1.003	0.405
AGE	-0.296	0.744	3.357*
TINC	-0.005	0.995	2.803*
EDUC	-3.343	0.035	2.036
SEX	-3.073	0.046	0.718
IRGN	-8.290	0.000	4.393**
Pearson Chi-square			107.07***
- 2 Log likelihood			20.54
Correctly Predicted (Count R^2)			97.4
Sensitivity			98.9
Specificity			92.9

Note: ***, ** and * is significant at 1%, 5% and 10% probability level, respectively.

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