Determinants of Rural Household Food Security in Jigjiga District of Ethiopia

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ABSTRACT

This study was carried out to identify determinants of rural household food security in the Jigjiga district of Ethiopia. Data used in this study were collected from 160 rural households in the study area using a stratified sampling technique. An empirical analysis based on a logit model was employed to analyze the primary data. The survey results of the study revealed that 63 percent of the households were food secure, while 37 percent were found to be food insecure.

Among various factors included in the logit model, six were found to be statistically significant determinants of household food security. Variables such as: total household income, fertilizer use, extension service, access to credit and veterinary service were found to have positive influence; while agro-ecology affected the food security of the households in lowland negatively. Access to fertilizer, extension, veterinary and credit would increase household food security in the study area by 84, 46, 36 and 141 percent respectively. It is therefore recommended that credit services, and agricultural input supply should be highly strengthened in the study area. The strategy directly focusing on agricultural economy in the district under the agricultural development-led industrialization policy should be continued.

Keywords: food security, Jigjiga district, Ethiopia

บทคัดย่อ

การศึกษาครั้งนี้เพื่อวิเคราะห์ปัจจัยที่มีส่วนกำหนดความมั่นคงด้านอาหารของครัวเรือนชนบทเมือง Jigjiga ประเทศเอธิโอเปีย โดยรวบรวมข้อมูลจากครัวเรือนตัวอย่างจำนวน 160 ครัวเรือน ด้วยวิธีการสุ่มตัวอย่างแบบจัดชั้น ผลการวิเคราะห์ด้วยแบบจำลองโลจิทพบว่าร้อยละ 63 ของครัวเรือนมีความมั่นคงด้านอาหาร และที่เหลือร้อยละ 36 ไม่มีความมั่นคงด้านอาหาร

ปัจจัยที่กำหนดความมั่นคงด้านอาหารของครัวเรือนอย่างมีนัยสำคัญทางสถิติ ได้แก่ รายได้รวมของครัวเรือน การใช้ปุ๋ยในการผลิต การเข้าถึงบริการส่งเสริมการเกษตร การเข้าถึงแหล่งสินเชื่อ และการเข้าถึงบริการด้านสัตวแพทย์ ซึ่งส่งผลทางบวก ในขณะที่แหล่งที่ตั้งของฟาร์มในเขตเกษตรนิเวศที่ราบต่ำส่งผลทางลบต่อความมั่นคงทางอาหาร การใช้ปุ๋ยในการผลิต การเข้าถึงบริการส่งเสริมการเกษตร บริการด้านสัตวแพทย์ และแหล่งสินเชื่อ ทำให้ความมั่นคงด้านอาหารของครัวเรือนเพิ่มขึ้นร้อยละ 84, 46, 36, และ 141 ตามลำดับ การศึกษาครั้งนี้มีข้อเสนอแนะว่าควรเน้นการให้บริการด้านสินเชื่อ และปัจจัยการผลิตทางการเกษตรแก่ครัวเรือนเพิ่มขึ้นในพื้นที่ศึกษา และควรกำหนดกลยุทธ์ที่เน้นการเป็น

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สังคมเกษตรของเมืองพื่อการดำเนินนโยบายที่ใช้การพัฒนาด้านการเกษตรนำทางไปสู่นโยบายด้านอุตสาหกรรมต่อไป

คำสำคัญ: ความมั่นคงทางอาหาร เมือง Jigjiga ประเทศเอธิโอเปีย

INTRODUCTION

Ethiopia is one of the most famine-prone countries with a long history of famines and food shortages that can be traced back to the 1960s and has left a significant proportion of the population food insecure (Ramakrishna & Demeke, 2002). According to Negatu (2004), the last major drought of 2002/2003 in the country affected 30 million people, which equaled 40 percent of the total population. Droughts have become frequent and more severe in recent years and are one of the most important triggers of malnutrition and food insecurity in the country (Dominguez, 2010).

In Ethiopia, the dimensions, determinants, and consequences of food security problems differ widely within the country. The Somali region of Ethiopia is one of the regions of the country most affected by recurrent drought and food security problems (United States Agency for International Development [USAID], 2011). In the study area of Jigjiga district in this region, rural households faced unrelenting food shortages and food security problems with 30 percent of the people in need of emergency food supplies (Ministry of Agriculture and Rural Development [MoARD], 2010).

To reverse the dire food insecurity situation of small scale rural farmers, the Ethiopian government formulated a long-term strategy—the agricultural development-led industrialization strategy (ADLI)—which takes agriculture as its point of departure and as the growth engine (Alemu, Oosthuizen, & Van Schalkwyk, 2002).

A food security strategy is the major component of the ADLI policy. The first version of the food security strategy was issued in 1996 and was revised in 2002 and 2005, highlighting the government's plan to address causality and the effects of the food security problem in the country. The strategy envisaged developing an agricultural-based economy by raising the production and income of farmers. It was implemented in all food insecure districts of Ethiopia.

The Jigjiga district administration has been implementing the food security program since 2004. The program was directed at improving the availability of and access to food for rural households. The rationale of the program at the district level was to strengthen the provision of and access to credit, extension services, veterinary services, improved agricultural inputs, income, and other services to the rural households in the district so that the food security situation would be improved.

However, program implementation by itself is not the final step (Wond & Macaulay, 2010). The question of how these policy factors affect the food security of the households and food security situation in Jigjiga district remained unanswered for policy makers in the district and country. Taking this fact into consideration, the present study was proposed to identify the food security status and its determinants with regard to the rural households in the study area.

LITERATURE REVIEW

Defining food security

Food security is defined in different ways by international organizations and researchers. According to Kidane, Alemu, and Kundhlande (2005), there are close to 200 definitions of food security. In the world food conference of 1974 (United Nations, 1975), definitions evolved from viewpoints that focused on food security at the national or global level. In the 1980s, the focus of food security shifted from the global and national levels to the household and individual levels, and

access to food security was emphasized. Definitions underwent another round of evolution after the 1996 World Food Summit, where according to the refined definition, food security is seen as a situation that exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life (Food and Agriculture Organization [FAO], 1996). Currently, a synthesis of this definition with the main emphasis on availability, access, and utilization, serves as a working definition in the projects of international organizations (Kidane et al., 2005). In the present study, food security is defined as adequate availability of and access to food for households to meet the minimum energy requirements as recommended by the Ethiopian government for an active and healthy life.

Food security measurement

There are commonly two food security measurement methods used in most food security studies (Shiferaw, Kilmer, & Gladwin, 2003). One is to estimate the gross household production and purchases over time, estimate the growth or depletion of food stocks held over that period of time and presume the food that has come into the household and disappeared has been consumed. The other is to undertake a twenty-four hour recall of food consumption by individual members of the household and analyze each type of food mentioned for its calorie content.

Food-secure households are able to produce enough food such that all household members can lead a productive and healthy life. The food can be produced, purchased, borrowed or received as a gift. Food security in the present study was measured by taking into account both actual household food productions from the farm and through other sources. The detailed steps are discussed in the analytical model section.

Determinants of household food security

The debate in Ethiopia over the causes and determinants of food insecurity has fuelled highly contested viewpoints between the academic disciplines and in development thinking in general over the past few decades, giving rise to a proliferation of demographic, economic, and political emphases across the food security literature (Devereux, 2001). The root causes of the problem at the national, regional, and household level, are quite complex. The key factors in general can be grouped under three main types as natural causes, socio-economic factors, and policy factors (Ramakrishna & Demeke, 2002; Shiferaw et al., 2003).

Demographic characteristics such as the gender, age, and education of the household head were expected to influence food security positively (Shiferaw et al., 2003). On the other hand, family size was expected to have a negative influence on food security (Muluken, 2005). Since most of the farm households are small holder subsistence producers, an increase in the number of people in the household tends to exert more pressure on consumption than the labour it contributes (Shiferaw et al., 2003; Paddy, 2004).

Ownership of assets such as cultivated land and livestock were expected to affect the food security of the households in this study positively. According to Nejafi (2003) and Muluken (2005), food production is increased extensively through expansion of the area under cultivation, while livestock provides not only food for the producers but also other products which could be sold to provide food or income (Muluken, 2005).

Fertilizer is used by most studies as a proxy for technology. According to Aliber and Hart (2009), subsistence farming by its nature is production for direct consumption. Any farm input that augments agricultural productivity is expected to boost the overall production; this contributes towards attaining household food security (Brown, 2004; Shiferaw et al., 2003). In the present study, fertilizer

usage was expected to increase household food production and hence enhance food security.

Income plays a key role in a household's accessibility to food. It enables households to modernize their production by giving them an opportunity to buy the necessary inputs, and reduce the risk of food shortage during periods of unexpected crop failures through purchases. It was expected the total annual income of the household and food security would be positively related (Muluken, 2005).

Access to extension and veterinary services was expected to have a positive impact on household food security in the study area. The availability of credit, another important variable, was expected to influence the household food security status positively. Households who have received credit had the possibility to fulfill their needs for food (Debebe, 1995).

METHODOLOGY

Location and description of study area

Jigjiga Woreda lies between 90°2'0" N to 90° 42'0" N and 420°29'00'' E to 420°13'00" E. It is located at about 650 km east of Addis Ababa, the capital city of Ethiopia. The mean monthly minimum temperature varies from 5.8 °C in November to 14 °C from July to September and the mean monthly maximum temperature varies from 25 °C in July to 29 °C from March to April. The area experiences a bimodal type of rainfall classified as a short rainy season from July to September and a main rainy season from March to April (Jigjiga Zone Office of Agriculture [JZAO], 2001).

The topography of Jigjiga has a range of lowland to midland agro-ecologies. Households undertake mixed farming which consists of commonly practiced crop production (maize, sorghum, wheat, and barely) and livestock rearing. Cereals generally constitute 89 percent of the total cultivated area and 91 percent of the production. In addition to crop farming, cattle, sheep, and goats are the main livestock reared (Eshetu & Teriessa, 2000).

Source of the data

A two-stage sampling procedure was employed to select 160 rural households in Jigjiga district. The study area was classified into two strata —midland and lowland—based on its agro-ecology. The twenty farming associations in both agro-ecologies were included, with 10 from each area. Probability proportionate to sample size was employed for the selection of 93 households from the lowland stratum and 67 households from the midland stratum. A structured questionnaire was completed by each of 160 households selected.

Analytical model

Following Shimalis, Janekarnkij, and Wangwacharakul (2011), food security in the present study was measured in three steps. Firstly, the food supply at a household level was determined by compiling a food balance sheet for each sampled household. Secondly, the food supply at the household level calculated in step one was used to calculate the calories available per kilogram per adult equivalent (AE) per day for each household by taking into account the age and sex of household members.

Thirdly, following Federal Democratic Republic of Ethiopia [FDRE] (2001) in the present study, households that managed to attain 2,100 kilo calorie per AE per day were considered as food secure, and those households who had a lower amount were deemed as food insecure.

The study employed a logit model (Equation 1) with the dependent variable (food security) being a binary variable having a value of one if a household was found to be food secure, and a value of zero otherwise:

$$P_i = (Y = \frac{1}{X_i}) = \frac{1}{1+\bar{e}^{z_i}} = \frac{e^{z_i}}{1+e^{z_i}} \quad (1)$$

Where e is an exponential term,

P_i is the probability of household i being

food secure. It is 1 if a household is food secure, otherwise 0.

Y is the observed food security status of a household.

X_i is the household set of explanatory variables

Z_i is a function of n-explanatory variables (X_i) which can be expressed in linear form as:

$$Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n$$

From Equation 1, the probability of a household being food insecure is given by $(1 - P_i)$ which can be written as Equation 2:

$$1 - \frac{1}{1+e^{-z_i}} = \frac{1+e^{-z_i} - 1}{1+e^{-z_i}} = \frac{e^{-z_i}}{1+e^{-z_i}} \quad (2)$$

Therefore, the odds ratio, $\frac{P_i}{(1 - P_i)}$ is given by Equation 3:

$$\frac{P_i}{(1 - P_i)} = \frac{1+e^{z_i}}{1+e^{-z_i}} \quad (3)$$

Now, $\frac{P_i}{(1 - P_i)}$ is the odds ratio in favor of food security. It is the ratio of the probability that a household would be food secure (P_i) to the probability that a household would be food insecure ($1-P_i$).

Finally, taking the natural logarithm of Equation 3 and assuming linearity produces Equation 4:

$$L_i = ln\left[\frac{p_i}{1-p_i}\right] = Z_i \quad (4)$$

Where L_i is the logarithm of the odd ratio which is assumed linear for both variables and parameters.

If the disturbance term is introduced, the logit model in Equation 4 is represented by Equation 5:

$$Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n + \varepsilon_i \quad (5)$$

In Equation 5, the terms β_i are parameters to be estimated, and X_1 to X_n are explanatory variables such as: the gender of the household head, household size, education of the household head, farm size, livestock ownership, total income, fertilizer use, agro-ecology, extension, access to veterinary services, and credit access, respectively.

From the estimated logit model, the marginal effects of each explanatory variable on household food security can be calculated using Equation 6:

$$\frac{\partial P_i}{\partial X_i} = P_i(1 - P_i)\beta_i \quad (6)$$

RESULTS AND DISCUSSION

Households socio-economic characteristics

A summary of statistics on the demographic characteristics of the sampled households is presented in Table 1 and shows that of the total 160 sampled households in the study, 152 households were headed by a male while only 8 households had a female as the household head. The average age of the household heads was 37.5 years, and the average size of the households was 4.5 AE. Of the sampled household heads, 12.5 percent were illiterate, whereas 82.5 percent had completed their primary education, and only 5 percent had attended junior school education.

Furthermore, the farm size and livestock holding per household form an important source of livelihood under subsistence agriculture (Nejafi, 2003; Kidane et al., 2005). According to Table 1, the average farmland size and livestock holding of the sampled households were 4.9 ha and 9.6 livestock units, respectively. Farmland size appears very high when compared with the national average figure of 1 ha per household (Central Statistical Agency [CSA], 2006).

Access of sampled households to fertilizer, extension, veterinary and credit services

As Table 2 shows, 51, 70, 44, and 39 percent of sampled households had access to fertilizer, extension services, veterinary services, and credit services, respectively.

Food security status of households in the study area

Table 3 shows that out of 160 sampled households, 101 were food secure (63%) and 59 were food insecure (37%).

Determinants of food security

The major variables that were expected to have an influence on household food security in the study area are summarized in Table 4.

The model results and the marginal effects of each variable on determining food security are presented in Table 5. Of the 11 variables included in the model, the significant variables were fertilizer use, total income, agro-ecology, access to extension services, access to veterinary services, and access to credit.

Use of fertilizer by farming households was found to have a positive and significant impact on household food security. It was significant at less

Table 1 Demographic characteristics of the sampled households in Jigjiga district

(n=160)

Household characteristic	n	%
Female head of household	8	5
Male head of household	152	95
Average age of household head (years)	37.5	–
Average household size (adult equivalents)	4.5	–
Average farm size (ha)	4.9	–
Average livestock ownership (tropical livestock units)	9.6	–
Educational level of household head		
Illiterate	20	12.5
Elementary school education	132	82.5
Junior school education	8	5

Source: Household survey results, 2011.

Table 2 Distribution of services in sampled households

(n=160)

Type of service	User (%)	Non user (%)
Fertilizer	51	49
Extension	70	30
Veterinary	44	56
Credit	39	61

Source: Household survey results, 2011.

Table 3 Food security status of sample households, Jigjiga district

Food security status	Number of households	Food security status (%)
Food secure	101	63
Food insecure	59	37
Total	160	100

Source: Household survey results, 2011.

Table 4 Description of variables in the model

Variable	Definition
Dependent variable	
Food security status	Food secure households with at least 2,100 Kcal/ AE/day (if household is food secure = 1, otherwise = 0)
Explanatory variable	
X_1= GENDER	Gender of the household head (if household head is Male = 1, otherwise = 0)
X_2= HHSIZE	Number of household members measured using the adult equivalent ratio(AE)
X_3= EDU	Education of household head (number of schooling years)
X_4= FARMSIZ	Farm size of a household (number of hectares)
X_5= TLU	Livestock ownership of household in tropical livestock units
X_6= TOTALINC	Total income of household in Ethiopian birr
X_7= FERTILIZER	Fertilizer use of household (if used = 1, otherwise = 0)
X_8= AGROECO	Agro-ecology stratum where household located (midland = 1, otherwise = 0)
X_9= EXTENSION	Access of household to extension services (has access = 1, otherwise = 0)
X_{10}= VETERINARY	Access of household to veterinary services (has access = 1, otherwise = 0)
X_{11}= CREDIT	Credit received (received = 1, otherwise = 0)

Table 5 Maximum likelihood estimates of the logit model

(n=160)

Variable[1]	Coefficient	Std. Error	Z-Statistic	Prob.	Marginal effects
Constant	-8.764	3.280	-2.672	0.0085	
FERTILIZER	3.627	1.199	3.026	0.0025	0.84
TOTALINC	0.005	0.003	1.648	0.0993	0.0012
AGROECO	-4.111	1.775	-2.316	0.0205	-0.96
EXTENSION	1.381	0.850	1.626	0.1040	0.46
VETERINARY	1.966	0.765	2.570	0.0102	0.36
CREDIT	6.071	1.374	4.419	0.0000	1.41
Mean dependent var.				0.631250	
Logistic regression statistic (6 df)				141.3297	
Probability(LR stat)				0.000000	
McFadden R-squared				0.670916	

Source: Household survey results, 2011.

[1] = Variable definitions are provided in Table 4.

than the 1 percent level of significance (Table 5). The marginal effect of the use of fertilizer on food security was 0.84 indicating that fertilizer use by farmers improved the probability of the household being food secure by 84 percent.

The total household income was hypothesized to have a positive influence on household food security. The results show that its influence was positive and statistically significant (Table 5). The marginal effect of this factor was 0.0012 which can be interpreted as the likelihood of a household being food secure increases by 0.12 percent for a one birr increase in the total income of the household (Table 5).

The agro-ecology stratum in which the households' farmland was located was found to have a negative and statistically significant ($p < .05$) influence on household food security in the study area (Table 5). The marginal effect indicates that a shift from midland to lowland decreases the probability of the household being food secure by 96 percent (Table 5). One possible explanation is that as one moves from midland to lowland in the study area, the rainfall and vegetation cover reduce which results in less crop production by the household and hence reduces food security.

As expected, access to extension services showed a positive and significant effect on household food security (Table 5). The marginal effect of gaining access to extension services was 0.46 which can be interpreted as the probability of a household being food secure increases by 46 percent when the household has access to extension services.

In agreement with *a priori* assumptions, access to veterinary services had a significant and positive influence on household food security. Thus, households whose livestock had access to animal health services produced more milk and meat. The marginal effect of access to veterinary services on the probability of household food security in the study area was 0.36 (Table 5) indicating that the probabilities of being food secure increases by 36 percent for a household with access to veterinary services.

The ability to get credit has a highly significant and positive effect on household food security in the study area which was in complete agreement with prior expectations. This might have been due to the fact that households with the opportunity to get credit would build their farm production capacity through the purchase of agricultural inputs. Moreover, as the marginal effect of this variable shows, households who had access to credit increased their food security status by 141 percent.

CONCLUSION AND RECOMMENDATION

The objective of the study was to identify factors that determine household food security in the Jigjiga district which is one of the food deficit areas of Ethiopia. The findings of the study revealed that 63.12 percent of the households are food secure whereas 36.88 percent are food insecure. A drought-induced food security problem has been a recurrent phenomenon exacerbating the food security status of the resource-poor farming households. Using a logistic regression model, factors identified as having a significant influence on household food security were: fertilizer use, total income, agro-ecology stratum, access to extension, access to veterinary services, and access to credit.

Analysis of the marginal effects indicated that a farmer's access to fertilizer, extension services, veterinary services, and credit will increase household food security in the study area by 84, 46, 36 and 141 percent, respectively. It is recommended that the government's Agricultural Development-led Industrialization activity in the district continues, with strengthening of the rural credit services, agricultural input supply, extension services, animal health services, and rural income generation activities. Furthermore, as the present study did not attempt to consider the nutritional contents of the food (it only focused on the calorific content), the

nutritional aspects of food security should be further researched.

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