Food Science and Quality Management
ISSN 2224-6088 (Paper) ISSN 2225-0557 (Online)
Vol.41, 2015

On-Farm Activities and Households Food Security in Wolaita Zone, Ethiopia

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Abstract
Objectives of the study were to measure status of household food security, to measure the severity levels of household food insecurity, and to analyze factors affecting on-farm activities. In the study multi-stage sampling techniques were used to select 5 kebeles and 140 sample households out of 23 kebeles of the study area. Primary data were collected through structured interview schedule, key informants interview, focus group-discussions and direct observation. Various documents were also reviewed to collect the secondary data. The quantitative data were analyzed by descriptive statistics and qualitative data were analyzed through generalization summarization and categorization. Household food security was measured using calorie consumption method. A binary logit model was used to analyze factors affecting on-farm activities. The findings of the study revealed that about 57% of the rural households were food insecure and 43% were food secure. A total of eleven explanatory variables were included in the model from which seven variables showed a significant effect on household food security. The estimated model correctly predicted 92.1% of the total sample households. To estimate the extent of food insecurity FGT index was used. Accordingly, the incidence of food insecurity, food insecurity gap and severity of food insecurity were found to be 57%, 24% and 11.67%, respectively.
Keywords: Food security, on-farm activities, binary logistic regression model, incidence of food insecurity, food insecurity gap, severity of food insecurity, FGT index.

INTRODUCTION

Background to the study

Today, almost 33 percent of the populations of sub-Saharan Africa (SSA), or close to 200 million people, are undernourished, of which close to 60 percent are in countries affected by conflicts. Chronic undernourishment is widespread throughout the region, but most of the increase in the number of undernourished over the last ten years took place in conflict countries – often endowed with abundant mineral resources - while the situation in other countries has in general improved, although unevenly and at a very slow rate. The region as a whole remains susceptible to frequent food crises and famines which are easily triggered by even the lightest of droughts, or floods, pests, economic downturns or conflicts (FAO, 2005).

FAO (2005) policy brief report demonstrated that agriculture is playing a dominant role of food supply in sub-Saharan Africa; however, the production is generally lagged behind the population growth.

According to Berhanu (2003), in Ethiopia agriculture plays important economic, social and environmental roles and is also a major source of livelihoods for 80% of rural population. The sector contributes about 50% to the national value of production. It is also sources of raw materials supply to the country's agro-industrial sector, and foreign export earnings.

Meeting food requirements of the growing population is one of the major development policy concerns and challenges in contemporary Ethiopia. The significance of food production for a household level and the national economy is quite well documented. The World Bank data (2000) shows that the share of a household income spent on food in Ethiopia is 72% as per estimates made during 1996. Despite efforts made to improve food production through increased use of chemical fertilizers and improved seeds, any notable improvement in national food production has not been yet attained.

Berhanu (2003) also argued that, the problems of food security in Ethiopia can be broadly identified as problems related to supply of food and access to food. Ethiopia's widely experienced food security challenge is mainly attributed to the poor performance of the country's agricultural sector. Dominance of subsistence production units, degrading soil fertility, low adoption of improved production inputs and techniques, and uncertainty induced by unfavorable weather situation are among the major reasons of low food production. Therefore, the main intention of the study was to assess factors affecting on-farm activities and state of household food security in the study area.

RESEARCH METHODOLOGY

Data types and sources

In this study, both primary and secondary sources were used to collect qualitative and quantitative data types. The primary data were collected from sample respondents, key informants and focused groups. The secondary data were collected from relevant secondary sources such as books, woreda annual report documents, and internet and journal articles.

Sampling techniques and procedures

Multi-stage sampling techniques were used to select sample respondents; in the first stage Offa woreda was purposively selected based on the researchers' experiences; in the second stage five kebeles out of 23 administrative kebeles were selected randomly and finally 140 sample households were selected using simple random sampling techniques assisted by probability proportion to size (PPS).

Methods of data collection

Primary data were collected through interview schedules administered by enumerators. Additionally, key informants interviews and focus group discussions were conducted by the researchers. Finally, all relevant secondary sources were also reviewed to support primary sources.

Methods of data analysis

Collected primary data were compiled using Statistical Package for Social Sciences (SPSS) version 20. To address the first specific objective of the study, household calorie consumption method was used. This was done by comparing total calorie consumed by household members with the minimum subsistence requirement (2100kcal/adult/day) as set by FDRE (1999). Data needed to obtain the food security status of sample households were collected using seven day recall method. The second specific objective of the study was addressed using the three FGT indices to measure head count index, food insecurity gap and severity of food insecurity. Finally, the third of objective was addressed by employing binary logistic regression model.

The dependent variable of this study which is food security status of household is dichotomous; hence, the value of 0 is assigned to food insecure household 1 is assigned to food secure household in the econometric model.

Following Gujarati (1995), the functional form of logit model is specified as follows:

$P_i = E(Y=\frac{1}{xi}) = \frac{1}{1+e^{-(\beta 0+\beta 1x1)}}$ ----------(3.1)

For the case of exposition, we write (1) as;

$P_i = \frac{1}{1+e^{-zi}}$ ----------(3.2)

The probability the given household is food insecure is expressed as by (2) while, the probability of food secure is;

$1-P_i = \frac{1}{1+e^{zi}}$ ----------(3.3)

Therefore, we can write;

$\frac{Pi}{1-Pi} = \frac{1+e^{zi}}{1+e^{-zi}}$ ----------(3.4)

Now (Pi/1-Pi) is simply the odds ratio in favor of food insecurity. The ratio of the probability that a household will be food insecure to the probability of that it will not be food insecure.

Finally, taking the natural log of equation (4) we obtain:-

$L_i = \ln(\frac{Pi}{1-Pi}) = Z_i = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \text{----------} + \beta_n X_n$ ----------(3.5)

Where P_i = is a probability of being food insecure they ranges from 0 to 1

Zi = is a function of n explanatory variables (x) which is also expressed as:-

$Z_i = \beta o + \beta 1X1 + \beta 2X2 + \ - - - - - - - + \beta nXn$ ----------(3.6)

βo, is an intercept, β_1 , β_2, ----------β_n are slopes of the equation in the model

Li = is log of the odds ratio, which is not only linear in Xi but also linear in the parameters.

Xi = is vector of relevant household characteristics

If the disturbance term (Ui) is introduced, the logit model becomes

$Z_i = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \text{----------} + \beta_n X_n + U_i$ ……. (3.7)

The FGT indices used to measure the severity levels of household food security is specified as follow: according to Hoddinott (2002) it is mathematically represented as below:

$p(\alpha) = \frac{1}{n}\sum_{i=1}^{q}[(z-y)/z]^{\alpha}$ ……..…… (3.8)

Where;

n= is the number of individuals;

y_i= is the measure of food security for the i^{th} person;

z= represents the cut-off between food security and insecurity (expressed here in terms of caloric requirements);

q= is the number of food-insecure individuals; and

α= is the weight attached to the severity of food insecurity.

Giving no weight to the severity of food insecurity is equivalent to assuming that α= 0. The formula collapses to $P_{(0)}$ = q / n, or the percentage measure. This is also called the head-count ratio.

$p(0) = \frac{1}{n}\sum_{i=1}^{q}[(z-y)/z]^{0}$ ……..…… (3.9)

Giving equal weight to the severity of food insecurity among all food-insecure households is equivalent to assuming that α=1. Summing the numerator gives the food-insecurity gap; dividing this by *z* expresses this figure as a ratio. This index (p_1) will provide the possibility to estimate resources required to eliminate food insecurity through proper targeting. That is, the product (n x z x p_1) gives the total calorie commitment required to bring the food insecure households to the given daily calorie requirement level.

$p(1) = \frac{1}{n}\sum_{i=1}^{q}[(z-y)/z]^1$ ..... (3.10)

Giving more weight to the severity of food insecurity among the most food-insecure households is equivalent to assuming that α> 1. A common approach in the poverty literature is to set α= 2, yielding.

$p(2) = \frac{1}{n}\sum_{i=1}^{q}[(z-y)/z]^2$ ..... (3.11)

This index gives greater attention to the most food-insecure households by weighting each food insecure household by the square of its proportionate shortfall below the subsistence requirement level.

RESULTS AND DISCUSSION

Table 1: Total land holding of households

Variable	HH Food security status	N	Mean	Std. Deviation	t-value	p-value
Total land holding of households	food insecure	80	.7097	.52810	3.345***	0.001
	food secure	60	1.0543	.65417		

Source: Survey result, 2014; ***significant less than 1% probability level

There is a significant difference (p=0.001) in mean total landing holding between food secure and food insecure households with a mean (±0.3446) difference of standard deviation (0.12607). Food secure households are nearly more than half times owning land than food insecure households.

Table 2: Household active labor

Variable	Household Food security status	N	Mean	Std. Deviation	t-value	p-value
Household active labor	food insecure	80	3.40500	1.558005	2.841***	0.005
	food secure	60	2.70333	1.281183		

Source: Survey result, 2014; ***significant less than 1% probability level

There is a significant difference (p=0.005) in mean total household's active labor force between food secure and food insecure households with a mean (±0.7017) difference of standard deviation (0.2768). Food secure households are more than half times owning active labor force than food insecure households.

Table 3: Agricultural income of the household

Variable	HH Food security status	N	Mean	Std. Deviation	t-value	p-value
Agricultural income	food insecure	80	1759.480	2580.31	1.734*	0.086
	food secure	60	1209.382	1022.96		

Source: Survey result, 2014; *significant less than 10% probability level

There is a significant (p=.086) in mean difference of agricultural income between food secure and food insecure households with a mean (±550.098) difference of standard deviation (1557.35). Food secure households have more income than food insecure households.

Table 4: Summary of grouped statics

Variables	Household Food security status	N	Mean	Std. Deviation	t-value	p-value
Age of household head	food insecure	80	45.64	12.38	0.854NS	0.395
	food secure	60	43.85	12.16		
Total land holding of households	food insecure	80	0.71	0.53	3.345***	0.001
	food secure	60	1.05	0.65		
Household active labor	food insecure	80	3.41	1.56	2.841***	0.005
	food secure	60	2.70	1.28		
Family size in adult equivalent ratio	food insecure	80	5.52	1.73	-	0.330
	food secure	60	5.84	2.13	0.977NS	
Agricultural income	food insecure	80	1759.5	2580.31	1.734*	0.086
	food secure	60	1209.4	1022.96		

Source: Survey result, 2014; ***,* significant less than 1% and 10% probability level respectively, NS= Not significant

Table 5: Chi square test results of discreet/categorical variables

Variables	Response	Food security status		χ^2-Value	p-value
		Food insecure	Food secure		
Sex of household head	Male	60	47	0.211 NS	0.646
	Female	20	13		
Education level of Household head	Illiterate	37	6	24.621***	<0.0001
	1-4 grades	28	25		
	5-8 grades	12	23		
	9-12 grades	3	6		
Access to credit	No	63	20	29.299***	<0.0001
	Yes	17	40		
Access to extension service	No	57	29	7.599***	0.006
	Yes	23	31		
Frequency to extension contact	No contact	37	16	33.048***	<0.0001
	Always	7	16		
	Once per week	9	23		
	Every fortnight	14	5		
	Once per month	13	0		
Livestock production	No	63	11	50.224***	<0.0001
	Yes	17	49		

Source: Survey result, 2014; ***significant less than 1% probability level; NS=Not significant

The chi square test indicated that there is significant relationship between household education level, access to credit, access to extension service, frequency to extension contact, livestock production and household food security less than 1% probability level (Table 5).

Descriptive results

The household food security status was measured by direct survey of household food consumption. In this regard, data needed to measure household food security were collected in terms of household food consumption from production, purchase and/or gift/loan/wage from the sample respondents using the seven day recall method. Data on the food consumption of households were converted into the amount of energy kilocalorie and was divided by the household size measured as adult equivalent (AE). Based on the minimum subsistence requirement per adult per day (i.e. 2100kcal), household food security status was determined. Those households whose calorie consumption is below the recommended amount were categorized as food insecure while the household hold whose calorie consumption is above the recommended amount was categorized as food secure. Accordingly, it was identified that 60 households (42.9%) were food secured and the remaining 80 (57.1%) households were found to be food insecure from the total of 140 sample households.

The extents and severity levels of household food security

This section deals with incidence, depth and severity of food insecurity of sample households.

Understanding the severity of food insecurity is essential for determining the best type of response. The head count index, food insecurity gap and severity of food insecurity were the indices employed to capture the incidence and severity of food insecurity.

As it is already discussed in methodology part, head count index measures the incidence of food insecurity and shows the proportion of households below the threshold level. In the study area the incidence of food insecurity was found to be 0.57. That means 57 percent of the sample households couldn't meet the energy requirement recommended for subsistence. In other words, head count ratio of 0.57 for 140 sample households means 80 sample households are deemed food insecure.

The head count index or incidence of food insecurity is good indicator to assess food insecurity but it does not take into account the severity of the food insecurity. Therefore, to address how far the food insecure households are below the subsistence energy requirement level, food insecurity gap was calculated from the survey data. Accordingly, the food insecurity gap index (P_1) came out to be 0.24. This means that if the woreda mobilizes resources that can cover or meet the 24 percent of the daily calorie requirement for every food insecure households and distribute these resources to bring each households up to the given daily calorie requirement level, then at least in theory food insecurity will be eliminated. In other words, assuming that the households are representative to the rural population of Offa Woreda and according to Office of Agriculture and Rural Development, it is estimated to be 20,562 households which are on average equivalent to 107,660 in AE.

Hence, based on the recommended subsistence energy (2100 kcal per day per person), the total resource required to bring all households at least to get the daily subsistence is amounted to 226,086,000 kcal per day. When this amount of calorie is converted to cereals, assuming that cereals can produce an average of 3,700 kcal per kg, it becomes 611 quintal of cereals per day. This implies that an estimated 223,015-quintal of cereals per year is required to bring all households at least to get the daily subsistence energy in a year.

Further, to address the most food insecure segment of the sample household, the severity of food insecurity was calculated. As is already discussed, the severity of food insecurity is a measure closely related to the food insecurity gap but giving those further away from the given subsistence energy requirement level a higher weight in aggregation than those closer to meet the daily recommended energy level. Hence, the survey result reveals that the severity of food insecurity in the study area is 0.1167. This implies that about 11.67% of sampled households were severely food insecure. Therefore, these severely food insecure households need immediate interventions.

Econometric results

Binary logistic regression model was used to analyze factors affecting on-farm activities in the study area. Variables included in the model were tested to check the existence of multi co-linearity effect. The dummy and categorical variables were tested using contingency coefficient and continuous variables were tested using variable inflation factor.

Table 6: Model output

Variables	B	S.E.	Wald	Sig.	Exp(B)
Sex of household heads	0.412	0.719	0.329	0.566	1.510
Age of household heads	-0.005	0.027	0.038	0.845	0.995
Education level of household heads	0.802	0.341	5.539	0.019**	2.231
Access to credit	1.663	0.611	7.418	0.006***	5.276
Farm size holding	1.441	0.558	6.663	0.010**	4.224
Household active labor	-0.636	0.244	6.787	0.009***	0.529
Access to extension service	2.211	0.702	9.910	0.002***	9.128
Frequency to extension contact	-0.755	0.294	6.568	0.010**	0.470
Family size (AE)	-0.020	0.173	0.014	0.907	0.980
Livestock production	3.082	0 .648	22.605	0.000***	21.812
Agricultural income	0.000	0.000	1.579	0.209	1.000

Source: Survey result, 2014; ***, **Significant at 1% and 5% probability level, respectively.

Education attainment is an important determinant of household food security, Lima (2008) argued that people need to be educated to know about the functioning of the food system in order to make informed choices and, thereby, support socially and environmentally-friendly food production, processing and trade. This study had found that educational status of the household head was significantly (p=0.019) affecting household food security. For every increase in one year of schooling, the odds ratio in favor of increasing household food security by 2.231 factors.

Access to credit was also significantly (p=0.006) affecting household food security. It was identified that an essential coping strategy for households whose sources of income are constrained and whose home production is insufficient to meet consumption needs and the result of this study was similar with the ACF (2010) report. Moreover, access to credit would enhance a household's input purchasing probability. It is positively related and significantly affects household food security at 10% probability level. Holding other factors constant, the odds ratio in favour of increasing household food security by a factor of 4.467 as a household has access to credit.

Land is an important asset of rural household in the country in general contributing about 80% of employment (Tenna, 2012). In the study area, land is a dominant means of getting livelihoods; however, the major problem associated with agriculture is land fragmentation due to over population. The binary logistic regression result showed that farm size is significantly (p=0.010) affecting household food security. For every increase in farm size by one hectare, the odds ratio is in favor increasing household food security by the factor of 4.224.

Economically active members of a household are those whose age is ranging between 15-64. Availability of active labor would save a household from hiring labors for agricultural production; especially for crop production. From the binary logistic regression model result, it can be understood that the availability of economically active labor force significantly (p=0.009) affects the household food security. For every one unit increase in the number of economically active labor in terms of adult equivalent, a household food insecurity decreases by a factor of 0.529.

In this study, access to extension service is implied as a household access to all extension packages

like improved livestock breeds, high yielding crop varieties, fertilizers, pesticides and others except technical advices. Access to extension services significantly (p=0.002) affects household food security. For every one unit increase in access to extension services, household food security increases by 9.128.

The frequency that a household contact extension agent determines the food security. We prefer this variable to treat separately from other extension packages because relatively it is too extensive activity .i.e. it is not limited to production information, farmers might need market information, and non-material related information. Rural households those are dominantly depending agricultural activities as a livelihood strategies are reasonably advised to have a frequent contact to extension agents. This is due rural agriculture is vulnerable to environmental changes, such as climate, pests, animal diseases and so on. This study identified that frequency to extension contact significantly (p=0.010) affects household food security in the study area. For every one unit increase in extension contact, household food insecurity decreases by 0.470. This implies that a household's probability of vulnerability to sudden shocks such as incidence of pests, non-seasonal rainfall and other environmental variability can be minimized and probability to food security can be enhanced.

Agriculture is a combination of crop and livestock production. Households owning large livestock are less likely to vulnerable to food insecurity through selling either livestock product or selling livestock themselves especially during harsh season. During the surveying, it was identified that very less households produce livestock as farm activities. Moreover, types of livestock were largely small ruminants (sheep and goat), and poultry. This was due to limited grazing land. The logistic regression result revealed that livestock production affects household food security significantly (p<0.0001). For every one unit increase in livestock ownership measured in tropical livestock unit, household food security increases by 21.812. From this result, we can summarize that, even though rural households in the study area rear small ruminants, the sector is playing a major role in household food security.

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