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Determinants of farm household food security in Hawi Gudina district, West Hararghe zone, Oromia Regional state, Ethiopia

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Improving household food security is the critical issue that needs to be addressed in Ethiopia. Therefore, this study sets out to assess the food security status and determine factors influencing food security status in Hawi Guddina district. A multi- stage random sampling technique was employed to select sample households randomly from six Kebele Administrations of the district by using Probability Proportional to Size. Both primary and secondary data were used. The required data set for the study were collected primarily through survey method from 140 randomly selected sample households through interview schedule. The collected data were analyzed by employing both descriptive statistics and logistic regression. Household calorie acquisition was analyzed to measure the status of household food security. Out of 140 households 32.9% and 67.1% were food secure and insecure, respectively. The model was initially fitted with fifteen variables, of which five were found to be significant and all exhibited the expected signs. These significant variables are family size (P<0.01), livestock ownership (P<0.05), distance from market center (P<0.05), access to nonfarm activity (P<0.1) and cash crop production (P<0.05). The econometric result revealed that the probability of being food secure increase with high livestock ownership, access to nonfarm activity and producing cash crops while large family size and far from market center reduce the probability of household to be food secure. On the basis of the study findings, promotion of family planning program through training and informal education, develop infrastructure and provision of nonfarm activity to diversify income of the community will help to improve food security status of households. The study also recommends the need to assist farming households in the study area to increase production and productivity of cash crop through provision of agricultural input and training to the community.

Key words: Binary logit model, determinants of food security, farm household, Ethiopia.

INTRODUCTION

The number of undernourished people in the world remains unacceptably high at near the one billion mark despite an expected decline in 2010 for the first time since 1995. However, a total of 925 million people are still estimated to be undernourished in 2010, representing almost 16 percent of the population of developing countries (FAO, 2010). Food is both a need and human right, but food insecurity is prevalent in today's world in general, and in sub-Saharan Africa in particular. Since early 2007, food-related riots have occurred in 15 countries, including 7 in sub-Saharan Africa (GAO, 2008). The persistence of hunger in the developing world means that ensuring adequate and nutritious food for the population will remain the principal challenge facing policy makers in many developing countries in the years to come (Omotesho et al., 2006).

According to FAO's classification in 2011, 43 African countries fell under the category of Low-Income-Food-Deficit-Countries in that their net food trade positions have been substantially negative for several years. Additionally, as of March 2011, out of 29 countries worldwide requiring external assistance for food, 21 are

in Africa (ADB, 2011). Genene and Wegayehu (2010) indicated that food insecurity and poverty are crucial and persistent problems facing the majority of Ethiopians. In Ethiopia, both chronic and transitory food insecurity is severe. Each year about five million people in the country, particularly in the rural areas, face food shortage. The problem of food insecurity has continued to persist in the Ethiopia as many rural households have already lost their means of livelihood due to recurrent drought and crop failures (Ayalneh and Shimalis, 2009).

Agriculture is the predominant and an important economic sector in Ethiopia. However, agricultural sector suffers from frequent periods of drought, pest infestation and technologically limited farming practices and it has not been productive enough to ensure farm households food security. Because of this, food security remains a critical issue for many rural households and for the country as a whole (Demese et al., 2010).

The causal factors of increasing food insecure caseload in the country are the interaction between environment degradation, high population growth, diminishing landholdings, and low use of on-farm technological innovation, which led to a significant decline in productivity per household (FDRE, 2002). According to Tassew (2008) about 44.2% of the Ethiopian people are under absolute poverty that is unable them to get the minimum required calorie intake due to insufficient food production of rural population from their farm.

Food security situation remain stable in most Oromia region due to good harvest and stable grain food price of 2010. However food security situation becoming volatile in pastoral and agro-pastoral areas of Oromia region due to water and pasture shortage, rising in prices of cereals and drastic fall in livestock price, especially cattle price in drought affected parts in east and west Hararghe resulted in increased request for relief food assistance by the region (WFP, 2011). West Hararghe zone is one of the food deficit zones of Oromia regional state, which falls in the second drought prone belt. In Hararghe, there have been very few years without famine relief distribution since the 1970's even during moderately dry or non-drought years. From this zone about 53% of the population is food insecure (Tesfaye, 2003).

Agriculture, which is the main source of livelihood of the people in Hawi Guddina district, is totally dependent on rain fed, and the pattern of rainfall is erratic and insufficient. In the absence of rainfall farmers constantly faced with food shortages and crises. Even in a good season, the onetime harvest or produce is too little to meet the yearly household needs. Various attempts have been made to overcome problems of declining agricultural productivity which have direct effect on food security but problems have been more serious and critical than ever before and threat many of the people at the study area.

Therefore, this study set outs to assess household food security status and identifying determinant of household's food security at Hawi Gudina district.

MATERIALS AND METHODS

Study area

Hawi Guddina is situated between 7˚52`15`` and 9˚25`43``N and 40˚34`13`` and 41˚9'14" E. Annual rainfall of the district is 500-900mm/year whereas minimum and maximum temperatures reach 14˚C to 35˚C, respectively with average of 25˚C. The pattern of rainfall is bimodal and its distribution is mostly uneven. Generally, there are two rainy seasons: the short rainy season 'Belg' lasts from mid-February to April whereas the long rainy season 'kiremt' is from June to September. The rainfall is erratic; onset is unpredictable, its distribution and amount is also quite irregular. The black and red soils are the dominant soil types of the district. The soil types vary with the topography mainly red soils are observed in the lowland areas while black soil observed in the midland areas. Topography of the district is mainly flat lowland with altitudes ranging from 976 to 2077 m.a.s.l. Agro-ecologically it is divided in to lowland (95%), midland (4%) and highland (1%) (HGPDO, 2011).

The major livelihood of the population of the district is subsistence agriculture (producing both mixed farming), which is entirely depend on seasonal rainfall performance. About 32% and 68% of the population of the district are Agro-pastoralist and Pastoralist, respectively. Major growing crop in the district are sorghum, maize, groundnut, sesame, coffee, Khat, sweet potato and Haricot bean. Sorghum and maize were the two most dominant food crops while Sesame, coffee, groundnut and chat was the major cash crop. Livestock production is one of the major components of the farming systems in the study area as well and contributes to the subsistence requirement of the population, among other, in terms of milk and milk products and meat and draft power. Cattle, goat and camel are the major livestock produced in the study area.

The District is characterized by low and erratic rainfall, lack of agricultural input and service, disease, shortage of water & feed and infertility of soil are major constraints that reduces the productivity of crop and livestock. Frequent crop failure problem usually leading to food shortage and drought induced food insecurity has been a common recurrent phenomena exacerbating the vulnerability of resource poor farm households in the area to be food insecure. The resource bases in the district are deteriorating from time to time. Deforestation is very serious problem in the district that almost all natural forests have destroyed. Soil erosion, exacerbated by deforestation and land mismanagement, has caused heavy damages to farm and other lands.

Consequently, productivity is constantly reducing; springs and rivers are drying up and induced food

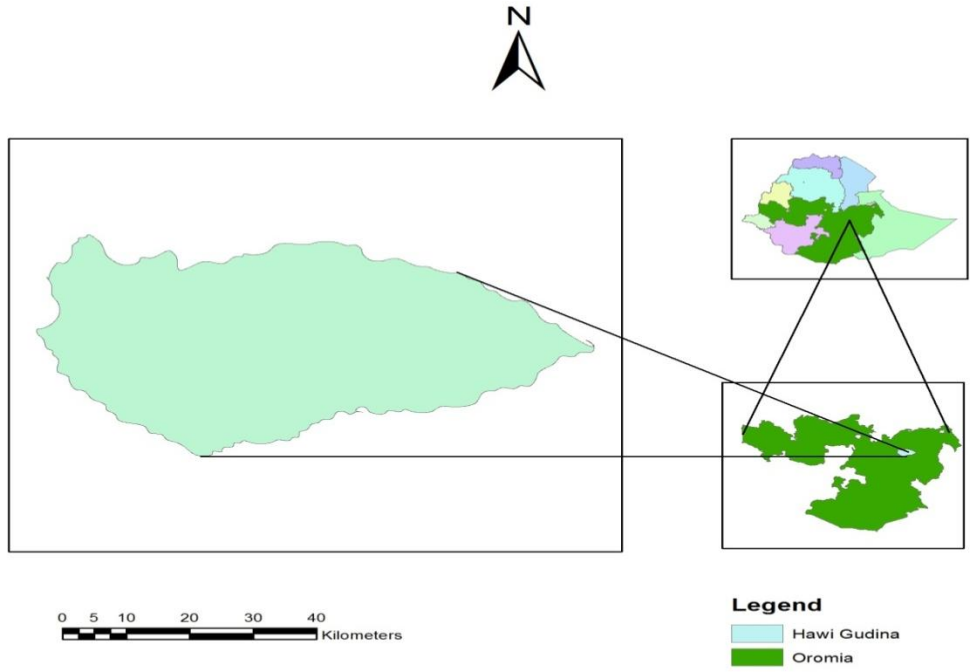

Figure 1. Map of study area.

insecurity problem in the district (HGPDO, 2011).

Sampling methods and source of data

The study was employed three-stage sampling techniques. In the first stage, the district was stratified based on Agro- ecology of the district (midland and lowland). In the second stage, one Kebele was selected from midland and five Kebeles were selected from lowland by using probability proportional to size (PPS) and random sampling technique (lottery method) and finally, 140 households were selected randomly by using PPS from the sampled Kebele. To determine appropriate sample size simplified formula provided by Yamane, (1967) was applied at 95% confidence level, 0.5 degree of variability and 9% precision level. Thus the formula is specified as follows:

$$n = \frac{N}{1+N\,(e)^2} \qquad (1)$$

Where, n=Sample size, N= Total household size and e= Level of precision. The above formula required a minimum of 119 households but this study was carried out on 140 households.

The survey was conducted through structured interview schedule to collect primary data. Questionnaires was developed and pre-tested among the non-sampled respondents of matching characteristics hence depending on the results of the pre-test the questionnaire was revised in the lights of suggestions received. Interview was conducted by trained enumerators who have knowledge about the area and well acquainted with the culture and language through closed supervision while secondary data were collected from journals, reports, books and the like.

Methods of data analysis

Household caloric acquisition is a measure of the number of calories, or nutrients available for consumption by household members over a defined period of time. Data on available food for consumption include all sources; own farm production, purchase and /or gift/loan/wage in kind were collected for the last seven days before the survey day from the household. The most used recall period for measuring household food security status is two weeks or less.

A one-week period may have an advantage over two weeks in that it is easier for households to remember what has happened since the same day last week. The day of the week can help set up a specific memory post of the beginning of the recall period in respondents' minds, bounding the period (Smith and Ali, 2007). After the data were collected using seven days recall, the data were converted to kilocalorie using the food composition table manual (Ethiopian Health and Nutrition Research Institute/EHNRI, 1997). Then the converted data were divided to household Adult Equivalent (AE) to identify whether the household is food secure or insecure. Then

the results were compared with the minimum subsistence requirement per AE per day (*i.e.* 2100 kcal). Households who consume below this minimum requirement (2100 kcal per AE per day) were categorized as food insecure and those households who consume above the threshold were considered as food secure.

Once the group are categorized as food secured and food in secured, the next step is to identify the socio-economic factors that are correlated with food security status of the households. Different statistical models were used to identify determinants of household food security. From these, logistic regression was widely used due to: (a) from a mathematical point of view, it is an extremely flexible and easily used function, and (b) it lends itself to a logically meaningful interpretation (Hosmer and Lemeshow, 1989). Therefore Binary Logit model was employed to address determinants of food security of the household. Following Pindyck and Rubinfeld (1981) the cumulative logistic probability function is specified as:

$$pi = F[\beta 0 + \sum(\beta ixi)] = \left[\frac{1}{1+e-\beta 0+\sum(\beta ixi)}\right] \qquad (2)$$

Where **e** is base of natural logarithms, $\mathbf{x_i}$ is i^{th} explanatory variable, **pi** is the probability that a household is being food secure given xi $\boldsymbol{\beta}_0$ and $\boldsymbol{\beta}_i$ are regression parameters to be estimated.

Similarly, equation (1) also written as:

$$(Pi)/= \frac{1}{1+e^{-zi}} \qquad (3)$$

Where Z_i = function of explanatory variables X_n which is expressed as:

$$Z_i = \beta 0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots\ldots\ldots\ldots + \beta_n X_n$$

Similarly, the probability of households being food insecure specified as:

$$(1 - Pi) = \frac{1}{1+e^{zi}} \qquad (4)$$

Where $1\text{-}P_i$ represents the probability that a households being food insecure given X_i
Therefore, we also write as:

$$\frac{pi}{1-pi} = 1 + e^{zi}/1 + e^{-zi} = \mathbf{e}^{zi} \qquad (5)$$

Here **Pi / 1-p_i** simply the odds ratio in favor of food security. The ratio of the probability that a household will be food secure to the probability of that it will be food insecure.

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

$$Zi = ln\left(\frac{Pi}{1-Pi}\right) = \beta 0 + \boldsymbol{\beta}_1 X_1 + \boldsymbol{\beta}_2 X_2 + \cdots + \boldsymbol{\beta}_n X_n \qquad (6)$$

Where Zi represents a function of explanatory variables X_n
$\boldsymbol{\beta 0}$ Represent the intercept of the model and
$\boldsymbol{\beta}_1, \boldsymbol{\beta}_2 \ldots\ldots\ldots \boldsymbol{\beta}_n$ are the slope of parameters in the model.

The interpretation of the coefficients will be understandable if the logistic model can be written in terms of the odds and log of odds (Hosmer and Lemeshow, 1989). The odds ratio is the probability that a household being food secure (Pi) to the probability that household being food insecure (1 - Pi) which is Zi in the model. The collected data was coded and entered into Statistical Package for Social Science (SPSS) version 20.0 software for statistical analysis.

RESULT AND DISCUSSION

Food secure and insecure households were identified based on the calorie intake extracted from the size and pattern of food consumption of each household based on seven day data. The results of the study showed that 32.9% and 67.1% of sample households were food secure and food insecure, respectively (Table 1).

The result of descriptive statistics showed that the existence of a significant mean difference between foods secure and insecure categories. Student t-test was employed to check their influence on household food security status. Continuous variables including family size (FSAE**)**, dependency ratio (DEPRATI), livestock ownership (TLU), number of oxen owned (NOXENOW), age of household (AGHH), land holding size (TOLAHSI) and distance from market center (DFRMRC) were significantly influence household food security status at various probability level (Table 2).

On the other hand Chi-square test was used to show significance among discrete variables. From eight discrete variables access to nonfarm activity (ACNOFRA), production of cash crops (DOPRCAC) and access to improved seed (ACTOIMSE) were found to have significant association with household food security status at various probability levels (Table 3).

Empirical result from the model and model fitting (-2log likelihood =63.946) and goodness-of-fit statistics (χ^2 =113.340, p= 0.000) show that the likelihood ratio for all explanatory variables are different from zero and the model fits the data very well. The model predict correctly at 90.7% of sampled household. The correct prediction for food secure and insecure households was 84.8% and 93.6 %, respectively indicating that the model predicts both groups accurately.

Out of the 15 variables included in to the model, five variables were found to have a significant influence on food security status of households and all variables get the expected direction (sign). The significant variables include family size of HH, livestock ownership, production of cash crops, access to nonfarm activities and distance from market center.

Table 1**.** Energy available per AE per day among sample households.

Energy available per AE in(kcal)	Food secure (n=46)	Food insecure(n=94)	Total sample (n=140)
Minimum	2152	1304	1304
Maximum	2995	2089	2995
Mean	2703.45	1759.35	2069.55
SD	233	241.35	504.5
SE	34.4	24.9	42.7

Source: survey result, 2012

Table 2. Descriptive summary of continuous variables.

Variables	Food secure (n=46)		Food insecure (n=94)		Total sample(n=140)		
	Mean	SD	Mean	SD	Mean	SD	t- value
Family size(AE)	4.56	1.43	8.03	2.59	6.88	2.79	8.455***
Age (years)	33.26	8.26	37.79	8.29	36.3	8.523	3.064**
Dependency ratio (no.)	1.45	0.84	2.16	1.33	1.93	1.24	3.333**
Land holding size(Ha)	2.04	0.79	1.79	0.58	1.96	0.72	1.909*
No. of oxen owned (no.)	2.02	1.59	1.1	1.07	1.41	1.34	-4.066***
Livestock owned(TLU)	6.06	4.65	4.40	4.85	4.95	4.83	-1.923*
Distance from market center (hrs)	1.34	0.89	2.29	1.65	1.98	1.51	4.418***

***, ** and * are indicates significant at less than 1%, 5% and 10% probability levels, respectively Source: Survey Result, 2012

Table 3. Descriptive summery of discrete variables.

Variables	Categories	Food secure (n=46)		Food insecure (n=94)		Total sample (n=140)		Chi-square value
		No.	%	No.	%	No.	%	
Sex of HH head	Male	40	86.9	72	76.6	112	80	2.072
	Female	6	13.1	22	23.4	28	20	
Education status of HH head	Illiterate	26	56.5	55	58.5	81	57.9	0.50
	Literate	20	43.5	39	41.5	59	42.1	
Cash crop production	Yes	39	84.8	53	56.4	92	65.7	11.06***
	No	7	15.2	41	43.6	48	34.3	
Access to PSNP	Yes	25	54.3	55	58.5	80	57.1	0.37
	No	21	45.7	39	41.5	60	42.9	
Access to nonfarm activity	Yes	36	78.3	43	45.7	79	56.4	13.28***
	No	10	21.7	51	54.3	61	43.6	
Access to credit service	Yes	30	65.2	56	59.6	86	61.4	0.42
	No	16	34.8	38	40.4	54	38.6	
Access to imp. Seed	Yes	26	56.5	33	35.1	59	42.1	5.81**
	No	20	43.5	61	64.9	81	57.9	
Access to contact DA	Yes	25	54.3	58	61.7	83	59.3	0.69
	No	21	45.7	36	38.3	57	40.7	

***, ** and *are indicates significant at less than 1%, 5% and 10% probability levels, respectively; Source: Survey Result, 2012

DISCUSSION

The influence of family size on food security of household is negative and significant. The result of the model revealed that family size measured in AE was significant at less than one percent probability level. This implies that, as family size increases by one person, the probability of household to be food secure decreases by a factor of 0 .248. This is due to the reason that, households in rural area with large family size mainly composed of non productive members could face difficulty in insuring food security due to high burden levied on active labor and less food availability to each person within the household and ultimately end up with difficulty to achieve food security. Also other findings which confirm result of this study is (Tesfaye, 2003;

Table 4. The maximum likelihood estimates of binary logit model.

Variables	Coefficients	Wald statistics	Sig.	Odds ratio
Constant	5.614**	5.778	0.016	
Sex of HH head	0.024	0.001	0.977	1.024
Age of HH head	0.002	0.001	0.970	1.002
Education status of HH head	0.905	1.348	0.246	2.473
Family size of HH head	-1.395***	17.297	0.000	0.248
Dependency ratio	-0.334	0.624	0.429	0.716
Total land holding size	0.826	1.175	0.131	2.138
No. oxen owned	0.279	0.969	0.325	1.321
Livestock ownership	0.184*	3.384	0.066	1.202
Cash crop production	1.834**	4.018	0.045	6.261
Access to PSNP	1.194	1.809	0.179	3.301
Access to nonfarm activity	1.269*	3.061	0.080	3.557
Access to credit service	0.853	1.234	0.267	2.347
Distance from market center	-1.078**	5.362	0.021	0.340
Access to improved seed	0.336	0.202	0.653	1.399
Access to contact DA	0.179	0.064	0.121	1.196
- 2 Log likelihood		63.946		
Pearson Chi-squared (χ^2)		113.340***		
Correct prediction of all samples (%)		90.7		
Correct prediction of food secure (%)		84.8		
Correct prediction of food insecure (%)		93.6		

***, ** and *are significant at less than 1%, 5% and 10% probability levels, respectively
Source: Survey Result, 2012

Asefech and Nigatu, 2007; Haile et al., 2005) concluded that large family size reduces the probability of household to be food secured.

Number of livestock owned was found to have significant influence on food security status at less than ten percent probability level and have positive relationship. The positive relationship indicates that when livestock owned increase by one TLU, the probability of a household to be food secure, increase by a factor of 1.202 keeping other factors constant. In other way livestock contribute to households' economy in different ways like as a source of pulling power, source of cash income, source of supplementary food and means of transport. Therefore, households with relatively large livestock size (TLU) were found to be less vulnerable to food insecurity. This implies that the family tends to be food secure when the herd of livestock increases which is consistent with the result of other studies like (Mulugeta, 2002; Tesfaye, 2003 and Genene and Wegayehu, 2010).

Distance from market center has been found to be negatively related with food security and significant at less than five percent probability level. It was expected that households nearer to market centers had better chances to be food secure than those who are away from market centers due to the reason that households nearer to market center have the probability of selling their produce and purchase food from market. In the study area, households sold their livestock and livestock product to purchase food for family consumption during drought and crop failure problem. The odds ratio in favor of food security decrease by 0.340 times if distance in hours of walk increases by one hours keeping other factor unchanged. In other case, as distance from market center becomes far and far the probability of households to sell their product and purchase supplementary materials becomes less which resulted in low probability of household being food secure become. The result of this study is confirmed with study of Shiferaw et al. (2003).

Cash crop production is another explanatory variable which was found to have a significant influence and positive relationship with household food security at less than five percent probability level which implies that the likelihood of food security increases with producing cash crop.

Therefore, those households who produce cash crops becomes in a better position than those who didn`t produce cash crops. The odds ratio of this variable was 6.261 and this implied that as the household was producing cash crop, the odds ratio for the household to become food secure increased by factor of 6.261. Based on the above results, one may say that cash crop production is important in ensuring food security of the farm households.

The result of this study confirm with study of Tesfaye (2003) which revealed that cash crop production is positively and strongly associated with higher income, higher rate and intensity of use purchased inputs and higher yield, and hence improved food security status of households.

The study result revealed that access to non- farm activity was found to have significant influence at less than ten percent probability level and positive relation with the food security of household. This showed that,

households who have access to non-farm activity have better chance to be food secure than others who have no access to nonfarm activity. The output of binary logit model indicated that, holding other explanatory variables constant, access of household to nonfarm activity had increase a probability of being food secure by a factor of 3.557. This is due to the fact that income from non-farm activity increase the probability of household to use modern agricultural inputs to produce more and enables household to fulfill his/her family consumption through purchasing from market.

In line with this result, Mequanent (2009) revealed that smallholder's farmers who solely depend on farm activities have inadequate income to purchase farm inputs and fulfill family needs and thus, they are found to be food insecure. This shows that non-farm activities play prominent role in managing household food security.

CONCLUSION AND RECOMMENDATION

Household family size showed negative and significant influence on food security. In view of the negative impact of large family size on the food security situation, farming households should be educated on the need to adopt the family planning program so that they may bear the number of children which their resources can accommodate.

Livestock ownership has positive influence on food security of household in the study area. Therefore, this study suggests that water supply, drought tolerant feed development, development of veterinary services, better management system and improve livestock breed will be the priority intervention to solve livestock production constraints in the study area to improve their productivity to their food security status of the households in the study area.

While agriculture play a major role in the ensuring of food security, the food security problem in the study district cannot be solved by promoting agriculture alone. In rural areas where agricultural production is not viable household try to seek additional cash by involving in nonfarm activity. In line to this the study generally highlighted that nonfarm activity have positive contribution in meeting household food security. However, nonfarm employment opportunities are found to be limited in the study area.

Therefore, promotion of nonfarm activity will be an issue in order to address issues of food security in the study area. Another area of intervention required to improve the state of food security at household level is increasing cash crop productivity via provision of improved varieties of crops (drought tolerant and early maturing), improved production system, development of irrigation facility and infrastructure facilities to farm community of the study area. Distance from market center influence household food security negatively which indicated reduce the probability of household to be food secure. Thus, there is a need to formulate intervention strategies by the local and federal governments to work jointly in order to alleviate the transportation problems and build a corporate institute that can supply materials and provide information about the market situation for the study area. Finally, the author recommends further studies should be conducted on the area of food security detail on various factors including climate change, natural resource degradation, livelihood strategies and others that affect food security status of farm households.

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APPENDIX

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Access to credit service	0.853	1.234	0.267	2.347
Distance from market center	-1.078**	5.362	0.021	0.340
Access to improved seed	0.336	0.202	0.653	1.399
Access to contact DA	0.179	0.064	0.121	1.196
- 2 Log likelihood		63.946		
Pearson Chi-squared (χ^2)		113.340***		
Correct prediction of all samples (%)		90.7		
Correct prediction of food secure (%)		84.8		
Correct prediction of food insecure (%)		93.6		

***, ** and *are significant at less than 1%, 5% and 10% probability levels, respectively
Source: Survey Result, 2012