Determinants of Food Security among Rural Households of Central Ethiopia: An Empirical Analysis

Fekadu Beyene
Haramaya University, Ethiopia

Mequanent Muche
Jimma University, Ethiopia

Abstract

The paper examines determinants of household food security among rural households in the Ada Berga district in central Ethiopia. Household calorie acquisition was analyzed to measure the status of household food security. Based on the survey of 196 farm households, the logistic model was estimated. Variables related to experiences in farming activities, off-farm and non-farm incomes, land and livestock holdings, as well as soil and water conservation practices significantly affect household food security. A difference in the use of chemical fertilizer has a positive impact on food security where improved food security was observed as the intensity of fertilizer use increases. Results indicate that development interventions aiming at increased income diversification, improved supply of fertilizer, increasing land and livestock productivity will immensely contribute to the attainment of food security. In general, the results of the study produce the implication that attaining food security in the highlands of Ethiopia requires adoption of mixed strategies and policies.

Keywords: food security, household assets, determinants, Ethiopia
JEL: Q1

1 Introduction

Nearly a quarter of the population in Ethiopia is malnourished where the largest proportion suffers from chronic hunger. Some assessments indicate that the probability of crop failure in certain parts of Ethiopia could reach 10 per cent (COLLIER and GUNNING, 1999: 76; FAO, 2006). This can be much worse where policies in attaining food security are underemphasized and the gap between per capita food production and consumption is induced by the slowdown of the agricultural production growth rates (FDRE, 2001). Researchers, planners, donors and international development

agencies have given high priority to the study of food system and the problem of food security due to deepening food crises. Despite the available resources and the efforts made by governments in different times, food insecurity remained one of the most crucial challenges to economic development and has been aggravated by recurring rainfall shocks and wars (DERCON, 2004; WHITE, 2005).

The smallholder peasant sector is the most important agricultural sub-sector in the country. Its emphasis is on food crops as well as animal husbandry where considerable improvements of cultivation practices, management and marketing need to be realized. The production volume of food crops as well as the per capita food production has shown tremendous fluctuations throughout the 1980s thus resulting in severe food shortage in the country. The main reasons for these are stochastic shocks such as recurrent drought, lack of market incentives for the small-scale food producers and poor extension services (GEZAHEGN, 1995; DERCON and KRISHNAN, 2000).

Adverse changes in climate, combined with long-term factors (technology, environmental, institutional) led to a decline of landholding, soil degradation and a decline in yield per hectare (SHIFERAW and HOLDEN, 1999; ANLEY et al., 2007). Moreover, policy induced stagnation of agriculture and internal conflict during the 1970s and the 1980s, resulted in continuous food gap for two decades that has to be covered with food aid (JAYNE et al., 2002) although a recent study identifies the negative impact of food aid on food security (HODDINOTT and GILLIGAN, 2007). Having peaked at about 26.2 % in 1984/85, food aid imports amounted to a significant proportion of domestic production of food crops, often, about 10% or more (FDRE, 2001).

The food insecurity situation in the west Shewa zone of Ethiopia shares similar features with that of the other regions (WVE, 2007). The problem of food insecurity has wide diversity and multiple dimensions, which ranges from the global to individual level. Previous studies have emphasized analysis at broader level. Nevertheless, variability, complexity and interrelated causes of household food security and local responses during crisis require an analysis to move down to a household level. This paper identifies those factors that could determine household food security and generate evidence for policy decisions where interventions are required to alleviate food insecurity. It also contributes to the food security literature within the context of the developing countries.

2 Review of Literature

The role of institutions and household assets in determining food security is well addressed in the livelihood studies (BEBBINGTON, 1999; DORWARD et al., 2003; DEVEREUX, 2001). The relationship between these two important interrelated dimensions

and food security is still not sufficiently investigated (BABU and TASHMATOV, 1999; LIPTON, 2005). Household food security is dependent on the physical availability of food, the ability of household to access the available food and the ability of individuals (particularly those susceptible to food deficits such as women, infants and children) to secure entitlement to it (BOUIS and HUNT, 1999)[1]. Hence, it has been broadened beyond notions of food supply to include elements of access (SEN, 1981), vulnerability (WATTS and BOHLE, 1993) and sustainability (CHAMBERS, 1989).

The focus in food security study is on calories rather than on the protein, micro-nutrients, food quality and safety. This is mainly because analysts operate on the principle that other needs are usually satisfied when calorie intake is satisfactory. Precise estimate of calorie needs for different groups in the population is found to be difficult. Thus, all estimates of nutritional requirements have to be treated as value judgments (MAXWELL and SMITH, 1992). An important aspect of assessing whether people have access to "*enough*" food is to ask how far they fall below the threshold. And the size of the gap is an important concern for the analysts (MAXWELL and FRANKENBERGER, 1992). Those studying availability go further and often refer to the possibility to produce sufficient food in a way food production generates income for small-scale producers without depleting the natural resource base (SHIFERAW and HOLDEN, 1999) and the presence of appropriate agricultural policies supporting food supply with affordable prices (HADDAD et al., 1994).

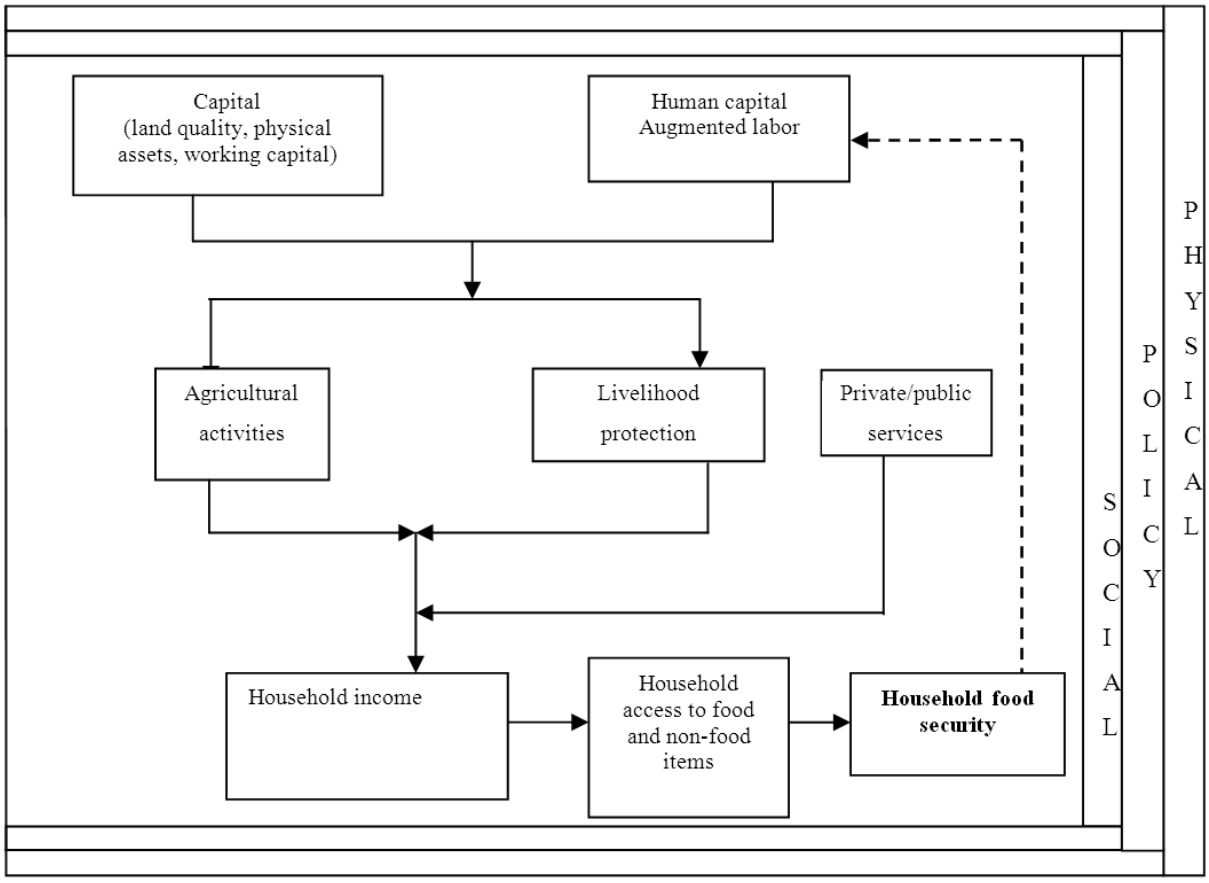
This idea has emerged based on the pioneering work of SEN (1981) on "food entitlements" in the 1980s, where individual's entitlement is rooted in his/her natural and other resources endowment that can be transformed via production and trade into food. Hence, analysis of determinants of food security can capture how the existing institutions and households assets (physical and non-physical) determine one's capacity to transform these assets into capability to secure food. The non-physical element might include, for example, household and public capacity to care for vulnerable members of society through creating access to assets needed to secure access to food (VON BRAUN et al., 1992; DERCON, 2004) where social capital plays a crucial role in undermining vulnerability (DERSHEM and GZIRISHVILI, 1998;).

An important extension to entitlement theory focuses on the role of investments in determining household vulnerability to food insecurity. When households are able to generate a surplus over and above their basic food requirements, the excess resources are diverted into assets of different kinds, which can be drawn upon when they face crises (SWIFT, 1989). In such circumstance, we may relate food security to the idea of

[1] Increased disparity in food intake among different societal groups despite overall adequate supply has motivated scholars to study it at a local, household, or individual level (FOSTER, 1992).

vulnerability to poor resource endowments of households, focusing more clearly on risk where its avoidance becomes central to attaining food security (MAXWELL and FRANKENBERGER, 1992) (figure 1). This risk undermining outcomes of an investment in agriculture can be originated from many sources and include weather unpredictability, market and price irregularity, health hazard and morbidity, variability and conflict (WEBB and VON BRAUN, 1994; CHUNG et al., 1997; GEORGE, 1999; CLOVER, 2003).

Figure 1. Framework for analysis



Source: based on MAXWELL and FRANKENBERGER (1992: 25), modified

Though availability and accessibility to livelihood assets are major determinants of food security, factors related to human resource development including education, health care and clean water; population growth, urbanization and displacement of people highly influence food security and human nutrition (DERCON and KRISHNAN, 2000; DERCON and HODDINOTT, 2003). For instance, conservation of agrobiodiversity becomes critical determinant when it integrates natural resource management and the use of improved agricultural technologies (ANDERSEN, 1997; THRUPP, 2002). Other factors like labor, land-to-man ratio, diversification into producing cash crops and

generating off-farm income, management of grazing land, household indebtedness, access to credit, performance of input-output markets, household expenditure (obligation to the state, rural institution, the household itself and other households), agricultural inputs and extension services which could help them in improving subsistence production and overall income streams determine food security (BOGALE, 2002; HARDAKER et al., 1997). As displayed in figure 1, a recent thinking that links food security with livelihood protection emphasizes the distortions of markets in the supply of these inputs and services coupled with the massive food aid can increase vulnerability and be potent causes of household food insecurity (DEVEREUX, 2001; HODDINOTT and GILLIGAN, 2007). The review here indicates that there are multiple and interrelated factors determining food security that might vary from one to other contexts implying that food policies that should address food security can pursue diverse strategies (VON BRAUN et al., 1992; BARRETT et al., 2001).

3 Methodological Approaches

3.1 Description of the Study Area

Ada'a Berga District is located in central Ethiopia and is 64 km away Addis Ababa, with an area of 798.35 sq. kilometers. It consists 34 rural *kebeles*[2] where its altitude ranges from 1,400 to 3,500 m and its agro-ecology is divided into lowland (37%), mid-altitude (34%) and highland (29%) with an annual rainfall of 918 mm to 1,368 mm. Agriculture is the mainstay of the household economy, intensively carried out by those who have land and livestock. The landless are engaged in sharecropping and other non-agricultural income generating activities like daily laboring. Crop production and animal husbandry are major activities. Agricultural products are consumed at home and partly sold to earn cash to meet other household needs, educate children, and contribute to social affairs. The main crops grown include cereals (barley, wheat and *teff*), pulses (horse bean, chickpea, and lentil), oil crops (rapeseed, Niger seed and linseed), fruits and vegetables (papaya, mango, and banana; are cabbage, kale, onion). The major livestock species managed in the area includes shoats, cattle, donkey, mule and horse. The proportion of households with no ox, one ox and two or more oxen is 30%, 40% and 30%, respectively (WoRAD, 2009).

[2] *Kebele* is the lowest administrative units in Ethiopia.

3.2 Data Collection

A structured questionnaire was used to collect quantitative data through a household survey involving household heads and their spouses from four *kebeles* (Biyo Wogidi, Regi mekoda, Gatera Nebe and Sire Berga). The survey covered a total of 196 randomly selected households. Data were collected on demographic characteristics, asset possession, off-farm/non-farm income, livestock and oxen ownership, soil conservation activities, and types and amount of food consumed by a household in a specific period (seven days recall[3]). Additional data on resource endowment, institutional factors such as access to credit and training, use of external farm inputs and access to extension services, problems in crop and animal production, pest infestation, productive resources and biophysical factors were gathered. Qualitative data were collected through focus group discussion from key informants subsequent to the survey.

3.3 Hypotheses

Based on critical review of the literature from section 2 and others' work, the following explanatory variables were hypothesized to have an influence on household food security.

1) *Age of household head (AGEHHH):* Age is a continuous explanatory variable. As age of a household increases, it is assumed that farmers could acquire more knowledge and experience. They are more risk averter and their chance to become more food secure increases with age. Thus, it is hypothesized that age of the household heads and food security are positively correlated.

2) Household size (FAMSIZ): Household size refers to the total number of household members who live and consume from the same household and is expressed in adult equivalent. It is an important variable which determines the state of household food security and expected to have negative impacts on household food security. An increase in household size implies more people to be fed from the limited resources. A study in Mozambique, for instance, shows that a large household size is negatively associated with food security (GARRETT and RUEL, 1999). Thus, it was hypothesized to have a negative association with food security.

3) Dependency ratio (DEPRAT): Dependency ratio is obtained by dividing inactive labor force (age less than 15 and above 65) by the active labor force (age between 15 and 65) with in a household. When a large household size corresponds with the

[3] Seven days period is appropriate assuming that it will be recalled (DERCON, 2004).

availability of adequate adult labor, it can have a positive effect. But a household with more inactive productive labor force compared to the active age shows a high dependency ratio and it is more likely to be food insecure (BIGSTEN et al., 2002). Therefore, it is hypothesized that dependency ratio and food security are negatively associated.

4) Off-farm/non-farm income (OFF/NONFARINC): Income from the agricultural production may not be the only source of income for the rural household. The success of households and their members in managing food insecurity is largely dependent on their ability to get access to off-farm/non-farm job opportunities, which could serve as livelihood diversification strategies (REARDON, 1997; BARRETT et al., 2001). Hence, it is expected that the availability of off-farm/non-farm income is positively associated with household food security.

5) Size of cultivated land (CULTLAN): Size of cultivated land is a continuous variable measured in hectare. Cultivated land is a salient resource expected to be associated with a household's food security status. Some have assessed that size of cultivated land is associated with food security (GARRETT and RUEL, 1999; GROOTAERT and NARAYAN, 2004). As the cultivated land size increases, provided other associated production factors remain the same, the possibility that the household gets more output is high as it remains the basic capital input in food production. Therefore, it is hypothesized that households with large cultivated land are less likely to be food insecure and vice versa.

6) Livestock ownership (LIVOWN): It is a continuous variable and measured in TLU (Tropical Livestock Unit)[4]. Unlike urban dwellers, the rural households accumulate their wealth in terms of livestock. They are prominent sources of wealth to farm households and supply manure to improve soil fertility. Households with large livestock size are expected to be less vulnerable to food insecurity especially in times of drought when crops fail to yield (LITTLE et al., 2006). Therefore, possession of large size of livestock increases the likelihood of the household to be food secure.

7) Number of ox/oxen owned (OXENOWN): It is a continuous variable measured in number. Oxen power is the main source of traditional means to cultivate land in Ethiopia. It allows effective utilization of land and labor resources where family labor could be spread over peak and slack periods to carry out both farm and non-farm activities. Households with relatively larger number of oxen can perform better on their farm and achieve sustainable food security. Thus, the number of oxen available to the household increases the probability of the household being food secure.

[4] Tropical Livestock Unit (TLU) is an animal unit equivalent to live-weight of 250 kg. In this case, 1 head of cattle = 0.7 TLU, 1 camel = 1 TLU, 10 sheep or goats = 1 TLU, and a donkey = 0.5 TLU.

8) Sex of household head (SEXHHH): Household head is a person who economically supports or manages a household or for reason of age or respect is considered as head by other members of the household. Male-headed households have more access to agricultural technologies and more security to farmland as compared to female-headed households. Women farmers may need a long adjustment period to diversify their income sources (GLADWIN et al., 2001). As most female-headed households lack labor, they often rent their land on a share-cropping basis. Hence, male-headed households are in a better position to pull labor force than the female-headed ones. Sex of household head is an important determinant of food security and it is a dummy variable (i.e. 1 if it is male and 0 otherwise). Thus, male headed households are more likely to be food secure than female headed households.

*9) Education level of household head (EDUHHH)***:** It is a dummy variable defined whether the household head is literate or illiterate. Education is an important variable determining household food security where educated households have a better chance of managing their farm by adopting improved practices, which in turn increases total yield. It is assumed that a literate household head often tends to adopt new skills and ideas which in turn have positive effects on food security (GARRETT and RUEL, 1999); hence, it is positively related with household food security.

10) Insect and pest infestation (PESTPROB): Crop-framing at present is plagued by an increased widespread of resistant pests to pesticides. Pests are one of the constraints of food security in the rural society (EHRLICH and EHRLICH, 1991). Insect and pest infestations are important biological factors restraining crop production and cause food deficit. In light of this, it is hypothesized that insect and pest infestations have negative correlations with food security status. It is a dummy variable that assumes the value of 1 if a household does not face insect pest problem and 0, otherwise.

11) Chemical fertilizer uses (CHEMFERT): It is a dummy variable taking value of 1, if a farmer uses chemical fertilizers and 0 otherwise. Fertilizer use improves productivity per unit of cultivated area. Households using fertilizer are expected to have better food production capacity than the non-users (BABU and TASHMATOV, 1999). Hence, a household which uses chemical fertilizer is expected to be more food secure than the non-users.

12) Use of improved seed (IMRVSEED): Seed is an essential agricultural input, which affects production. It is a dummy variable taking value of 1, if a farmer used improved seeds and 0 otherwise. Improved seeds may withstand drought and erratic rainfall distribution when they are resistant to moisture stress. They can increase agricultural productivity by boosting overall production, which in turn contributes to attaining food security at the household level (LIPTON, 2005; DORWARD et al., 2003). Hence, using improved seeds has positive association with household food security.

13) Access to nearest market (ACCESMART): It is dummy variable that takes value of 1 if a household has market access and 0 otherwise. Closeness to market centers creates access to additional income via off-farm/non-farm employment opportunities, easy access to information on inputs and transportation (DORWARD et al., 2003). It is thus, expected that a household having better access to market has better opportunity to be food secure than the one which does not have access. Therefore, it is hypothesized that there is positive association between access to the nearest market center and household food security.

14) Access to credit (CREDRECIVED): Credit serves as a means to boost production and expand income generating activities (DIAGNE, 1998; DEVEREUX, 2001). It is a dummy variable taking the value 1, if the household takes credit 0 otherwise. Thus, a household which has access to credit does initiate investment in farm and non-farm activities and achieve food security. Thus, it is hypothesized that a household which has access to credit is more likely to be food secure.

15) Soil and water conservation measures (SWCPRACTICE): The long-run objective to achieve food security is determined by whether there are some programs and activities on soil conservations or not. In Ethiopia, erosion and soil degradation are constraints to food production since unsustainable management of soils, upon which agriculture depends, considerably affects food security (BROWN and WOLF, 1984; GRAY and PADDOCK, 1993; VON BRAUN et al., 2005: 18). A soil conservation measure is a dummy variable taking value 1 if a household is practicing soil and water conservation activities and 0 otherwise. Thus, a household which practices any type of soil conservation measures is more likely to be food secure.

16) Land rented out (LNDRENTOUT): This is a dummy variable that assumes the value 1 if a household rents land out and 0 other wise. This variable measures the renting out of land under private holdings. It can be expressed in terms of fixed cash or sharecropping to be used by others who are capable of generating reliable benefits out of this land. Thus, a household which is involved in such an informal institutional arrangement is likely to be food secure.

3.4 Data Analysis

The data analysis started with the conversion of the weekly consumption data into kilocalorie using the nationally standardized food composition table manual (EHNRI, 1997). The converted data were divided into household Adult Equivalent (AE). Following this, the amount of energy in kilocalorie (kcal) available for the household was recorded. Then after, the results obtained were compared with the minimum subsistence requirement per AE per day (which is 2,100 kcal). Households which

consume below this minimum requirement were categorized as food insecure and those households which consume above the threshold were considered as food secure. The next step involved identification of variables that are assumed to have association with food security at a household level. As the dependent variable has a dichotomous nature (food secure or insecure households), a binary logistic regression was used where the estimated probabilities lie between logical limit 0 and 1 (GUJARATI, 1995). Food security as a dependent variable, thus, assumes the value of Y= 1 if a household is food secure, 0 otherwise. Following GUJARATI (1995), the functional form of logistic regression model was specified as follows:

$$(1) \qquad \Pi(x) = E(Y = 1/x) = 1 \Big/ 1 + e^{-(\beta 0 + \beta i Xi)}$$

For ease of exposition, we write (1) as,

$$(2) \qquad \prod(x) = 1 \Big/ 1 + e^{-Zi}$$

Where Π(x) is a probability of being food secure ranging from 0 to 1 and Z_i = is a function of n explanatory variables (X_i) which is also expressed as:

$$(3) \qquad Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ...\beta_n X_n + U_i$$

In other words, the probability for a household to be food insecure can be expressed as,

$$(4) \qquad 1 - \Pi(x) = 1 \Big/ 1 + e^{Zi}$$

Thus,

$$(5) \qquad \Pi(x) \Big/ 1 - \Pi(x) = \left(1 + e^{Zi} \Big/ 1 + e^{-Zi}\right) = e^{Zi}$$

Then, the expression Π(x) /(1-Π(x)) represents the odds ratio in favor of food security. It means the ratio of the probability that a household will be food secure to the probability that it will be food insecure. After checking for multicollinearity among the continuous variables (Variance Inflation Factors (VIF)) and the associations (computing contingency coefficient) among discrete variables, the regression model was estimated. A further correlation analysis of explanatory variables and multi-collinearity diagnostics was carried out to detect the presence of collinearly and the result shows the absence of serious multicollinearity (see the Annex). For instance, a few of the variables that are correlated do have similar effects on the dependent variable. Area of cultivated land and age seem to have significant relationship but difficult to explain because these two variables are not close to each other; hence, the

correlation might be spurious. Others like, family size and age are positively correlated but do have opposite effect on food security. In any case, however, some have argued that it is natural to find some relationship among explanatory economic variables (ASHENFELTER et al., 2003: 195).

4 Results and Discussion

4.1 Descriptive Statistics

The amount of energy available for the household is compared with the minimum subsistence requirement per AE per day[5] (i.e. 2,100 kcal). Accordingly, the percentages of food insecure and secure households were found to be 64% and 36% respectively. The survey indicates that the mean value of the energy available for food insecure and secure households was 1,822 Kcal/AE/day and 2,908 Kcal/AE/day, respectively. The minimum and maximum energy available for food insecure households was 1,043 Kcal and 2,098 Kcal, respectively. Whereas the minimum and maximum energy intakes of food secure households were 2,203 Kcal and 3,492 Kcal, respectively. The mean energy intake of all sample households was 2,216 kcal. The t value (21.68) confirmed that there is a significant mean difference between food insecure and secure households.

Table 1. Descriptive statistics for continuous variables

Variables	Total (N=196)		Food insecure (n = 71)	Food secure (n=125)	t-value
	Min(Max)	Mean(SD)	Mean(SD)	Mean(SD)	
Age	22(90)	49(15.87)	47(16)	52(15)	2.32**
Household size (AE)	1.35(9.75)	5.2(1.76)	5.12(1.80)	5.3(1.7)	0.484
Dependency ratio	0(4)	1.11(0.78)	1.13(0.80)	1.1(0.74)	-0.329
Off-farm /non-farm income per annum(Birr)	0(4800)	500(731)	390(756)	693(645)	2.85**
Land holding (ha)	0(11.25)	2.88(2.07)	2.2(1.75)	4.1(2)	6.91***
Livestock ownership (TLU)	0(25.33)	4.81(4.38)	2.83(2.42)	8.3(4.86)	10.53***
Number of oxen	0(10)	1.45(1.48)	0.88(0.96)	2.42(1.7)	8.10***

** p< 0.05; *** p< 0.01

Source: Household Survey (2008)

[5] Kilo calorie per adult equivalent (AE) is calculated by dividing the consumed food by household size after converting it into kilo calorie.

The descriptive statistics for continuous and discrete variables were presented separately for the sake of convenience. The variables are helpful to observe differences among food insecure and secure households include age of household head, household size and dependency ratio, landholding, off-farm/non-farm income, asset possession, livestock ownership and number of oxen. The results show that there is significant mean difference between food secure and insecure households with respect to age, off-farm income, landholding, asset possession, livestock possession, and oxen ownership (table 1). Similarly, a chi-square test for the discrete choice variables indicate that greater proportion of food secure households are literate, use fertilizer and improved seed, and practice improved soil and water conservation practices (table 2).

Table 2. Descriptive statistics for discrete variables

Description of variables	Categories	Food security status		Chi square
		Insecure (%)	Secure (%)	
SEXHHH	Male	84	92	2.243
	Female	16	8	
EDUHHH	illiterate	69	24	36.54***
	Literate	31	76	
USEFSEERT	Users	30	86	55.83***
	Non users	70	14	
IMPROVSEED	Users	16	28	4.13**
	Non users	84	72	
PESTPROB	Yes	47	49	0.08
	No	53	51	
ACCESSMART	Yes	77	86	2.36
	No	33	14	
CREDITACCESS	Yes	27	35	1.38
	No	73	65	
SWCPRACTICE	Users	42	83	30.626***
	Non users	58	17	
LANDRENTOUT	Yes	18	20	0.14
	No	82	80	

** $p< 0.05$; *** $p< 0.01$

Source: Household Survey (2008)

4.2 Econometric Analysis

Logistic regression model was used to identify determinants of food security. Accordingly, variables assumed to have influence on household food security in different contexts were tested in the model and out of 18 variables nine of them were found to be significant. Among variables fitted into the model age of household head, educational level of household head, off-farm/ non-farm income, use of chemical fertilizer, size of cultivated land, livestock ownership, oxen ownership and soil and water conservation practices were found to be significant in determining household food security.

The model reveals that age of the household head has positive and significant (at $p <$ 10 %) relationship with household food security (table 3). The logit increases by a factor of 1.042 as the age of a household head increases by one year keeping the other variables constant. The possible explanation for such positive association is that an older household head devotes his/her time on farming activities compared to young farmers. Young people spend much time in towns and prefer urban life than the rural for a number of reasons. Moreover, as age increases, one can acquire more knowledge and experience becoming effective in exploiting these experiences.

Although we hypothesized that education of household head has positive impact on state of household food security, the model output revealed that it has negative association. The possible explanation for the unexpected output might be literate households might not have chance to apply their knowledge towards achievement of household food security. Similarly, GARRETT and RUEL (1999) found negative and significant association between educational level of a household head and with food security. Whereas, others found out that it is mother's attendance of primary education that positively contributes to food security (BIGSTEN et al., 2002). In our sample, a greater proportion of female headed households are food insecure, in agreement with this finding.

Consistent with the hypothesis, household size (AE) has a negative significant (at $p<5\%$) influence on household food security. The negative sign in the model output implies that family planning policies that will have an impact in reducing household size will increase the probability of a household to be food secure. The odds ratio in favor of food security decreases with increasing household size and was found to be 0.625. This implies, ceteris paribus, the odds ratio in favoring food security decreases by 0.625 as household size increases by one AE. This reaffirms the findings of others in which a household with large size, composed mainly of non-productive members is more likely to be food insecure due to high burden levied on active labor (BIGSTEN et al., 2002).

Table 3. The logistic regression results for the determinants of food security (Y=1)

Variables	Coefficients	Wald statistics	Sig.	Odds ratio
CONSTANT	-5.920	10.891	0.000	0.003
AGEHHH	0.041*	3.733	0.053	1.042
SEXHHH(cat)	-0.179	0.045	0.975	0.836
EDUHHH(cat)	-1.346**	4.460	0.035	0.260
AE	-0.470**	5.558	0.018	0.625
DEPRAT	-1.065	0.024	0.467	0.937
OFF/NONFRINC	0.040**	5.984	0.014	1.004
CULTLAN	0.304*	3.106	0.078	1.356
PESTPROB(cat)	0.027	0.002	0.867	1.027
CHEMFERT(cat)	1.780**	9.260	0.002	5.930
IMPRSEED(cat)	0.517	0.615	0.452	1.677
LIVSTOWEN	0.242*	3.583	0.058	1.273
OXENOWN	0.660*	3.422	0.064	1.934
ACCEMART(cat)	0.698	0.622	0.308	2.010
RECIEVCRED(cat)	0.448	0.649	0.357	1.566
SWCPRACTIC(cat)	1.253**	3.891	0.049	3.501
LANDRENTOUT(cat)	0.069	0.100	0.978	1.071
-2Log likelihood		102.2		
Chi-squared		155.0***		

* p<0.1; ** p< 0.05; *** p< 0.01

Source: Household Survey

The model also reveals the important role of off–farm/non-farm income in contributing to household food security as expected (at p<5%). In this circumstance, smallholders 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. The odds ratio in favor of food security increases by a factor of 1.004 when off-farm/non-farm income increases by one birr.

Moreover, it indicates that the size of land cultivated, as a basic input in farming, is significantly associated with food security status of a household. Land in this district serves as means of coping mechanism during serious food shortage and collateral to receive credit service. This means households with large cultivated land produce more for household consumption and for sale and have better chance to be food secure than those having relatively small size of cultivated land. The odds ratio for this variable is

1.356. This indicates that maintaining other determinants constant, additional hectare of cultivated land will enhance food security status of the household by factor of 1.356 and vice versa.

Use of fertilizer is another variable which was found to have a positive and significant impact on household food security (at $p<5\%$). The odds ratio for this variable was found to be much higher 6.084 where the odds ratio from the use of chemical fertilizer favors attaining food security with a factor of 6.084. Most households in the rural communities in Ethiopia accumulate their wealth in terms of livestock. Results here support such a practice where households with relatively large livestock size (larger TLU) were found to be less vulnerable to food insecurity. In this case, the odds ratio in favor of food security increases by factor of 1.273 for a unit increment in TLU.

Oxen are the main source of traction power among rural households of the district. This is clearly indicated in the model where oxen ownership was positively and significantly associated with household food security. The odds ratio in favor of household food security increases by a factor of 1.934 for each additional ox owned. Among poor households, having even a single ox enables them to tie with others having same status to cultivate their plots of land.

The sign for the soil conservation measure in the model is also consistent with the hypothesis in which the odds ratio is in favor of being food secure for adoption of certain soil conservation measures. This result conforms to the findings of the studies conducted elsewhere which have also shown a positive relationship between food insecurity and natural resource degradation that stand to be a prominent challenge to developing countries (BAHU and TASHMATOV, 1999; HOLDEN and SHIFERAW, 2004). In some countries, poor farmers may practice a biomass transfer from hedges which can increase yield enormously in the short-term other than the use of other expensive soil conserving technologies whose effects are observed in the long-term (SANCHEZ, 2000). A similar practice could be adopted in Ethiopia when farmers cannot afford to pay for fertilizer since its price has increased enormously subsequent to the removal of input subsidies and due to other reasons.

5 Conclusions

We examined the determinants of food security. Surprisingly, the result does not support the importance of human capital development in food security. But this unexpected result is consistent with the study conducted in Mozambique (GARRETT and RUEL, 1999). The findings clearly indicate the role of household assets and income diversification in contributing to household food security. The crucial contribution of different forms of capital (financial and physical) to attaining food

security can be indirect and direct because farmers in the area could be engaged in share cropping and land renting where part of their cultivated land is operated by other families who do have the capacity to invest on the land. Therefore, access to land alone could increase the chance to attain food security through getting involved in other forms of economic transactions. In that sense, informal institutions that facilitate crop-sharing arrangements and engagement in informal land lease contracts will play a crucial role.

Moreover, the results also imply that scaling-up of the supply of chemical fertilizer can immensely contribute to enhancing food security. Policies and strategies that involve regulation of the trend of increases in the prices of agricultural products vis-à-vis chemical fertilizer and introducing necessary adjustments are essential to sustain this positive effect. Absence of this might cause a disproportional increase in input prices that will in turn create disincentives for farmers to purchase such inputs.

From the model results, we learn that technical interventions enhancing soil and water conservation practices of farmers reinforce the desirable effects of these practices on food security. As conservation structures are labor demanding while their effects are realized in the longer term, their contribution to food security might not be as immediate as the use of fertilizer or increased access to off/non-farm incomes. Although it is generally argued that property rights insecurity could hinder investment in abatement of soil degradation, expectation of higher returns in the future produces an incentive to invest in land management (SHIFERAW and HODEN, 1999; ANLEY et al., 2007). In general, the results of this study produce the implication that attaining food security in the highlands of Ethiopia requires adoption of mixed strategies and policies along those variables found to have a significant effect on food security.

References

ANDERSON, P. (1997): 2020 Vision for Food, Agriculture, and the Environment in South Africa. In: Haddad, L. (ed.): Achieving Food Security in South Africa New Challenges, New Opportunities. IFPRI, Washington, D.C.

ANLEY, Y., A. BOGALE and A. HAILE-GABRIEL (2007): Adoption decision and use intensity of soil and water conservation measures by smallholder subsistence farmers in Dedo District, Western Ethiopia. In: Land Degradation and Development 18 (3): 289-302.

ASHENFELTER, O., P.B. LEVINE and D. J.ZIMMERMAN (2003): Statistics and econometrics: methods and applications. Johns Wiley and Sons, New York, USA.

BABU, S.C. and A. TASHMATOV (1999): Attaining food security in central Asia – emerging issues and challenges for policy research. In: Food Policy 24 (4): 357-362.

BARRETT, C.B., T. REARDON and P. WEBB (2001): Non-farm income diversification and household livelihood strategies in rural Africa: concepts, dynamics, and policy implications. In: Food Policy 26 (4): 315-331.

BEBBINGTON, A. (1999): Capitals and capabilities: a framework for analyzing peasant viability, rural livelihoods and poverty. In: World Development 27 (12): 2021-2044.

BOGALE, A. (2002): Land Degradation, Impoverishment, and Livelihood Strategies of Rural Households in Ethiopia: Farmers' Perceptions and Policy Implication. Shaker, Aachen.

BIGSTEN, A, B. KEBEDE, A. SHIMELIS and M. TADDESSE (2002): Growth and Poverty Reduction in Ethiopia: Evidence from Household Panel Surveys. In: World Development 31 (1): 87-106.

BOUIS, H. and J. HUNT (1999): Linking food and nutrition security. Past lessons and future opportunities. In: Asian Development Review 17 (2): 168-213.

BROWN, L. and E. WOLFE (1984): Soil Erosion: Quiet Crisis in the World Economy. Worldwatch paper 60. Worldwatch Institute, Washington, D.C.

CHAMBERS, R. (1989): Vulnerability, coping, and policy. In: IDS Bulletin 20 (2): 1-7.

CHUNG, K., L. HADDAD, J. RAMA KRISHNA and F. Riely (1997): Identifying The Food Insecure: The Application of Mixed-Method Approach in India. IFRPI, Washington, D.C.

CLOVER, J. (2003): Food security in sub-Saharan Africa. In: African Security Review 12 (1): 1-10.

COLLIER, P. and J.W. GUNNING (1999): Explaining African Economic Performance. In: Journal of Economic Literature 37 (1): 64-111.

DERCON, S. and P. KRISHNAN (2000): Vulnerability, seasonality and poverty in Ethiopia. In: Journal of Development Studies 36 (6): 25-53. In: http://www.informaworld.com/smpp/content~db=all~content=a787132584?words=dercon

DERCON, S. (2004): Growth and shocks: Evidence from rural Ethiopia. In: Journal of Development Economics 74 (2): 309-329.

– (2005): Insurance against poverty. Oxford University Press, Oxford.

DERCON, S. and J. HODDINOTT (2003): Health, shocks and poverty persistence. Discussion Paper No. 2003/08. United Nations University/WIDER, Helsinki.

DEVEREUX, S. (2001): Livelihood insecurity and social protection: a re-emerging issue in rural development. In: Development Policy Review 19 (4): 507-519.

DERSHEM, L. and D. GZIRISHVILI (1998): Informal social networks and household vulnerability: empirical findings from Georgia. In: World Development 26 (10): 1827-1838.

DIAGNE, A. (1998): Impact of access to credit on income and food security in Malawi. FCND Discussion Paper No. 46. IFPRI, Washington, D.C.

DORWARD, A., N. POOLE, J. MORRISON, J. KYDD and I. Urey (2003): Markets, Institutions and Technology: Missing Links in Livelihood Analysis. In: Development Policy Review 21 (3): 319-332.

EHNRI (Ethiopian Health and Nutrition Research Institute) (1997): Food composition Table for use in Ethiopia. Part III, from 1968-1997. A research project sponsored by Government of Ethiopia through former ENI and EHNRI. Addis Abeba.

EHRLICH, P. and A. EHRLICH (1991): Healing the Planet. Addison-Wesley, Boston.

FAO (2006): State of food insecurity in the World: Eradicating world hunger, taking stock ten years the World Food Summit. Rome, Italy.

FDRE (Federal Democratic Republic of Ethiopia) (2001): Food Security Strategy. An update. Addis Ababa, Ethiopia: 8-22.

FOSTER, P. (1992): The World Food problem: Tackling the Causes of under Nutrition in the Third World. Lynne Rienner Publisher, London and Boulder, CO.

GARRETT, L.J. and M.T. RUEL (1999): Are determinants of rural and urban food security and nutritional status different? Some insights from Mozambique. In: World Development 27 (11): 1955-1975.

GEORGE, S. (1999): Some Reflections on Food Security in India. In: Indian Journal of Agricultural Economics 54 (4): 465-489.

GEZAHEGN, K. (1995): Agricultural marketing policies and food security in Ethiopia. In: Mulat Demeke et al. (eds.): Food security, nutrition and poverty alleviation in Ethiopia: problems and prospects. Proceedings of the Inaugural and First Annual Conference of the agricultural economics society of Ethiopia, Addis Ababa.

GLADWIN, C. H., A. THOMSON, J.M. PETERSON and A.S. Anderson (2001): Addressing Food Security in Africa Via Multiple Livelihood Strategies of Women Farmers. In: Food Policy 26 (2): 177-207.

GRAY, R. and R. PADDOCK (1993): Land set aside: Is it food security? In: Canadian Journal of Agricultural Economics 41 (4): 441-451.

GROOTAERT, C. and D. NARAYAN (2004): Local institutions, poverty and household welfare. In: World Development 32 (1): 1179-1198.

GUJIRATI, D.N. (1995): Basic Econometrics. Third Edition. McGraw-Hill, New York.

HADDAD, L., E. KENNEDY and J. SULLIVAN (1994): Choices of indicators for food security and nutrition monitoring. In: Food Policy 19 (3): 329-343.

HARDAKER, J.B., R.B.M. HUIRNE and J.R. ANDERSON (1997): Coping with Risk in Agriculture. CAB International, Wallingford, UK.

HOLDEN, S. and B. SHIFERAW (2004): Land degradation, drought and food security in a less-favored area in the Ethiopian highlands: a bio-economic model with market imperfections. In: Agricultural Economics 30 (1): 31-49.

HODDINOTT, J. and D.O. GLIGAN (2007): Is there persistency in the Impact of Emergency Food Aid? Evidence on Consumption, Food Security, and Assets in Rural Area. In: American Journal of Agricultural Economics 89 (2): 225-242.

JAYNE, T.S., J. STRAUSS, T. YAMANO and D. MOLLA (2002): Targeting of food aid in Ethiopia: chronic need of inertia. In: Journal of Development Economics 68 (2): 247-288.

LIPTON, M. (2005): The Family Farm in a Globalizing World: The Role of Crop Science in Alleviating Poverty. 2020 Discussion Paper No. 40. IFPRI, Washington, D.C.

LITTLE, P.D., M.R. STONE, T. MOGUES, A.P. CASTRO and W. Negatu (2006): Moving in Place: drought and poverty dynamics in south Wollo, Ethiopia. In: Journal of Development Studies 42 (2): 200-225.

MAXWELL, S. and T. FRANKENBERGER (1992): Household food security: Concepts, indicators, measurements. International Fund for Agricultural Development (IFAD) and UNICEF, Rome.

MAXWELL, S. and M. SMITH (1992): Household Food Security: Conceptual indicators and measurements: A technical review. UNICEF, New York and IFAD, Rome: 1-52.

REARDON, T. (1997): Using evidence of household income diversification to inform study of the rural non-farm labor market in Africa. In: World Development 25 (5): 735-747.

SANCHEZ, P.A. (2000): Linking climate change research with food security and poverty reduction in the tropics. In: Agriculture, Ecosystems and Environment 82 (1-3): 371-383.

SEN, A. (1981): Poverty and famines: an essay on entitlement and deprivation. Oxford University Press, Oxford.

SHIFERAW, B. and S. HOLDEN (1999): Soil erosion and smallholders' conservation in the Highlands of Ethiopia. In: World Development 27 (4): 739-752.

SWIFT, J. (1989): Why are rural people vulnerable to famine? In: IDS Bulletin 20 (2): 8-15.

THRUPP, L.N. (2002): Linking Agricultural Biodiversity and Food Security: the Valuable Role of Agrobiodiversity for Sustainable Agriculture. In: International Affairs 76 (2): 283-297.

VON BRAUN, J., H. BOUIS, S. KUMAR and R. LORCH (1992): Improving Food Security of the Poor: Concept, Policy and Programs. IFPRI, Washington, D.C.

VON BRAUN, J., M.W. ROSEGRANT, R. PANDYA-LORCH, M.J. COHEN, S.A. CLINE, M.A. BROWN and M.S. BOS (2005): New risks and opportunities for food security: scenario analysis for 2015 and 2050. IFPRI, Washington, D.C.

WATTS, M. and H. BOHLE (1993): Hunger, famine, and the space of vulnerability. In: GeoJournal 30 (2): 117-126.

WEBB, P. and V.J. BRAUN (1994): Famine and food security in Ethiopia. Lesson for Africa. John Wiley and sons Ltd., Chichester, England.

WHITE, P. (2005): War and food security in Eritrea and Ethiopia. In: Disasters 29 (1): 92-113.

WOARD (Woreda Agricultural and Rural Development) (2009): Ada Berga District Official Report. Unpublished.

WVE (World Vision Ethiopia) (2007): Five years Design Document (2007-2011). World Vision Ethiopia, Addis Ababa Program Office, Ada Berga Area Development Program, Inchini.

Acknowledgements

We are very much grateful for the financial support of the World Vision Ethiopia.

Contact author:
Fekadu Beyene
Department of Rural Development and Agricultural Extension, College of Agriculture and Environmental Sciences, P.O. Box 161, Haramaya University, Haramaya, Ethiopia
phone: +(251)-25-55 03 14 fax: +(251)-25-55 30 325 e-mail: keneefbk@gmail.com

Annex

Table A1. Correlation matrix for the continuous explanatory variables

Explanatory variables	AGE HHH	FAM SIZ	DEP RAT	OFF/NON FARMINC	CULT LAN	LIV OWN	OXEN OWN
AGEHHH	1						
FAMSIZ	.213(**)	1					
DEPRAT	-.153(*)	-.109	1				
OFF/NONFARMINC	.000	.063	-.073	1			
CULTLAN	.276(**)	.327(**)	-.112	-.043	1		
LIVOWN	.094	.238(**)	-.001	.076	.468(**)	1	
OXENOWN	-.017	.316(**)	.048	.089	.386(**)	.831(**)	1

** Significant at the 0.05 level (2-tailed). * Significant at the 0.1 level (2-tailed).

Source: Household Survey (2008)

Table A2. Correlation matrix for the discrete explanatory variables

Explanatory variables	SEX HHH	EDU HHH	PEST PROB	CHEM FERT	IMRV SEED	ACCES MRT	CREDRE CIVED	SWCPRA CTICE	LNDREN TOUT
SEXHHH	1.000								
EDUHHH	-.101	1.000							
PESTPROB	.016	-.074	1.000						
CHEMFERT	-.034	.266(**)	.051	1.000					
IMRVSEED	-.011	.026	.173(*)	.071	1.000				
ACCESMRT	-.031	.090	-.187(**)	-.008	.062	1.000			
CREDRECIVED	-.125	.089	-.007	.004	.054	.076	1.000		
SWCPRACTICE	-.117	.204(**)	.047	.298(**)	.029	.111	.051	1.000	
LNDRENTOUT	.048	.024	.125	.074	.021	-.094	.005	.011	1.000

** Significant at the 0.05 level (2-tailed). * Significant at the 0.1 level (2-tailed).

Source: Household Survey (2008)

Table A3. Multicolinearity diagnostics using Variance Inflation Factor

Continuous variables	Tolerance	VIF
Age of Household head in years	0.783	1.076
Family size in adult equivalent	0.632	2.378
Dependency ratio	0.110	2.912
Off farm and non farm income	0.411	1.301
Landholding of the household in hectare	0.991	2.300
Number of livestock in TLU	0.155	1.400
Number of oxen the household owned	1.046	5.297

Source: Household Survey (2008)