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Farmers' perceptions of land degradation and determinants of food security at Bilate Watershed, Southern Ethiopia

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ABSTRACT

Land degradation reduces the productivity of land which poses a serious threat on food security status of households. The present study was designed with objectives of examining farmers' perceptions of land degradation, assessing the food security status and identifying its determinants at middle catchment of Bilate watershed, in Southern Ethiopia. A two- stage random sampling technique was employed to select 130 sample households. Using Household Core Food Security Module (HCFSM), about 73% and 27% of the sample households were food insecure and secure, respectively. The extent of food insecurity ranges from moderate (45% of the cases) to very severe (18% of the cases). Econometric results indicate that variables such as gender, family size, education, adoption of soil conservation techniques, livestock ownership, farm income and land degradation perception index were found to be significant factors influencing household food security status. The findings suggested that policy makers and development practitioners must give due attention and high priority in improving farmers' perception level that enables them to maintain land productivity through conserving both their farm and communal land that can have significant contribution in improving food security status of households.

Keywords: farmers' perception, food security, land degradation

INTRODUCTION

Agriculture is the predominant and an important economic sector in Ethiopia. Despite its importance, food insecurity prevailing in the country is one of the crucial issues challenging the sector. Land degradation coupled with erratic rainfall, drought and poverty problems pose a serious threat on households' food security in Ethiopia. *Bilate* watershed, that transects the central zones of the southern region of Ethiopia, is among the most degraded low-land plains in Ethiopia. The watershed area is exposed to various physical and biological forms of land degradation. Besides, overgrazing, improper cultivation practices, mismanagement of land resource are the main causes for land degradation in the study area. Among the various forms of land degradation, soil erosion is the most serious problem, which results in soil nutrient depletion and loss of fertility of farm land. Soil erosion poses an ominous threat to the food security status of population and future development prospects of the country (Wagayehu, 2005). Different soil conservation activities have been undertaken throughout the country by government and

World Food Programme (WFP) under the food for work (FFW) schemes. Moreover, new land conservation technologies were also introduced in degraded and food deficit areas of Ethiopia through food-for-work in the early 1980s (Shiferaw and Holden, 1998). Nonetheless, soil erosion problem still persists and becomes the major cause for food insecurity. Loss of soil nutrient and its productive capacity due to soil erosion leads to low productivity of land, which in turn brings loss in crop yields and results in a vicious cycle of poverty and food insecurity (Alemneh *et al*., 1997).

Land degradation is a cause for low productivity of land resulting in declining crop yield and this in turn affects food security condition of people. Food security affects many dimensions of well-being (Tweeten, 1993). For instance, women with insufficient diet give birth to children with low birth weights and high mortality risk at birth. Mothers cannot breast feed their babies properly. Children do not get adequate food with balanced diet and this affects their development in all aspects. Adults without proper food intake are susceptible to disease and hence have low life expectancy. These all in turn affect the productivity of labour force in production process of the economy. In Ethiopia, food security is among the government priority areas of its economic policy to mitigate food insecurity problems and challenges. The national economic development policy of Ethiopia aimed at sustainable economic development through its strategy called 'Agricultural Development Led – Industrialization, (ADLI)' has given high emphasis to food security situation of the country. The food security strategy that was developed in 1996 and revised in 2002 was based on three important pillars: a) increasing the availability of food through agricultural production, b) improving access to food (entitlement) and c) strengthening capacity to response and/ or manage food crises (FDRE, 2002). As a pro-poor growth strategy, ADLI based on strong agriculture-industry linkage focused on improving the food security status of the country by equalizing the availability and entitlement of food both at national and household levels. In addition to this, currently large number of government and non-governmental organizations are working on food security issues. However, the vulnerability and prevalence of food insecurity still are the severe threats and challenges in Ethiopia. Studies that focus on the determinants of household food security status and perception of farmers to land degradation both in the study area and in the low land areas of the southern region are rare and far between. Thus this study was designed with the objectives of identifying the proportion of households by food security status, the major factors contributing to household food insecurity and examines households' perception of land degradation. The study employed both parametric and non-parametric methods to analyze the data.

METHODOLOGY

Description of the study area

Bilate watershed is located in southeastern part of Ethiopia. It transects Hadiya, Kembata Tembaro, Wolaita and Sidama zones and Alaba district. It is located at about 88 km southwest of Awassa and 315 km south of Addis Ababa. Climatically, large proportions of the two districts are categorized under *Woina-Dega* agro-ecology zone with an estimated total annual rainfall of 850 to 1085 mm. Its elevation ranges from 1700 to 2000 m asl (BoPED, 2004). The annual mean temperatures vary from 8.2 °c to 28.1 °c for Alaba. Both woredas are characterized by bimodal rainfall, that is, *belg and Meher* and one dry season, that is, *bega*. Alaba is known as a moisture stress area in the region, which experiences continuous and frequent drought.

Data collection and sampling procedure

Detailed information on household demographic characteristics, land characteristics and management, institutional factors, food security status and vulnerability and coping strategies were collected by interviewing sample household heads. Before the formal survey, informal survey was conducted to collect general information about the study area and farming system. Moreover, personal observations were done through transect walk. A two-stage random sampling technique was employed to draw sample households. In the first stage, out of the total fifteen kebeles bordering *Bilate* watershed five kebeles were selected randomly. At second stage, a total of 130 sample household heads were selected using probability proportional to size sampling technique.

Methods of data analysis

Binary choice models such as linear probability (LPM), logit and probit are the most widely used models in empirical studies (Gujarati, 2003). Although logit and probit yield similar parameter estimates, a cumulative logistic regression model is preferred because of its comparative mathematical simplicity (Gujarati, 1998; Greene, 2000). Thus for this study binomial logit model was selected for the analysis of determinants of food security. A dichotomous dependent variable household food security status was taken as dependent variable and was represented in the model by dummy variable taking the value of 1 if a household is food secure and 0 otherwise. To set the cut-off point into food secure and insecure groups, categorization of a household into the two groups was made based on the Household Core Food Security Module (HCFSM). A set of 18 questions for households with children and 10 questions for no children were employed to calculate the household food security scale and then to estimate the prevalence of food insecurity whether a household is food insecure without hunger or with hunger (Opsomer *et al*., 2002; NAC, 2005; Wunderlich and Norwood, 2006).

On the other hand, household's food or calorie acquisition per adult equivalent (AE) per day is also used to identify the food secure and insecure groups. Those households who have energy per AE beyond the minimum subsistence requirement 2100 Kcal per capita are deemed to be food secure, otherwise food insecure. This type of food security measurement is typically based on food balance sheets, national income distribution and consumer expenditure data (Maxwell, 1996). This estimation method need a daily and continuous data record on food balance sheets for each sample household food intake and need long time and huge financial requirement. Therefore, in this study this approach was not employed to set a breakeven point. The independent variables are; age, sex, family size, education, size of cultivated land, adoption of soil conservation, farm inputs, off-farm income, livestock ownership, perception index (Farmers' perception index of land degradation is computed as, $PI_T = \sum_{N=1}^{130} \frac{PI_Y}{N}$, where PI_Y perception) and farm income.

The cumulative logistic probability function is specified econometrically as:

$$P_i = F(Z_i) = F\left[\alpha + \sum_{i=1}^{n} \beta_i X_i\right] = \left[\frac{1}{1 + e^{-\left(\alpha + \sum \beta_i X_i\right)}}\right] = \text{----------} \quad (1)$$

Where, P_i represents that the probability that i^{th} farmer is being food secure given X_i

X_i represents the i^{th} farmer explanatory variables, i = 1, 2, 3. . , n

Z_i a linear function of n explanatory variables (X_i),

e represents the base of natural logarithms (2.718)

α and β_i are regression parameters to be estimated in the model, where α is the intercept and β_1, β_2, ... β_n are slope coefficient of the equation.

The model can also be written in terms of the log of the odds ratio (the probability that the farmer is food secured (P_i)) to the probability that he/she is food insecure ($1-P_i$) (Gujrati, 1998). The probability that he/she is food insecure ($1-P_i$) is defined by:

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

Using equation (1) and (2), the odds ratio becomes $\left(\frac{P_i}{1-P_i}\right) = \left[\frac{1+e^{z_i}}{1+e^{-z_i}}\right] = e^{Z_i}$ ----(3)

Alternatively,

$$\left(\frac{P_i}{1-P_i}\right) = \left[\frac{1+e^{z_i}}{1+e^{-z_i}}\right] = e^{(\alpha+\sum\beta_i X_i)} \text{------ (4)}$$

Taking the natural logarithms of odds ratio of equation (4) it results as, $Z_i = \ln\left[\frac{P_i}{1-P_i}\right]$

$= \ln e^{\left[\alpha+\sum_{i=i}^{n}\beta_i\chi_i\right]} = \alpha + \beta_1X_1 + \beta_2X_2 + - - - + \beta_nX_n$ ---------- (5)

If the disturbance term (U_i) is introduced to the model, the logit model becomes:

$$Z_{i=}\alpha+\beta_1X_1+\beta_2X_2+---+\beta_nX_n+U_i$$

Or $Zi = \alpha + \sum_{i=1}^{n}\beta_iX_i + U_i$ ---------- (6)

The parameters of the model are estimated using the iterative maximum likelihood estimation (MLE) procedure. The hypothesized explanatory variables were checked for the existence of multicollinearity. The variance inflation factor (VIF) analysis and condition index (CI) were chosen to handle the collinearity problem among and/or between continuous variables. Likewise, multicollinearity problem among dummy variables was checked using contingency coefficient calculated from chi-square. VIF shows how the variance of an estimator is inflated by the presence of multicollinearity (Gujrati, 2003).

Variables definitions and the hypotheses

In this study, a dichotomous household food security status was taken as dependent variable and was represented in the model by dummy variable:

Y=0 if the household is food insecure (households that affirmed three or more items, includes food insecure without hunger and with hunger) and

Y=1 If the household is food secure (households that denied all items or affirmed one or two items out of 18 items for a household with children and 10 items without children).

Based on economic theories, empirical works and type of qualitative data collected during the survey, eleven explanatory variables, which are expected to have significant impacts in determining the food security status of household in the area were selected and hypothesized.

Age: It measures age of the household head in years. Rural households are mostly devoting their time on their farming activities. As age of households' increases, they can acquire more knowledge and experience and pre - assume vulnerability and risk conditions of food insecurity and the chance of a household to become more food secure increases. Thus, age of household head is hypothesized to affect food security status positively. This hypothesis is supported by findings of Abebaw (2003) that age has positive relation with food security status of households.

Sex: it is represented in the model by dummy, that is, 1 if the household head is male and 0 if female. The sex of household was considered to affect food security differently. Male headed households have more access to agricultural technologies; have more labour power and high asset like farmland, livestock and other assets as

compared to female-headed households. Thus, male-headed households are hypothesized to be more food secure than female headed.

Family size: it refers to the total number of household members who lived and ate with household head for at least six months and more. It could have both positive and negative impacts on food security status of households. A family size with more inactive productive labour force shows a high dependency ratio and the vice versa holds true. High family size with large number of inactive labour force affects negatively the availability and accessibility of enough food on time for active and healthy life. This hypothesis is supported with findings of Abebaw (2003); Yilma *et al.* (2010) stated as a large family size results in increase of food demand ultimately ends up with food insecurity.

Education: is the level of grades or schooling years attained by the household heads. It is an important determinant of household food security in that, educated households have a better chance of adopting soil conservation measures (Million and Belay, 2004) which in turn increases crop production. Moreover, educated households are very sensitive to management of renewable and non-renewable resources in view of averting risk condition of food insecurity. Thus, education was hypothesized to have a positive impact on household food security.

Size of cultivated land: it refers to the cultivated farmland in hectare (owned, shared and rented) allocated for annual and perennial crops, vegetable and for homestead farming activities. A larger size of cultivated land implies more production and availability of food grains. Hence, size of cultivated land was expected to have positive impact on household food security status. Some empirical studies revealed that size of cultivated land is important physical variable that affects food security status of households positively (Mulugeta, 2002; Abebaw, 2003).

Adoption of soil conservation practices: it was represented as dummy in the model, that is, 1 if the household head adopt and practicing improved type of conservation methods and 0 if the household didn't apply or practice any soil conservation measures. Adoption of soil conservation practices increase attitude of farmers towards soil conservation measures (Shiferaw and Holden, 1998). Thus adopting and practicing any soil conservation techniques will mitigate land degradation that in turn increase crop production and was hypothesized to have positive impacts on food security status of households.

Use of farm inputs: it refers to use of chemical fertilizer and high yield variety. The amount of farm input used was converted to monetary value based on market price. A household who could have used farm inputs was hypothesized to have positive relation with food security. This hypothesis was supported with findings of Ahmed and Bezabih (2009). They stated that the use of farm input is important to boost domestic food production which should play positive role in food security.

Off-farm income: it is annual off -farm and/or non -farm income in Birr (Ethiopian national currency, during the survey time it has an official exchange rate of 1 US $= 9.40 Birr) that a household heads or his family members earn from off- farm activities. It provides cash to buy food grains and non-food items required for household members. Thus it was hypothesized that off-farm income is positively associated with household food security which this hypothesis is supported with findings of Yilma *et al.* (2010).

Livestock owned: this variable is a continuous variable defined as the total livestock (cattle, equines, sheep, goat, and chicken) owned by a household heads measured in Tropical Livestock Unit (TLU). Livestock is an indicator of wealth, source of

income to purchase food and non food items, sources of draft power which in turn increases crop production, as coping mechanisms for food insecurity and for source of food. Thus, livestock owned is hypothesized to have a positive relation with food security that the hypothesis is supported by the findings of Abebaw (2003).

Perception index: this variable is a continuous variable that measures farmers' perception of land degradation problems calculated by the weighted perception index of soil erosion, reduced soil fertility, importance of soil conservation measures and institutional support in mitigating land degradation. Positive attitude towards soil conservation measures indicates the level of farmers' perception towards land degradation problems. Therefore, it was hypothesized that farmers who perceive land degradation problems are more likely to be food secure.

Farm income: is the total annual income earned from crop and livestock sale. Income is very crucial for purchase of agricultural inputs, food and non-food items, hiring of labour, and generally utilized for basic necessities of human beings. In economic theory since income and expenditure are proxy indicators of wealth, the impact of food expenditure on food security status of the area was assumed to be reflected in farm income. Therefore, farm income was hypothesized to have positive and direct relation with household food security status of the area and this hypothesis was supported by findings of Mulugeta (2002).

RESULTS AND DISCUSSION

Descriptive analysis

The statistical analysis revealed that there is no significance difference in the mean age of sample households between food secure and insecure groups. However, the mean age shows that as age of household increases the possibility of a household being food secure increases. This is due to the fact that, as age of household increases their experience of risk averting capability increases. The overall mean family size of sample households was 6.99 persons (with most common family size of 5 to 8 members) which is above the national average family size of 4.9 persons per household (CSA, 2007). Thus a household whose composition is more inactive labour force was more likely to be food insecure and this agrees with prior expectation. Education is a very important determining factor in food security. An educated farmer is able to use agricultural technologies and manage resources properly all aimed at boosting production. The overall mean of education was 2.22 grades with mean difference of 2.32 grades between the two groups and found to be statically significant at 1 percent significance level (Table 1). The mean cultivated land for food insecure and secure sample households was found to be 1.44 and 1.83 ha. The overall mean of cultivated land of sample household for food insecure and secure group was 1.54 ha and the difference is found to be statistically significant. This implied as the size of cultivated land increases, the probability of a household to be food secure increases. The amount of farm inputs used for food insecure and secure households was found to be 220 and 392 Birr, respectively. The overall mean of farm input used was 266 Birr. The t- test revealed that the mean difference between the two groups was significant at 1% level. Use of farm inputs such as chemical fertilizer and high yield variety has positive effects on food security.

Off-farm income source includes petty trade, selling firewood, labour market. The off-farm income earned is central to food and non-food item consumption and thus it is an alternative to improve the level of food security. As off -farm income earned by a household increases, the household to become food secure increases. The survey result revealed that the mean off–farm income for food insecure and secure household heads was 201 and 627 Birr

respectively. The overall mean of off-farm income was Birr 316 and was statistically significant at 1% level. The average livestock holding for food insecure and secure groups of sample households in TLU was found to be 3.45 and 6.42 respectively. The total average livestock holdings for sample households were 4.25 with mean difference of 2.97 TLU, which shows statistically significant at 1% significance level. The statistical result revealed that a household who owns more livestock is more likely to be food secure as compared to households who owns less (Table 1). The mean perception index for food insecure and secure groups was found to be 2.17 and 2.66 respectively. The total sample means was 2.30 that the mean difference was statistically significant at 1% significance level. This result was in agreement with expectation that a higher perception index of farmers to land degradation has positive impact on food security status. Farm income is obtained from crop and livestock production. The mean farm income for food secure and insecure sample household heads was Birr 4137 and 2043 respectively. The overall mean of farm income for both groups was Birr 2607. The mean difference between the two groups shows statistically significant at 1% significance level (t= -8.041) and was similar to the prior expectation.

With respect to sex of household heads male headed are more food secure than female headed ones which is in line with prior hypothesis. This is because of the fact that male headed households have more access to use agricultural technologies, more farm resources and better labour power than female-headed. The chi -square value revealed there is asymptotic symmetric relation between household sex and food security status. Adopting soil conservation technologies result in a higher crop yield and income and this has direct contribution to food security. The survey result revealed that, farmers adopting and practicing soil conservation measures are more likely to be more food secure as compare to those who do not practice. From the total food secure household farmers, 97.1 percent were found to be users of soil conservation practices. The chi-square test shows significant difference between households adopting soil conservation measures to the non-adopters of the practices (Table 2).

Farmers' perception of land degradation

Forms and causes of land degradation

Land degradation is a severe problem that resulted in natural capital asset depletion, drought, environmental and ecological imbalance. Soil erosion, nutrient depletion and soil structural change are the main forms of land degradation observed in the study area. As reported by farmers, soil erosion was the main forms of land degradation followed by nutrient depletion and soil structural change manifested through gully formation. Cultivation of steep slopes, over cultivation, removing of crop residue, excessive rainfall, absence or weak soil conservation practice, deforestation and overgrazing are the major causes of soil degradation (Table 3).

Farmers' perception of land degradation

Land degradation reduces the capability of land to produce and cannot give what it is acquired by human. It lowers productivity of land by depleting its resources through various agents. A higher number of farmers were aware of land degradation particularly soil erosion, soil nutrient depletion and development of gullies and rills on their farm fields. During the field visit, it was observed that most farmers didn't practice technically sound soil conservation activities. About 85 and 84 percent of sample household heads perceived the presence of land degradation and soil erosion in their farm fields, respectively. From the case taken, only 37.7% and 60.8% of sample household farmers were practicing improved and traditional type of soil conservation measures, respectively.

Table 1. Summary statistics of continuous variables and their mean difference test

Variable name	Unit	Insecure (95)		Secure (35)		MD	t- test
		Mean	SD	Mean	SD		
Age	Years	38.51	12.59	39.11	12.57	-0.6	-0.245
Family size	persons	7.31	2.94	6.87	3.16	0.44	1.392
Education	Grade	1.59	2.42	3.91	3.47	-2.32	-3.652***
Cultivated land owned	Ha	1.44	0.64	1.83	0.77	-0.39	-2.729***
Farm inputs	Birr	219.9	193.94	392	207.48	-172	-4.268***
Off-farm income	Birr	201	248	627	978	-426	-3.934***
Livestock owned	TLU	3.45	2.42	6.42	2.88	-2.97	-5.434***
Perception index	No.	2.17	0.54	2.66	0.39	-0.49	-5.775***
Farm income	Birr	2043	1090	4137	1390	-2094	-8.041***

*** Indicates significant at 1% level, Source: Own computation, 2007.

Table 2. Summary statistics of discrete variables

Variable name	Variable type	Score	Insecure (95)		Secure (35)		χ^2-value
			Number	Percent	Number	Percent	
Sex	dummy	1	74	56.9	34	26.2	6.74***
		0	21	16.2	1	0.8	
Soil conservation	dummy	1	57	43.8	34	26.2	16.803***
		0	38	29.2	1	0.8	

Table 3. Major causes of soil degradation

Main causes of soil erosion	Number of responses (n=130)	
	Number of response	Percentage
Cultivation of steep slopes	115	88.5
Excessive rainfall	110	84.6
Weak soil conservation practice	105	80.8
Deforestation	93	71.5
Over grazing	84	64.6
Over cultivation	73	56.2
Population pressure	41	31.5
Removing of crop residue	7	5.4

Source: Own computation, 2007

Table 4. Perception level of land degradation

Perception level	Percent of respondents (n=130)			
	Soil erosion problem	Decline soil fertility	Soil conservation activities	Institutional support
Nil	16	12	10	4
Low	13	6	10	7
Moderate	38	36	38	38
Strong	33	46	42	51

Source: Own computation, 2007

Perception index of land degradation is computed as the ratio of summation of perception index for each factor associated to land degradation to the total sample size. The result of analysis of perception index revealed that the indices lie between 1.00 and 3.00. Farmers' perception of land degradation is crucially affected by social, economical, environmental and political factors. Factors such as land size, method of land preparation, land tenure arrangement, distance between farm plot and home, education and wealth status of farmers aggravate soil fertility depletion and this in turn affects food security status of households (Genene *et al*., 2009). Land size is closely associated with soil fertility and soil erosion perception of farmers. Farmers with bigger farm size perceive soil erosion better than the smaller ones (Genene *et al*., 2009). They also used to practice traditional fallowing and allot enough plot of grazing land for their livestock. Similar study conducted in Ghana, concluded that large farm holders are better than the smaller ones to maintain traditional fallowing practices. They allocate large portion of their land for non-food uses such as grazing, wood lot and other land use practices that help to mitigate or control soil erosion and fertility depletion (SADAOC, 2002). Method of land preparation was also observed to affect perception level of farmers. Higher soil erosion is observed on fields where improper farming practices are common. Ploughing of steep slope, burning of crop residue, destruction of bush and vegetation cover, land preparation using animal power on steep and mountainous land are the dominant practices that affect framers' perception in the study area.

Education and wealth are important socio economic factors influencing farmers' perception of land degradation. Educated farmers are always in a position to adopt and make use of soil conservation technologies so as to mitigate soil erosion and nutrient depletion. Moreover, the adoptions of soil conservation technologies are strongly associated with a wealth status of farmers. Hence it can be concluded that educated and wealthy farmers have a strong perception of land degradation. The distance between farm fields and home is another determining factor of perception of land degradation. Farm plots around homestead have always supplemented with farm yard manure and better in soil fertility status than fields away from homestead. Likewise, farmers practiced mixed cropping system in their homestead and some water harvesting techniques. This in turn increases vegetation cover which directly helps in preventing soil erosion and nutrient depletion. Land tenure arrangement is a very important factor that influences farmer's decision to invest on their farmland. Land tenure is defined as farmers' full access to land resources. In Ethiopia, land is owned by government and farmers have rights and they can also rent out their land. Several empirical studies reported that rental land is more likely to be degraded (Alemneh *et al*., 1997; Gete, 2000; SADAOC, 2002) than titled land (land held under secure land rights).

Household food security measurement

Food insecurity exits when people do not have adequate physical, social or economic access to sufficient, safe and nutritious food for their active and healthy life. The possible consequence of food insecurity is hunger Maxwell (1996) expressed at individual level. Based on CFSM, the sample households were categorized into food secure, food insecure without hunger and food insecure with hunger. Based on this classification 27, 10 and 63 percent of sample households were classified as food secure, food insecure without hunger and food insecure with hunger respectively (Table 5).

Food secure: households' members' faced no or minimal evidence of food insecurity. Those household experienced capability that the food grain the household produced would not run out before the next harvest or have money to buy food was grouped under

food secure. *Food insecure without hunger:* is observed in a household when there is insufficiency in a balanced diet food group. The balanced diet includes carbohydrates, vitamins, minerals and certain amount of protein and fat food items. Households who could not afford balanced meals for both adults and children and also relied on low cost food items were categorized under this. *Food insecure with hunger:* is manifested for household members who reduced quantity of food intake or who perceived sensation of hunger. In CFSM, households who responded affirmatively questions on reduced food intake, skipping meals, going a whole day without food and loss of weight were categorized as food insecure with hunger. Food insecure with hunger can further be classified as food insecure with moderate hunger and sever hunger. Food insecure with moderate hunger is related to adults within a household that whether the individual has lost weight due to reduced intake of food. Likewise, food insecure with severe hunger is food insecurity on children such as skip or reduces meal; lose weight and overall painful sensation.

Table 5. Categorization of households by their food security status

Food security status	Households with children		Household without children		Total households	
	Number	%	Number	%	Number	%
Food secure	32	25	3	2	35	27
Food insecure	88	68	7	5	95	73
Food insecure without hunger	9	7	4	3	13	10
Food insecure with hunger	79	61	3	2	82	63
Food insecure with moderate hunger					59	45.4
Food insecure with severe hunger					23	17.7
Total	120	92	10	8	130	100

Source: Own computation, 2007

Table 6. The maximum likelihood estimates of the binary logit model

Variable name	Estimated coefficient (B)	Odds ratio Exp(B)	Significance level	Standard error (SE)	Wald statistics
Constant	-8.045	0.000	0.003***	2.686	8.975
Age	0.005	1.005	0.899	0.036	0.016
Sex (1)	5.198	0.006	0.021**	2.257	5.305
Family size	-0.407	0.666	0.014**	0.166	5.993
Education	0.247	1.281	0.099*	0.150	2.729
Cultivated land owned	0.047	1.048	0.935	0.580	0.007
Soil conservation (1)	-4.358	0.013	0.004***	1.512	8.305
Farm inputs	0.000	1.000	0.940	0.002	0.006
Off-farm income	0.000	1.000	0.776	0.001	0.081
Livestock owned	0.326	1.385	0.094*	0.194	2.810
Perception index	1.623	5.069	0.068*	0.890	3.327
Farm income	0.001	1.001	0.002***	0.000	9.419

Pearson chi-square = 93.025*** ; -2 log likelihood = 58.423; Prediction success (count R^2) = 91.5[a]; Sensitivity = 77.1[b]; Specificity = 96.8[c]; Sample size = 130; ***, **, * Indicate significance at 1%, 5% and 10% level respectively; a -- Based on a 50% probability classification schemes; b-- Correctly predicted food-secure households based on a 50% probability classification; c -- Correctly predicted food-insecure households based on a 50% probability classification; Source: Model output, 2007

Econometric results

Based on the result of the multicollinearity diagnostics test for both continuous and dummy explanatory variables, no variable was found to be highly correlated or associated with one or more of other variables. After the multicollinearity test, the hypothesized eleven variables were entered to the model. Out of the variables analyzed the coefficients sex, family size, education, livestock owned, perception index and farm income have correct signs and were found to be significant to affect the food security status of the households. Adoption of soil and water conservation has negative sign but was statistically significant to affect food security status. On the other hand, the remaining four variables namely age, cultivated land, farm inputs and off-farm income were found to have correct signs but insignificant relationship with food security status of the household which was contrary to the prior expectation (Table 6). The maximum likelihood estimates of the binary logit model result shows that the household food security status is determined by the interaction of several socio-economic factors. To check measure of goodness of fit in logistic regression analysis, the likelihood ratio test (LR) that follows chi-square distribution with degree of freedom equal to number of explanatory variables included in the model shows that, the model was significant at 1% significance level. Another measure of goodness of fit was the count R^2 obtained by dividing the number of prediction to the total number of sample. The count R^2 was calculated to be 91.5 (92 out of 95 for food insecure and 27 out of 35 for food secure households) which indicate the model correctly predicts the observed values. The sensitivity and specifity was 77.1% and 96.8 % for food secure and insecure households respectively indicating the model predicts both groups fairly and accurately.

Sex: sex of household head was significant at 5% level and positively related with food security status of the households. This implies that male headed households are more likely to be food secure than the female ones. This is due to the reason that they have better access to farmland, labour, agricultural technologies which all these increase crop yield and thus improve access to enough food. Moreover, male headed households are more risk averters and better user of farm planning, that increases the probability of them to become more food secure than female headed.

Family size: it was significant at 5% significance level and negatively related with food security status. This implies that, as family size increases by one person, the likely probability to become food secure decreases by a factor of 0.666. Increases in family size, whose members are more of inactive labour force increases the number of dependent family members and decrease the availability of enough food for a household. Thus family size with high number of inactive members bring high dependency ratio and this is related negatively with food security status of households. The finding of this research is supported with findings of Abebaw (2003) and Yilma (2009), both revealed that large family size has a negative impact on food security status.

Education: it has positive impacts on food security status and was significant at 10% level. Holding other regressors constant, a change in household head education level by one unit, say one grade, will increase the probability of being more food secure by the factor of 1.281. The possible justification for this finding was that educated farmers tend to use modern agricultural technologies, adopt soil conservation technologies, use agricultural extension services and diversify their source of income than the illiterates. These are important instruments in boosting production which makes farmers to be wealthier and reverse food security problems. This result agrees with findings of Paulos *et al.* (2004), stated that educated people recognize the risk associated with soil

erosion and spent more time and money on soil conservation.

Soil conservation: The model result is theoretically inconsistent and statistically shows a significant effect to food security status of households in the area. The negative sign of estimated coefficient shows a negative relation with food security status and the odds ratio in favor of being the probability of food secure, *ceteris paribus,* decreased with factor of 0.013 with household applying soil conservation measures. Theoretically, applying soil conservation measures mitigate soil erosion caused by water and this will increase the food security status of households. However, in the study area farmers often reject soil and water conservation practices due to the returns are low in short run and it also needs high maintenance cost. This finding was supported by findings of Shiferaw and Holden (1998) and Million and Belay (2004). They reported that, rate of adoption of soil and water conservation is low and even adopted conservations are either partially or totally removed.

Livestock owned: it had a significant and positive impact on the household food security status of the household. The positive sign of slope coefficient indicates that when livestock owned increase by one TLU, the probability of a household to become food secure, *ceteris paribus*, increase by a factor of 1.385. This is due to the fact that as farmers have large number of livestock, they become in a better position to be more food secure than farmers who own few. Livestock is important source of farm income and enables farmers to purchase food items during period of food shortage. Moreover, it serves as source of food which is important nutritional values that contributes to healthy life. It also serves as non-human labour, for example, draft power in land preparation that directly contributes to supply food grain for a household.

Farm income: as expected, total farm income shows a positive and significant effect on a household food security status at a 1% significance level. The positive sign of slope coefficient indicates that when farm income increases by one Birr, the probability of a household to become food secure, *ceteris paribus*, increase by the factor of 1.001. The possible explanation is that those household who have sufficient access to farm income from sale of crop, livestock and their products are more likely to be food secure than those who don't have enough access.

Perception index: perception index of land degradation is very important factor that indicates the level of perception of land degradation problems. As presented in table 6, as the household perception index of land degradation increases by one unit, the likely probability of farmers to be food secure increases by a factor of 5.069, *ceteris paribus*. This finding is similar to a study conducted in Ghana, by SADAOC (2002), stated that increased trend of land degradation and declining fertility of Ghanaian soils resulted from different levels of farmers' perception of land degradation contribute to food insecurity and poverty of the country.

CONCLUSIONS AND RECOMMENDATIONS

Food insecurity is the most crucial and persistent problem threatening millions of people in Ethiopia. Land degradation particularly soil erosion coupled with rapid population growth aggravates households food insecurity in the study area. This research was designed with the objectives of examining farmer's perception of land degradation and identifying determinants of food security in one of the most degraded low-land areas, SNNPR. To achieve the objectives, a total of 130 sample household heads were selected. Our findings indicate that about 27 and 73 percent of sample households were found to be food secure and food insecure respectively. Econometric results indicate that variables such as sex, family size, education, soil conservation adoption, livestock ownership, perception

index and farm income were found to have significant effect influencing households' food security. However, other variables such as age, size of cultivated land, farm inputs and off -farm income were found to have no significant effect. Households with large family size is more likely to be food insecure than a household with less family size. High family size exerts pressure on land resources that accelerated land degradation Therefore, it is very crucial to consider family planning in any development interventions. Likewise, education is central to adopt and use agricultural technologies, agricultural information and institutional services which this in turn improve households' food production and income. Thus due attention has to be given to train farmers by establishing and strengthening both formal and informal type of framers' education and farmers' training centers. Farm income shows positive and significant result in determining food security. The income obtained from agricultural activities is limited in volume due to the reason that, farmers have limited access to modern agricultural inputs, institutional support and irrigation schemes. This can be reversed through introduction and provision of agricultural technologies, credit, adequate and timely veterinary services, irrigation schemes, rural roads and marketing facilities. Therefore, due attention and policy consideration has to be given in area of research, extension, and rural infrastructural development that can improve farm income and competitiveness of the sector. In a similar fashion, the finding of this paper found that households with large livestock holdings are more likely to be food secure. However, their livestock is constrained by problems of inadequate and inefficient veterinary services, lack or shortage of feed and absence of improved breeds. Therefore it is imperative that the extension system in place has to give due attention to improve the livestock sector of the area.

Lastly, farmers' awareness about soil erosion, nutrient depletion, soil conservation measures in mitigating land degradation, institutional support that assist in investing and using soil conservation measures were found to be in a different level due to various factors. Socio-economic and policy related factors such as land size, method of land preparation, education and wealth status of farmers were very imperative factors for farmers' perception of land degradation. Therefore, any policy and program aimed at agricultural development has to give due attention and priority in training and mobilizing farmers that help in raising their perception and awareness level so as to manage and use the land resource farmers have in sustainable way.

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REFERENCES

Abebaw, S. 2003. Dimension and determinants of food insecurity among rural households in Dire Dawa Area, Eastern Ethiopia. MSc Thesis Presented to the School of Graduate Studies of Alemaya University: 112-118.

Ahemed, A and Bezabih, E. 2009. Determinants of Food Security in Ethiopia. pp.57-89. *In* Proc. of the 11th Annual Conference of the Agricultural Economics Society of Ethiopia: On exploring factors behind the agricultural development in Ethiopia: Favorable Conditions and Constraints. May 2009, Ethiopia, Addis Ababa.

Alemneh, D, Shishira, EK, Yanda, PZ and Johnsen, FH. 1997. Land degradation in Tanzania: Perception from the village. World Bank Technical Paper, No.370. Washington, D.C: 1-17.

BoPED, 1994. Gross regional production estimates. Southern Nation, Nationalities and Peoples' Region, Ethiopia, Awassa.

CSA (Central Statistical Agency) Federal Democratic Republic of Ethiopia, 2007. The 2007 Population and Housing Census of Ethiopia, Ethiopia, Addis Ababa: CSA.

Federal Democratic Republic of Ethiopia (FDRE), 2002. Food Security Strategy. Ethiopia, Addis Ababa.

Genene, T, Legesse, D and Wagayehu, B. 2009. Farmers' Perception of Land Degradation and its Consequences to Food Insecurity at Middle Catchment of Bilate Watershed, SNNPR. pp. 65-75. *In* Proc. of the National Conference: On Sustainable Land Management and Poverty Alleviation, December 2009, Ethiopia, Addis Ababa.

Gete, Z. 2000. Land Scape Dynamics and Soil Erosion Process Modeling in North-Western Ethiopian Highlands. *African Studies Series, A16*, Geographica Bernengia, Switzerland, Berne.

Greene,WH. 2000. Econometric Analysis, 4th ed. Prentice Hall International, Inc.,USA.

Gujarati, DN. 1998. Essential of Econometrics, 2nd ed. The McGraw-Hill, Inc., Singapore.

Gujarati, DN. 2003. Basic Econometrics, 4th ed. The McGraw-Hill, Inc., New York.

Maxwell, S. 1996. Food Security: A post-modern perspective. *Food policy* **21(2):** 155-170.

Million, T and Belay, K. 2004. Adoption of Soil Conservation Measures in Southern Ethiopia: The Case of Gununo Area. *Journal of Agriculture and Rural Development in the Tropics and Subtropics* **105(1):** 49-62.

Mulugeta, T. 2002. Determinants of household food security in Eastern Oromia, Ethiopia: the case of Boke district of Western Hararghe zone. MSc Thesis Presented to the School of Graduate Studies of Alemaya University: 118-119.

NAS (National Academy of Sciences), 2005. Measuring Food Insecurity and Hunger: Phase 1 Report, Washington, D.C. http://www.nap.edu/catalog : 1-48.

Opsomer, J.D, Jensen, H.H and Pan, S. 2002. An evaluation of the USDA food security measure with generalized linear mixed models. Working Paper 02-WP 310: www.card.iastate.edu: 1-20.

Paulos, A, Belay, K and Desta, H. 2004. Determinants of farmers' willingness to pay for soil conservation practices in the southern highlands of Ethiopia. *Land degradation and development* **15**: 433-435.

SADAOC, (2002). Soil degradation and farmers' perception of soil fertility in Ghana. www.sadaoc.bf: 4-17.

Shiferaw, B and Holden, ST. 1998. Resource degradation and adoption of land conservation technologies in the Ethiopian Highlands: A case study in Andit Tid, North Shewa. *The Journal of the International Association of Agricultural Economics* **18(3):** 233-247.

Tweeten, LG.1993. Food Security. pp. 225-226. *In* Tweeten, LG and Donald G McClelland (eds.) Promoting Third-World Development and Food Security, Praeger Publishers, USA.

Wagayehu, B. 2005. Stochastic dominance analysis of soil and water conservation in subsistence crop production in the Eastern Ethiopian highlands: The case of the Hunde-Lafto area. *Environmental and Resource Economics* **32**: 533-550.

Wunderlich, GS and Norwood, JL. 2006. Food Security and Hunger in the United States: An Assessment of the Measure. Washington, D.C. http://www.nap.edu/catalog/11578.

Yilma, M, Ayalneh, B and Workneh, N. 2010. Rural Household Food Security Status and Agricultural Practices in Assosa District. pp.43-64. *In* Proc. of the 12th Annual Conference of the Agricultural Economics Society of Ethiopia: On Current Status of Agricultural Performance and Productivity Enhancing Mechanisms. September 2010, Ethiopia, Addis Ababa.