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Determinants of rural household food insecurity in Laelay Maichew Woreda Tigray, Ethiopia

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The study was conducted in Tigray, Laelay Maichew *woreda*. Different concepts and empirical findings are profoundly organized and presented. Both quantitative and qualitative methods were used. The primary data was collected using survey questionnaires, key informant interview, focus group discussion and observation. One hundred fifty households were randomly selected for the survey type while secondary data were collected from published and unpublished materials. Data was analyzed using descriptive statistics and multiple linear regressions. To undertake regression analysis, linearity, normality and homoscedasticity tests were employed. For the multiple regression analysis, total calorie availability/adult equivalent/day was taken as dependent variable and 16 explanatory variables were taken. Off these variables only five variables are found to be significant at 95% confidence level and the selected explanatory variables explains 39.9% of the variation in calorie availability. In general, age of household head, use of improved seeds, number of TLU/household, number of adult equivalent/household and land size in hectare were found to be significant at 95% (α=0.05) confidence level. The government should exhaustively work on promoting irrigation, providing credit and subsidize the farmers to solve the problem of food insecurity.

Key words: Food security, household, Linear regression, Food insecurity, Laelay Maichew, Tigray.

INTRODUCTION

Everybody has the indispensable human right to access food in order to grow his/her physical and mental faculties fully (UN 1974). This is from the angle of international covenant on economic, social and cultural right but the real situation of the globe is unlike. According to the current report of State of Food Insecurity in the world (2012) reported about 870 million people are undernourished off these large percent is found in third world countries. Food insecurity is devastating in rural areas where their livelihood depends on backward farming system, safety net program and food aid with limited access to productive assets to fulfill their requirements (PIF, 2010). Different studies conducted in this area indicated that food insecurity is a result of multidimensional factors. For example, FAO (2009) changes in world food and climate system are the most

inducing factors to food insecurity. Others also suggest that food insecurity is an aggregate of environmental tribulations, crude population growth, governance issue, poorly conceived policies, unstable food prices, natural calamities, instability of institutions, prevalence of diseases, and other socio-economic factors which deteriorate household food security situation coupled with weak household capacity (Hart, 2009; Tsegay, 2012).

Ethiopia is one among the developing countries with shocking food security where daily calorie intake is below 2,100 kcal/person/day and realizing food security becomes challenging due to its long standing conventional farming system (Mwaniki, 2005; FAO, 2010). General speaking, food insecurity in Ethiopia is a result of multiple and integrated factors.

Tigray is among the national regional state of Ethiopia which is grouped under food insecure regional states with high levels of vulnerability caused by repeated shocks allied with diminished entitlements, low natural resource endowments and limited access to infrastructure. Since the late 1970s, the fragility of household economies in the

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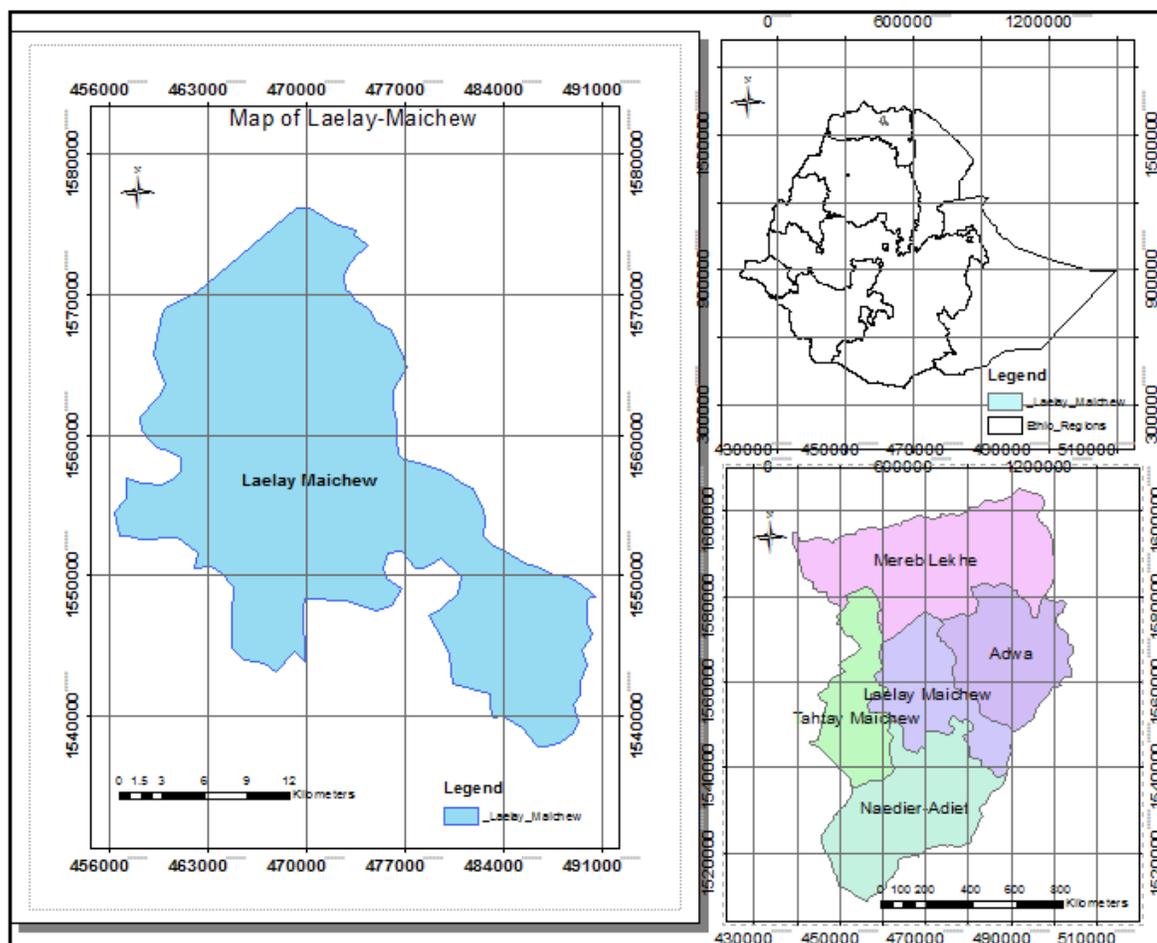
Figure 1. Map of the study area.

region has increased in the face of eroded coping strategies and limited opportunities for income and employment. Consequently malnutrition, health impairment and asset depletion has pushed households further down the poverty ladder and placing them at risk of famine (Sgro and Naerstad, 2009).

Although, many empirical studies (example, Elias, 2006; Firehiwot, 2007; Ejiga, 2006; Degefa, 2002; Misgna, 2010; Tsegay, 2012) have been carried out on the determinants of food insecurity, most of the studies are on the socio-economic factors which failed to show broad picture of the problem understudy. More over scanty studies had done in the study area. So the study fills these gaps with the aim of identifying the socio economic factors, environmental factors and to identify the coping strategies they experience.

MATERIALS AND METHODS

Study area

The study was conducted in Aksum National Regional State of Tigray 1024 km north of Addis Ababa. It is a home to rugged and gentle slope arable lands with an elevation of 1200-2050 meters above sea level and average annual rainfall and temperature of between 550 - 750 mm and 20-27c° respectively. Livelihood of the *woreda* is dominated by subsistence agriculture and petty trading, daily laborer, mining and other sources of income. According to *Woreda* Bureau of Agriculture (WBoA, 2009) average size of cultivated land own by household with five family sizes is about 0.75 ha. Teff, barely, wheat, horse bean, sorghum, finger millet and Chicken pea are the major crops grown in this area.

Research techniques and sampling method

It is debatable whether to use pure qualitative or quantitative or a combination of the two. According to Degefa (2005:1) 'a combination of qualitative and quantitative household data in a single research project allows a comprehensive and holistic understanding of food security situations'. For this study a combination of qualitative and quantitative methodological approach is

Table 1. dependent and independent variables .

Dependent variable	Independent variables
Calorie availability/adult equivalent/ day in kcal	X_1: Sex of household head (1: female, 0: male)
	X_2: Age of household head
	X_3: Family size
	X_4: Educational level of household head in years
	X_5: Off farm work (1: yes, 0: no)
	X_6: Number of non-working days/month
	X_7: Access to PSNP (1: yes, 1: no)
	X_8: Access to irrigation(1: yes, 1: no)
	X_9: Use of commercial fertilizer(1: yes, 0: no)
	X_{10}: Use of improved seeds(1: yes, 0: no)
	X_{11}: Market distance in km
	X_{12}: Number of oxen/household
	X_{13}: Access to rural credit(1: yes, 0: no)
	X_{14}: Number of LTU/household
	X15: Number of AE/ household
	X_{16}: Land size/household

used to identify the determinants of household food insecurity and the response experienced to shortage of foods in the real life.

Both probability and non-probability sampling was used. The study area is selected purposively because of its seasonally or chronically food insecure, it has potential to irrigation, it has good potential for irrigation but still it is food insecure, relative convenience in infra structures to collect data on time and it has diverse agro-ecological zones. Moreover, I grew up there and have valuable information about the life experience of the community, topography of the woreda and can entertain the regional language which is imperative to communicate easily.

Primary and secondary data were gathered. Primary data were collected through household survey, focus group discussion, observation and key informant interview, whereas secondary data were gathered from books, journals, articles and proceeding.

Data analysis

Quantitative data were analyzed using descriptive and inferential statistics. Mean, percent and standard deviation were used in the descriptive statistics. To generalize findings of the representative sample households to the target population, inferential statistics particularly multiple linear regression were used. This is specified as;

$Y = a + b_1x_1 + b_2x_2 + \ldots\ldots b_{16}x_{16}$, where
Y= the dependent variable (calorie intake/adult equivalent/day)
a= the intercept
b= coefficient

x= explanatory variables
Moreover, Statistical Package for Social Science (SPSS 18 version) software was used and results were presented in tables and graphs. Qualitative data were analyzed by quoting, paraphrasing and photography.

RESULTS

Multiple regression analysis, tests and determinants of household food insecurity

Booming agricultural production is a priceless option to solve the problem of food availability in the study area. Calorie available/adult equivalent/day in kcal is taken as dependent variable and from (X_1-x_{16}) are taken as independent (explanatory) variables which assumed to be a paramount factor to encumber or enhance household food availability. The first point of view is availability of total calorie intake/adult equivalent/day is not affected by the following independent variables while the second orientation is the independent variables have impact on total calorie availability/adult equivalent/day.

For the above mentioned dependent and independent variables the overall significance of the independent variables are tested using ANOVA as below;
1. Null Hypothesis (H 0) X1 $= X_2 = \ldots.. X_{16}$ i.e.: There is no linear relationship between the independent variables and dependent variable.
2. Alternative Hypothesis (H1) $X_1 \neq X_2 \neq \ldots.. X_{16}$ i.e.: At least one independent variable influences dependent variable.
Table 2 below shows the overall significance of the regression model for the total calorie per adult equivalent
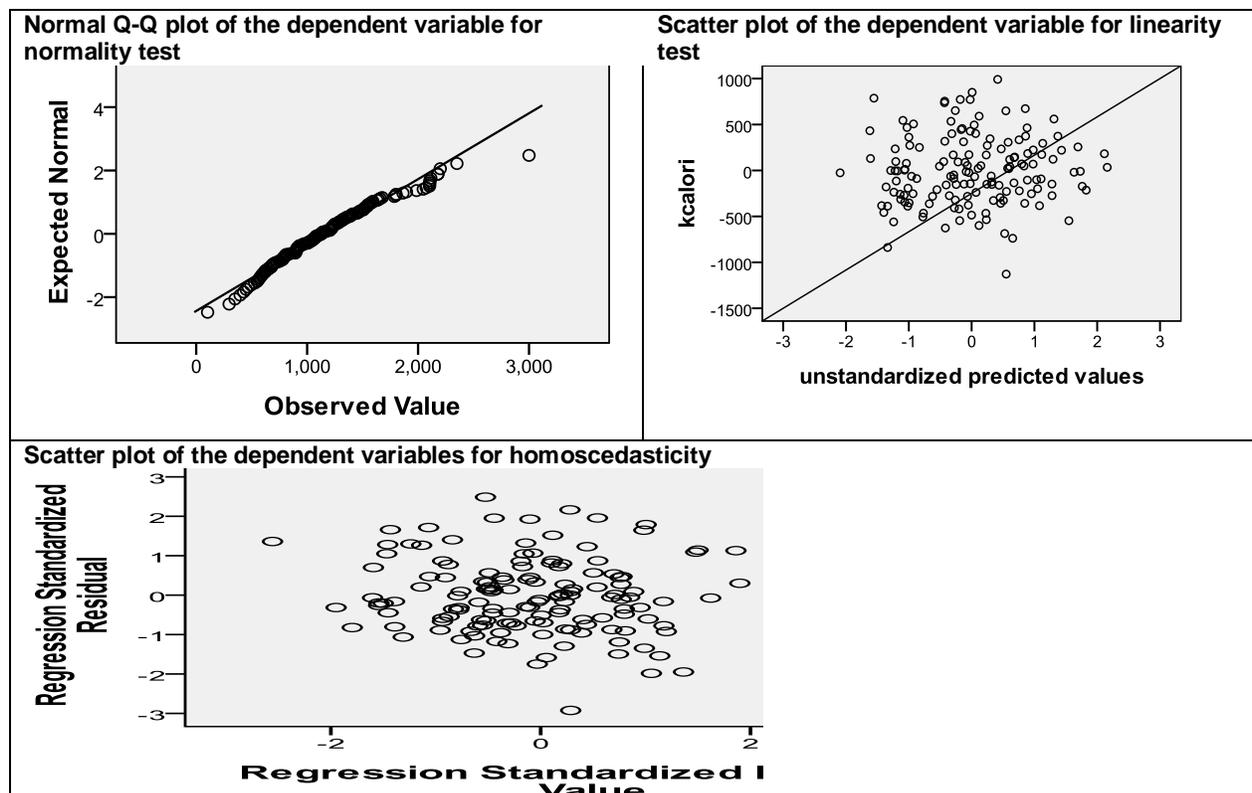
Figure 2. Plots of linearity, normality and homoscedasticity.

Table 2. Test of the Model ANOVA.

	Sum of squares	Mean square	F	sig
Regression	1.365E7	852969.459	5.446	0.000
Residual	2.060E7	156038.309		
Total	3.424E7			

per day variation was found to be statistically significant with F ratio = 5.446 and α =.000. This model indicates, at least there is one explanatory variable is different from zero and influences the dependent variable which is total calorie available per adult equivalent per day. So, the whole model is significant at 0.05 sig. level.

The Kolmogorov- smirnov and Shapiro-Wilk test as well as Q-Q plot was employed. Since the sample size of this study is more than 100, Kolmogorov-Smirov test was used for this study. Therefore, the data is normally distributed as p-value is >0.05(Table 3) and the Q-Q plot points also lies close to the regression line. The linearity test also implies there is linear relationship between the dependent variable and independent variables. Similarly, homoscedasticity test shows, the graph does not show any observable residual shape that bears V shape which

inclined towards left or right. So, this indicates that the variance of residuals is homogenous across the predicted value.

Similarly Table 4 also indicates, the explanatory variables selected for the model explained 39.9 percent (R=0.631 and R^2=0.399) of the variation in total calorie available/adult equivalent/day. But, the rest variation is from the insignificant explanatory variables and other unstudied variables. According to the analysis of the dependent variable and independent variables, the following variables are found to be significant at 95% (α=0.05) confidence level; age of household head (x_2), use of improved seeds (x_{10}), number of LTU/household (x_{14}), number of adult equivalent per households (x_{15}) and land size in hectare (x_{16}) are found to be affect total calorie available.

Table 3. Tests of normality.

Dependent variable	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig	statistics	df	sig
Calorie intake per adult equivalent per day	.068	150	.087	.967	150	.001

The general formula for the model linear regression is presented as follows;

$Y = e + b_1x_1 + b_1x_1 \ldots\ldots\ldots b_{16}x_{16} +$

From this analysis the reduced model of regression analysis for this study is found to be

$Y = e + b_2x_2 + b_{10}x_{10} + b_{14}x_{14} + b_{15}x_{15} + b_{16}x_{16}$

$Y = e - 20.498_{x2} - 227.153x_{10} + 61.542x_{14} - 211.607x_{15} + 797.457x_{16}$, this reduced regression model implies, total calorie availability decrease as the age of household head increases. Similarly, the dummy variable improved seed indicates that increasing the use of improved seeds diminishes the total calorie availability of households. An increase in total livestock unit of households increases total calorie availability of households, while increase in the number of adult equivalent of households decreases total calorie availability of households. The analysis for land size also shows, an increase in land size of households increases total calorie availability of households.

DISCUSSION

Among the sixteen explanatory variables, only five variables are found to be significant at 95% confidence level. The rest eleven explanatory variables are not significant, even if some of them are found to have positive and negative relationship with the total calorie availability of households.

Sex of household head: This variable has a strong positive and has not statistically significant relationship with total calorie availability of households. It is not surprising to observe inverse relationship between sex of household head and total calorie availability of households. This emanates from domestic and field work burden, low asset possession and low risk acceptance particularly in technology adoption, therefore, prevalence of food insecurity is severe in female headed households. This study has a similar finding with study of Rushad and Syed (2010), Kakota, Nyariki, mkwambisi and Makau (2013) who implied, female headed households are severely affected by food insecurity than male headed households.

Age of household head: This continuous variable has a negative and significant relationship with total calorie availability of households. As age of households head getting higher and higher food security status of the households deteriorate. In fact this is true, if household head gets older and older the opportunity of participating in other income generating activities will be reduced, because they cannot be competent enough with adults. Studies conducted in Ethiopia by van deer veen and Tagel (2011) in Tigray region and Messay (2009) in Oromia region found a similar result.

Family size Family size has also a negative and not significant relationship with total calorie availability of households. The composition of the family size is a determinant to household food security. If there are job opportunity and all family members are capable of doing it, they will have a crucial role to generate additional income and may reduce vulnerability to food insecurity. But, the study area is dominated by subsistence farming system and the land size is very small which is unmatched with the need of households, due to this case, family size undermines food security status of the households. Earlier researches conducted by Kakota, Nyariki, mkwambisi and Makau (2013) determinant of household vulnerability to food insecurity in Malawi (Haile, Alemu and Kudhlande, 2005) causes of household food insecurity in Oromia region have similar findings.

Education level of household head: This is not significant to total calorie availability but has a positive prelateship. Education opens a remarkable opportunity of working environment, creates awareness on the introduction of agricultural technologies and develops risk minimizing and accepting mechanisms. The research outputs of Messay (2011), Haile, Alemu and Kudhlande (2005), and van deer veen and Tagel (2011) substantiate this educated household heads have better food security status than not educated.

Off-farm work opportunity: There is a positive and not significant relationship with total calorie availability of households. Households participating in off-farm activities have better total calorie availability than those who do not participate. The findings of Nyariki et al. (2002), Misgna (2010) found a similar output.

Number of non-working days: This has a positive and not significant relationship with total calorie availability of households. Different literature indicates non-working days affect agricultural production. Nevertheless, the key informants and focus group discussants explained that they have enough time to collect their agricultural products as their farm plot is very small compared to their family size need, so, they harvest quickly and they do not have time poverty.

Table 4. Summary of the result of multiple linear regression analysis.

Explanatory variables	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
Sex of household head	-57.040	93.433	-0.054	-0.610	0.543	0.593	1.687
Age of household head	-20.498	5.856	-0.375	-3.500	0.001	0.396	2.525
Family size	-2.132	45.312	-0.009	-0.047	0.963	0.138	7.227
Education level of household head	4.197	12.612	0.026	0.333	0.740	0.721	1.387
Off-farm work opportunity	118.176	111.292	0.076	1.062	0.390	0.882	1.134
Number of non-working days per month	23.191	36.225	0.045	0.640	0.523	0.916	1.092
Access to PSNP	89.106	72.253	0.091	1.233	0.220	0.830	1.205
Use of irrigation	39.197	77.674	0.040	0.505	0.615	0.711	1.406
Use of fertilizer	68.335	149.000	0.032	0.459	0.647	0.928	1.077
Use of improved seeds	-227.153	73.547	-0.220	-3.089	0.002	0.897	1.115
Market distance in km	27.179	30.840	0.066	0.881	0.380	0.804	1.244
Number of oxen	-21.399	71.148	-0.045	-0.301	0.764	0.207	4.822
Access to rural credit	61.976	80.524	0.055	0.770	0.443	0.881	1.135
Number of TLU / household	61.542	29.211	0.276	2.107	0.037	0.259	3.857
Adult equivalent	-211.607	56.948	-0.707	-3.716	.000	0.126	7.945
Land size in hectare	797.457	141.882	0.661	5.621	.000	0.329	3.036
Constant	1963.819	347.876	--------	5.645	.000	------	-------
R	0.631						
R square	0.399						
Adjusted R Square	0.326						
Sta. error of estimate	397.017						

Access to PSNP: This also has a positive and not significant relationship with total calorie availability of households. In areas where shortage of food is common, PSNP is a means of averting food shortage. Households benefiting from PSNP have better food availability than non-beneficiary households, which matches with the findings of (Messay, 2011).

Use of irrigation: This has a positive and not significant relationship with total calorie availability. Currently, irrigation becomes on the public and governmental eye regardless of the developmental level could be traditional or modern irrigation. Irrigation users have better total calorie availability per households than not users. The use of irrigation reduces the likelihood of food insecurity. Since the study area is a one season grower during the kiremt season, different water harvesting structures are developed to produce variety of agricultural products in the extended non-growing seasons. This matches with the finding of Messay (2011), van deer veen and Tagel, (2011).

Use of fertilizer: This has a strong relationship with availability of food. The result shows, it has a positive and not significant relationship with total calorie intake of households. It is not uncommon to increase agricultural products using fertilizers, but the question is, does the doze per hectare they use is adequate? all the farmers introduce organic fertilizer to enrich fertility of the soil as the soil is exploited for many centuries. This result has a consistency with the findings of Feleke, Kilmer, and Gladwin (2005) and Messay (2011).

Use of improved seeds: The obsession of the government is escalating domestic agriculture using improved agricultural inputs. The result shows, improved seeds has a negative and significant relationship with total calorie availability of households. Van deer veen and Tagel (2011) found a positive and significant relationship between use of improved seeds and total availability of food. The key informants and focus group discussants explained the reason behind the negative relationship as follows;

The price of fertilizer is getting worst and worst from year to year and this limits to buy adequate amount of fertilizer to their plot based on the recommended per plot, because they can't afford the price. Since they don't have any resort, they simply distribute the fertilizer to all their plots. Nevertheless, usually improved seeds are tested under controlled environment with the application of recommended growth enhancer fertilizers per hectare and weeded at the appropriate time. But, households of the study area is failed to do so, that is why the use of improved seed has a negative relationship with total calorie availability of households.

Distance to market: This also has a positive and not significant relationship with total calorie availability of households however research outputs of others indicated the negative relationships. This assumption is associated with the accessibility of information and access of market to perishable agricultural products. They explain as households who are far away from the market are diminished food security status than those are quite close to the market. But the situation of the study area strictly opposes. Even if they are a part from their main administrative zone, they can get information through mass media. Moreover, nowadays farmer cooperatives are expanded in almost all administrative kebeles and this helps them to get adequate information on time and to supply their perishable and other products without going too far from their habitat.

Number of oxen: This also has a negative and not significant relationship with total calorie intake of households, but many research findings magnify the positive relationship and significant relationship. In areas where oxen driven farming system is used, number of oxen are determinant to household food security. This statement clashes with findings of Haile, Alemu and Kudhlande (2005) and Degefa (2005). Based on the personal observation, key informants and focus group discussans in the study area, there is a critical shortage of land whatever the number of oxen you have. You plow nothing except the land you possess so, large number of oxen increases extra costs to the households to buy feeds for the oxen. Therefore, increasing number of oxen undermines total calorie availability of households. This is supported by the key informants and focus group discussants, selling oxen and cow is not acceptable by the community at a normal condition except under critical shortage of food shortage.

Access to rural credit: This has a positive and not significant relationship with total calorie availability of households. Households who have access to credits from governmental or non-governmental have better food availability than who do not have credit access. Credit is crucial for farmers to increasing agricultural products through introducing agricultural technologies and diversifying livelihood strategies. As mentioned earlier there is critical shortage of farming land and as a result of this, the woreda is working towards expansion of micro and small enterprises to strength purchasing power. This relates positively with result of Messay (2009).

Number of TLU/ household: This has a positive and significant relationship with total calorie intake of households. Interestingly, this has a positive impact on the household food security and increase in the number of TLU increases household food security. At the times of crop failure, those who have large TLU will survive better than those who don't through buying grains from market and boost their total calorie availability. This also fits well with finding of Messay (2011) and Misgna (2010).

Adult equivalent/household: This has a negative and sign-ficant relationship with total calorie availability of households. Adult equivalent seems to be the only working body of households but it is a combination of different age groups. This fits with findings of Devereux, Sharp and Yared (2003), destitution in Wollo, Ethiopia.

Land size in hectare: This also has a positive and significant relationship with total calorie available of households. Since the study area is dominated by subsistence farming system, land size is a priceless resource to the households. The result shows that an increase in land size increases total calorie availability to households. This is quite similar with the studies of Fisher and Lewin (2013), Degefa (2005), van deer veen and Tagel (2011), Haile, Alemu and Kudhlande (2005).

CONCLUSION

Determinants of household food insecurity are multidimensional and interrelated features. But, the result of multiple linear regression analysis shows, large TLU per household, large land size per household and educated households contributes positively to household food security. So, proper veterinary services, proper handling and management of farming land, and expansion of educational coverage in the woreda are a priceless option to solve the problem household food insecurity. Moreover, Commitment of the community and the government in expansion of irrigation and strengthening rural farmer cooperatives are very crucial to solve the rooted problem of household food insecurity. Family size also contributes to devastating household food insecurity, so, the impact of large family sizes on household food security should be aware and family planning intervention should be in place.

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