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ASSESSMENT OF FACTORS DETERMINING HOUSEHOLDS' VULNERABILITY TO FOOD INSECURITY AND ITS LOCAL COPING MECHANISMS IN THREE WOREDAS OF GURAGE ZONE

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ABSTRACT

This study has been identified household vulnerability to food insecurity and its local copping mechanism in three selected Woredas of Gurage zone with the objective to assess factors determining households' vulnerability to food insecurity and its local coping mechanisms in Gurage zone. Both primary and secondary data sources have been used with structured questioner to collect the relevant data. The descriptive parts of the study were analyzed by mean, variance, standard deviation and frequency distribution, whereas the econometric analysis was analyzed by logistic regression model. The findings of the study revealed that49 percent and 36 percent of the households' in Mareko and Meskan districts, respectively are not able to meet the daily recommended caloric requirement. Descriptive statistics results revealed that family size in AE, Livestock holding in TLU, crop income per AE, livestock income per AE, annual income per AE, off- farm income per AE and annual food expenditure per AE are contributed to better food security status in Meskan and in Mareko family size in AE, livestock income per annum, annual income per AE, off-farm income per AE and better annual food expenditure per AE, distance to market contributed to better food security status.The binary Logit model indicates that family size, education level, access to credit, cultivated land size, off-farm income per AE and livestock holding measured in TLU were important factors affecting food insecurity status of households. Reducing the number of meals per day and eating less quality and less preferred food were commonly used coping methods followed by sale of animal and animal products.Finally the policy implications of the study are:(1) Proper attention should be given to limit the increasing population in areas by awareness creation and practicing family planning activities through integrated health and education services and training.(2)improving households' off-farm or non-farm income and identify different possible types of off-farm/non-farm activities that farmers can engage in,necessary knowledge and skills of the various types of off-farm and non-farm activities should be given.Finally, farmers should be encouraged to engage in livestock husbandry and farmers should be provided improved livestock production technologies (health service, improved breeds and feeds, etc.) to improve production and productivity of the sector.

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INTRODUCTION

Ethiopia is one of the poorest countries in the world. The proportion of the total population living in poverty is 44% and its per capita income is around 160 USD, which is less than Sub-Saharan African countries average of 500 USD (World Bank, 2006). Based on Human Development Index, Ethiopia is ranked 170th out of 177 countries (UNDP, 2007). Like many other developing countries, agriculture accounts for half of the GDP, 80% of employment and 60% of Ethiopia's exports (World Bank, 2006). However, rapidly growing population, environmental degradation and low agricultural production and productivity are major problems faced the country. The problems of poverty and food insecurity are the major challenges in Ethiopia. Some portions of the populations living in Ethiopia are vulnerable to frequent impacts of shortage of rainfall and drought which resulting in crop failure and losses of livestock that are important assets to their livelihood. In addition, the farmers have limited access to improved crop production technologies (improved seeds, fertilizers, etc…) and services such as animal health; credit and extension that would enable them increase production and productivity. As a result, the communities living in these areas rarely get enough agricultural produce for family consumption and are food insecure. Consequently, the vulnerability of household to food insecurity is strongly high in these areas of the country compared to areas with relatively good rainfall distribution. Thus, assessment of the extent to which household vulnerability to food insecurity and factors influencing in the study areas is crucial. However, the specific and most important factors affecting household food insecurity and poverty have not been identified. The formulation of effective national policies that would enable to counteract the problem of food insecurity and poverty depends on the availability of

research based information. In this regard, it is appropriate to assess households' vulnerability to food insecurity and its influencing factors in Gurage zone of Ethiopia, particularly in Mesqan, Marko and Geta Woreda. So far there is little research work undertaken to elicit the problems. This study, therefore, attempts to fill this gap by conducting empirical study on the households' vulnerability to food insecurity and its influencing factors in three Woreda of Gurage zone central part of Ethiopia. Objectives of the study are, to assess the extent of household's food insecurity in the study area, to identify the major causes of households' vulnerability to food insecurity andassess local coping strategies of households to overcome food insecurity and to identify policy options for minimizing rural household susceptibility to food insecurity in study area. The study is vital in giving evidence that serve as input for smooth development process of the country. It will provide basis for recommendations of policy and other interventions that can assist community to achieve pathways to intensification that are socially preferred. It has a paramount role in identifying areas in which government policies affect community livelihoods. This in turn reduces at least biases of planners and policy-makers in finding development area or interest for community. In addition, since little work has been done in the study area in this regard, the findings of this study can be a tool in providing information that enables relevant entity to compare the food security situation of the households in the study areas. The findings from this study can be used by the concerned bodies to plan and identify the most vulnerable groups to be assisted in the study area. It will also pin point policies that will be directed to enlarge scope of choice by food insecure individuals' or households.

RESEARCH METHODOLOGY

Gurage zone is located in the northern parts of southern nation nationalities and peoples regional state (SNNPRS) of Ethiopia. The Zone seat is Wolkite which is 155 km faraway from Addis Ababa just on the main road of Jimma. The zone has thirteen (13) Woredas and two (2) administrative towns which are again divided in to 437 kebeles (409 rural and 28 urban kebeles).The two administrative towns are Wolkite and Butajira. Majority of the population the likelihood are dependent on subsistence agriculture (92 percent), and this sector is mainly rain fed farming. The study was employed multi stage sampling methods. To collect the relevant data from the study area the researchers randomly select three rural Woredas of Gurage zone using simple lottery method. These are Mesqan, Mareko and Geta Woredas of Gurage zone. To select representative sample from each Woredasresearchers used proportional probability sampling method. As data obtained from Gurage Zone finance and economic development (population issue bureau, 2015), the numbers of household in the zone are 223,379. But, there are 66,590 household in the three selected Woredas. Having this information the researchers' selected 398 sample households using (Yamane, 1967) sample size determination. Additionally focus group discussions with 36 households' were undertaken.

$$n = \frac{N}{1 + N\,(e)2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (equ1)$$

Where, N = Total household size in the study area (Three Gurage Zone Woredas), n is sample size, and e is confidence level at 95%, Depending on the above formula 398 sample sizes were selected.

Table 2. Distributions of Sample Size of Each Woredas

No.	Name of Woredas	Numbers of households	Sample size of each Woreda
1.	Mesqan woreda	36594	218
2.	Geta woreda	13284	80
3.	Mareko woreda	16712	100
Total		66,590	398

Source, Gurage zone finance and economic development (population issues bureau, 2015)

Both primary and secondary data were collected for this study. To obtain primary data structured questionnaire with closed and open-ended questions were used to collect data from sample households. Important variables on economic, social and institutional characteristics of households in the sampled districts were collected. Enumerators, with at least secondary education who can speak local languages are recruited. They were given an intensive training on data collection procedures, interviewing techniques and detailed contents of the questionnaire. The households' questionnaire is translated in to local language and pre-tested, administered, filled by the trained and experienced enumerators in each district. Strict supervision was made during the course of survey. Secondary data were collected from documents and publications of CSA; IMF; Ethiopia Grain Trade Enterprise; FAO and other relevant offices. Moreover, available documents such as policies, strategies, guidelines and reports relevant to food security are reviewed. To get important and detail information about households' vulnerability to food insecurity and its influencing factors, focus group discussion, informal discussion and key informants interview were made.

In this study the descriptive statistics like mean, variance, standard deviations, and frequency distributions, ratios, and percentage, graphical and tabular analysis were used to examine and understand the demographic and socio economic situations of sample households. The hypotheses were tested using t-test and Chi-square analyses. To measure the extent of rural households' poverty and food insecurity in the study area household's food or caloric acquisition per Adult Equivalent (AE) per day were used. Household caloric acquisition is a measure of the number of calories, or nutrients available for consumption by household members over defined period of time. Accordingly, the data on available food for consumption, from home production, purchase and / gift/loan/wage in kind for the last seven (7) days before the survey day to household were collected. This seven days recall period is selected due to the fact that it is appropriate for exact recall of the food items served for the household within that week. If the time exceeds a week for instance 14 days, the respondent may not recall properly what he has been served before two weeks. Also this method is applied in the poverty and livelihood studies conducted at national level by Addis Ababa University in collaboration with International Food Policy Research Institute (IFPRI) and other international organizations. After that the collected data using seven days recall method were converted to kilocalorie using the food composition table manual (Ethiopian Health and Nutrition Research Institute/EHNRI, 1997). Then the converted data is divided to household AE. Following this the amount of energy in kilocalorie (kcal) available for the household were recorded. Then the results were compared with the minimum subsistence requirement per

AE per day (i.e. 2100 kcal). This means that the values of minimum amount of energy (2100kcal/AE/day) were used as a threshold beyond which the household is said to be food secure and if below, food insecure. As Ravallion (1992) stated, though there are many poverty/food insecurity measurement indexes, for this study Foster, Greer and Thorbecke poverty index is employed since it captures the most desirable properties; decomposability and can be sub grouped consistently. Foster, Greer and Thorbecke (FGT) index (1984) is used to calculate and capture the incidence and severity of food insecurity in the study. The mathematical formulation is expressed as:

$$\text{FGT}(\alpha)=\left(\frac{1}{n}\right)\sum_{i=1}^{q}\left[\frac{(c-y_i)}{c}\right]^{\alpha} \quad (2)$$

Where n is the number of sample households; y_i is the measure of per adult equivalent food calorie intake of the i^{th} household; c represents the cutoff between food security and insecurity (expressed here in terms of caloric requirements); q is the number of food-insecure households; and α is the weight attached to the severity of food insecurity. In FGT index, $c-y_i=o$ if $y_i \geq c$ (which shows that the specified household is food secure).Within this FGT index, the three most commonly employed indices are the incidence of food insecurity (also called head count ratio), the depth of food insecurity (food insecurity gap) and severity of food insecurity (FGT2) (Hoddinott, 2001; Ayalneh, 2002).

Head Count Ratio (HC): According to these authors, the simplest and most frequently applied measure of food insecurity is the incidence of food insecurity. This index describes the percentage of sampled households whose per capita income or consumption is below the predetermined subsistence level of energy (2100kcal). Hoddinott (2001) explained that giving no weight to the severity of food-insecurity is equivalent to assuming that α=0; then, the formula collapses to FGT (0) = q/n .

This measure has the advantage of being easy to calculate and interpret, but it tells nothing about the depth or severity of food insecurity. Moreover, this index also does not reveal whether all the food insecure households are about equally food insecure or whether some are severely food insecure and others just below the subsistence level. Hence, it needs to be complemented with the measure of depth of and severity of food insecurity in order to see what happens to the most food insecure segment of sampled HHs. The food insecurity gap index (FGT1): is a measure that takes into account how far the food insecure, on average, are below subsistence level of energy. Here, it means that, giving equal weight to severity of food insecurity among all the food insecure households is equivalent to assuming that α = 1. This index characterizes how many/much resources are required to bring all the food insecure to this subsistence level. To put it differently, it will provide the possibility to estimate resources required to eliminate food insecurity through proper targeting. Severity of food insecurity (FGT2): is a measure closely related to severity of food insecurity gap but giving those further away from the subsistence level, a higher weight in aggregation than those closer to the subsistence level. That is, giving weight to the severity of food insecurity among the most food-in secured households is equivalent to assuming that α = 2. This index gives greater attention to the most food-insecure households by weighting each food insecure household by the square of its proportionate shortfall below the subsistence requirement level. The degree of households in the study area able to smooth consumption during times of environmental stress can be identified by their local copping strategies practiced by the households to overcome food insecurity. Local copping strategies of different households are different since food insecurity conditions vary for different households. Therefore, in order to identify the mechanisms used by households to smooth consumption during times of stress the different copping strategies of the household to food insecurity were collected. Finally, simple descriptive statistics (percentages and frequencies) were employed in computing coping strategies of rural households. The descriptive statistics were computed using STATA version 12.0 software of statistical analysis.

One of the purposes of this study is to assess the causes of rural households' vulnerability to food insecurity in the study areas. The dependent variable in this case is a dichotomous variable, which takes a value of zero if the household is food insecure and one if it is food secure. To assess the relation between households' vulnerability to food insecurity (dependent variable) and the explanatory variables, food insecurity were taken as dichotomous variable. Thus the dependent variable is a dummy variable which takes a value of zero or one, depending on whether a household is food secure or not. That is to say, household food insecurity takes 1 if household is food insecure (i.e., when it is below the subsistence requirement level, 2100kcal), 0 otherwise. In order to address this study, the logistic regression, the normal log linear regressions as well as the probit models are among the possible alternatives that can be used. Although a variety of qualitative econometric models can be used to establish relationship between household characteristics and dichotomous response variable (food-insecure and food-secure), Logit and probit models are usually the most commonly used ones (Gujirati, 1988; Maddala, 1993). Gujarati (1995) also pointed out that in principle one can substitute probit model for logistic model, as their formulations are quite comparable; the chief difference being that logistic has slightly flatter tails than the cumulative normal distribution that is the probit curve approaches the axes more quickly than the logistic curve. Though, Logit and probit models produce similar parameter estimates, logistic distribution model is preferred (Agresti, 1990) and has got advantage over the others, in analysis of dichotomous outcome variables, because it is extremely flexible and easily used model from mathematical point of view and results in meaningful interpretations. The logistic regression analysis of determinants/causes of the households' vulnerability to food insecurity is used to investigate the relationships between food insecurity and its determinants in this study by using the Logit model. The dependent variable is food insecurity situation of the household that is dichotomous taking a value of 1 if the household is food-insecure and zero otherwise. The specification of the model is (Gujarati, 1995):

$$P_i = F(Z_i) = F(\alpha + \sum \beta_i X_i\ ) = \frac{1}{1+e^{-(\alpha+\sum \beta_i X_i)}} \quad (3)$$

Where: P_i is the probability that an individual is being food insecure; $Z_{i=\alpha} + \sum \beta_i X_i$; X_i represents vector of the $_i^{th}$

explanatory variables; α is a constant term; β_i is vector of coefficients to be estimated, i = 1, 2… 12; and e is the base of the natural logarithm.

Equation (3) can be written in the form of odds and logs of odds ratio so as to interpret the coefficients. The odds ratio is ratio of the probability that household will be food-insecure (P_i) to the probability of a household will not be food-in secured (1-Pi).

$$(1\text{-}P_i) = \frac{1}{1+e^{Z_i}} \quad \text{……..(4)}$$

$$\left[\frac{P_i}{1-P_i}\right] = \left[\frac{1+e^{Z_i}}{1+e^{-Z_i}}\right] = e^{Z_i} \quad \text{……(5)}$$

$$\left[\frac{P_i}{1-P_i}\right] = \left[\frac{1+e^{Z_i}}{1+e^{-Z_i}}\right] = e^{(\alpha+\sum B_i X_i)} \quad \text{…….(6)}$$

Since equation (6) is the exponential function, it is possible to change it into natural logarithmic function, and after doing so, by considering the error term it will become

$$L_i = \ln\left(\frac{P_i}{1-P_i}\right) = Z_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_m X_m \quad ...(7)$$

$$L_i = \ln\left(\frac{P_i}{1-P_i}\right) = Z_i = \alpha + \sum_{i=1}^{m} \beta_i X_i + U_i \quad i = 1, 2…12 \quad ….(8)$$

household food insecurity for all sampled households. The dependent variable of the model: Households' vulnerability to food insecurity (HFI_a) is a dichotomous dependent variable in the model and it takes 1 if the household is food-insecure; 0 otherwise. The information, which identities the food secured from the food in secured, is obtained by comparing the total food calorie available for consumption in the household per AE to the minimum level of subsistence requirement per AE (2100 kcal). A household beyond this threshold is said to be food secured, otherwise not. The independent variables of the model: The independent variables expected to have association with households' vulnerability to food insecurity were listed below.

RESULTS AND DISCUSSION

This section presents and discusses the results of household's food security analysis in the study areas. The first section of the chapter reports the demographic and socio-economic background of the sample households. The next section presents the results of econometric analysis of the determinants of food insecurity status of households.

Results of Descriptive Analysis

Family size, which measure number of individual members of household, is a variable used by many empirical studies to see how it affects food security status of households.

Table 2. Types, Expected Result and Definition of Variables in the Model

Variable Type	Hypothesis	Variable definition
Dummy	Negative	1, if household head is male; 0 otherwise
Dummy	Negative	1, if household head is literate; 0 otherwise
Dummy	Positive	1, if spread of livestock diseases is severe; 0 otherwise
Dummy	Positive	1, if livestock feed problem was severe in the past year ;0 otherwise
Dummy	Negative	1, if the farmers used chemical fertilizers and 0 otherwise.
Dummy	Negative	1, if the farmers used improved seeds and 0 otherwise.
Dummy	Negative	1 if the household uses irrigation, 0 otherwise.
Dummy	Positive	1, if the household faces problem of soil fertility and 0 otherwise.
Continuous	Negative	Size of cultivated land in ha
Continuous	Negative	Food aid in kg
Continuous	Positive	Distance from market center
Continuous	Negative	Amount of farm credit received in Birr
Continuous	Negative	Pattern of food consumption in kg
Continuous	Negative	Off-farm income in Birr
Continuous	negative	Number of oxen owned
Continuous	negative	Annual income in Birr
Continuous	positive	Household family size in number
Continuous	negative	Age of household head in years
Continuous	negative	Total livestock holding per household in TLU

After the econometric model is specified the researcher estimates the parameters of the model by maximum likelihood function (MLE). The model was computed using STATA version 12.0 software of statistical analysis. Now it is important to identify important explanatory variables that will affect the household vulnerability to food insecurity in relation to the study area. By reviewing the existing theory, and past findings of empirical research, the possible determinants of food insecurity in the study area were identified. The analysis was carried out for all sampled households of which its output would represent the study area in particular. By this, VHFI is assigned for all sampled households' food insecurity as dependent variable to be regressed on the identified independent variables. Consequently, the following explanatory variables were selected for the analysis of

significant difference in the mean household size between food secure and food insecure households at 5%, and 1% probability level in Meskan, and Mareko respectively (table 3.1).The mean age of food secure households was 47 years and that of food insecure households was 41 years in Meskan where as in Mareko the mean age of food secure and food were 48 and 45 years, respectively. The statistical analysis revealed that there was significant difference in the mean age of the household head between food secure and food insecure household heads in Meskan at 5% probability level (table 3.1).Survey result shows average dependency ratio of food insecure and food secure in Meskan were 1.14 and 0.94, respectively where as in Mareko 1.30 for food insecure and 1.13 for food secure. The overall dependency ratio the household in Meskan and Mareko districts were 1.01 and 1.21

percent respectively. This means, every 100-person in economically active population groups supported not only themselves, but also additional 1.01in Meskan and 1.21in Mareko economically dependent persons with all basic necessities. The statistical analysis revealed that there was significant difference in the mean dependence ratio of the households between food secure and food insecure households in Mareko district at 5% significance level (Table 3.1).

household in terms of education status at 5% probability level (table 3.3).Sex of household head was hypothesized to be one of the variables that make a difference on the level of food security. According to the survey result in Meskan district, 27 % of the sample households were headed by female and the rest 73% were headed by male where as in Mareko district, 22% of households were headed by females and the rest 78 %

Table 3. 1.Household food security status by family size in AE, mean age and dependence ratio

	Mesqan district				Mareko district			
	Food insecure (N=73)	Food secure (N=27)	P-value	Total (N=100)	Food insecure (N=69)	Food secure (N=31)	P-value	Total (N=100)
Family size	7.73	6.33	0.03**	6.84	8.21	6.7	0.00***	7.42
DR	1.14	0.94	0.12	1.01	1.30	1.13	0.31**	1.21
AGE	41	47	0.03**	44	45	48	0.36	46

Source: Survey result (2015/2016), *** and ** significant at 1% and5% probability level

Table 3. 2. Distribution of sample households by Age group in Geta district

Age Group (year)	Percentage
0-14	46.1
15-29	27.4
30-39	17.9
50-64	6.3
Above 65	2.3

Source: survey result (2015/2016)

Table 3.3. Distribution of household food security status by sex, education and access to credit service (%)

		Meskan district				Mareko district			
Category		Food insecure (73)	Food secure (27)	χ^2	Total (100)	Food insecure (69)	Food Secure(31)	χ^2	Total (100)
Sex	F	30.56	25	3.56*	27	25	19.23	0.49	22
	M	69.44	75		73	75	80.77		78
EDUC	Illiterate	33.33	31.25	0.23	32	75	65.38	0.002	79
	Literate	66.67	68.75		68	25	34.61		30
CRDT-	No	58.33	49	0.11	53	83.33	59.62	0.41**	71
ACC	Yes	41.67	51		47	16.67	40.38		29

Source: Own survey (2015/2016)

The average age of the sample farmers in Geta district was 45 years with a STD of 13.05 years. From this it could be said that majority of the householdsare within economically active age group. Regarding the age structure, children less than 15 years constituted 46.1% of the population who would sooner or later join the working force i.e., economically active group. This has a serious implication for land holdings. This means that additional demand for land will be generated, which will have an impact on the land size. Generally, the age structure shows a declining trend (Table 2), which is due to high birth rate, out-migration of economically active groups and high mortality rate at old ages. According to the survey results (Table 2), economically active and non-active population groups in the study area constituted 51.6% and 48.4%, respectively. The dependency ratio was 93.8%, which means, every 100 economically active persons had an extra 94 persons to feed, clothe and educate. This has a serious implication for food security. Categorization of household head as literate and illiterate in Meskan and Mareko districts exhibited that 68% and 30% were literate, respectively. It was hypothesized that as the level of education increases, the probabilities of being food secure increases. The survey results in Meskan district shows that out of 32% households, 33.33% of the food insecure was illiterate and 31.25% of the food secure was illiterate. On the other hand, in Mareko district out of 30% of households34.61% food secure and 25% food insecure households were literate. The chi-square test shows that there was no difference between food secure and food insecure were headed by male. Out of 73% households in Meskan district 75% food secure and 69.44% food insecure households were male headed households where as in Mareko district, out of 78% household 80.77% food secure and 75% food insecure households were male headed households. The chi-square test showed that there was statistical significant difference between food secure and food insecure household at 5% probability level in Meskan district (Table 3.3). Among the sample household heads in Geta district, 35.8% were illiterate while 64.2 were literate. 42.5 % could read and write only. The literacy pattern of households indicates that the number of household heads decreases as one goes to higher grades of education. Land size is considered as a critical production factor that determines the type of crops grown and the amount of crop harvested. About 80% of the growth in the agricultural outputs in Africa has been attained through the expansion of cultivated land (Degefa, 2002). Survey result shows the mean cultivated land size of households in Meskan was 0.99 hectare with a range of 0to 5.25 ha while in Mareko it was 0.56 ha with a range of 0to3ha. The mean farmland size for food insecure and food secure households were 0.66 and 1.71 ha in Meskan where as in Mareko, 0.64 and 0.48 ha, respectively. The mean comparison of two groups in terms of mean cultivated land size in Meskan revealed that there was a significant difference between food secure and insecure households at 5% probability level (Table 3.4).

Table 3.4. Food security status by mean of cultivated land size (in ha)

	Meskan district				Mareko district			
Land size (ha)	Food insecure (N=36)	Food secure (N=64)	P-value	Total (N=100)	Food insecure (N=48)	Food secure (N=52)	P-value	Total (N=100)
Mean	0.66	1.17	0.02**	0.99	0.64	0.48	0.16	0.56
Maximum				5.25				3
Minimum				0				0

** implies 5% level of significance Source: Survey result (2015/2016)

Table 3. 5. Mean crop production (in Kg) of sample households in the study areas

Crop	Meskan district			Mareko district		
	Food insecure (N=36)	Food secure (N=64)	Total (N=100)	Food insecure (N=48)	Food secure (N=52)	Total (N=100)
Maize	710.61	1030.31	922.65***	400.00	277.50	310.91
Wheat	1051.52	1048.89	1049.79**	0.00	138.75	138.75
Sorghum	125.00	297.73	271.15	0.00	0.00	0.00
Chickpea	272.22	121.43	206.25	337.50	62.50	200.00
Barley	650.00	1175.00	950.00	0.00	0.00	0.00
Vegetables	505.00	2443.75	1797.50*	0.00	100.00	100.00
Mean	1977.14	2448.55	2280.76	458.33	255.42	323.06
P-value			0.13			0.97
Total	83000	186000	269000	2750	3065	5815

***, ** and *Significant at 1%, 5% and 10% probability level, Source: Survey result

Table. 3.6.Mean livestock holding (in TLU) of sample household groups in the study areas

	Meskan district				Mareko district			
Item	Food insecure (N=73)	Food secure (N=27)	P-value	Total (N=100)	Food insecure (N=69)	Food secure (N=31)	P-value	Total (N=100)
	Mean	Mean		Mean	Mean	Mean		Mean
Cow	1.79	2.56	0.18	2.12	4.46	4.98	0.37	4.74
Heifer	1.10	1.54	0.12	1.32	0.67	0.77	0.00***	0.72
Calf	0.39	0.48	0.45	0.44	1.40	1.59	0.40	1.50
Oxen	1.71	1.79	0.07*	1.74	3.32	2.32	0.46	2.79
Sheep/ goat	0.23	0.25	0.06*	0.24	0.85	1.53	0.08	1.22
Camel	2.20	2.11	0.85	2.16	0.26	0.29	0.05**	0.23
Donkey	0.47	0.75	0.01**	0.62	0.26	0.20	0.03**	0.23
Mule	2.20	1.89	0.71	1.98	0.26	0.19	0.05*	0.23
Chickens	0.02	0.03	0.02**	0.03	0.01	0.04	0.00***	0.01
TLU	3.35	5.6	0.02**	4.16	7.31	8.07	0.03**	7.70

***, **, * implies significant at 1%, 5%and 10% probability level Source: Survey result

Farmers' objectives in crop production are mainly for dietary and cash income. Major crops grown in Meskan area was cereals like wheat, maize, sorghum and root crops; potato and sweet potato, vegetables such as cabbage, spinach and onion whereas in Mareko district wheat and maize crops were produced. The annual total crop production of households in Meskan and Mareko districts were 269,000 kg from 93.82 ha and 5,815 Kg from 55.63 ha, respectively. About 186,000kg and 83,000 kg of food crops were produced in Meskan by food secure and food insecure households where as in Mareko districts the total amount of food crops produced by food secure and food insecure households were 3,065 and 2,750 kg, respectively. Mean comparison shows that there was no a statistically significant difference between food secure and food insecure households groups in terms of annual crop production at 5% probability level (Table 3.5). Livestock provide milk, meat, traction power, income and transport. Moreover, they are sold for cash as a coping mechanism during food shortage. Livestock owned by the sample households include cattle, sheep and goat, equine and poultry. The average livestock owned by the sample respondents Meskan and Mareko districts were 7.31 TLU and 7.70, respectively. Overall, survey result shows that food secure households own more TLU than food insecure in the study areas.

The statistical test result demonstrated that the between two sample household groups regarding most of livestock group was significant at 5% probability level in both districts (Table 3.6). Household income has a paramount importance in achieving household food security for all segments of rural population. It is important to buy food and non-food items. The major income sources for the households in the study areas include crops, livestock and their products and off-farm activities. Analysis of the mean difference between the food insecure and secure households with regard to the main source of income shows that the food-secure and food-insecure groups differ on crop income per AE, livestock income per AE, off-farm/ non-farm income per AE and total annual income per AE in Meskan while in Mareko, the two groups differed in crop income per AE, off-farm/ non-farm income per AE and total annual income per AE. It was observed from the survey that crop production was the most important source of income in the Meskan district followed by livestock production and off-farm activities, respectively where as in Mareko district livestock production was the most important source of income followed by off-farm activities and crop production, respectively. The mean annual incomes per AE of sample households in Meskan and Mareko districts were Birr 606.41 and 494.29 respectively. The mean annual income per AE of food secure and food insecure household in Meskan was Birr 745.33 and 363.29, respectively.

Table 3. 7. Household food security status by household income sources per year per AE

	Meskan district				Mareko district			
Income source	Food insecure (N=73)	Food secure (N=27)	P-value	Total (N=100)	Food insecure (N=69)	Food secure (N=31)	P-value	Total (N=100)
Crop	337.66	645.54	0.07*	533.59	54.07	80.06	0***	67.59
Livestock	17.15	46.9	0.06*	36.19	230.89	255.28	0.43	243.57
Off-farm	8.48	49.53	0.01**	34.76	119.68	241.70	0***	183.13
Total	363.29	745.33	0.0***	606.41	404.64	577.05	0***	494.29

***, ** and *** implies significant at 1%, 5% and 10% level, respectively. Source: Survey result (2015/2016)

Table 3.8. Total consumption expenditure per AE of households in the study

	Meskan district				Mareko district			
Type	Food insecure (N=36)	Food secure (N=64)	P-value	Total	Food insecure (N=48)	Food secure (N=52)	P-value	Total(N=100)
Food	455.83	1103.28	0.00***	874.38	326.35	852.71	0.04**	600.06
Non-food	61.14	113.58	0.04**	95.04	118.46	150.19	0.03	134.96
Total	517.03	1216.75	0.03**	969.37	444.81	1002.9	0.02**	735.02

** implies significant at p<5%,Source: Survey result (2015/2016)

Table 3.9. Mean expenditure shares of food items from total food expenditure

	Meskan district				Mareko district			
Food type	Food insecure (N=73)	Food secure (N=27)	P-value	Total (N=100)	Food insecure (N=69)	Food secure (N=31)	P-value	Total (N=100)
Item	Mean	Mean		Mean	Mean	Mean		Mean
Cereals	0.65	0.59	0.07*	0.61	0.74	0.65	0***	0.70
Sugar	0.03	0.04	0.96	0.03	0.09	0.10	0.94	0.09
Coffee	0.18	0.20	0.71	0.19	0.00	0.02	0.34	0.01
Meat	0.05	0.04	0.92	0.04	0.01	0.01	0.71	0.01
Vegetable	0.03	0.07	0.15	0.05	0.02	0.02	0.93	0.02
Other	0.07	0.06	0.88	0.07	0.15	0.10	0.13	0.12

***, * implies significant at P<10%, Source: Survey result (2015/2016)

Similarly in Mareko districts the mean annual income per AE of food secure and food insecure household were Birr 577.05 and 404.64, respectively. The statistical test showed a significant mean difference between food secure and food insecure household groups in terms of annual income per AE at1% probability level in the study areas (Table 3.7). Survey result showed that the mean annual consumption expenditure per AE for sample households in Meskan and Mareko were Birr 969.37 and 735.02 per year, respectively. The mean annual consumption expenditures per AE for food secure and food insecure households in Meskan were Birr 1216.75 and 517.03, respectively whereas in Mareko district, the mean annual consumption expenditure per AE for food secure and food insecure households were Birr 1002.9 and 444.81, respectively. The statistical analysis showed that there was a significant mean difference between food secure and food insecure households at 5% probability level in terms of total consumption expenditure in both districts (table 3.8).Analysis of the mean difference between the food insecure and secure households with regard to the main source of income shows that the food secure and food insecure groups differ on food expenditure in both districts. According to ASARECA (2008), households that are net sellers of food benefit from rising prices while net buyers of food lose because their food budgets rise. Rural households in Ethiopia spend a higher proportion of their income (68%) on food compared with urban households (55%). Survey result showed that 82% of household expenditure in Meskan district and 80%expenditure in Mareko district were spent on food. The share of household expenditure spent on food for food secure and a food insecure household in Meskan was 82% and 83% respectively. However in Mareko district, the corresponding figures were 85% for food insecure and 75% for food secure households. The share of household expenditure spent on food is higher than national average (66%) these indicating that poor households in the study area suffer more because of spending a large proportion of their income (expenditure) on food. Analysis of the mean difference between the food secure and food insecure household with regard to the expenditure share from total consumption expenditure (total income) shows that the food secure and food insecure groups differ in food expenditure and non-food expenditure per AE per day (Appendix table 7).On average, estimate of cereals expenditure share from total food expenditure in Meskan district s shows cereals expenditures account 61% (59% of food secure and 65% of food insecure) of households where as in Mareko district, the cereals food expenditure was 70% (74% food insecure and 65% of food secure) of household food budget share. This implies a cereal is dominant in household food budget and total dietary energy intake in the study areas. For this reason, the relative impact of high cereal price was higher in both districts. The mean comparison between two groups show there was a significant difference between food secure and food insecure household at 10% probability level in terms of cereals expenditure share in both districts (Table 3.9)

Credit service improves food security status of households through purchase of agricultural inputs like improved seed and chemical fertilizers. It was hypothesized that households who are willing to participate in credit service can improve their income status through performing different activities with the credits acquired and hence improve their food security condition. Survey result shows about 47% of the respondents in Meskan and 29% in Mareko district have access to farm credit services. Out of 47% of households in Meskan district , 50% of food secure and 41.67% of food-insecure households have access to farm credit where as in Mareko district out of 29% of the households about 40.38%food secure and 16.67% food insecure households. The chi-square test revealed that the relationship between access to farm credit and food security

Table 3. 30 Distance to market (in km) and total food aid received (in Birr) of households

	Meskan district				Mareko district			
Item	Food insecure (N=73)	Food secure (N=27)	P-value	Total (N=100)	Food insecure (N=69)	Food secure (N=31)	P-value	Total (N=100)
MKX	18.17	14.9	0.05*	16.08	35.73	28.96	0.06*	32.21
AID	412.28	442.2	0.73	431.43	1457.65	1516.08	0.47	1488.0

*implies significant at p<10%,Source: Survey result (2015/2016)

Table. 3.11Summary of incidence and severity of food insecurity (%)

Type of food insecurity	Meskan district	Mareko district
Incidence food insecurity	36	49.50
Depth food insecurity	12.38	17.12
Severity food insecurity	7.35	8.47

Source: Own survey (2015/2016)

Table 3. 12 Coping mechanisms to deal with food price inflation in the study areas

	Meskan district				Mareko district			
Item	Food insecure	Food secure	χ^2	Total	Food insecure	Food secure	χ^2	Total
Cutback quantity food per meals	0.17	0.16	4.44**	0.17	0.16	0.14	9.99**	0.16
Reduce quality of food	0.14	0.15	5.55	0.15	0.22	0.18	6.97	0.20
Eating wild food	0.13	0.12	4.97	0.12	0.12	0.12	2.81**	0.12
Reducing health and school expense	0.13	0.15	6.33	0.14	0.14	0.13	4.03	0.13
Migrating to other places	0.12	0.12	4.73	0.12	0.07	0.13	4.44**	0.10
Sold firewood and charcoal	0.14	0.12	2.84	0.13	0.13	0.11	7.52	0.11
Sold livestock and asset	0.15	0.17	2.39*	0.16	0.14	0.16	5.76**	0.15
Other	0.03	0.01		0.02	0.03	0.04	3.87	0.03
Total	1.00	1.00		1.00	1.00	1.00		1.00

Source, survey (2015/16)

was statistically significant in Mareko district. Proximity to market center creates access to additional income by providing off-farm/non-farm employment opportunities and easy access to inputs and transportation. It was, therefore, expected that households nearer to market center have better chance to improve household food security status than who do not have proximity to market centers. Table 12 depicts the statistical results of the two groups in relation to the effect of market distance on food security. The mean difference between the two groups with regard to distance from the market place is statistically significant at 10% probability level in the study area. This result is in agreement to the hypothesis stated for this study. Food aid is essential to relieve many (though not all) humanitarian emergencies stemming from natural disasters, armed conflict, or a combination of the two. The survey result shows that the mean amount of food aid received by the household in Meskan and Mareko districts were Birr 431.43 and Birr 1488.03 respectively. The mean amount of food aid received by the food insecure and food secure sample respondents in Meskan were Birr 412.28 and Birr 442.20 respectively. While in Mareko district, the mean amount of food aid received by the food insecure and food secure sample respondents were Birr 1457.65 and 1516.08, respectively. The mean comparison showed that there is no statistically significant difference between two groups at 5% probability level (Table 3.10).

Intensity of Food Insecurity

The three FGT indices used in this study are head count index, food insecurity gap and severity of food insecurity. The results of the survey revealed that the head count ratio or incidence of food insecurity was 0.48 in Mareko and 0.36 for Meskan district, respectively. This implies that 49% and 36% of the sampled household's in Mareko and Meskan district s respectively were not able to meet the daily recommended caloric requirement.

To know how far the food insecure households are below the recommended daily caloric requirement, food insecurity gap was calculated. Food insecurity gap provides the possibility to estimate resources required to eliminate food insecurity through proper targeting. The calculated values for food insecurity gap were found to be 17% for Mareko and 12% for Meskan district. These show that if it is possible to mobilize resources that can meet 17% and 12% of caloric requirement of every food insecure households and distribute to each household to bring up to the recommended daily caloric requirement level, then theoretically food insecurity can be eliminated. On the other hand, to approach the most food insecure sample households, severity of food insecurity was calculated by assigning a higher weight, $\alpha = 2$. The survey result indicated that the severity of food insecurity is 8.5% in Mareko and 7.35% in Meskan district s (Table 3.11).

Coping strategies to deal with food prices inflation in study areas

There has been a lot of evidence documented in the literature on shocks and coping mechanisms that households faced by uninsured risk and households adopt their own coping mechanisms to protect themselves against a serious decline in welfare or to maintain normal consumption (Frankenberg, 1992; Teklu, 1992; Debebe, 1995). In view of this, the households surveyed were asked about coping strategies they adopted in response to food price inflation. Table 3.13 presents the local coping mechanisms which have been practiced by household to cope with food price inflation in the study areas. The principal strategies used by the sample respondents to cope with food price inflation were reducing the quantity, number of meals per day, reducing quality of food, consuming wild food, sale of livestock, sale of fire wood/charcoal and migrating to other places. Reducing the quantity served per meals and reducing quality of food was ranked as a 1st coping mechanisms considered by Meskan and Mareko households,

respectively. This was practiced by 17% of household (16% of food secure and 17% of the food insecure) in Meskan and 20% household (18% of food secure and 22% of the food insecure) in Mareko. Eating less quality and less preferred food was the seconded most widely used coping mechanism in the Mareko practiced by 16% of total households. Livestock, besides their complimentary relationship with crop production, provide hedging against risk of food insecurity. As a result, when food produced is fully consumed and or no cash reserve is available to purchase more of it, animal products and live animals are sold as ways of getting access to cash income and to buy food for the household. Accordingly, about 16% Meskan and 15% of Mareko districts were involved in the sales of livestock to acquire food whenever there is shortfall in food supply. Sales of livestock were common for the two groups showing that the farm households keep animals as principal assets to manage the shortage. This mechanism is ranked as the third most important coping practice in Mareko because household livelihood mostly depends on livestock, particularly cattle. Sales of livestock to purchase food grains during supply shortage have considerable effects on farmers' and pastoralist economy mainly because of sharp decline in livestock prices. Another 11% of all households in Mareko district and 13% households were used sale of fire wood/charcoal to overcome food shortage problems. These and other were frequently mentioned and practiced coping strategies currently used by household in the study area. The chi-square test showed that there was a statistical significant difference between food secure and food insecure households at 5% probability level in terms of reducing quantity of meals served and sold livestock both districts.

Results of Determinants of Food Security

Logit model was employed to assess determinants of food insecurity of households. Before fitting the models, it was important to check whether there exists serious problem of multi-collinearity among the hypothesized explanatory variables. The value of VIF for each of the continuous variables shows less than 10. Hence, there was no a multi-collinearity problem among all the hypothesized continuous variables included in the model. The result of the computation of contingency coefficients revealed that there was no a serious problem of association among discrete explanatory variables as the contingency coefficients did not exceed 0.75. Therefore, all the hypothesized dummy variables were included in the logistic regression model.As repeatedly stated, household food security variable was used in the model as a dependent dummy variable with a value of 1 describing the probability of the household being food insecure, 0 otherwise. For analyzing food insecurity status of the sample households, a total of 15 explanatory variables were included in the model. In order to identify the most important determinants from the potential hypothesized independent variables assumed to influence food insecurity of households in the study areas, binary Logit model was estimated. For the purpose, a statistical package, STATA version 12 was used. The results of the Logit regression model are presented in Table 3.14. The likelihood ratio has a chi-square distribution and it is used for assessing the significance of logistic regression. Model chi-square provides the usual significance test for a logistic model i.e. it tests the null hypothesis that none of the independent variables are linearly related to the log odds of the dependent. It is an overall model test which doesn't assure every independent variable is significant. The result is significant at less than 1% probability level revealing that the null hypothesis that none of the independent variables are linearly related to the log odds ratio of the dependent variables is rejected. In addition, goodness of fit in logistic regression analysis is measured by count R^2 which indicates the number of sample observations correctly predicted by the model. The count R^2 is interpreted based on the principle that if the predicted probability of the event is less than 0.50, the event will not occur, and if it is greater than 0.50, the event will occur (Maddala, 1989). Hence, the model results showed that the logistic regression model correctly predicted 79% of sample households (which is greater than 0.50). Out of the 15 independent variables hypothesized to have influence on household food insecurity, 7 variables were found to be statistically significant. The maximum likelihood estimates of the Logit model showed that family size (FSIZE), education, livestock holding (TLU), off-farm income per AE (OFF-FI) and access to credit were found to be the important determinants identified to influence household food insecurity status in the study are (table 3.13). The discussion and interpretation of the significant explanatory variables in the model in the study area are presented as below:

Family size in AE (FSIZE): This variable was significant at 1% probability level and positively related with the state of food insecurity. The result indicated that larger household size tends to be food insecure compared to smaller family size. The possible explanation is as family size increases, the amount of food for consumption in one's household increases thereby that additional household member shares the limited food resources. Other things being constant, the odds ratio in favor of being in food secure increase by a factor of 1.348 as family size increase by one adult equivalent. This result is in conformity with the findings of Mulugeta (2002); Abebaw (2003), Ayalew (2003), Tesfaye (2005) and Yusuf (2007).

Livestock size (TLU): Livestock are important source of income, food and draft power for crop cultivation. Livestock size is negatively and significantly associated with the probability of being food insecure in the study area. This indicates that households with more livestock produce more milk, milk products and meat for direct consumption and owners could be more food secured. Besides, this enables the farm households to have better chance to earn more income from livestock production which enables them by increasing purchasing power of food during food shortage and could invest in purchasing of farm inputs that increase food production, and able in ensuring household food security. The result indicates that, other things held constant, the odds ratio in favor of being food insecure decrease by a factor of 0.91 as the total livestock holding increase by one TLU. This result is in agreement with the prior expectation and the findings of Tesfaye (2005) and Yusuf (2007).

Off-farm/non-farm income per AE (OFF-IN): This variable represents the amount of income earned in cash or in-kind, during the year. In the areas, where the farmers face crop failure and sales of livestock and livestock product is inadequate, income earned from off/non-farm activities are an important means of acquiring food. Accordingly, in the study area, the success of farm households and their family members in coping with food insecurity is highly determined by their ability to get access to off/non-farm job opportunities. The result suggests that households engaged in off-farm activities are endowed with additional income and less likely to be food

insecure. As expected, availability of this type of income was negatively and significantly (10% probability level) associated with household food insecurity status. As off-farm income rises by one Birr odds ratio in favor of being food insecure decrease by factor of 1.0035 when other variables are constant. This result is in conformity with the findings of Pearce *et al*. (1996), Mulugeta (2002), Ayalew (2003), Tesfay (2005) and Yilma (2005).

Access to credit (AC-CREDT): Access to credit is negatively and significantly associated with the probability of being food insecure in the study area. Those households who received farm credit have possibility to invest in farming activities, which is important component in small farm development programs. As access to credit increases by one Birr odds ratio in favor of being food insecure decrease by a factor of 0.399, when other variables are constant. Empirical evidence shows that access to credit has positive effect on food security (Abebaw, 2003; Tesfaye, 2005). Therefore, it is expected that access to farm creditwere negatively related with food insecurity.

Size of cultivated land (CU-LAND**):** This variable stands for the total land area cultivated in hectares. Losses of farm land to other uses because of population pressure and limits to the amount of suitable new land that can be brought in to production is one of the constraints of food production (Brown *et al.,* 1990). Fertile farmland is often sacrificed to meet the growing demands of population growth (Ehrlich *et al*., 1991).

Table 3.13. The maximum likelihood estimates of the Logit model

	B	S.E.	Wald	Sig.	Exp(B)
SEX	-0.686	0.564	1.478	0.224	0.504
AGE	-0.024	0.017	2.013	0.156	0.977
FSIZE	0.299	0.084	12.778	0	1.348
EDUCN	-0.931	0.49	3.612	0.057	0.394
CROP	-0.003	0.001	5.726	0.017	0.997
FINCOME	0.000	0	10.065	0.2	1
Offincm	-1.253	0.518	5.854	0.016	0.286
LSIZE	-0.58	0.34	2.9	0.089	0.56
TLU	-0.094	0.044	4.643	0.031	0.91
FPRICE	0.108	0.57	0.036	0.849	1.114
CRDTACC	-0.918	0.482	3.625	0.057	0.399
MKTX	0.008	0.019	0.178	0.673	1.008
Feedproblem	1.603	1.023	2.458	0.117	4.97
Extservice	-0.065	0.658	0.01	0.921	0.937
AID	0	0.001	0.072	0.788	1
Constant	0.228	1.581	0.021	0.885	1.256

Variables	Coefficients	Odds Ratio	P-value
SEX	0.4230	1.5265	0.5280
AGE	0.0498	1.0511	0.0640*
FSIZE	-0.2218	0.8011	0.0530*
DR	-0.6390	0.5278	0.2070
EDU	0.8218	2.2746	0.2300
TOTFAIN	0.0002	1.0003	0.0520*
OFF-FI	0.0035	1.0035	0.0640*
LSIZE	0.4631	1.5890	0.2950
TLU	0.2165	1.2417	0.0260**
AC-CRDT	0.6192	1.8574	0.2970
MKTX	0.0005	1.0005	0.9910
FOODAID	0.0009	1.0009	0.2680
CONS	-3.0485		0.1640
Pearson Chi-square		79.95***	
Log likelihood		-39.5541	
Percent correctly predicted (R^2)		79%	
Sensitivity		84.38%	
Specificity		69.44%	
Sample size		100	

**, * significant at 5 and 10 % respectively Source: Model output

As the cultivated land size increases, provided other associated production factors remain normal, the likelihood that the holder gets more output is high. As cultivated land size rises by one unit, odds ratio in favor of being food insecure decrease by a factor of 0.56, when other variables are constant.

Summary and Conclusions

Food insecurity is the most critical problem facing a large number of households in Ethiopia. That is, the problems of drought, diseases, and livestock feed, institutional and policy factors, land/rangeland degradation, low agricultural productivity, food price inflation and other-related problems which result in food insecurity and poverty in the country. In this line, identifying and analyzing the major causes of food insecurity at household level through research is found as one of the way-outs in a process of pinpointing alternative interventions and policy options. In this study both descriptive statistics and econometric methods were used for the analysis of the survey data. Sample households were classified into food secure and food insecure groups based on food consumption in kcal by the households in the last seven days either from own produce or through purchase. The amount of food consumed by each household during the seven days was converted in to equivalent daily kcal per AE and then compared with recommended daily kcal per adult equivalent (2100 kcal). If this recommended daily kcal per adult equivalent was less than 2100 kcal, the household was considered as food insecure and food secure otherwise. Based on the above the intensity of food insecurity was estimated using FGT index. Accordingly, head count ratio or incidence of food insecurity were found to be 0.49 and 0.36 in Mareko and Meskan district s, respectively. This implies that 49% and 36% of the sampled households' in Mareko and Meskan district s respectively were not able to meet the daily recommended caloric requirement or food insecure. Also, the calculated values for food insecurity gap were found to be 17% for Mareko and 12% for Meskan district.

These show that if it is possible to mobilize resources that can meet 17% and 12% of caloric requirement of every food insecure households and distribute to each household to bring up to the recommended daily caloric requirement level, then theoretically food insecurity can be eliminated. The descriptive analysis result revealed that farm households used different mechanisms to cope with the negative impacts of food insecurity. Reducing the number of meals per day and eating less quality and less preferred food were the most commonly used coping methods followed by sale of animal and animal products. Based on the survey data, demographic and socio-economic factors related to food security were estimated using the descriptive statistics and the results revealed that family size in AE, Livestock holding in TLU, crop income per AE, livestock income per AE, annual income per AE, off- farm income per AE and annual food expenditure per AE contributed significantly to a better food security status in Meskan district .Similarly, in Mareko district the family size in AE, livestock income per annum, annual income per AE, off-farm income per AE and better annual food expenditure per AE, distance to the market contributed significantly to a better food security status. To identify the major determinants of food insecurity in the study area binary Logit model was employed and the result indicates that family size, , education level, access to credit, cultivated land size, off-farm income per AE and livestock holding measured in TLU were found to be important factors affecting food insecurity status of farm households. Based on the findings of the study, the following policy recommendations are forwarded. Family size and food security were strongly and positively related. Therefore, proper attention should be given to limit the increasing population in the areas. This could be achieved by proper awareness creation about practicing family

planning activities through integrated health and education services. A proper training and awareness creation activities have to be conducted in order to make effective the family planning activities so as to limit the growing family size.Improving households' off-farm / non-farm income have a significant negative influence on the state of food insecurity. Farmers engaged in selling of fire wood, charcoal, petty trade, house construction and employed as daily laborers on other farms and in nearby towns were found to have better food security status.

Therefore, concerned stakeholders should identify the different possible types of off-farm/non-farm activities that farmers can engage in. Moreover, they should be provided with the necessary knowledge and skills of the various types of off-farm and non-farm activities that could improve their food security status. Livestock holding has a negative influence on food insecurity. This implies that farm households with larger livestock holdings are more probability to be food secured than farmers with less livestock holdings since livestock used as food (meat, milk and milk products) for direct consumptions, income source from the sale of live animals and their byproducts during the food shortages. Therefore, farmers should be encouraged to engage in livestock husbandry. Furthermore, the farmers should be provided with improved livestock production technologies (health service, improved breeds and feeds, *etc.*) to improve production and productivity of the sector. This will ultimately increase food security status.

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Appendices'

Appendix 1.Calorie value of food items (in Kcal per Kg)

Food items	Unit	Kcal
Teff	Kg	3589
Wheat	Kg	3623
Maize	Kg	3751
Barley	Kg	3723
Peas	Kg	3553
Beans	Kg	3450
Potato	Kg	1037
Onion	Kg	713
Cowpea	Kg	3450
Chickpea	Kg	3450
Vegetable	Kg	370
Meat	Kg	1148
Milk	Litter	737
Egg	each	61
Butter	Kg	7364
Edible Oil	Litter	8964
Coffee	Kg	1103
Sugar	Kg	3850
Salt	Kg	1780

Source: EHNRI, 2006

Appendix 2.Conversion factor for adult- equivalent (AE)

Age Group	Male	Female
<10	0.60	0.60
10-13	0.90	0.80
14-16	1.00	0.75
17-50	1.00	0.75
>50	1.00	0.75

Source: Storck, *et al*., (1991)

Appendix 3. Conversion factor for Tropical Livestock Unit (TLU)

Animal Category	Tropical Livestock unit
Calf	0.25
Weaned Calf	0.34
Heifer	0.75
Cow and Ox	1.00
Horse and Mule1.10	
Donkey (adult)	0.70
Donkey (Young)	0.35
Sheep and Goat (adult)	0.13
Sheep and Goat (young)	0.06
Sheep and Goat (young)	0.06
Chicken	0.013

Appendix 4.Variance Inflation Factor (VIF) for continuous variables

	Meskan district		Mareko	
Variables	Tolerance (T*)	VIF	Tolerance	VIF*
Age	0.80	1.24	0.88	1.13
FSIZE	0.81	1.24	0.87	1.15
DR	0.83	1.21	0.93	1.07
FOODAID	0.64	1.57	0.89	1.12
TOTFAIN	0.69	1.45	0.92	1.09
OFF-FI	0.76	1.31	0.86	1.17
LSIZE	0.92	1.08	0.85	1.18
TLU	0.82	1.22	0.92	1.09
MKTX	0.59	1.68	0.87	1.14

Source: own computation,* Tolerance greater than 0.1and VIF less than 10

Appendix 5. Contingency coefficient (C) value of dummy variables

	Meskan district			Mareko district		
Item	SEX	EDUCN	CRDT	SEX	EDUCN	CRDT
SEX	1			1		
EDUCN	0.023	1		0.186	1	
CRDT	0.059	0.069	1	0.086	0.203	1

Source: own computation

Appendix Table 7. Household income spent on food and non-food consumption per AE/day

	Meskan district				Mareko district			
Expenditure share	Food secure (n=64)	Food insecure (n=36)	P-value	Total (n=100)	Food secure(n=52)	Food insecure (N=51)	P-value	Total (n=100)
Food	0.82	0.83	0.66	0.82	0.76	0.85	0***	0.80
Non-food	0.18	0.16	0.44	0.18	0.15	0.24	0***	0.20

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