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The Level and Determinants of Food Insecuritamong Rural Households in East Wollega Zone: The Case of Diga Woreda

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Abstract
This study examines the level and determinants of food insecurity among rural households in western Ethiopia. The struggle to achieve food security at the household level in the rural area of Ethiopia dated back a long period. In light of this the study aims to identify the determinants of household food insecurity and estimate the extent and intensity of food insecurity. For this purpose, data was collected from 338 randomly selected rural households (131 food insecure and 207 food secure) from five Kebeles of the randomly selected Peasant Associations using two-stage proportionate stratified random sampling technique. In the first stage, the PAs were stratified into high and low altitude and then after five PAs (three low and two high) from 21 PAs were selected randomly and finally 338 household heads were selected randomly from five PAs with probability proportional to stratum size. To examine the problem, the study used descriptive statistics like mean, standard deviation, percentage, and frequency distribution on socio economic characteristics of the sampled households. In addition, t and chi-square tests were used to compare food secure and insecure sample groups with respect to the explanatory variables. Binary logistic regression was fitted to analyze the determinants of food insecurity. Besides the FGT poverty analysis was used to analyze the incidence and extent of food insecurity. The result indicated that family size, sex of the household head, age square of household head, status of education of household head, cultivated land size, livestock ownership and proportion of food expenditure pattern were found to be significantly influence food insecurity. The incidence, gap and severity were 38.76%, 8.4% and 2.64% respectively. The amount of resource required to bring all households to the minimum recommended daily requirements (2100kcal) is estimated to be 10203.63 quintals of cereals per year. The findings suggest limiting population size and giving priority to gender mainstreaming, capacity building for old household heads and subsidizing them, increasing rural household heads' enrolment ratio in adult education, enhancing appropriate land use, using of improved technologies and proper extension services to raise land productivity, improving the provision of adequate veterinary services, improved water supply points, introduction of timely and effective artificial insemination services to up-grade the already existing breeds, and enhancing the diversified income of the poor rural household were suggested.
Keywords: Food insecurity, Intensity of food insecurity

I. INTRODUCTION

1.1. Background of the Study

We are living in a world where more than one billion people are poor, 800 million are food insecure and where about 170 million children are malnourished. While food insecurity occurs in most countries to varying degrees,75 percent of the food insecure lives in rural areas of developing countries (FAO, 2000); (IFPRI, 2002).Food is essential in human being's life. Lack of food in long terms will lead to hunger and starvation that can cause death. So that enough food is a necessity condition to be well nourished(Sila,O., and Pellokila,R., 2007).In view of the importance of food in man's life food is rate as the most basic of all human needs(Oluyole K.A and Lawal J.O., 2008).

Food is both a need and human right, even though it is need and human right, food insecurity is prevalent in today's world in general, and in Sub-Saharan Africa in particular. Since early 2007, food-related riots have occurred in 15 countries, including seven in Sub-Saharan Africa(GAO, 2008).

As part of Africa, Ethiopia faces daunting poverty and food insecurity challenges that are worsening over time. In the 1990s, an estimated 30 million Ethiopian were food insecure, and food crises were persistent. Among this food insecure people, the majority reside in the rural areas of the country. About 52 percent of the rural population and 36 percent of the urban population consume under the minimum recommended daily intake of 2100 calorie per person per day(FAO, 2002),(MEDAC, 1999).

Ethiopia is among the poorest and most food insecure countries of the world where 44 percent of its population live below the national poverty line and 46 percent of its population get below the minimum levels of dietary energy consumption compared with other Sub-Saharan and developing countries (World bank, 2005).In terms of food security, Ethiopia is one of the seven African countries that constitute half of the food insecure population in Sub-Saharan Africa (SisayA., 1995).

Ethiopia has reasonably good resource potential for development of agriculture, biodiversity, water

resource, and minerals. Yet, Ethiopia is faced with complex poverty, which is broad, deep and structural. The proportion of the population below the poverty line is 44 percent in 1999/2000 (MoFED, 2002)and which was about food poverty of 33.6 percent, with overall poverty of 29.6percent in the country (MoFED, 2012).

The presence of hunger in Ethiopian households due to insufficient resources to obtain food has been a long-standing challenge to Ethiopian government, donors, and other local and international organizations. In general, the Ethiopian government implements poverty reduction strategy (PRS) hence, examination of food insecurity at regional, zonal or household levels to identify the specific characteristic of the problem is crucial. Having this background, this study tries to investigate the level of food insecurity and its determinants in rural households of Diga woreda of East Wollega Zone.

1.2 Statement of the Problem.

There is a prevalence of both severe transitory and chronic food insecurity in Ethiopia. Numerous studies have confirmed that there is a problem of food insecurity in Ethiopia with wide range of area to be covered and large number of people to be attended for different identified causes of food insecurity problem. Empirical evidence of food security in Ethiopia indicates the prevalence of a high level of food insecurity, with significant idiosyncratic and spatial characteristics. The specific food security studies by Berhanu, A.(2004), Frehiwot F., (2007), Abebaw S. and Ayalnew B, (2007), and Hailu M.,(2012) generally suggest that the depth and intensity of food insecurity are high, influenced by poor functioning of marketing systems and other household and socioeconomic factors.

Rural households are vulnerable to food insecurity not simply because they do not produce enough, but either they hold little in reserve or they usually have scant saving and few other possible sources of income to obtain adequate food to meet their daily subsistence food energy requirements (Ayalneh B., 2002).

Despite the general improvements in living conditions for Ethiopians around 25 million people in the country (29 percent of the population) live below the nationally defined poverty line(MoFED, 2013a), and (MoFED, 2012), and Chronic malnutrition is very high at 40 percent(CSA, 2014).

Diga woreda is one of the districts of East Wollega Zone which is endowed with potential natural resources that can be tapped for the well-being of the people(DBOA, 2014).The district is blessed with various potentials and opportunities mentioned above, but some of the population are in need of food aid. According to the annual report of Disaster Prevention and Preparedness Agency bureau of East wollega zone about738 households (a population of 3375 people) of Diga woreda were supported by of food aid in the year of 2013/2014 (EDPPA, 2014).The same source also identified that about 645 children and 601 females needs immediate food aid support in this woreda.

Food insecure and food secure farm households reside as neighbors and could share common climate and weather situation and mainly similar socio-economic, cultural and land topography. Yet, one faces seasonal food crisis and become dependent on food aid, while the other remains food secure, requiring no food aid. Recent literature discovered that even in years of adequate rainfall and good harvest, the households in the study area remain in need of food assistance. This clearly reflects the deeply entrenched poverty and transitory situation of the area irrespective of conducive environmental conditions. This implies the existence of structural, socio-economic, cultural, demographic and other factors underlying the poverty and seasonal food insecurity problem in the study area.

Thus this study aims to analyze the level and determinants of food insecurity among rural households of Diga woreda of East Wollega Zone with specific objective to:

- Identify the determinants of food insecurity among the rural households of Diga woreda of East Wollega Zone.
- Estimate the food insecurity gap and its severity among rural households in Diga woreda

2. RESEARCH METHODOLOGY

2.1. The Study Site

Diga woreda, is one of the 262 districts in the Oromia regional state, located in the south-west of the Abbay basin and at 09 01’ 29.2” N; 036 27’ 28” E. It is approximately 343 kms west of Addis Ababa and about 12 kms from Nekemte town. The altitude in the area varies from 1200 to 2342m.a.s.l. and an annual rainfall that exceeds 2,000mm.The woreda comprises both lowland (60 percent) and midland (40 percent) in an agro ecologies (DBOA, 2014). A survey of the land in Diga shows that 27,817ha (68.2 percent) is arable land, 4999 ha (12.2percent) is grazing land, 6894 ha (16.9 percent) is forestland and the rest 1078 ha (2.6 percent) is used for roads, housing, and others (DBOA, 2011).

Based on the 2007 national housing and population census reported a total population for the woreda is 106,664 (62513 were women and 44,351 were men) and 26559 of its population were urban dwellers.

This is to mean that about 80105 population of whom 39249 are male and40856 women were rural dwellers that can be grouped into a household of 11425 (that is about seven (7) persons per household) (CSA,

2007).

2.2. Data Sources and Sampling Technique

For the purpose of this study Diga woreda was selected purposively among the woredas of East wollega zone due to the relative problem of food secure and the presence of high population of re-settlers in the woreda. Both primarily and secondary type of data were used. The primary data sources were the sampled household heads and the secondary data sources were government regional offices, like food security and disaster prevention and preparedness bureau reports, libraries, internet sources, agricultural offices and CSA reports.

In order to obtain the primary data, the study used a multi-stage stratified random sampling technique. In the first stage, the PAs were stratified into high and low altitude and then after five PAs (three low and two high) from 21 PAs were selected randomly and finally 338 household heads were selected using systematic random sampling methods from five PAs (Jirata, Damaksa, Arjokotebula, and Mada Jalala) using probability proportional to size of the stratum.

The study used (Kothari, C. R., 2004)to decide the sample size as:

$$n = \frac{z^2.p.q.N}{e^2(N-1)+z^2.p.q} = 338 \text{ households}$$

Where:

n = sample size
N = Number of household in the study woredas
e = is the desired level of precision (5%=0.05)
z = is the Z-score value at 95 percent of level of confidence interval (z=1.96)

2.3. Methods of Data Collection

The study used structured questionnaire to collect primary data for the purpose of the study. Detail information on household demographic characteristics, household assets, land characteristics and management, institutional factors, food security status and vulnerability data were collected by interviewing sample household heads. Five enumerators who completed diploma and speak the local language of the study area were recruited and one-day training were given on the contents of questionnaire, method of data collection and the way to approach the respondents.

2.4. Method of Data Analysis

The study employed both descriptive and econometric method of data analysis. The descriptive method was employed to explain the situation of demographic and socioeconomic variables. The specific methods of data analysis involved were tabulation, frequency, percentages, and computation of descriptive statistics such as mean, and standard deviation and the econometric method was employed to analyze the determinants of food insecurity.

To test the intensity (level)of food insecurity of the study area FGT was employed (Ayalneh B., 2002.).and the FGT model could be expressed as follows:

$$P(\alpha) = \frac{1}{n}\sum_{i=1}^{q}\left[\frac{m-\gamma i}{m}\right]^{\alpha}$$

Where:

P= number of food insecure households
n=is the number of sample households;
yi= is the measure of per adult equivalent food calorie intake of the i^{th} household;
m=represents the cutoff between food security and insecurity (in terms of caloric requirements);
α=is the weight attached to the severity of food insecurity.
In equation, m-yi = 0 if yi> m.

2.4.1. Specification of Econometric Model

To examine the association between food insecurity (dependent variable) and the relative importance of independent variables the study employed the logit model. The dependent variable in this case, food insecurity was binary variable which took a value one if a household would be food insecure, and zero otherwise the cumulative logistic probability model could be econometrically specified as:

$$\rho i = F(Zi) = F(Zi) = F[\alpha + \sum_{i=1}^{m}\beta ixi] = \left[\frac{1}{1+e^{-(\alpha+\sum\beta ixi)}}\right] \quad (1)$$

Where:

Pi is the probability that an individual being food insecure given xi

Xi represents the i^{th} explanatory variable and βi are regression parameter to be estimated,
e is the base natural logarithm.
F is standard normal CDF. For ease of interpretation of the coefficients a logistic model could be written in terms of the odd and log of odd.
According to Hosmer, D. W, and Lemeshew, S. , (1989) a logistic model could be written in terms of theodds and log of odds. The odds ratio was the ratio the probability that an individual or household would be foodinsecure (pi) to the probability of household would be food secure (1-pi).

(1-ρi) = 1/ (1+e^zi) (2)

(ρ/(1-ρi) =((1+e^zi)/(1+e^(-zi)))= e^zi (3)

(ρi/(1-ρi)) =(1+e^zi/(1+e^(-zi))) =e^((α+∑βixi)) (4)

Or taking the natural logarithm of equation

$$Zi = \ln\left[\frac{\rho i}{1-\rho i}\right] = \ln = e[\alpha + \sum_{i=1}^{m} \beta ixi] = \alpha + \beta 1x1 + \beta 2x2 - - - + \beta mx \quad (5)$$

If the disturbance term (ui) is taken to account, the logit model becomes

$$Z_i = \alpha + \sum_{i=1}^{m} \beta ixi + ui \quad (6)$$

Where x_1, x_2, x_3, ----- x_m explanatory variable
Ui is the error term
e = represents the base of natural logarithms (2.7181)
α = intercept
β_1, β2----- β_m slope of coefficient of explanatory variable in the model
Zi = a linear function of m explanatory variable (xi)
Xi= represents the i^{th} farmer explanatory variable i=1, 2, 3… m.

The parameters of the model, alpha and beta could be estimated using the maximum likelihood method.

2.5. Hypothesis

Based on review of literatures, past research findings, experts and authors knowledge of the food insecurity situation of the study area the following variables were identified as the potential determinants of household's food insecurity.

Household food insecurity (FODINS): is a dichotomous dependent variable in the model and it takes 1 if the household is food insecure, 0 otherwise. The information, which identifies the food secured from the food insecure, 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). Household beyond this threshold is said to be food secured, otherwise no. This hypothesis is supported by findings of some researchers (Abebaw S., 2003).

Family size in number (FASZ): It is an important variable, which determines the household food insecurity status in the study area. As the family size increases, the number of mouths to be fed obviously increases which shares the available food in the household. Hence, it is hypothesized that family size and food insecurity in the study area are positively related (Mulugeta, T., 2002), (Abebaw S., 2003).

Age of the household head (AGE): Age matters in any occupation. It is measured in age square. Rural households mostly devote their live time or base their livelihoods on agriculture. The older the household head, the more experience he has in farming and weather forecasting. Moreover, older persons are more risk averters and mostly they intensify and diversify their production activities. As a result, the chance for such household to be food insecure is less. In light of this, it is supported by findings of some researchers hypothesized that age of the household head and food insecurity is negatively correlated in the study area (Abebaw S., 2003).

Dependency ratio (DPR): In a household where adults or productive age groups are higher than the non-productive age groups, the probability of the household to be in shortage of food would be less, provided that the area provides good working atmosphere and production potential. The reverse is also true in that the higher the number of the nonproductive age groups, individuals whose ages are less than 14 years and greater than 64 years, in relation to the number of productive age groups of individual that the household has, the higher the probability of the household to be food in secured. Leave alone the productive potential and other issues dependency ratio in the study area is substantially high. Most individuals share what the few productive age groups produce. Accordingly, households with large dependent individual are deemed to be food insecure. Therefore, it is expected for dependency ratio to be directly related with food insecurity (Genene T., 2006).

Education (EDUC): Education of household head is treated as a continuous variable. Education equips individuals with the necessary knowledge of how to make living. Literate individuals are very ambitious to get information and use it. As agriculture is a dynamic occupation the conservation practices and agricultural production technologies are always coming up with better knowledge. So if the household head is literate he will be very prone to accept extension services and soil and water conservation practices including any other income

generating activities. Hence, in the study area different activities are undergoing and it is perceived that households who have had at least primary education or informal education are the ones more likely to participate than the others and their chance to be food secured will be higher. As a result, it is expected that education to have negative impact on food insecurity. This hypothesis is supported by findings of a study made on dimension and determinants of food insecurity among rural households in Dire Dawa areas (Abebaw S., 2003).

Cultivated land size (CLSZ): Production output is increased either by intensification or extensification. As the cultivated land size increases, provided other associated production factors remain normal, the likelihood that the holder gets more output is high. In the study area average land holding per household or per AE is very low so much that it could not support the household for an average of six months. Moreover, the fertility status of the soil of the area is not good. So that households who have large cultivated land size can have a better option to diversify production and to increase its production so a household will be in a better position in its food security status. Consequently, it was hypothesized that the larger the cultivated land the less will be the chance to be food insecure.

Irrigation (IRGN): It is a dummy variable in the model taking value 1 if the household uses irrigation, 0 otherwise. Needless to mention in areas where agriculture is the prime mover of the livelihoods of the society moisture is very crucial. If the climatic condition in a given area is promising, then it would be far better to be supplemented with irrigation so that increased production output could be attained. Therefore, since irrigation is the key technology to boost the production of the households, many agencies are trying to upgrade the existing traditional irrigation technology. As a result, many households keep on improving their production. With this justification it is hypothesized that irrigation and food insecurity are negatively related in the study area.

Total income (TOTANINC): Income determines the household's ability to secure food. It is an important variable which explains the characteristics of food secured and food insecure households. Income earned from any source improves the food security status of the household. High-income families are less likely to be food insecure. In other words, households who managed to secure larger income from any source have better chance to secure access to food they want than those households who did not. Since large income groups in the study area are better in their food security status, it is expected that total annual income and food insecurity are negatively related.

Amount of credit received (AMDT): Credit is an important source of income. Those households who received the credit they wanted have better possibility to spend on activities they want. Either they purchase agricultural input (improved seed, and fertilizer) or they purchase livestock for resale after they fattened them. All these activities increase income of the household. The possible explanation is that, in the study area, those households who were willing to participate in credit scheme and managed to earn higher amount became capable to improve their income position through performing different activities and succeeded to secure better access to food than those who were not. Moreover, in the study area, households who have easy access to credit at times of food shortage copped the risk by using the credit they got directly for food consumption. Hence it was expected that credit will have a negative impact on food insecurity.

Total livestock owned (TLU): is the total number of livestock holding of the household measured in livestock unit. Livestock play a major role in food security. Livestock are source of income for farming households. Households who have better possession of livestock are expected to be less vulnerable to food insecurity. This is so because livestock directly or indirectly contribute to household food security. The direct contribution includes meat, milk and egg for direct consumption in the household and the indirect contribution of livestock to household food security includes the draft power, manure and income from sales of livestock and livestock products which are often used for purchase of food grains during times of food shortage in the household. Therefore, it is expected that livestock holding have a negative impact on food insecurity.

Food aid received (FAID): It is a dummy variable taking a value of 1 if the household receive food aid and 0 if not. Food aid helps the households to cover their food shortfall. In addition, it is also act as an off farm income for the households that increases their income. So the access of food aid received by the household is good indicator of household food insecurity in the study area. As a result, it is expected that households who are receiving food aid are more likely to escape the risk of food insecurity.

Total off- farm income (TOFFI): Crop production output and income earned from sales of livestock and livestock products is inadequate in the farming households of the study area and often look for other income source other than agriculture to push them to the threshold of securing access to food security. So income earned from off farm activity is an important variable, which determines household food insecurity in the study area. As a result, it is expected that households who managed to earn higher off farm income are less likely to be food insecure. So that, off farm income is expected to have a negative impact on food insecurity (Tefera M., 2009).

Sex of household head (HHLD): Dummy variable taking value 1 if the household head is male, 0 otherwise. In the study area, where the environment is debilitating smallholders, farmers are not working for a long time in a day like in the highland. As a result, labor factor plays a great roll in such an area. Hence, male-headed households are in a better position to pull labor force than the female headed ones. Moreover, with regard to

farming experience males are better than the female farmers. So sex of the household head is an important determinant of food insecurity in the study area. Therefore, it was hypothesized that male-headed households are less likely to be food in-secured (Genene T., 2006)and (Guled A., 2006).

Number of ox owned (NUOXEN): There is a symbolic relationship between crop production and ox ownership in the mixed farming system. Oxen provide manure and draught power to crop cultivation therefore used to boost crop production. As a result, it is expected that number of oxen owned and food insecurity be negatively related in the study area.

Food Expenditure Pattern (FODEXPT): Household expenditure pattern on food, which includes own production consumed, has been taken to represent the major part of family's purchasing power and will be related to the size of income obtained by the household. It can be shown as the proportion of expenditure on food to total expenditure. Accordingly, those who have more purchasing power could primarily spend a substantial portion of their income on the basic necessities, particularly on food. Hence, it is hypothesized that the proportion of household expenditure on food for poor consumer is negatively correlated with the household food insecurity status.

3. RESULT AND DISCUSSION

3.1. Food Insecurity Status of the Households

The food security status of the household was best measured by direct survey of income, expenditure and consumption and comparing it with the minimum subsistence requirement was used to identify the two groups. For this study the daily calorie consumption per AE per day was used to identify food secure and food insecure households. The households' food security status was measured by direct survey of consumption. The data on available food for consumption from own production or purchased or from stock for the seven days' back was collected and converted to Kilocalorie and then divided for AE's of the households (Sisay, B., 2012).

After that this energy level was compared with the minimum subsistence energy requirement per AE per day, 2100kcal. Following this procedure 131that means 38.76% of the sample households were unable to meet their minimum energy requirements and 207 which means 61.24% sample households were found to meet their minimum energy requirements. The mean differences among the two groups on hypothesized variables were computed and found that food insecure and food secure household groups revealed significant mean differences with respect to some socio-economic variables like family size, total off-farm income/AE, total annual income/AE, food expenditure pattern/AE, age square of household head, dependency ratio, cultivated land size in hectare, number of oxen owned, total livestock owned, education level of the household head, and amount of credit received/AE were found significant at less than 1 percent probability level (Table 3.1).

On top of that out of 3 hypothesized categorical variables, sex of the household head, use of irrigation and access to food aid received, were analyzed and found that the two sample groups were differentiated in mean with respect to use of irrigation, and sex of household head at 5% and 1% probability level respectively (Table 3.2).

Table 3.1 Summary Statistics of continuous variables included in the model

Variable	Food Insecure=131		Food Secure=207		t-Value
	Mean	SD	Mean	SD	
FASZ	7.80	1.78	5.24	1.45	14.58***
AGE	45.42	11.27	38.20	10.30	5.95***
DPR	1.98	0.94	0.98	0.54	12.42***
EDUC	3.05	3.22	5.49	3.41	-6.35***
CLSZ	2.03	1.04	2.79	1.25	-5.86***
TOTANINC	2362.21	1374.73	5410.85	2504.10	-14.42***
AMDT	205.79	320.76	391.20	628.51	-3.57***
TLU	6.50	3.11	12.04	4.82	-12.82***
TOFFI	68.66	203.84	213.20	559.32	-3.38***
NUOXEN	1.41	0.94	3.11	1.43	-12.82***
FODEXPT	2402.85	1163.47	5487.96	2312.82	-16.22***

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

Table 3.2Summary statics of dummy variables

Variable	Score	Food insecure (N=131)		Food Secure (N=207)		X^2
		Number	Percent	Number	Percent	
HHLDS	Male	101	77.10	189	91.3	13.28***
	Female	30	22.9	18	8.7	
IRGN	Irrigation users	34	25. 95	76	36.71	4.23**
	Non irrigation users	97	74.05	131	63.29	
FAID	Receive food aid	26	19.85	53	25.60	1.48
	Not received food aid	105	80.15	154	74.40	

***, **, Significant at 1% and 5% probability level respectively
Source: Survey Result

To test the extent and severity of food insecurity the FGT indices was used. It was specified as:

$$P(\alpha) = \frac{1}{n}\sum_{i=1}^{q}\left[\frac{m-\gamma i}{m}\right]^{\alpha}$$

Where:

P= number of food insecure households
n=is the number of sample households;
yi= is the measure of per adult equivalent food calorie intake of the i^{th} household;
m =represents the cutoff between food security and insecurity (expressed here in terms of caloric requirements);
α=is the weight attached to the severity of food insecurity.
In equation, m-yi = 0 if yi> m.

The three FGT indices employed were head count index, food insecurity gap and severity of food insecurity. The study result revealed that the head count ratio or incidence of food insecurity are 0.387 which indicates that about 38.7% percent of the sampled households cannot meet the daily recommended calorie intake of the household i.e. consuming below 2100 kcal/AE/day set by the Ethiopian health and nutrition institution and the household's food insecurity gap of the sampled household was calculated and found to be about 0.084.This is to mean that if the government or other non-government planned to mobilize and distribute resources that can meet the 8.4 percent of the caloric requirement of every food insecure households the food insecurity can be eliminated.

Assuming that the sampled households represents the whole woreda there are about 11425 households with a total population of 80105 for the study woreda, and based on the average Adult equivalent the total AE of the study area constitutes 54040.25AE. Considering the daily caloric requirements of the AE i.e.2100kcal/AE/day, the amount of resource required to bring all households to the daily requirements (at least to the minimum subsistence caloric requirements of 2100 kcal) is estimated to(F*n*2100kcal) becomes as 0.084*54040.25*2100kcal gives 9532700.1kcalper AE per day was required to bring all households to the minimum calorie requirements. When this was converted to cereals that constitute 3410kcal/kg leads to about 2795.52kg cereals or about 27.96 quintals of cereals per day was required to eliminate food insecurity in the study area. This shows about 10203.63 quintals of cereals or comparable amount of money that purchase this amount of cereal per year was required to eliminate food insecurity in the study woreda or to bring all households to obtain daily subsistence caloric energy in a year. Finally, to approach the most food insecure sample households, severity of food insecurity was calculated by assigning a higher weight, α =2. Thus, the survey result indicated that the severity of food insecurity becomes 0.0264.

In a similar way the incidence of household food insecurity was affected by some household factors like demographic (household head sex, age, education, and family size) and services (irrigation, credit and cultivated land size) of the households. The prevalence of food insecurity among households shows that as family size increases the incidence of food insecurity increases which was confirmed by the incidence of food insecurity of the households showed that the households with having family size of between 11-14 were about 19 times of the households having family size of less than or equal to 4 members.

In line to education level, the head count index is decreasing as education level of the household is increasing. With regard to gender of household head, female-headed households have higher incidence of food insecurity than male-headed ones, i.e., 62.5percent and 34.83 percent, respectively. Likewise, prevalence of food insecurity declines as farm size per capta of the household increases. This also supports the logit output result. On top of that the amount of credit received per AE was hypothesized as it was negatively correlated with household food insecurity. As the prior expectations the incidence of household food insecurity decreases as the amount of credit received per AE increases (Table 3.3 below confirms the result).

In considering of the use of irrigation system the users of irrigation were less in incidence of food insecurity than the non-users of irrigations. As it can be seen on the table below the head count ratio for

irrigation users and non-users was 30.91 percent and 42.54 percent respectively. This negative correlation of incidence of food insecurity and Use of irrigation supports the logit-output and the prior expectations (Table 3.3).

Table 3.3 Distribution of Incidence of food insecurity by household factors

House Hold Factor	Grouping Criteria	HHs Number	Number of food insecure HHs	Incidence Of food insecure
Family Size	<=4	69	4	5.79
	5-7	189	58	30.69
	8-10	72	61	84.73
	11-14	8	8	100
	Total	338	131	38.76
Age of HH head	<=25	12	2	16.67
	26-45	230	78	33.91
	46-64	74	35	47.30
	>=65	22	16	72.73
	Over all	338	131	38.76
Sex of HH head	Male	290	101	34.83
	Female	48	30	62.5
	Over all	338	131	38.76
Education level	Illiterate	85	48	56.47
	Grade 1-4	82	44	53.66
	Grade 5-8	110	26	23.64
	Grade 9-10	51	11	21.57
	Grade11-12	10	2	20
	Over all	338	131	38.76
Cultivated Land Size	<0.25	75	59	78.67
	0.25-0.50	161	62	38.51
	0.50-0.75	55	6	10.91
	0.7501-1.00	33	3	9.10
	>1.00	14	1	7.15
	Total	338	131	38.76
Amount of Credit Received/AE	<100	215	81	37.67
	100-500	30	25	83.33
	500-1000	55	23	41.82
	1000-1500	27	1	3.71
	>=1500	11	1	9.10
	Total	338	131	38.76
Use of Irrigation	User	110	34	30.91
	Non User	228	97	42.54
	Over all	338	131	38.76

Source: Survey Result

3.2. Results of Econometric Analysis

Logit model was employed to analyze the effects of fourteen determinants of household food insecurity of hypothesized explanatory variables from a randomly selected 338 households of five kebeles of the study area. For this study the variable food insecurity (FODINS) was used as a dichotomous dependent variable, with an expected mean value of 1, implying the probability of being food insecure and 0 indicating the probability of a household to be food secures. The model was estimated using STATA version 12. Codes, types and definitions of the variables were depicted in Table 3.4; and the maximum likelihood binary logit estimates were presented in table 3.4 respectively. Before fitting the logit model, all the necessary tests were conducted.

The result of the binary logistic regression model estimate revealed that out of the thirteen explanatory variables hypothesized to influence household food insecurity in the study area, seven variables namely household head sex, age square of the household head, education level of household head, family size of the household, cultivated land size of the household, proportion of food expenditure pattern, and tropical livestock unit were found to have a significant influence on the probability of being food insecure in the study area (Table 3.5).

Table 3.4. Variable Code, type and definition of variables included in the Logit Model

Variable code	Variable Type	Definition of variables
FASZ	Continuous	Family size in number
AGE	Continuous	Age square of the household head in years
DPR	Continuous	Dependency ratio in number
EDUC	Continuous	Education level of household head
CLSZ	Continuous	Cultivated land size in hectare
AMDT	Continuous	Amount of Credit received per AE in birr
TLU	Continuous	Total livestock unit owned in TLU
TOFFI	Continuous	Total off farm income pert AE in birr
NUOXEN	Continuous	Number of oxen owned in number
FODEXPT	Continuous	Proportion of food expenditure pattern per AE in birr
IRGN	Dummy	Use of Irrigation (1 for users and 0 otherwise)
FAID	Dummy	Food Aid Received(1 for access to aid and 0 otherwise)
HHLDS	Dummy	Household Head Sex(1 for male and 0 for female headed)

Table 3.5. The Maximum Likelihood Estimates of the Logit Model

FODINS	Coefficient	Std. Err.	Z	P>z	Odds Ratio	Marginal effect
FASZ	.56	.175	3.18***	0.001	1.75	0.084
AGE	.001	.0003	2.26**	0.024	1.001	.0001
CLSZ	-1.02	.52	-1.96**	0.050	2.76	-.16
EDUC	-.59	.24	-2.45**	0.014	.56	-.091
HHLDS	-1.84	.71	-2.62***	0.009	.16	-.38
DPR	.41	.28	1.46	0.143	1.50	.063
IRGN	-.33	.46	-0.71	0.475	1.40	-.051
AMDT	-0.001	.001	-0.86	0.389	.99	-.0001
FAID	-.14	.21	-0.68	0.495	1.20	-.022
FODEPT	-.001	.0002	-3.14***	0.002	0.99	-.0001
TLU	-.18	.062	-2.95***	0.003	.84	-.03
NUOXEN	-.02	.07	-0.20	0.844	.99	-.002
TOFFI	-.001	.001	-0.61	0.545	.99	-.0001
_CONS	-2.03	1.92	-1.06	0.290	.13	
Number of obs=338				Log likelihood= -80.14		
Wald Chi2(13) =291.06				Pseudo R2=0.6449		
Prob>Ch2=0.0000				Sensitivity 87.79%		
Correctly classified 89.94%				Specificity 91.30%		

***, **, & * indicates the level of significance of variables at 1%, 5% & 10% respectively

Dy/dx is for discrete change of dummy variable

Source: own computation from Model output.

In light of the above summarized model results possible explanation for each significant independent variable are given one by one as follows.

Family size was positively related and it was found to be highly significant to determine household food insecurity at less than 1percentprobability level. The odds ratio in favor of food insecurity, ceteris paribus, increases by a factor of 1.75 as the family size increases by one number. This indicates that larger household size tends to be more food insecure compared to smaller family size in the study area. The possible increase in household size implies more mouth to be fed from the limited resources and in an area where households depend on less productive agricultural land, increasing household size results in increased demand for food. But this demand will not be matched with the existing food supply so ultimately end up with food insecurity. The marginal effect of family size revealed that the probability of being food insecure will increase by approximately 8.4% with one additional family member in number. This result is in conformity with the findings of(Abebaw S., 2003)(Frehiwot F., 2007); and(Getachew D., 2003).

The age square of the household head was expected to have negative effect on food insecurity of the household head unfortunately the result of the logit model revealed that the sign was positive and significant. The positive relationship indicates that the odds ratio in favor of the probability of being food insecure increases with an increase in age square of a house hold head. Keeping other things constant the odds ratio in favor of food insecurity increases by a factor of 1.001as the age square of the household increases by one year. The possible reason could be as the age of the person increase they transfer their land to others, they couldn't participate in

other income generating activities and older household heads are less productive and they lead their life by remittance and gifts. On the other hand, older households have large number of families and their resources were distributed among their members. The marginal effect of age of household head indicates that the probability of being food insecure will increase by approximately 0.01%when age square of the household increases by one year. This result confirms with other findings of(Abebaw S., 2003), and (Frehiwot F., 2007).

The model output revealed that education of the household head affects food insecurity status negatively and significantly at5% probability level. The negative relationship indicates that as the education level of the household head increases the chance for the household to be food insecure decreases. Keeping other variables constant the odds ratio in favor of food insecurity decreases the probability of a household being food insecure by a factor of 0.56 as education of the household increases by one level. This is due to educated individual largely contribute on work efficiency, in willing to adopt new technologies, accepting extension service advice, diversifying income, becoming visionary in educating his family, producing market oriented crops than illiterate ones. It is similar with what the findings of (Ramakrishna,G. and Asseffa,D., 2002) and(Haile, K, Alemu G., and Kudhlande,G. , 2005). The marginal effect of education level of the household head indicates that the probability of being food insecure will decrease by approximately 9.1 percent when the level of education of household increases by one year(level).Therefore the finding of this study was found consistent with what had been found by (Girma Gezmu, 2012)and(Aschalew, 2006).

The logit-output result revealed that household sex influences household food insecurity negatively and significantly at 1% probability level. The odds ratio in favor of food insecurity decreases by a factor of0.16 as the sex of the household head become male. This is to mean that male headed households are more food secure than female headed households. This is mainly because of differences between male and female heads to participate in non-farm activities that help to generate income(Adane T., 2008). On top of that male headed household have more exposure (have more opportunity) to real environment, receiving information, access to social services than female headed households. The marginal effect of household head sex indicates that the probability of a household to be food insecure decreases by approximately 38 percent when sex of household head become male. The finding was in agreement with prior expectations and also found consistent with findings of (Tsegaye Gebrehiwot, 2009).

Consistent with the hypothesis, cultivated land size influences household food insecurity negatively and significantly at less than 5% probability level. The negative sign of the result implies that households that have larger cultivated land size have less risk of food insecurity than the smaller ones. Keeping other things constant, the odds ratio in favor of food insecurity is decreased by a factor of2.76 as the size of cultivated land of the household increases by one (1) hectare. The possible justification is that farm households who had larger farm size had better chance to produce more, to diversify the crop they produce and to get larger volume of crop residues. On top of that larger farms are associated with greater wealth and income and increased availability of capital, which increase the probability of investment in purchase of farm inputs that increase food production and ensuring food security. The marginal effect of households cultivated land size indicates that the probability of a household to be food insecure decreases by approximately 16 percent as the size of cultivated land size of the household increases by 1 hectare. This result is in an agreement with the prior expectations and supported by the findings of (Getachew D., 2003), and(Mulugeta, T., 2002).

More over Food Expenditure Pattern is significantly and negatively associated with food insecurity status of the households in the study area at less than 1 percent probability level. The odds ratio of the logit model result revealed that the probability of a household to be food insecure will decrease by a factor of 0.99 as the proportion of food expenditure per AE increases by one birr (Unit). The possible explanation for this is that farmers, who have good purchasing power or spend high proportion of income on food, have the likelihood of becoming food secure than those whose expenditure on food is relatively small. Or the proportion of expenditure on food increases, access to food by household also increases to the amount needed for household consumption. In addition, the amount of expenditure that a household incur is a good indication of income that the household have, the more the income the more food expenditure he pays for living standard. The marginal effect of the variable proportion of household food expenditure pattern of the logit result revealed that the probability of a household to be food insecure will decrease approximately by 0.01 % as the share of food expenditure per AE increases by one unit. This result was in an agreement with the prior expectations and also confirmed by other studies of (Aschalew, 2006),(Mulugeta, T., 2002)and(Frehiwot F., 2007).

The logit-output result of livestock holding revealed that it was negatively and statistically significant at less than 1 % probability level. This is an indication that ownership of livestock acts as a hedge against food insecurity in the study area. The possible explanation for the negative relationship is that livestock besides its contribution to the subsistence need and nutritional requirement, and crop production by provision of manure, it also serves as accumulations of wealth so that disposed during times of need, especially when food stock in the household deteriorate and also it is to mean that herd sizes being a proxy for farmer's resource endowment, those sample farmers with large herd size have better chance to earn more income from livestock production. This in

turn enables them to purchase food when they are in short of their stock, and invest in purchase off-farm inputs that increase food production, and thus ensuring food security at household level. Keeping other things constant the odds ratio in favor of food insecurity decreases by a factor of 0.84 as the amount of livestock of the household rises by one TLU. The marginal effect of the variable, total livestock unit revealed that the probability of a household to be food insecure will decrease approximately by 3% as the total livestock unit increase by one unit in TLU.The result is supported by the studies of(Getachew D., 2003),(Mulugeta, T., 2002),(Abebaw S., 2003) and (Mequanint M., 2008).

4. SUMMARY

The study was conducted with the objective to study food insecurity situation, identifying the intensity of food insecurity, mainly the incidence of food insecurity, food insecurity gap and severity and also further identifying the determinants of food insecurity in the study area. The study was conducted with the specific objective of examining food insecurity determinants and intensity of food insecurity. To come up with the objective of the study, it was realized through conducting a household survey from randomly selected five kebeles of the woreda by collecting a data from a randomly selected 338 rural household head. Household demographics, and other data deemed to be relevant were collected, organized, analyzed and interpreted to come up with possible results. The analysis employed both descriptive statistics and econometric methods. Descriptive statistics were employed to describe household characteristics with food insecurity status.

Binary logistic model was specified to identify determinants of food insecurity and FGT indices were used for the computation of incidence and severity of food insecurity among sample households. The sample households were classified into food secure and food insecure groups based on kcal actually consumed by collecting the food consumed by the households during the seven days back of survey date either through purchase or other means. The total amount of food consumed by each household during the survey date were converted into their equivalent kcal per AE and then compared with the recommended daily kcal per AE according to the daily kcal contents of the commodity type(Appendix-1).

Total daily food energy per adult equivalent 2100kcal was considered as cutoff point between food secure and food insecure households. To this reality the result of the study revealed that about 207(61.24%) and 131 (38.76%) of the households were became food secure and food insecure households respectively. As discussed on the methodology part the study employed both descriptive and econometric method to analyze the result. So the descriptive statistics analyzed the households mean difference in household family size,sex of the household head, household food expenditure pattern, education level of the household head, cultivated land size of the household in hectare, total live stock holding of the household in TLU,Use of irrigation, annual income per AE,Access to food aid, Amount of credit received per AE ,Number of Oxen owned by the household head, Age of the household head, Total off farm income, Dependency ratio, were analyzed and discussed as follows.

The descriptive t- test statistics for mean difference on Family size, Age of household head, and dependency ratio, were positively and significantly differs in their mean between the two groups at less than 1 percent probability level, However Education level of the household head, Food Expenditure pattern, Total annual income, Total off farm income, Total Livestock in TLU ,Number of oxen owned, cultivated land size, were found differ in their mean at less than 1 percent probability level and correlated negatively with the household food insecurity at the study area. On top of that the Chi square test for Food aid received, House hold head sex, and use of irrigation were analyzed and found that Household head sex and Use of irrigation was significant at 1percent and 5 percent probability level respectively. But the descriptive result for amount of credit received and access to food aid were statistically insignificant between the two groups at the study area. Binary logit econometric model was employed to estimate determinants of the probability of being food insecure as a function of various household characteristics among sampled Diga woreda rural households. From the 13 explanatory variables hypothesized and entered into the logit model as the determinants of household food insecurity, as a factors seven out of thirteen variables namely Family size,sex of the household head, proportion of food expenditure, and Total livestock unit were significant at less than one percent probability level where as Age square of the household head, Education level of the household head, and Cultivated land size were found to be statistically significant with the hypothesized signs as the determinants of household food insecurity in the study area except the household head age square that was statistically significant but opposite in sign with the hypothesized at less 5 percent probability level.

To test the intensity of food insecurity the FGT was employed and found the head count ratio (incidence of food insecurity) revealed that 38.76 percent and 61.24 percent of sampled households in the study area were found to be food insecure and food secure respectively. The gap and severity of food insecurity were estimated to be 8.4percent and 2.64 percent respectively. Considering the daily recommended 2100 kcal per adult equivalent; a resource needed to bring all households to daily subsistence requirement amounted to 9532700.1kcal per day. This shows daily requirements estimate of 27.56quintals of cereal per day which is equivalent to 10203.63 quintals per year. This study highlighted to come up with the result of the analysis with

the defined scope; however, a lot remained to be unanswered.

To give a relevant information on the determinants and level of food insecurity, the social, political, and environmental dimensions, roles of rural agriculture, lively hoods of the rural poor, purchasing patterns of food insecure, coping mechanisms demands future researchers' attention to give areal, crude, concrete information and all sided food insecurity situations of the study area.

4.1. Conclusion

The study deals with the level and determinants of food insecurity among rural households of east wollega zone the case of Diga woreda. The results of the study revealed that family size and Age of the household head, were positively and significantly affects food insecurity at the study area where as cultivated land size, Total food expenditure, education level of the household head, Total livestock unit and sex of the household head being male influences household food insecurity significantly and negatively. We examined the determinants of food insecurity, Surprisingly, the result does not support the importance of food aid received, Use of Irrigation, number of oxen owned and amount of credit received in the study area. This unexpected result was due to the credit delivering institution does not separate them to food secure and insecure households while delivering the credit. On top of that the importance of oxen and application of irrigation scheme was not as such important factor in influencing food insecurity situation of the study area.

4.2. Recommendations and Policy Implications

The result of the study underlines that the determinants of household food insecurity are complex and interrelated, requiring a multifaceted and all round interventions for improving the state and eventually alleviating the problem. This study examines the level and determinants of food insecurity at household level specifically of the Diga woreda rural households. Among the thirteen variables that were fitted to the logit model seven of them were found statistically significant. So based on the study result the possible policy recommendations and areas of interventions that emanate from the results of the research study are presented as in the following paragraphs.

Household family size was found to be directly related with household food insecurity. According to the result of the study family size was found significant among the major factors that lead households more vulnerable to food insecurity. As most related studies indicated in Ethiopia the proportion of population growth and level of food and agricultural production could not match each other that mean they did not meet the growing demand of farming community. This is to mean that the rate of food and agricultural production often grows slowly compared to the rate of growth in population. In line to this proper attention should be given to limit the rapid population growth in the study area. Activities that lead to boost agricultural production on one hand and limiting the fast growing population on the other hand are crucial to meet the demand of food. Government and non-government organizations working in the area are supposed to focus on intensive agriculture, integrated health and education services and family planning to equate food supply and demand equation in the long term. In addition, the policy that limits the acceptable number of children should be encouraged. On top of that, action based awareness creation on the impacts of population growth at the family, community and national level should be strongly advocated that lead to reduction in fertility and lengthen birth spacing should encourage households having acceptable number of children through provision of especial offer such as covering schooling cost, giving training and other related incentives.

The study has provided evidence that gender of head of a household play a key role in determining food security status of households. Thus, gender-sensitive food insecurity alleviation policies that enhance endowments of female-headed households should be a key ingredient of food insecurity reduction strategy.

Age has positive impact on food insecurity. This means older households are more likely to be food insecure. Therefore, capacity building for old household heads should be given, and the policy that encourages old aged individuals and subsidize them should be encouraged. Also it is best if the social security issue that supports the households of the old age like that of government employees pension contribution should be designed to support the older households. In addition, a policy that encourages shareholding institution should be promoted to help the households at their old age from their contribution.

Reforms must be introduced in education system to make it productive in terms of food security. Special emphasis must be given to education for every member of the household. The effect of education on household food security confirms the significant role of the variable in consideration for betterment of living condition. The more household head educated, the higher will be the probability of educating family member and familiar with modern technology, which the twenty first century so badly demands. So, strengthening both formal and informal education and vocational or skill training should be promoted to reduce food insecurity in the study area. In addition, a policy that encourage adult education program should be designed. Generally, to address the issue of illiteracy, based on the Sustainable Development Goal (SDGS), rural household heads' enrolment ratio in adult education should be increased.

Size of cultivated land was found to have negative influence on household food insecurity. Agricultural strategies should be designed and implemented that would have effect on maintaining the existing land size on one hand and promoting intensive agriculture and livestock production on the other hand. Measures such as appropriate land use, improved technologies and proper extension services should be in place to raise land productivity. Rural development plans should include government and nongovernmental organization in promoting biophysical conservation activities, use of improved seed and fertilizers, intensification of agricultural production should be emphasized.

Both livestock ownership and food insecurity have Negative association. Sticking to the findings of this study, livestock sub sector plays a great role in the struggle to eliminate food insecurity. Despite its prominent role in household food security, this sector has received less attention as compared to crop production. Thus, besides physical availability of animal health services, trained health personnel and necessary medical equipment and supplies should be fulfilled in the study area. Moreover, the introduction and distribution of crossbreed animals should be widely implemented to increase the productivity of livestock. Hence, necessary effort should be made to improve the production and productivity of the sector. This can be done through the provision of adequate veterinary services, improved water supply points, introduction of timely and effective artificial insemination services to up-grade the already existing breeds, launching sustainable and effective forage development program, provision of training for the livestock holders on how to improve their production and productivity, and improving the marketing conditions. Generally, Livestock was found as an important source of wealth that could contribute to food security in the study area. Hence, the output of the livestock sector should be strengthened through the provision or supply of better veterinary services.

The proportion of food expenditure pattern of the household and food insecurity in the study area was inversely related. Income and expenditure are the same coin of different faces. That means expenditure is the function of income. Therefore, increase in food expenditure decreases the food insecurity of the households. Moreover, rural households in the study area have very limited room for generation of income. Hence, for these households to enhance their welfare in general and food security in particular, they must have diversified access to income alternatives. In the face of this, provision of credit must be taken as a measure, though not the only one, to build the capacity of household to invest in the agricultural sector, such as purchase of fertilizer, pesticides, improved seed, live and productive animals. Moreover, development strategies should be able to identify income alternatives other than agriculture. In light of this, non-governmental organizations that are not focusing on agriculture should also channel their scarce resources to creation of income generating activities, trading, crafting, etc. which would greatly help in strengthening off-farm activities which would enable the households to secure their food through purchase. Therefore, the policy that enhances the diversified income of the poor rural house hold should be promoted.

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Appendix 1. Calorie value of food items consumed by sample households

Food group Item	Unit	Mean Kcal	Food group Item	Unit	Mean Kcal
Cereals	Kg	3410	Oil and fats		
Maize			Butter	Kg	8120
Teff			Oil		
Sorghum			Vegetables	Kg	370
Finger millet			Onion		
Barley			Tomato		
Wheat			Sweet Potato		
Oats			Beetroot		
Lentils			Cabbage		
Pulses	Kg	3450	Black pepper		
Beans			Carrot		
Peas			Irish Potato		
Cow pea			Coffee/Tea	Kg	1190
Chickpea			Coffee		
Soybean			Tea		
Salt/Sugar	Kg	1780	Spices	Kg	2970
Salt			Meat	Kg	1148
Sugar			Milk and milk products	Lt	737

Source: (EHNRI, 1998)

Appendix 3. Conversion factor used to calculate adult equivalent

Age Category(years)	Female	Male
Less than 10 years	0.6	0.6
10-13 years	0.8	0.9
14-16years	0.75	1.00
17-50years	0.75	1.00
Above 50 years	0.75	1.00

Source: Strock etal (1991) adopted from (Abebaw S., 2003)

Appendix 4: Conversion factors used to Estimate Tropical Livestock Unit (TLU) Equivalents

Animal Category	TLU
Calf	0.25
Donkey (young)	0.35
Weaned Calf	0.34
Camel	1.25
Heifer	0.75
Sheep and Goat (adult)	0.13
Cow and Ox	1.00
Sheep and Goat (young)	0.06
Horse	1.10
Chicken	0.013
Donkey (adult)	0.70

Source: Storck, *et al*. (1991) adopted from (Aschalew, F, 2006)