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Determinants of household food security in southern Tigray, northern Ethiopia

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Abstract
The objective of this study is to examine the determinant of household food security in Southern part of Tigray Regional State, Northern Ethiopia. To achieve this objective, both primary and secondary sources were employed to collect the data for the study area. Descriptive statistics and logistic regression model were used to analyze the determinant of household food security in the study area. The results show that livestock ownership, land holding size, age of head, amount of rain fall, concrete river diversion and deep well irrigation were robust and positively influence food security while family size had a negative effect.

Keywords: food security, households, determinant

1. Introduction
The world still faces a great challenge in ending extreme poverty and improving prospects for the poorest. According to [1], estimates of the poverty impact of the growth slowdown range from 55 million to 90 million more extreme poor in 2009 than expected before the crisis. However, the food crisis and the global financial crisis are reversing past gains in fighting hunger and malnutrition. Before the onset of the food crisis in 2007, there were about 850 million chronically hungry people in the developing world. This number rose to 960 million people in 2008 and is expected to climb past 1 billion in 2009, breaking the declining trend in the proportion of hungry people in the developing world are seriously jeopardizing the goal of halving this proportion by 2015 [2].
Even though food security is currently a global issue, the problem of food insecurity is still more pronounced in developing countries. Estimates indicate that more than one billion people worldwide continue to live on less than $1.25 per day which 80% percent of this one billion is found in Sub-Saharan Africa (415 million) and South Asia (399 million) are in developing countries, Nevertheless, based on the 2011 data, slightly more than one billion people globally-around 17 percent of the developing world's population-continue to live on less than $1.25 per day [3]. Almost three-fifths of the world's extreme poor are concentrated in Bangladesh, China, the Democratic Republic of Congo, India, and Nigeria.
Sub-Saharan Africa has the highest share of food-insecure people, with 31.7 percent of the population (301 million people) food insecure in 2017. The 39 Sub-Saharan Africa countries vary considerably in their food security status. Nine countries have more than half of their population food insecure. Five countries- Burundi, Central African Republic (CAR), Democratic Republic of Congo (DR Congo), Eritrea, and Liberia-have more than 70 percent of their population food insecure in 2017. The intensity of food insecurity is highest in the SSA region-at 478 calories per capita per day, representing a food gap of 55.4 kg per food-insecure person per year [4].
According to [5] stated that El Niño drought is one of the strongest droughts that have been documented in Ethiopian history were more than 27 million people become food insecure and 18.1 million people require food assistance in 2016. Food insecure households are typically resource-poor and highly vulnerable to shocks. To combat this problem, the Ethiopian Government has designed food security policy and strategy [6].
To address food insecurity, the government of Ethiopia is taking a strong leadership role with programs that meet the varying needs of vulnerable households [7]. Besides the government together with international development agency have taken a number of steps to reduce poverty, improve productivity, and increase the incomes of smallholder farmers for the last several years. However, poverty and food insecurity is still a big obstacle to overcome in Ethiopia. Nearly one third of the population lives below the poverty line, and a vast majority depends on subsistence agriculture. Chronic and acute food insecurity are prevalent, especially among rural populations and smallholder farmers. About 10 percent of Ethiopia's citizens are chronically food insecure, and this figure rises to more than 15 percent during frequent drought years [7].
Various studies have been carried out to identify the determinants of food security at household levels in different rural areas. Different studies identified as major determinants

of farm households' food security in Ethiopia such as family size gender, educational attainment, age of the household head; income and consumption patterns, food and input prices, land size, productivity, fertilizer application, ownership of cattle, rainfall, oxen ownership [8, 9, 10, 11, 12, 13].

Ethiopian farmers live in different agroecology areas and may have looking different challenges in securing adequate food at household level. Due to the presence of spatial and temporal variations throughout the country, the determinant of food security may differs across geographic space and time. Moreover, despite the depth of the problem of food security in Ethiopia, there is relatively little empirical research on the subject.

Therefore, the objective of this study is to examining the determinant of household food security in Southern part of Tigray Regional State, Northern Ethiopia.

2. Study area and research methodology

2.1 Description of the study area

Tigray region is one of the nine regional states of Ethiopia established in 1993 and located in the northernmost reaches of Ethiopia. The region is astronomically situated between $12^0 15'$ to $14^0 57'$ North latitude and $36^0 27'$- $39^0 59'$ East longitude with an area of 54,593 km^2. It is bordered by Eritrea in the north, Sudan to the west, Amhara to the south and Afar in the east [14].

The region is administratively divided in to seven zones: Western zone, Northwestern zone, Central zone, Eastern zone, South-eastern zone, Mekelle zone and Southern zone, comprising a total of 47 Woredas and 767 Tabias. Each woreda is subdivided in to Tabias", again each "Kebelles" is subdivided in to Kushet, which are the lowest units in administrative hierarchy.

According to the 2007 Population and Housing Census, the total population of Tigray was 4,327,342. Based on the base year of 1999 EC projection, the total population for 2012 was estimated to be 4,772,782 [14].

The landform of Tigray is complex: composed of highlands (in the range of 2300 to 3200 meters above sea level, (masl), lowland plains (with an altitude range of less than 500 to 1500 masl)1, mountain peaks (as high as 3935 masl) and high to moderate relief hills (1600-2200 masl). On the basis of altitude six major types of agro-ecological zones are identified: upper Dega, Dega, Weyena dega, upper Kola, Lower Kola and Wurch. Kola (lowland) 53 per cent, weyena dega (midland) 39 per cent and dega (high/upper land) 8 per cent where temperature ranges from 12 0c in some highlands to 40 0c. Most parts of the region have an annual temperature between 15 ^{0}c- 17 ^{0}c.

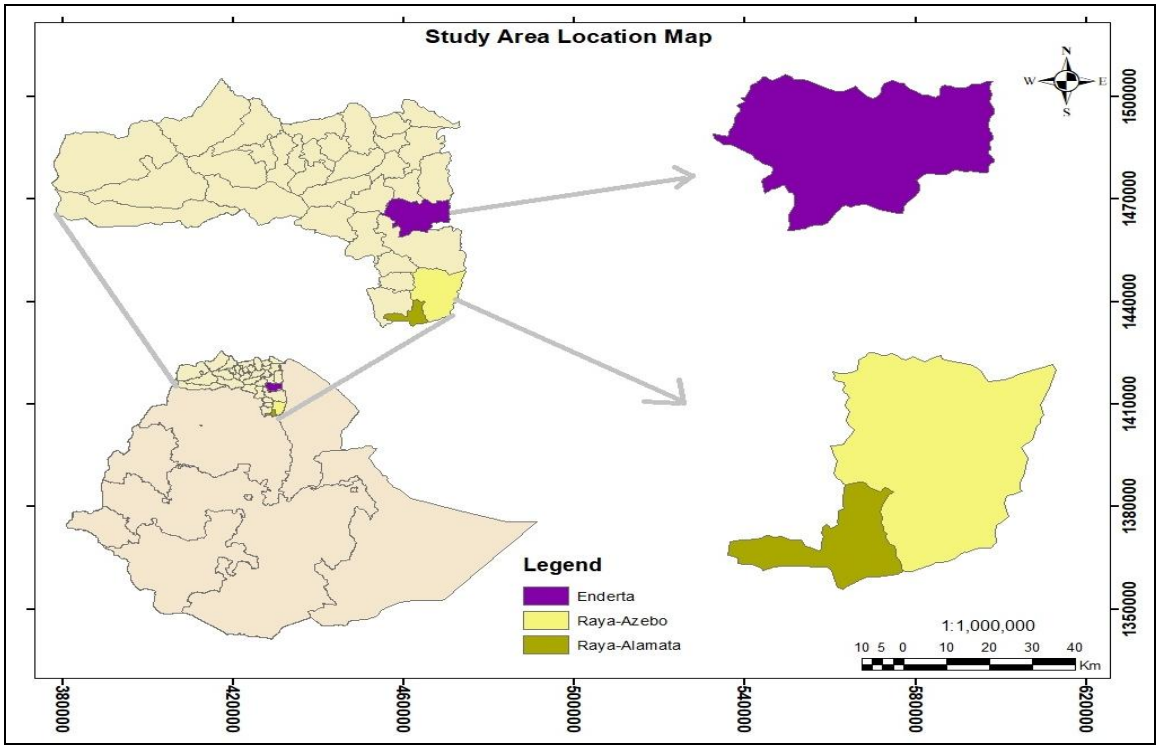

Fig 1: Location map of the study area

The rainfall condition of the region is characterized by erratic and variable both temporally and spatially resulting for the occurrence of frequent drought. The amount of rainfall in the region increase with altitude from East to West and decreases from South to North direction. Average rainfall varies from about 200mm in the northeast lowland to over 1000mm in the south western highlands.

In Tigray Agriculture is the main economic stay and means of livelihood to the majority of the rural people. It is characterized by traditional mixed farming as it includes both crop production and livestock rearing, dependent mainly on rainfall. In most areas of the region the crop pattern comprises of cereals (Teff, barely, wheat, maize, and sorghum), pulses, oil seeds, vegetables, spices, fruits. Livestock production is a

major component of the agricultural economy of Tigray region and goes to beyond direct production. Sales of livestock and their products provide direct cash income to farmers. Livestock are the living banks of main farmers and have critical role in the agricultural intensification process through provision of drought power and manure for fertilizer and energy [14].

2.2. Research Methodology

2.2.1. Research Design

The study adopted a cross-sectional survey research design as its framework to guide the process of data collection. According to [15], cross-sectional survey research design is the collection of data mainly using questionnaires or structured interviews to capture quantitative or qualitative data at a single point in time. It also provides information in a short amount of time for administering the survey and collecting the information [16].

To assess the impact of irrigation on the poverty reduction and on the contribution of enhancing to food security, quantitative research methodology was used to achieve the objectives of the study.

2.2.2. Study Area and Beneficiary Selection Procedure

The data for this study were collected from a household survey conduct in the rural woredas of Rayaalamata, Rayaazebo and Enderta woredas. Multi-stage sampling technique were employed to pick the sample households. Accordingly, in the first stage, they were purposively selected. Due to the presence of irrigation intervention availability and highly affected by recurrent drought were taken into consideration in the selection of woredas to include in the study. In the second stage five tabias were selected purposively from these sample woredas. This is due to the presence of a large number of beneficiary, their accessibility and proximity, the study tabias were chosen. The third stage, using stratified sampling technique; the population under study were grouped into two classes: irrigation beneficiaries and non-beneficiaries. A household list in the selected tabais were obtained from tabia administration. For each study site the sample size proportional to the entire population of the respective tabias were determined, and hence the samples were self-weighting [17]. Then from each sample study tabias, irrigation user and non-irrigation user households were selected for the household survey. The sample size for each tabia were determined based on a proportional probability sampling method. Based on this multi stage sampling process a total of 340 households were selected on a random sampling basis from 5 tabias in study areas.

2.2.3. Data Sources

A single household was taken as the basic survey unit for the analysis. A household was defined as a number of people (it may be only one person) living and eating together in the same dwelling who share the same budget. Given that the household is a production unit, a farm is defined as all the agricultural activities under the control of the household members [18]. Both primary and secondary sources were employed to collect the data for the study area.

2.2.4. Methods of analysis

This title examines determinants of household food security among rural households in the study area. In our study, one month calories consumption have been used to assess the household's food security status. First each of food items consumed was converted in to calorie adjusted for household age and sex composition using the national food composition table compiled by Ethiopian health and nutritional research institute [19]. The calorie consumption among the members of the household and across the households may vary due to the variation in age, sex, body size climate and quality of diet. Seconder all consumed food calories were then summed up and converted in to daily amounts. Finally, the aggregated food calories were adjusted to an adult equivalent unit per household. The minimum level defined by Ethiopian Finance and Economic Development for the rural population was used 2200 Kcal/day/person as the threshold for food security [20].

Model Specifications

In this section, the authors examined the determinants of food security using a logistic regression model with a binary dependent variable. The binary choice model arises in the context of a model in which the nature of the observed data dictate the special treatment of a binary choice model [21].

The dependent variable is the food security status of household i, if the household is classified as food secure when its daily calorie intake per adult equivalent during 2016 was recorded greater than the 2200 kcal, otherwise 0 if the household is classified as food insecure. The logit model is used to analysis the determinants of food security at household level.

The logistic distribution (logit) is also more preferable than the others in the analysis of dichotomous outcome variable due to it is flexible and simple from mathematical point of view and the results can interoperate in a meaningful way [22].

Logistic Regression Model

$$y_i=\beta x_i+\mu_i \quad \text{..... (1)}$$

Where

Yi is equal to one (1) when a households is food secured and zero (0) otherwise;

β = the vector of parameters,

x_i =the vector of household characteristics and

μ_i = the error term.

Following [23], we applied the logit regression on the determinant of household food security in this study.

Logistic regression model was specified as follows:

$$P_i=\text{E}(Y=1|X_i)=\frac{1}{1+e^{-(\beta_1+\beta_2 X_i)}} \quad \text{..... (2)}$$

For ease of exposition, we write

$$P_i=\frac{1}{1+e^{-Z_i}} \quad \text{..... (3)}$$

Where $Z_i=\beta_1+\beta_2 X_i$

Where Equation (3) represents the (cumulative) logistic distribution function.

The dependent variable in a logit model is nonlinear and the marginal effects of each independent variable on the dependent variable are not constant it is not therefore straightforward to interpret the estimated logit coefficient parameters as the effect of the independent variables upon food insecurity from regression equation (3) since they are estimated on a logit form [24, 25]. Thus, the regression equation was expressed in odds ratios, and can be written mathematically as:

If P_i, the probability of household food secure, is given by (3), then $(1 - P_i)$, the probability of household food insecure, is

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

Therefore, odds ratio = $\left[\frac{P_i}{1-P_i}\right] = e^{Z_i}$ .... (5)

By considering the natural logarithms in both sides, the specific logit model to predict the odds' of household food security are the following equation.

$$ln\left[\frac{P_i}{1-P_i}\right] = Z_i = \beta_1 + \beta_2 X_i + \mu \quad \text{........................} (6)$$

Then, the expression $\left[\frac{P_i}{1-P_i}\right]$ represents the odds ratio in favor of food security. It means the ratio of the probability that a household will be food secure to the probability that it will be food insecure. After checking for multicollinearity among the variables ((Variance Inflation Factors (VIF)), the regression model was estimated.

Hypothesis of the variables

The predictor variables were selected from the empirical studies of food security status previously studied in Ethiopia and other countries.

Age of household head

It is a continuous explanatory variable measured in years. Relatively older people have more experience of farming activities, have better understanding of the social and physical environments. Older household heads have better access to land than younger heads. They are more risk averter and their chance to become more food secure increases with age.

Household Size

Household size refers to the total number of household members who live and consume from the same household and is expressed in adult equivalent. It is a significant variable that determines the situation of household food security. As a family size increase in a household tend to exert more pressure on consumption and this leads to food insecure. Thus, it was theorized to have a negative relation with food security.

Dependency Ratio

It is a measure showing the number of dependents, people younger than 15 or older than 64-- to the total working-age population. A household with more economically inactive tend to be food insecure. [26] stated that an increase in the number of non-productive member of household increases the food insecurity level of household. Hence, it is expected that dependency ratio have a negative impact on food security situation of the household.

Size of cultivated land

It is a continuous variable measured in hectare. Land is to be considered the most important aspect of production, especially agricultural production and has a positive impact on food security and broader development outcomes. [13] found that there is Positive relationship has been established between farm size and improvement in household's income and food security. Thus it is expected of a household with a larger farm size to be more food secure than a household with a smaller farm size. Therefore, it is hypothesized that households with large cultivated land are less likely to be food insecure and vice versa.

Livestock Ownership

Livestock play a key role in contributing to food security through enabling direct access to milk, meat, and eggs. It thus becomes an important source of income for the rural households through the sale of livestock and livestock products for purchasing food, especially during times of food shortage. Livestock also contribute to increased grain yields as a result of improved productivity from use of manure and traction. Households with large livestock size are expected to be improved their food security status. Therefore, possession of large size of livestock increases the likelihood of the household to be food secure.

Number of ox/oxen owned

Oxen are the most important means of land cultivation and basic factors of production. Households with relatively larger number of oxen can perform better on their farm and achieve sustainable food security. Thus, positive correlation is expected between number of ox/oxen owned and household food security.

Sex of household head

Household head is a person who economically supports or manages a household. The gender of the household head is an important factor in households because it influences farm organization and income earning opportunities of a household which in turn determines household food security. However, Male-headed households have better access to agricultural technologies and more security to farmland as compared to female-headed households. Thus, male headed households are more likely to be food secure than female headed households.

Education level of household head

Education influences food security through access to information on better agricultural production, nutrition and sanitation; increased efficiency, hence increased production and better decision making as well as the pride that comes with education. The better educated a household head is, the lower the risk of food insecurity. It can be postulated that

household food security is directly influenced by household education attainment.

Access to credit

Credit can enable households to achieve greater caloric intake via larger meal portions or additional meals. With the help of credit, households also improve their meal quality and the diversity of their consumption patterns by adding healthier food. Moreover, improved credit access can potentially stabilized consumption of food and other essential goods more efficiently in the household. It provides capital for financing agricultural inputs, labor and equipment to generate income for the households. Thus, it is hypothesized that a household which has access to credit is more likely to be food secure.

Access to irrigation

Irrigation provides a powerful management tool against the vagaries of rainfall and makes it economically attractive to grow high-yield seed varieties and to apply adequate plant nutrition as well as pest control and other inputs, thus giving room for a boost in yields. Irrigation farming is a critical industry that increases per unit area food production leading to improvement in food availability and accessibility. Crucially irrigation results in sustainable household economic performance and a broad spectrum of crop production. Irrigation is crucial in facilitating the use of fertilizers, adoption of high-yielding seed varieties. Hence, household who have an access to irrigation was expected to have positive impact on household food security status.

3. Results and Discussions

3.1. Descriptive Statistics

Table 1 presents a summary of variables used in the logit regression. Some characteristics of the sample population, with a comparison between the food security and food insecurity in study area. Chi-square and t-statistic test were used to test whether they are statistically significance. The t-test is used to test the significance of the mean values of continuous variables for two groups i.e. food security and food insecurity while chi-square is used to test the significance of the percentage association of the potential discrete (dummy) explanatory variables. Table 1 is to make comparison of some important characteristics of the food security and the food insecurity households, classified based on direct calorie intake, with the overall sample. On average, in comparison to the food insecurity, food security households tend to be older by 5 years, have lower dependent ratio, are better educated, have better access to land and have larger number of livestock wealth at their disposal.

Table 1: Summary statistics of determinant for household food security

Variable	Mean		Difference	T value	P value
	Food security	Food insecurity			
	a	b	c=a-b		
Family size	3.86	4.72	-0.86	- 4.8251	0.0000***
Livestock	11.97	8.27	3.70	4.4084	0.0000***
Cultivated land in ha	0.63	0.43	0.20	4.1495	0.0001***
Education level	0.29	0.12	0.17	10.5650	0.001***
Age of heads	46.94	42.00	4.94	3.9071	0.0001***
Amount of rain fall	605.89	603.17	2.72	1.0872	0.2787
Dependence ratio	0.31	0.36	-0.05	-2.0177	0.0225**
Concert canal river diversion	0.21	0.15	0.06	1.7510	0.186
Deep well irrigation	0.18	0.054	0.126	8.8833	0.003***
Gender	0.77	0.82	-0.05	-1.7627	0.184

Note: ** = significant at p<0.05; *** = significant at p<0.01; * = significant at p<0. 1

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Household size is one of the most important demographic characteristics which determine the food security status of the households. Household with large family size have more consumption and more individuals to share the available resources than those with smaller size.

According to the survey result, the average family size of the total sample is found to be about 4.59 persons per household, which is nearly below the regional and the national average for the rural households. When the average family size is compared between food security and food insecurity, the study indicated that households with food insecurity have more family sizes than households with food security. The average household size of food security and food insecurity were found to be 4.31 and 5.33 persons respectively. The mean difference between the two groups shows a statistically significant at 1 percent of probability level.

Most households in the rural communities in Ethiopia accumulate their wealth in terms of livestock. Livestock is the source of food, draught power, fuel, cash income, security and investment. In fact, in most cases possession of livestock is used as an important measure to define poverty levels of households with those having larger possessions being considered as rich and those with little or no possessions considered as poor. The households based on household food security status are analyzed in terms of their livestock possessions. It indicates that food secure households have

significantly higher livestock possessions compared to those food insecure households as shown in the table 1. Therefore, an increasing in the livestock population enables the people to be food secure either through income or direct consumption than the food insecure households.

The study further shows that the mean separation test comparing land holding size of food security and food insecurity households. It is found that there exists significant difference in favor of food security households as shown in the table 1 with a difference of about a quarter hectare.

[27] Explained that rainfall changes influence crop yields, having an impact not only on local food production and food availability, but also on prices, thus contributing to food insecurity and shortages. In Sub-Saharan Africa (SSA), climate variability and the occurrence of extreme weather conditions are among the major risk factors affecting agricultural production and food security. Ethiopia's economy is mainly based on rain fed agriculture; as a result food production is highly vulnerable to the influence of adverse weather conditions such as drought. In the study area, agricultural production is mainly dependent on the availability of sufficient rain fall. The amount of rain falls were compared to determine whether there were changes in the overall food security situation of sample households. A paired t-test analysis shows that there is no statistically significant difference among food secure households and food insecure households in study area.

It is a measure showing the number of dependents, people younger than 15 or older than 64-- to the total working-age population. A household with more economically inactive tend to be food insecure. Hence, it is expected that dependency ratio have a negative impact on food security situation of the household. The important factor here is number of dependency which is 1.85 and 1.43 persons on average for each food insecure and food secure household in study area. The study further shows that the mean separation test comparing dependence ratio of food security and food insecurity households. We found that there exists significant difference in favor of food insecurity households and significantly at 5% probability level as shown in the table 1.

Age is also one of the most important demographic characteristics which determine the food security status of the households. The mean age for the food security and food insecurity respondents were 46.94 and 42.00 years respectively. The independent mean separation t-test analysis shows that there is statistically significant difference among food secure households and food insecure households in study area at 1% significant level.

The survey indicated in table 1, while 82 percent male head households are food insecure while 18 percent of female head households are also food insecure. Whereas 77 percent of male headed household are food secured while 23 percent of female headed households are also food secured. Generally chi square test has been applied to study whether there is significant difference in calorie intake per capita between the male and female headed households. The result show that there is no statistically significant difference of per capita calorie intake between that of male headed and female headed households at 0.05 level of probability.

Education raises people's productivity and creativity and promotes entrepreneurship and technological advances [28]. pointed out that educated household head largely contributed on working efficiency, competency, diversify income and becoming visionary in creating conducive environment to educate dependents with long term target to ensure better living condition than illiterate ones. This is due to educated household head plays a significant role in shaping household members. Thus, being literate reduces the chance of becoming food insecure in the households.

Hence the study try to assess the educational level of the respondents. In terms of education level (illiterate), it was found that about 11.83 % of the head of households in the study area are food insecure. Whereas 28.74 percent of primary school and above of headed household are food secured. Generally chi-square test has been applied to examine whether there is significant difference in calorie intake per capita between the primary and above and illiterate headed households. The result show that there is statistically significant difference of per capita calorie intake between that of illiterate and primary and above achieved headed households at 1% level of probability.

The same to that of previous discussions, the survey indicated that while 5.38 percent deep well household's users are food insecure while 94.62 percent of non-users deep well irrigation households are also food insecure. Whereas 18.22 percent of deep well user households are food secured while 81.78 percent of non-users deep well irrigation households are also food secured. Generally chi square test has been employed to study whether there is significant difference in calorie intake per capita between the deep well irrigation users and non-users of deep well irrigation households. The result show that there is statistically significant difference of per capita calorie intake between that of deep well irrigation users and non-users of deep well irrigation households at 1% level of probability.

Similarly, the survey indicated that while 15.05 percent concert river diversion household's users are food insecure while 84.95 percent of non-users of concert river diversion households are also food insecure. Whereas 21.46 percent of concert river diversion user households are food secured while 78.54 percent of non-users of concert river diversion irrigation households are also food secured. Generally chi square test has been employed to study whether there is significant difference in calorie intake per capita between the concert river diversion irrigation users and non-users of concert river diversion irrigation households. The result show that there is no statistically significant difference of per capita calorie intake between that of concert river diversion irrigation users and non-users of concert river diversion irrigation households at 10% level of probability.

3.2. Econometric analysis

The logit model regression estimates for the determinant of food security of households are presented in Table 2. The model containing majority of explanatory variables was significant, indicating that the model was able to distinguish between the various explanatory variables used in the model. The regression model as a whole explained 26.77 % (R2 =0.2677) of the variations in all cases. The chi-square for the model was calculated at 106.80, which is also highly significant ($p < .001$).

Household calorie intake is influenced by several variables like household size, age of households head, education of households head, gender of the heads of households, size of cultivated land etc.

This study found that educational level household heads affect positively and insignificant the food security status while dependence ratio and the gender of the heads of the households influenced negatively and insignificant of food security status.

In this study the family size has a negative influence on food security status of a household which implies households with small family size have better chance of being food secure than those with large family size. The odds ratio of the household size indicated that as the size of the household increases by one unit (one person), the odds of occurring food security decreases by increases 0.48 times. This result shows that large size households have higher probability of being food insecure than small size households. Subsistence agricultural production with limited involvement in non-agricultural activities, large household size exert more pressure on consumption than the labor it contributes to production. This result is in line with the results of [29, 30, and 31], who found that family size has negative relation with household food security status.

The age of a household head was positively and significantly affected food security of households at 1% probability level showing a directly relationship with household food security. This means for every unit increase in head of household's age, the odd ratio is in favor of household's food security increased by 1.08 times in study area, keeping other variables constant. The finding was consistent with finding of [32] who demonstrated that age of household head has positive relation with household food security status. They found that with increased age, the household head gains experience in managing food insecurity by developing relevant coping strategies

Table 2: The logistic regression results for the determinants of food security (Y=1)

Determinant of food security	Coef.	Std. Err.	z	Odds Ratio Exp()	Std. Err.	z
Family size	-0.74	0.17	-4.37***	0.48	0.081	-4.37
Livestock	0.067	0.02	2.89***	1.07	0.025	2.89
Cultivated land in ha	1.17	0.48	2.46***	3.23	1.54	2.46
Education	0.549	0.37	1.48	1.73	0.64	1.48
Age	0.081	0.02	4.05***	1.08	0.026	4.05
Amount of rain fall	0.015	0.008	1.86*	1.01	0.008	1.86
Dependence ratio	.064	0.78	0.08	1.07	.83	0.08
Concert canal river diversion	1.20	0.42	2.83***	3.32	1.41	2.83
Deep well irrigation	1.27	0.55	2.30**	3.56	1.97	2.30
Gender	-.09	0.38	-0.23	0.916	0.35	-0.23
_cons	-10.40	5.02	-2.07	.00003	0.0002	-2.07
Pseudo R2 =26.77 % Model chi-square = 106.80 Sample size (N) =340 Log likelihood =-146.09282						

Note: ** = significant at p<0.05; *** = significant at p<0.01; * = significant at p<0. 1

Livestock are the main sources of income, food and draft power in study area. The odds ratio of number of livestock was statistically significant at 1% and had a positive effect on food security status of households in the study area. The odds ratio of number of livestock explained that for every unit increase in livestock the odd ratio in favor of households food security increase by 1.07 times in the study area. Prior studies found that livestock possession have positively influenced household food security outcomes [33, 11, 34]. This indicates that the higher livestock size has a positive and significant effect on food security. This is due to the fact that households consume animal products like egg and milk and generate income by selling these products and renting some domestic animals like donkeys for transportation. Moreover, livestock is used in times of production shortfalls as safety nets and farm households used oxen for ploughing. This agrees with a priori expectation.

Irrigation enabled households to utilize different resources like land, labor more efficiently during dry season. It also contributed irrigation users to grow crops more than once in a year thereby not only increased output but also contributed to stabilize consumption. The estimated coefficient (table 2) for dummy variable access to deep well irrigation with the odd of being food security over food insecurity was positively associated and significant at less than 1% significance level in the model. This suggests that the probability of being food security relative to food insecurity increase if one has access to deep well irrigation, all else being equal. As expected, in relation to dummy variable access to concrete river diversion irrigation, it was found to be positively correlated with the probability of being food security and significant at one percent level of significance. This indicates that households who have deep well or concrete river diversion irrigated plot has less risk of becoming food insecurity than those who did not use irrigation.

The finding supports the validity of the initial hypothesis that access to irrigation water has a positive impact on household welfare, is also consistent with earlier findings of [35] in Asia. They found that access to irrigation has a positive effect in reducing poverty and food insecurity. Similarly, a study in South Africa made by [36] confirmed that the irrigation supported for ensuring household food security and for sustainable rural development.

As expected in relation to land holding size and the amount of

annual rainfall variables, they were found to be positively correlated with the probability of a person being food security and statistically highly significant at 5% and 10 % respectively. The odds ratios in Table 2 illustrate that with each increase in land holding, the odds of being food security (versus food insecurity) multiplied by a factor of 3.23. This finding supports the validity of the initial hypothesis that land holding size has a positive impact on household welfare. A study conducted by [37] made comparison among households based on depth and severity of food insecurity and found that socio-economic factors are the main determinants of food insecurity. The study concluded that both depth and severity of food insecurity are higher in small farms. Similarly, with each increase in amount of annual rainfall, the odds in favor of food security (versus food insecurity) multiplied by a factor of approximately 1.01. The positive impact of availability of rainfall on food security has been well recognized in the theoretical as well as empirical literature. For instance, [38] have reported a positive and significant effect on household food security of sufficient amount of rainfall in rural areas. Our findings are, therefore, consistent with the theory and past empirical finding.

4. Conclusion

Food insecure households are typically resource-poor and highly vulnerable to shocks. To combat this problem, the Ethiopian Government has designed food security policy and strategy (FDRE, 2012). The study results illustrated that age of the household head is positively related to household food security. Similarly, households with a larger size of cultivated area with concrete river diversion and deep well irrigation all contributed positively to food security. The findings noticeably show the role of household livestock holding and amount of rain fall have vital importance to attain food security at household level. On the other hand, larger family size contributed negatively to household food security.

5. References

1. FAO. Assessment of the World Food Security and Nutrition Situation, Committee on World Food Security 34th Session, 2009.
2. Bingxin Yu, Liangzhi You, Shenggen Fan. A Typology of Food Security in Developing Countries under High Food Prices Contributed Paper prepared for presentation at the International Association of Agricultural Economists Conference, Beijing, China, 2009, 16-22.
3. World Bank Group and World Trade Organization. The Role of Trade in Ending Poverty. World Trade Organization: Geneva, 2015.
4. Birgit Meade, Karen Thome. International Food Security Assessment, 2017-2027, GFA-28, US. Department of Agriculture, Economic Research Service, 2017.
5. Catley, *et al*. USAID/Ethiopia Agriculture Knowledge, Learning, Documentation and Policy Project. No. 663-13-000006: implemented by the Feinstein International Center, Friedman School of Nutrition Science and Policy, Tufts University, 2016.
6. FDRE. Ethiopia‟s Progress towards Eradicating Poverty*:* An Interim Report on Poverty Analysis Study (2010/11). Development Planning and Research Directorate, Ministry of Finance and Economic Development, Addis Ababa, Ethiopia, 2012.
7. Care. Achieving Food and Nutrition Security in Ethiopia Findings from the CARE Learning Tour to Ethiopia, 2014. http://www.care.org/sites/default/files/documents/Ethiopia_Trip_reportv3.pdf accessed in April 24/2018
8. Kidane H, Alemu ZG, Kundhlande G. Causes of household food in security in Koredegaga peasant association, Oromia Zone, Ethiopia. Agrekon. 2005; 44(4):543-560.
9. Shiferaw F, Kilmer R, Galdwin C. Determinants of Food Security in Southern Ethiopia- a Selected Paper Presented at the 2003 American Agricultural Economics Association Meeting in Montereal, Canada, Agricultural Economics. 2003; 33:351-363.
10. Webb P, Braun J, Yohannes Y. Famine in Ethiopia: Policy Implications of Coping Failure at National and Household levels. Research Report 92, IFPRI, 1992.
11. Bogale A, Shimles A. Household Level Determinants of Food Security in Rural Areas of Dire Dawa, East Ethiopia. Journal of American Food, Agricultural Nutrition and Development. 2009; 9(9):1914-1926.
12. Jemal Abafita, Kyung-Ryang Kim. Determinants of Household Food Security in Rural Ethiopia: An Empirical Analysis Journal of Rural Development. 2012; 37(2):129-157-129.
13. Yilma M. Measuring rural household food security status and its determinants in the Benishangul Gumuz region. Master's Thesis, Alemaya University, Alemaya, Ethiopia, 2005.
14. Bureau of Planning and Finance (BoPF) Atlas of Tigray, 2013-14.
15. Bryman A. Social Research Methods. Third edition. New York: Oxford University, 2008.
16. Creswell J. Educational research; planning, conducting, and evaluating quantitative and qualitative research, fourth edition, Pearson, 2012.
17. Dercon S, Hoddinott J. The Ethiopian rural household surveys: Introduction, International Food Policy Research Institute (IFPRI), Washington DC, 2004.
18. Upton M. The Economics of Tropical Farming Systems, Cambridge University Press, Great Britain, 1996.
19. EHNRI (Ethiopian Health and Nutrition Research Institute) Food composition table for use in Ethiopia. Part III, from, 1968-1997.
20. MoFED. Ethiopia's progress towards eradicating poverty: an interim report on poverty analysis study (2010/11). Ministry of Finance and Economic Development: Addis Ababa, Ethiopia, 2012.
21. Greene William H. Econometric Analysis. 5th edition. Pearson Education, Inc., Upper Saddle River, New Jersey, 07458. New York University, 2003.
22. Greene WH. Econometric Analysis. 6th Edition, Pearson Prentice Hall, Upper Saddle River, 2008.
23. Gujarati Damodar N. Basic Econometrics Fourth Edition United States Military Academy, West Point, 2003.
24. Stolzenberg RM. The Measurement and Decomposition of Casual Effects in Nonlinear and Nonaddtive models. In Scheussler, K.E. (Ed.). Sociological Methodology, 1980.

Sna Francisco, CA: Jossey Bass, 1979, 459-88.
25. Haile Tesfay. Impact of Irrigation Development on Poverty Reduction in Northern Ethiopia, a PhD unpublished Thesis, Department of Food Business and Development, National University of Ireland, Cork, 2008.
26. Feleke ST, Kilmer RL, Gladwin CH. Determinants of food security in Southern Ethiopia at the household level. Agric. Econ. 2005; 33:351-363.
27. Rademacher-Schulz C, Afifi T, Warner K, Rosen Feld T, Milan A, Etzold B, Sakdapolrak P. Rainfall variability, food security and human mobility. An approach for generating empirical evidence. Intersections, 10. United Nations University, Institute for Environment and Human Security (UNU-EHS), Bonn, 2012.
28. Kifle Lemma, Yosef Gebrehiwot. The Food Security Situation in Ethiopia. Concept, Status and Trends. In: Taye Assefa (ed.): Food Security through Sustainable Land Use. Proceedings of the First National Workshop of NOVIN Partners. Forum on Sustainable land Use. NOVIN, Addis Ababa, 1999.
29. Frankenberger TR, Sutter P, Teshome A. Ethiopia: The Path to Self-Resilience. Final Report. Ethiopia: Prepared for Canadian Network of NGOs in Ethiopia, 2007.
30. Mossa E. Access of Rural Female-headed Households to Land in Ethiopia. Radix International Journal of Research in Social Science Andhra University, India, 2012; 1(7):1-30.
31. Arega Bazezew Berlie. Determinants of Rural Household Food Security in Drought-Prone Areas of Ethiopia: Case study in Lay Gaint District, Amhara Region, 2013.
32. Joshi GR, Binaya Joshi. Household food security: Trends and determinants in mountainous districts of Nepal Future of Food: Journal on Food, Agriculture and Society, 2017.
33. Abdissa F, Tesema G, Yirga. Impact Analysis of Small Scale Irrigation Schemes on Household Food Security the Case of Sibu Sire District in Western Oromia, Ethiopia Irrigation & Drainage Systems Engineering, 2017.
34. Million T. Essays on Contracts, Risk Coping and Technology Adoption in Ethiopia. Unpublished PhD Thesis, Norwegian University of Life Sciences, Norway, 2010.
35. Hussain I, Hanjra MA. Irrigation and poverty alleviation: Review of the empirical evidence, IWMI, Irrigation and Drainage. 2004; 53:1-15.
36. Tekana SS, Oladele OI. Impact Analysis of Taung Irrigation Scheme on Household Welfare among Farmers in North-west Province, South Africa, 2011.
37. Keshav L. Household food Security in Rural Areas of Nepal: Relationship between Socio Economic Characteristics and Food Security Status, Hiroshima University, Japan, 2006.
38. Jemal Abafita, Kyung-Ryang Kim. Determinants of Household Food Security in Rural Ethiopia: An Empirical Analysis Journal of Rural Development. 2012; 37(2):129-157-129.