Factors Affect Participation of Rural Households' Off-farm Activities in Tigray National Regional State

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Abstract: *In Ethiopia agriculture is a main stay of the economy. However, agriculture is still largely traditional and subsistence type. Therefore, agriculture alone cannot provide sufficient livelihood opportunities to achieve food security. There are other methods to cope up the problem of food security like, rural off-farm employment. Thus the main objective of paper is to analyze the determinants of rural household off-farm participation in Tigray national regional state to increase farm production. To achieve this objective cross sectional data was collected from 393 sample households. The method of data analysis was carried out in this study comprises both descriptive and econometric analysis. The econometrics model result indicated, out of the 12 factors included in the model 9 variables were found to have a significant influence on the probability of off-farm participate at less than 10 percent level of significance. The survey also found that about 17.34 percent, 7.97 percent, 16.92 percent, 19.58 percent and 7.83 percent, of the respondents faced problems of lack of available materials, lack of experience, busy with agricultural activities, lack of capital and lack of available land, respectively.*

Keywords: Off-farm, Agriculture, food security, food insecurity, Tigray

1. Introduction

1.1 Back ground of the Study

In many countries of south East Asia, Africa, and Latin America, more than half of their population depends on agriculture. Agriculture led growth plays an important role in solving poverty and transforming the economies of many Asian and Latin America countries. Even in highly industrialized economies of Europe and America agriculture plays a huge role for their development, but the same has not occurred in Sub-Saharan Africa (Somasheker, 2003; Diao et al, 2007).

In Ethiopia agriculture is a main stay of the economy. The development of agriculture has direct impact on the overall development of the country. However, agriculture is still largely traditional and subsistence type and through this it is difficult to assure food security easily because of inadequate use of modern technologies in agricultural sector.

The National Regional State of Tigray is located in the Northern part of Ethiopia. It borders the state of Eritrea in the North, the Sudan Republic in the West, Amhara Region in the South and Afar Region in the East. The region is one of the most vulnerable areas of the country where significant size of the population is suffering from food insecurity. The extent food insecurity of the population of the region can roughly be observed from the unbearable burdens of natural and human-made calamities and socio-economic and environmental situations of the region. Realizing the magnitude and severity of the food insecurity, lot of efforts has been made to tackle the problem of food insecurity and related problems faced in the region. However, have not yield the expected positive outcome. This is mainly due to weak performance of agricultural sector. Then it is important of linking agriculture and non-agricultural activities (i.e. farm production and off-activities) to increase farm productivity via rural progress. (Mohammed, 2011).

Therefore, this study was initiated with the tasks of analyzing the factors that affect off-farm in Tigray and arriving at some indications that will help to enhance sustainable and successful transformation from agricultural development to industrial development for achieving food security.

1.2 Statement of the problem

Now days, Ethiopia's economy is one of the fastest growing in Africa. It is expected to grow by around 10 percent every year. Yet food security is still a major concern. The main challenge for food security is low productivity in agricultural sector. Because it is controlled and governed by the old customs and traditions, production technologies were not familiar and use of improved and modern techniques in agriculture sector is regarded as risk bearing by most of the people who live in rural areas. In addition, challenges of low incomes, lack of adequate farm asset, high share of food in household budgets, a very high dependency ratio, weak institutional capacities that expose them to very high risks of food insecurity, inadequate rural market for inputs and outputs, dependence on rain-fed agriculture and hunger and malnutrition still are serious concerns in the country.

Tigray Region is one of the food insecure regions of the country. Prior to 1995 E.C, the regional government had identified 16 woredas as food insecure. However, the number of food insecure woredas increased from 16 to 31 as reported by the food security office of the region. According to recent data obtained from the Tigray Bureau of Agriculture, out of the 34 woredas of the region only three woredas (Kafta-Humera, Welkayte and Tsegede) are food secure. The remaining 31 woredas are classified as food insecure (WFP. 2009).

Therefore, agriculture alone cannot provide sufficient livelihood opportunities to achieve food security. There are other methods to cope up the problem of food security like, rural off-farm employment. However, some studies and planners underestimated the importance of the off-farm to solve the problem of insecurity. Thus this study was identified determinants of off-farm participation in Tigray regional state to increase farm production.

1.3 Objective of the study

1.3.1 The main objective of the paper
To analyze the main factors that affect participation of household on off-farm activities in Tigray regional state.

1.3.2 The specific objectives
1. To assess the characteristics of non-farm activities of smallholder farmers,
2. To identify households level challenges on participation of non-farm activity.
3. To indicate policy options on the basis of findings of the study.

1.4 Significance of the Study

In order to increase agricultural productivity and to increase income of the consumer, this study will help to some planners for further investigation toward the contribution of factors that affect off-farm participation on the region. The study will also give high lights to researchers and students interested in the topic to stimulate further investigations in the area.

1.5 Scope and limitation of the Study

The research focuses on studying the factors that affect participation of off-farm among rural households in region Tigray and the study was shown some theoretical and empirical evidences of off-farm participation from deferent documents.
Because of geographical and finance constraint the study was limited to 8 woredas out of 34 woredas in Tigray regional state and was used one year cross-sectional data from which a total sample of 393 households was drawn.

1.6 Organization of the Paper

This study classifies in five chapters. First chapter deals the introduction part of the study which includes, back ground of the study, statement of the problem, objective, significance, scope and limitation of the study as well as organization of the paper. The second chapter discusses theoretical and empirical review of literature on off-farm participation. In third chapter the paper focuses on research methodology and fourth chapter studies analysis and discussion. Finally chapter five is presents summery and conclusion of the study.

2. Literature Review

2.1 Theoretical Literature Review

2.1.1 Definition of concepts
Off-farm income opportunities have been widely documented as an important strategy for overcoming credit constraints faced by the rural households in many developing countries. (De Janvry and Sadoulet, 2001; Iiyama et al., 2008; Barrett et al., 2001; Reardon et al., 2007 cited in Gracious, 2013).

Off-farm employment refers to employment in activities not on his/her farm. It includes employment on another farmer's farm. The different types of off-farm activities are self- and wage employment. Off farm wage employment describes those households that are working off their land against payment in cash or in kind. (Beyene, 2008). Off-farm employment was also facilitated by economic growth in the nonfarm economy, improved infrastructure (communications and transportation), as well as education level of farm household members (Banker and MacDonald cited in Economic Research Service/USDA, 2005).

Off-farm income and non-farm income are used interchangeably in several studies. The difference between the two is that off-farm income is much broader than non-farm income and it is made up of agricultural wage income plus non-farm income. Some authors adopt non-farm income, which exclude income from agricultural employment on other people's farm. They prefer to include it as a component of farm income, but in most papers included as component of off-farm income. (Raphael and Andre Leliveld, 2011).

In general, the concept and definition of off-farm activities were developed and clearly expanded based on the growing hunger, food insecurity and malnutrition scenarios in developing countries. From the above definitions of off-farm, slight variations were observed. However, the overall basic principles and definitions of off-farm, that is, "a broader concept than non-farm and mostly related with activities outside of own farm against payment in cash or in kind" were stressed in the definitions cited above. Therefore, for the purpose of this study, this definition taken as a working definition of off-farm and the household level is considered as the key unit of off-farm activities analysis.

2.1.2. Conceptual frame work
Now days, Ethiopia's economy is one of the fastest growing in Africa. Yet food security is still a major concern. The main challenge for food security is low productivity in agricultural sector. Tigray Region is one of the food insecure regions of the country. Prior to 1995 E.C, the regional government had identified 16 woredas as food insecure. According to recent data obtained from the Tigray Bureau of Agriculture, out of the 34 woredas of the region only three woredas (Kafta-Humera, Welkayte and Tsegede) are food secure. The remaining 31 woredas are classified as food insecure (WFP. 2009).

Therefore, agriculture alone cannot provide sufficient livelihood opportunities to achieve food security. There are

other methods to cope up the problem of food security like, rural off-farm activities. However, some studies and planners especially at woreda level underestimated the importance of the off-farm to solve the problem of insecurity. Thus this study will be identified determinants of off-farm activities and analysis the impact of off-farm on rural household farm production and their livelihood in Tigray national regional state.

From this the conceptual frame work of the study is explained below.
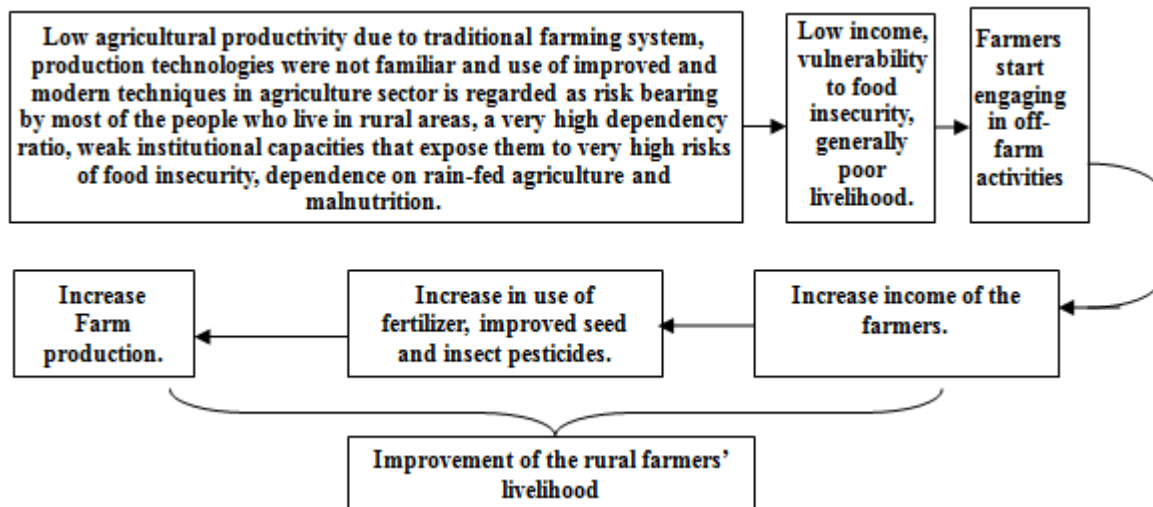
2.2 Empirical Literature Review

The concept of off-farm activity is a relatively recent development as compared to other concepts of economics. Despite this, some of the empirical studies that were made to identify the factors affect off-farm activity participation which mainly has got from Internet similar to the topic of the study have been summarized into developed countries, developing countries and Ethiopia, respectively as follows.

Gudbrand et al (2008) by using an unbalanced panel data set from 1991 to 2005 from Norwegian grain farms showed that the likelihood of off-farm work and the share of time allocated to it increase with increasing age (up to 39 years), and with low relative yields (compared to others farms in the surrounding area/region). The level of support payments is not significantly associated with the extent of off-farm work. Large-scale farms and single farmers tend to have a lower likelihood of off-farm work and average technical efficiency was found to be 79%. Farmers with low variability in farm revenue were found to be more technically efficient than farmers with high revenue variability. We did not find any evidence of off-farm work share affecting farm productivity − the predicted off-farm work share was not statistically significant. In other words, the result did not find any systematic difference in farm productivity and technical efficiency between part-time and full-time farmers.

Benjamin and Guyomard cited in Beyene (2008), in their study of off-farm work decisions of French agricultural households, show that the main effects on off-farm labor market participation decisions of both members (husband and wife) are: -
- Higher general education was reflected in higher off-farm labor market participation of both operators and spouses.
- The younger wives are the more likely to work off-farm.
- The number of children decreases the wife's participation in the off-farm labor market, i.e. increases her reservation wage, and

- Farm operators seem to be more responsive to farm characteristics than wives.

Using survey data from rural Nigeria, the study conducted by Raphael and Andre Leliveld (2011) by using farm production outcome model examined the effect of off-farm income on farm output, expenditure on purchased inputs and technical efficiency among farm households. The results indicated that off-farm income has a positive and significant effect on farm output and demand for purchased inputs. Though the result does not establish that off-farm income improves technical efficiency, there is a slight efficiency gains in households with off-farm income.

The study analyzed on the impact of off-farm earnings on the intensity of adoption of improved maize varieties and the productivity of maize farming in Uganda in the years 2005/06 and 2009/10 by using a Tobit model showed a positive and significant association between off-farm income and the proportion of land planted with improved maize varieties. The study, however, found farm households without off-farm work to be more efficient maize producers than those with off-farm income. (Gracious, 2013).

The paper, explored the extent to which off-farm work affects farm production decisions through reinvestment in farm input use and intensification, estimated farm input demand functions for fertilizer and impoved seed for maize producing households in Kenya. The results indicated differences in off-farm work effects across different inputs and off-farm activity types. While the results suggests possible use of off-farm earnings for input purchase especially for those without other forms of credit, the 'fertilizer/seed package' may represent a substantially greater commitment of money and orientation, to which those households with higher off-farm earnings may be unwilling to invest. Thus engagement in off-farm work may allow some partial intensification but may compete with farming at higher levels. The paper found that the presence of a regular source of earnings in form of a salaried wage or

pension seems to be the driving force behind any reinvestment behavior. (Mary K. and David, 2007)**.**

The study was conducted in two districts of Bangladesh to determine the factors affecting the participation in off-farm activity. A total of 150 sample farmers were selected for interview through random sampling technique. The probit model results showed that the average annual income was higher for service holders compared to business and off farm labor activities. Participations in activities like business and services were positively influenced by the farm size and education respectively. On the other hand, farm size and education were inversely related with participation in off-farm labor activities. Farmers in the study areas mentioned low income from agriculture as a reason for participating in off-farm activity.(M.S. Rahman, 2013).

The paper evaluated the household- and community-level factors influencing women's and men's decisions to participate in off-farm activities, either in the off-farm labor market or in local community groups, and the relationship with on-farm crop returns in Ghana by using bivariate probit. Results revealed female participation in off-farm labor markets increases at higher levels of labor availability, and female on-farm work and group participation are complementary activities. Results also indicate that male labor is relatively more productive on-farm versus off-farm than female labor. Finally, the study showed that education increases the likelihood for both women and men to work off-farm, although the impact is greater for women. (Nancy and Yan, 2009).

The study analyzed the determinants of off-farm work participation decisions off farm households in Ethiopia. A bivariate probit model was applied to account for the simultaneity of participation decisions of both male and female members of farm households. The results of the analysis show that human capital variables such as health and training on non-farm activities have a positive effect on the off-farm participation decisions of male members of farm households. The education status of the head has no significant impact on the participation decisions of the members of the family as most of the off-farm activities do not require formal education. The availability of credit and transfer income is the other factors that have a positive impact on the decisions of male members to participate in off-farm activities. (Beyene, 2008).

Finally, based on the above empirical evidences the researchers have taken the initiative to study the socio-economic factors that are associated with household off-farm participation to provide directions for further research, extension and development schemes that would benefit the farming population in Tigray region. In addition this study takes an additional and dissimilar result in methodology that was not discussed beyond the above empirical findings.

3. Methodology

3.1 Description of study area

The National Regional State of Tigray is located in the Northern Part of Ethiopia. It borders the state of Eritrea in the North, the Sudan Republic in the West, Amhara Region in the South and Afar Region in the East.

The region has a total population of 4,314,456 (80.5% rural population and the remaining 19.5% in urban areas, 49.2% male and 50.8% female) and an approximate area coverage of 80,000 Km^2 (CSA, 2010).

The research site of the study was located at eight districts of the region. To be representative of the region, the sites was selected based on their representations for the central (NaederAdiet & Laelay Machew), south (Endamekeni & Ofla), eastern (Ganta afe shum and Wukro kilteawlaelo) and north western (Endabaguna and Tahtay Qoraro) of the districts of the region considering their practices of off-activities for the past decade.

3.2 Data Sources and Sampling Procedure

To collect the data needed to the study, primary and secondary sources was used. In the primary, this thesis was used a qualitative and quantitative type of data of one year cross sectional survey gathered from the study area pertaining to social, demographic and economic aspects of households. However, secondary sources was included books, reports, senior essays, Internet website and other published materials of the region and woreda office of agriculture and woreda office of finance and economic development was also used as an additional for analyzing the socio-economic condition of the region as well as for the literature review part of the paper.

The survey conducted in region Tigray was based on multi stage sampling technique. Initially, in the first stage, eight woreda was randomly selected out of the 34 woredas found in Tigray region. In the second, households in the selected woredas, was classified into non-farm activity participants and non-participants. In the third stage, simple random sampling based on probability proportional to sample size sampling technique was used to select respondents from each household category. Given the limited resource and time at the disposal of the researcher, only 393 households were prepared for interview.

3.3 Data Collection Instruments

This study was used a sample survey method of data collection to select 393 respondents from Tigray region. Therefore, structured questionnaire was prepared and information was collected from the selected households. A discussion checklist was also used for focus group and key informant discussions.

3.4 Method of Data Analysis

All the information collected from the household was used to prepare the final output of the study. The method of data analysis was carried out in this study comprises both descriptive and econometric analysis. Quantifiable information collected from closed questions was analyzed and discussed based on descriptive statistics such as tables, percentages, mean and standard deviation, t-test for the continuous and chi-square for the discrete independent

variables. As well as the study was used STATA software for analysis of variables in the econometric analysis part of the paper.

In addition, information from open end questions was discussed through qualitative descriptions. In qualitative study where the set of alternatives is binary, the dependent variable is given value of 0 and 1; Gujarati (2003) set three approaches to develop a probability model for a binary response. These are:-
1. The linear probability model (LPM)
2. The logit model and
3. The probit model

LPM, logit and probit are qualitatively similar results. However, we was confined our attention to logit and probit models because of the problems like non-normality of the disturbances, heteroscedastic variances of the disturbances, non-fulfillment of $0 \leq E(Y/X) \leq 1$) and questionable of

goodness of fit with the LPM.

Logit and probit models in most applications are quite similar, the main deference being that the logistic distribution has slightly flatter tails. That is to say, the conditional probability P_i approaches 0 or 1 in a slower rate in logit than probit. Therefore, there is no compelling reason to choose one over the other. In practice also many researchers choose the logit model because of its comparative mathematical simplicity (Maddala, 1977 and Gujarati, 2003).

Setting f $(X_i\beta)$ to be the logistic distribution or assuming that ε_i (disturbance term) follows the logistic distribution gives rise to the logit model. The logistic distribution of the probability that a household would be participate on off-farm activities is given by:-

$$P_i = \Pr ob(Y_i = 1/X_i) = 1 - \frac{e^{-Xi\beta}}{1 + e^{-Xi\beta}} = \frac{e^{Xi\beta}}{1 + e^{Xi\beta}} \dots\dots\dots\dots(1)$$

Similarly, the non-response probability which is household non-participate on off-off farm activities is evaluated as:-

$$1 - P_i = \Pr ob(Y_i = 0/X_i) = 1 - \frac{e^{Xi\beta}}{1 + e^{Xi\beta}}$$

$$= \frac{1}{1 + e^{Xi\beta}} \dots\dots\dots\dots(2)$$

The odds ratio is the ratio of the probability that a household would be participate on off-farm activities (P_i) to the probability that a household would be non-participate on off-off farm activities $(1-P_i)$. The odds ratio is given by:

$$\frac{Pi}{1 - Pi} = \frac{Prob(Yi = 1/Xi)}{Prob(Yi = 0/Xi)} = \frac{\frac{e^{Xi\beta}}{1 + e^{Xi\beta}}}{\frac{1}{1 + e^{Xi\beta}}} = e^{Xi\beta} = e^{X1\beta1 + X2\beta2 + X3\beta3 + ... + Xk\beta k} \quad\dots\dots\dots\dots(3)$$

The natural logarism of the odds ratio (logs-odds ratio) is therefore: -

$$\ln\left(\frac{P_i}{1 - P_i}\right) = X_i\beta = \beta_1 + X_{2i}\beta_2 + X_{3i}\beta_3 + ... + X_{ki}\beta_k \dots\dots\dots\dots(4)$$

Where, β_1 is an intercept
$\beta_2, \beta_3, ----\beta_k$ are slopes of the equation in the model
$\ln\left(\frac{P_i}{1 - P_i}\right)$ = is log of the odds ratio, which is not only linear in Xi but also linear in the parameters.
$X_2 X_3 ... X_i$ = is vector of relevant household characteristics

Thus, the log-odds ratio is a linear function of the explanatory variable. The above transformation equation (4) has certainly helped the popularity of the logit model. The parameters of the model were estimated using the maximum likelihood estimation procedure. Since, we cannot estimate by the standard ordinary least square (OLS) because to apply OLS we must know the value of the dependent variable $\ln\left(\frac{P_i}{1 - P_i}\right)$, which obviously is not known and more over the methods of OLS

doesn't make any assumptions about the probabilistic nature of the disturbance term (Maddala, 1977 and Gujarati, 2003). Therefore, in this study we have a random of 393 observations. Letting f (Y_i) denote the probability of a household participate on off-farm that $Y_i = 1$ or 0 if the household doesn't participate on off-farm activities, the joint probability of observing the '**n**' value, i.e.,

$f(Y_1, Y_2, ------, Y_n)$ is given by:

$$f(Y_1, Y_2, ..., Y_n) = \prod_{i=1}^{n} fi(Yi) = \prod_{i=1}^{n} PiYi(1-Pi)^{1-Yi} \quad ....(5)$$

Where, Π is the product operator
Then after we take a natural logarism we obtain what is called the log likely hood function (LLF).

$$\ln(f(Y_1, Y_2, ..., Y_n)) = \sum_{i=1}^{n} (Y_i \ln(P_i) + (1-Y_i)\ln(1-P_i))$$

$$= \sum_{i=1}^{n} (Y_i \ln(P_i) - Y_i \ln(1-P_i) + \ln(1-P_i))$$

$$= \sum_{i=1}^{n} Y_i \ln\left(\frac{P_i}{1-P_i}\right) + \sum_{i=1}^{n} \ln(1-P_i) ....(6) \quad \text{Where, } \sum \text{ is the sum operator}$$

From equations (2) and (4) we have:-

$$1 - P_i = \frac{1}{1+e^{Xi\beta}} \text{ And } \ln\left(\frac{P_i}{1-P_i}\right) = X_i\beta$$

Therefore,

$$\ln(f(Y_1, Y_2, ..., Y_n)) = \sum_{i=1}^{n} \left(Yi(\beta_1 + \beta_2 X_2 + ... + \beta_k X_i) + \sum_{i=1}^{n} \ln(e^{Xi\beta}) \right)$$

The first order conditions are:-

$$\frac{\partial \ln(Y)}{\partial \beta_1} = 0 \rightarrow \sum_{i=1}^{n} \left(Y_i - \frac{e^{X_i\beta}}{1+e^{X_i\beta}} \right) = 0 ....(7)$$

$$\frac{\partial \ln(Y)}{\partial \beta_2} = 0 \rightarrow \sum_{i=1}^{n} \left(Y_i - \frac{e^{X_i\beta}}{1+e^{X_i\beta}} \right) X_{2i} = 0 ....(8)$$

The maximum likelihood estimates for β can be found by setting each of the K + 1 similar to equation 8 equal to zero and solving for each β_k. Finally, these equations can be solved for β_1, β_2 and so on. Since both equations are non-linear functions of β, the solutions are obtained using numerical methods. Prior to the estimation of the logistic regression model, the explanatory variables was check for the existence of multicolinearity and hetroscedasticity. First, as Gujarati, (2003) on his book stated that multicollinearity is the existence of linear relationship among or all

explanatory variables of a regression model. In this study among the other methods, Variance Inflation Factor (VIF) was used to measure the degree of linear relationships among the explanatory variables. VIF shows how the variance of an estimator is inflated by the presence of multicollinearity.

The speed with which variances and co-variances increase can be seen with the VIF, which is defined as:-

$$VIF(Xj) = \frac{1}{(1-r^2 j)} ....(9)$$

Where: Xj = the jth quantitative explanatory variable
r^2j = the coefficient of determination when the variable Xj regressed on the remaining explanatory variables.
A VIF value greater than 10 is used as a signal for the strong multicollinearity for the continuous variables (Gujarati, (2003).

Similarly, there may also be relations between two dummy variables, which can lead to the problem of multicollinearity or association. To identify this problem, coefficients of contingency was computed. The contingency coefficients was computed as:

$$C = \sqrt{\frac{\chi^2}{N+\chi^2}} ....(10)$$

Where:
C=Coefficients of contingency,
χ2= Chi-square random variable and
N = total sample size. (Rachev, et al , (2007), http://www.mpihd.mpg.de/astrophysik/HEA/internal/Numerical_Recipes/f144.pdf and NIST (2011)

If there will be a serious multicollinearity in the model. There are two choices:

1. Do nothing or
2. Follow some rules of thump like, dropping a variable, transformation of variable, additional or new data, reducing collinearity in polynomial regressions and use ridge regression are some methods to solve the problem (Maddala, 1997 and Gujarati, 2003). Therefore, this paper was used some rules of thump to solve multicollinearity and association problems by dropping a variables.

Second, heteroscedasticity is the violation of Classical

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Linear Regression Model (CLRM) of common variance. This is a problem that is encountered more often in cross-section data than in time series data (Maddala, 1977).

Documenting the consequences of heteroscedasticity is easier than detecting it. There are several diagnostistic tests available but one cannot tell for sure which will work in a given situation. Even if hetroscedasticity is suspected and detected, it is not easy to correct the problem (Gujarati, 2003).

However, according to Maddala (1977), there are two remedies that are often suggested and used for heteroscedasticity. One is transforming the variables in to logs, and the other is to deflate all variables by some measure of size. Therefore, this paper will use one of the remedies that are often suggested and used for hetroscedasticity on the above. Finally, the logistic regression model was selected for this study. The analysis of the logistic regression model was shown that changing household characteristics will change the probability that a given individual household becomes participate on off-farm activities. This will help to predict the probability of participate on off-farm activities and to predict policy implications through logistic regression model.

3.4.1 Variable definition and hypothesis
Different variables were expected to have an effect on household participate on off-farm activities in the study area. However, the major variables expected to have influence on the household participate on off-farm activities are explained below. Before that it is better to explain the dependent variable.

1. Dependent variable
The dependent variable is a dichotomous variable. It will represent in the model by 1 for those who participate on off-farm and 0 for those who not participate on off-farm activities.

2. Independent Variables
The independent variables expected to have link with those who participate on off-farm activities were selected based on available literature. These were identified as demographic, agro-ecological and socioeconomic factors that are relevant and feasible in the farming systems of the Tigray region are defined as follows.

1. Family size in AE (FAMSZ): - this refers to the size of household members converted in adult equivalent. The existence of large number of family members with limited resources could affect the decision to participate on off-farm activities of the household due to increasing demand for food with limited food supply. But those households, which have labor abundant, would send more members to off-farm activity. Family size, as an indicator of labor availability, has a positive influence on off-farm participation.
2. Age of the household head (AGE): - Age is an important factor for agricultural production in the study area. As the age of the household head increases the farmer acquires more knowledge and experiences with possible positive impact on participation of off-farm activities.
3. Sex of household head (SEX): - with regard to farming experience and access to technology males are better than female farmers. Then, sex was expected a positive impact on off-farm participation.
4. Education (EDUC): - agricultural production technologies are always coming up with better knowledge. Evidences in different literatures showed education has positive impact on off-farm participation. Then, level of education was expected a positive impact on off-farm participation.
5. Size of cultivated land in hectare (SIZCUL): As the cultivated land size increases, provided other associated production factors remain normal, the likelihood that the holder gets more output is high. Then, the study hypothesized that participation on off-farm activities and large cultivated land size are positive relationship.
6. Irrigation (IRRIG): - It is dummy variable taking value 1, if the farmers used irrigation and 0 otherwise. Irrigation is one of the modern technologies that increase production of farm output. Therefore, this study hypostasized that irrigation is positively relate with off-farm participation.
7. Total livestock owned in tropical livestock unit (TOTLIVOW): - it is the total number of livestock holding of the household measured in livestock unit. Livestock play a major role in food security. Therefore, it expects livestock holding is a positive impact on participation of off-farm activities.
8. Credit (CREDIT): is a dummy variable that takes the value 1 when the household takes loan and 0 otherwise. This variable is expected to have positive correlation with off-farm participation.
9. Access to urban market center (DIS-MARKET): Urban center encourages off-farm activities by serving as center for input sales and presenting demand for products. Thus, proximity to urban market centers gives rise to diversified rural off-farm activities and higher off-farm earnings. Therefore it is positively correlated with off- farm activities.
10. Farm input use (INPUTUSE): Farmers who are engaged in off-farm activities are expected to purchase inputs. This variable can be positively or negatively related to participation in non-farm activities.
11. Household Asset in Birr (HHASSET): total household owned being a proxy for farmer's resource endowment, those sample farmers with large household asset have better chance to earn more income and then a household able to participate on off-farm participating .

4. Results and Discussions

The measurements and findings of the factors that affect household off farm participation in the study area have covered both descriptive and econometric analysis by using STATA software. The descriptive analyses are used tools such as mean, standard deviation, t-test, chi-square and percentage of all independent variables which are expected influence on participation of off-farm. Econometric analysis was used to estimate the logistic regression model for the most important determinants of off-farm participation among the rural households in Tigray region.

4.1. Descriptive Statistics Results

4.1.1 Measuring the off-farm participation Status of the Households

As already reviewed in literature review part of this paper the selection and definition of off-participation is difficult. Since, there is a different definition of off-farm which is defined by different economists. However, the overall basic principles and definitions of off-farm, that is, "a broader concept than non-farm and mostly related with activities outside of own farm against payment in cash or in kind".

Following this definition, from the total 393 sample households only 99 households were found to not participate on off-farm while the remaining 294 participate on the off-farm. In other case, 74.81 percent of the households were participating on the off-farm and 25.19 percent were not participating on the off-farm (See figure 1).
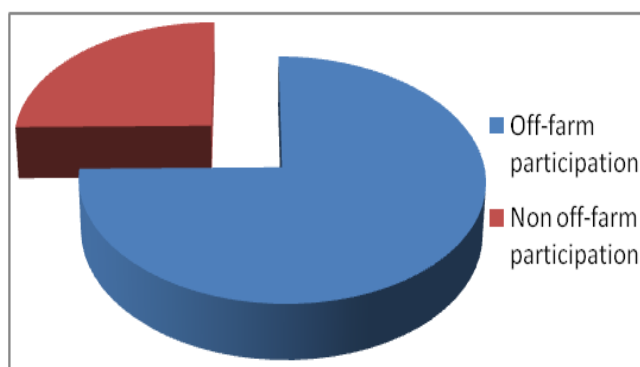

Figure 1: Off-farm participation status of the households
Source: Own Survey, 2014/15

4.1.2 Demographic, Economic and Social Characteristics of the Households

1. Family size

The mean of family size in adult equivalent is found to be 3.962 and 2.197 for off-farm participation and non off-farm participation households, respectively in the study area. While the overall mean family size in adult equivalent of the sample households in the study area was found 3.517. (Table 1)

Table 1: Distribution of the Household by Family Size in Adult Equivalent

S No	Family size in AE	Off-farm participation		Non off-farm participation		Total	
		(N=294)		(N=99)		(N=393)	
		Number	Percent	Number	Percent	Number	Percent
1	≤ 3	77	26.19	84	84.84	161	40.97
2	3.01 – 5	137	46.60	15	15.15	152	38.68
3	5.01 – 7	74	25.17	0	0	74	18.83
4	≥ 7.01	6	2.04	0	0	6	1.53
Mean		3.962		2.197		3.517	

Source: Own Survey, 2014/15

About 26.19 percent of the 294 off-farm participation and 84.84 percent of the 99 non off-farm participation sample households are found to have family size less than or equal to 3. While 6 of the off-farm participating households and nil of non off-farm participating households had family size over 7.01, which constituted 2.04 percent and 0 percent of

the off-farm participation and the non off-farm participation, respectively (Table 1).

2. Age, sex composition and marital status of household heads

The average age (AGE) of the respondents was about 47.22 years. (See table 2).

Table 2: Distribution of sample household head by age

S. No	Age of the household head	Off-farm participation		Non off-farm participation		Total	
		(N=294)		(N=99)		(N=393)	
		Number	Percent	Number	Percent	Number	Percent
1	≤ 25	11	3.74	21	21.21	33	8.40
2	26 – 45	139	47.28	73	73.74	212	53.94
3	≥ 46	144	48.98	5	5.05	149	37.91
Mean		45.993		32.848		42.681	

Source: Own Survey Result, 2014/15

Out of 393 respondents 8.40 percent were less than 25 years of age whereas about 37.91 percent was above 46 of age. The majority of the household heads about 53.94 percent were aged between 26 and 46 years. On the other hand, group statistics showed that the mean age of the household off-participation is 45.993 as compared to 32.848 for the non off-farm participation household heads (Table 2).

Male headed and female headed households in the overall sample households were 70.74 and 29.26 percent, respectively. About 76.19 percent of the off-farm participating households were male headed and the remaining 23.81 percent were female headed. Likewise, 54.55 percent and 45.45 percent of the non off-farm participating households were male and female headed, respectively. Though in this research it was hypothesized that male headed households are less likely to be non off-farm participating than female headed ones, the survey result revealed that also this based on the percentage of the descriptive results (Table 3).

Table 3: Distribution of sample households by sex of the household head

Sex of the household head	Off-farm participation		Non off-farm participation		Total	
	(N=294)		(N=99)		(N=393)	
	Numb	Perce	Numb	Perce	Numb	Perce
Male (1)	224	76.19	54	54.55	278	70.74
Female(	70	23.81	45	45.45	115	29.26
Total	294	100	99	100	393	100

Source: Own Survey, 2014/15

Table 4 shows that majority of the respondents (63.36 percent) was married, while 36.64 percent are found either single, divorced or widowed. The survey result also discovered that there is significant difference between off farm participating and non off farm participating sample household groups. This assured that married households have a significant influence on off farm participating as compared to those unmarried, divorced and widowed.

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Table 4: Distribution of sample households by marital status of the household head

Marital status of household heads	Off-farm participation		Non off-farm participation		Total	
	(N=294)		(N=99)		(N=393)	
	Number	Percent	Number	Percent	Number	Percent
Married (1)	206	70.07	43	43.43	249	63.36
Otherwise (0)	88	29.93	56	56.57	144	36.64
Total	294	100	99	100	393	100

Source: Own Survey, 2014/15

3. Education status of the household head

The role of education is clear in affecting socio-economic status of the family. Literacy rate of the sample respondents was 72.01 percent. It was hypothesized that as level of education increases, the probability of being off farm participating increases. The survey result approved the hypothesis and indicated that 86.87 percent of the non off-farm participating were illiterate. Because, there were not responsible to learn education only they focus for other activities of their household. Whereas, only 8.16 percent of the off farm participating households were illiterate. In this area of study most of the sample farmers have learnt only through non-formal education. (See table 5).

Table 5: Distribution of sample households by educational status of the household head

Educational status of the household head	Off-farm participation		Non off-farm participation		Total	
	(N=294)		(N=99)		(N=393)	
	Number	Percent	Number	Percent	Number	Percent
Literate (1)	270	91.84	13	13.13	283	72.01
Illiterate (0)	24	8.16	86	86.87	110	27.99
Total	294	100	99	100	393	100

Source: Own Survey, 2014/15

4.1.3 Land Resource of the Households

Availability of suitable cultivable land is the main factor for crop production. Table 6 presents the distribution of cultivated land size between off-farm participating and non off-farm participating groups. The total cultivated land size of sample households ranged from 0 to 3.25 ha. The average land size of the respondents was 1.091 ha (Table 6). As also indicated in table 6 below 28.24 percent of the respondents have a farm size of less than 0.5 ha. The mean comparison of two groups in terms of mean cultivated land size revealed that there is significant difference between off-farm participating and non off-farm participating households, which was 1.32 ha for off-farm participating and 0.42 ha for non-off-farm participating households. This result supports the hypothesis that farmers who have larger cultivated area are more likely to participate on off-farm than those with smaller land area due to the fact that there was high possibility to produce more and get an opportunity to acquire high income.

Table 6: Distribution of the Household by Cultivated land size in ha

S/No	Cultivated land size in ha	Off-farm participation		Non off-farm participation		Total	
		(N=294)		(N=99)		(N=393)	
		Number	Percent	Number	Percent	Number	Percent
1	≤ 0.5	39	13.27	72	72.72	111	28.24
2	0.51 – 1	81	27.55	11	11.11	92	23.41
3	1.01 – 2	150	52.72	14	14.14	164	41.73
4	≥ 2.01	24	8.16	2	2.02	26	6.62
	Mean	1.318		0.416		1.091	

Source: Own Survey, 2014/15

4.1.4 Modern Agricultural Inputs Used

As shown in table 7 below about 68.96 percent of the sample farmers reported that they used chemical fertilizers. This was mainly due to a sound accessibility of fertilizer and awareness change. The difference between the off-farm participating and non off-farm participating farmers in terms of using chemical fertilizer is significant. Therefore, this result approves the hypothesis stated in this study.

Table 7: Distribution of sample households by status of use services

Services		Off-farm participation		Non off-farm participation		Total	
		(N=294)		(N=99)		(N=393)	
		Number	Percent	Number	Percent	Number	Percent
Fertilizer Use	Yes	238	80.95	33	33.33	271	68.96
	No	56	19.05	66	66.67	122	31.04
Irrigation	Yes	88	29.93	15	15.15	103	26.21
	No	206	70.07	84	84.85	290	73.79

Source: Own Survey, 2014/15

In the survey it was observed that only 26.21 percent of the overall sample households were users of irrigation. To compare the two sample groups, 29.93 percent of off-farm participating and 15.15 percent of non off-farm participating households were users of irrigation. This may be do you to an accessibly of irrigation in most of the sample households (Table 7).

4.1.5 Livestock Production of the Households

Livestock plays a great role for off-farm participation and it is one of the main coping mechanisms during food shortage in the study area. The total livestock population owned by the sample households was 2500.02 tropical livestock unit (TLU) but 17.05 percent of the respondents were owned less than 1. The maximum and minimum number of TLU was 32.52 and 0 respectively and the average holding was 6.36 TLU. In the study area in addition to oxen dry cows, horse and camel serve as traction power (Table 8).

As indicated in table 8, 62.92 percent of off-farm participating households and 9.09 percent of non off-farm participating households own greater than 5.01 TLU. So this survey result demonstrated that, the difference between the two sample household groups regarding to livestock holding is significant. This result supports the hypothesis that a person who owned more TLU was more likely to be participate on off-farm activities than the one who had less.

Table 8: Distribution of the Household by Total livestock owned

S. No	Total livestock Owned in TLU	Off-farm participation (N=294)		Non off-farm participation (N=99)		Total (N=393)	
		Number	Percent	Number	Percent	Number	Percent
1	≤ 1	11	3.74	56	56.56	67	17.05
2	$1.01 - 3$	42	14.28	20	20.20	62	15.77
3	$3.01 - 5$	56	19.05	14	14.14	70	17.81
4	≥ 5.01	185	62.92	9	9.09	194	49.36
	Mean	7.886		1.835		6.362	

Source: Own Survey, 2014/15

4.1.6 Marketing and Credit Services of the Households
1. Distance from main market

On average the respondents traveled 40.35 minute to access market. The statistical result of the two groups in relation to the effect of market distance on off-farm participation is statistically significant. Since 38.38 percent of the non off-farm participation households' and 9.86 percent of the off-farm participation households traveled above 1 hr. This shows closeness to market creates way in to additional income through off-farm participation (Table 9).

Table 9: Distribution of the Household by Distance from main market

S. No	Distance from main market in min	Off-farm participation (N=294)		Non off-farm participation (N=99)		Total (N=393)	
		Number	Percent	Number	Percent	Number	Percent
1	≤ 30	178	60.54	24	24.24	202	51.40
2	$30 - 60$	87	29.59	37	37.37	124	31.55
3	≥ 61	29	9.86	38	38.38	67	17.05
	Mean	34.663		57.222		40.346	

Source: Own Survey, 2014/15

2. Use of credit

Table 10 below proved that 78.63 percent of the overall sample households were users of credit. To compare the two sample groups, 98.98 percent of the off-farm participating and 18.18 percent of non off-farm participating households were uses a credit for their livelihood. Since, the availability of agricultural credit to subsistence farmers who have little or no capital or savings to invest in farming is important component of small farm development programs. Then such difference was observed between the groups. The survey result supports the hypothesis made in this research, which states that households with more access to farm credit have more chance to be off-farm participating than those households with less access to credit.

Table 10: Distribution of sample households by status of use credit

Status of credit use		Off-farm participation (N=294)		Non off-farm participation (N=99)		Total (N=393)	
		Number	Percent	Number	Percent	Number	Percent
Credit	Yes	291	98.98	18	18.18	309	78.63
	No	3	1.02	81	81.82	84	21.37

Source: Own Survey, 2014/15

4.1.7 Household Assets

The average household asset owned of the respondents was 5,274.46 Birr. The mean comparison of two groups revealed

that there is significant difference between off-participating households and non off-farm participating households, which 5,784.69 Birr for off-farm is participating and 3,759.22 Birr for non off-farm participating households. (See table 11 below).

Table 11: Distribution of the Household by Total asset in Birr

S. No	Total asset in Birr	Off-farm participation (N=294)		Non off-farm participation (N=99)		Total (N=393)	
		Number	Percent	Number	Percent	Number	Percent
1	≤ 500	18	6.12	6	6.06	24	6.11
2	$501 - 1000$	45	15.31	25	25.25	70	17.81
3	≥ 1001	231	78.57	68	68.69	299	76.08
	Mean	5784.687		3759.222		5274.455	

Source: Own Survey, 2014/15

4.2. Econometric Model Results

In this section, the selected explanatory variables were used to estimate the logistic regression model to analyze the determinants of household off-farm participation. However, before fitting the logit model, it was important to check whether serious problem of multicollinarity and association exists among and between the potential continuous and discrete explanatory variables of the model estimation. For this purpose, VIF and contingency coefficient were used for the continuous and discrete variables, respectively to check multicollinearity. This study also used robust estimation option remedies that are often suggested for hetroscedasticity.

The value of VIF greater or equal to 10 was an indicator of a serious multicollinearity problem and it used to omit such variables from the model. However, in this analysis the values of VIF were less than 10. Hence, there was no as such a serious problem of multicollinearity. Then all the six explanatory variables were entered into logistic analysis.

Uniformly, the contingency coefficients were calculated for the discrete variables. The $\chi2$ was computed to check the degree of association among the discrete variables. The contingency coefficient ranges between 0 and 1 where the value of 0 indicates no association between the variables and the value closer to 1 indicates strong association. Accordingly, the results of contingency coefficient computation presented less than 0.8. Therefore, in this thesis there was no a serious problem of association among the explanatory of discrete variables. Hence, all the six discrete variables were entered into logistic analysis.

The Logistic regression method used in this paper was the maximum likelihood which is a main tool to find the function that maximizes our ability to predict the probability of off participation based on what we know about the explanatory variables. Using the household off-farm participating status as a dependent variable where by a value of 1 is given to households belonging to off-farm participation group and 0 for non off farm participation, and this paper analysis by using the 12 explanatory variables (6 continuous and 6 discrete).

After fitting a model to the observed data, one of the next

essential steps is to investigate how the proposed model fits the observed data. Measurement of goodness of fit of the model shows that the model fit the data well. The likelihood ratio test statistic exceeds the chi-square critical value with 12 degree of freedom at 1 percent significance level. So the hypothesis that all coefficients except the intercept are equal to zero is rejected (Table 12).

Table 12: Logit estimates of the factors that affect household off-farm participation.

No	Variables	Coefficients	Odds Ratio	Wald Statistic
1	CONSTANT	-17.0313		2.87
2	MARTSTA	-0.9351	0 .3925	0.77
3	SEX	- 0.9428	0.3895	0.62
4	AGE	0.0950	1.0997	1.93*
5	EDU	5.5405	254.8238	1.99**
6	FAMSIZAE	0.9547	2.5979	2.33**
7	CULTHR	4.1980	66.5565	1.80*
8	FERTLZ	2.3894	10.9075	2.02**
9	IRRIG	-1.4545	0.2335	0.91
10	LIVINTLU	0.4959	1.6420	2.71***
11	CRED	5.1033	164.5744	3.47***
12	DISMKTMIN	-0.0458	0.9551	2.78***
13	HHASSET	0.0002	1.0002	2.46***
	-2 Log Likelihood Ratio -18.2957 Number of observations 393 Chi-square 42.17*** Correctly Predicted (Count R^2) 91.75 percent			

***,** and * are significant at less than 1percent, 5percent and 10 percent probability level, respectively.
Source: Model result, 2014/15

The model result indicated, out of the 12 factors included in the model 9 variables were found to have a significant influence on the probability of off-farm participate at less than 10 percent level of significance. The variables considered were family size in adult equivalent, cultivated land size in hector, the use of credit, number of livestock owned in tropical livestock unit, age, education, distance from main market in minute, household asset and fertilizer. Whereas, the remaining 3 of the 12 explanatory variables i.e. marital status, sex and irrigation were found to be no significant influence on the probability of off-farm participating. Therefore, only significant explanatory variables, which affect the household off-farm participating, are discussed below.

1. *Family size (FAMSIZAE):* is found to be a significant and positively influence on household off-farm participating of the sample households in Tigray national regional state at less than five percent probability level. The positive sign of the coefficient of family size indicates that odds ratio in favor of the probability of participating in off-farm increases as family size increases i.e. all other things are held constant, the odds ratio in favor of off-farm participating increases by a factor of 2.60 as family size increase by one adult equivalent. This implication indicates that, households with large family size, having children of productive age, could be participate in the off-farm. Therefore, this result is in agreement with the hypothesis that family size has an influence for households' off-farm participating.

2. *Cultivated land size in hector (CULTHR):* The coefficient's sign of this variable was hypothesized to have a positive influence on off-farm participation. The

model result revealed that cultivated land size is significantly and positively influenced the rural household off-farm participating at ten percent level of probability. The possible justification is that sample households who had larger farm size had better chance to assess other additional income activities. The odds ratio notice us; other things remain constant, in favor of off-farm participating increases by a factor of 66.56 when household's cultivated land size increases by a one hectare. This shows that, households with a larger cultivated land size has more likely to participate on off-farm activities than those have small cultivated land.

3. *Total livestock owned in tropical livestock unit (LIVINTLU):* This variable is found positively and significantly related to the probability of participating on off-farm in the study area at less than one level of significance. The positive relationship is explained by the fact that total livestock owned 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 enabled them to participate on off-farm participation. This empirical finding suggests that total livestock owned is important in explaining the probability of participate on off-farm in Tigray regional national state. The odds ratio for total livestock owned indicates that, other things being constant, the odds ratio in favor of participating on off-farm increases by factor of 1.64 as the total livestock owned increases by one tropical livestock unit. Thus, livestock is an integral part of the farming system. Increase ownership of livestock results in increase off-farm participating through the multipurpose of livestock like provides milk and meat, and manure from livestock which is an important fuel for the sample households and used as a fertilizer.

4. *Fertilizer use (FERTLZ),* is found statistically significant at five percent level of significance. The odds ratio of fertilizer use shows that, the probabilities of rural households to off-farm participation increases by a factor of 10.91 as households use fertilizer. Fertilizer was occurred on those households use fertilizer use as compared with those households which have not use fertilizer. Because fertilizer enhances household off-participation by giving increase in crop production and then increase additional income.

5. *Access to credit (CRED):* The result of the logit model showed that access to credit has a significant and positive influence on off-farm participation in the study area at less than one percent level of significance. This was due to the fact that households which have the opportunity to receive credit would build their capacity to participate on off-farm more and an important factor to smooth condition on a better status and also a means to escape vulnerability to food insecurity. Thus, the odds ratio in favor of off-farm participation increases; other things remain constant, by a factor of 164.57as a household get access to credit. This result is completely in agreement with the prior expectation.

6. *Education (EDU);* as one farmer is literate it is not difficult to be able to participate on off-farm participation. The results of the survey revealed that the variable under consideration is found positively and significantly related to off-farm participation at less than

five percent probability level. Holding other things constant, the odds ratio in favor of off-farm participation increases by a factor of 254.82 as a household has join in education. The possible explanation is that education of the household is an opportunity to thing other income opportunity activities.

7. *Age of the household head (AGE):* is found to be a significant and positively influence on household off-farm participating of the sample households in Tigray national regional state at less than ten percent probability level. The positive sign of the coefficient of age indicates that odds ratio in favor of the probability of participating in off-farm increases as age increases i.e. all other things are held constant, the odds ratio in favor of off-farm participating increases by a factor of 1.09 as age increase by one age. This implication indicates that, as the age of the household head increases the farmer acquires more knowledge and experiences with possible positive impact on participation of off-farm activities.

8. *Distance from main market in minute (DISMKTMIN):* is found to be a significant and negatively influence on off-farm participating of the sample households in national regional state of Tigray at less than one percent probability level. The negative sign of the coefficient of distance from the main market indicates that odds ratio in favor of the probability of off-farm participating decreases as distance from main market increases i.e. all other things are held constant, the odds ratio in favor of off-farm participation decreases by a factor of 0.95 as distance from main market increase by one minute. In other expression the inverse of the odds ratio was 1.05. Thus, a household who have travel more is about 1.05 times more likely to be non off-participating as compared to one who has travel less to the main market. This implication indicate that, households which have access to the main market, can easily transport their output from the production site and procure inputs from near-by areas.

9. *Household Asset in Birr (HHASSET):* this variable is found positively and significantly related to the probability of participating on off-farm in the study area at less than one level of significance. The positive relationship is explained by the fact that total household owned being a proxy for farmer's resource endowment, those sample farmers with large household asset have better chance to earn more income and then a household able to participate on off-farm participating . This empirical finding suggests that total household asset owned is important in explaining the probability of participate on off-farm in Tigray regional national state. The odds ratio for total household asset owned indicates that, other things being constant, the odds ratio in favor of participating on off-farm increases by factor of 1.00 as the total household asset owned increases by one birr.

4.3 Households Level Barriers on Participation of Off-Farm Activity

Farmers in Tigray national regional state have been affected by various problems which cause to none participate on off-farm activities. Out of total respondents who cited the various problems, the major perceived causes of non off-farm participating were lack of income, lack of awareness as well as lack of experience and lack of available land in the study area.

In order to identify the major perceived barriers of participation of off-farm activity, the sample households were asked to respond to each question of the major barriers of off-farm activity participation. Regardless of the differences in perceived magnitude of their influence, in the different ecologies, the farmers rated lack of awareness about 21.53 percent as the most dominant one. The proportion of farmers who reported to have awareness problem was almost similar for both groups. About 21.21 percent of non off-farm participation and 21.66 percent of off-farm participation farmers reported to have lack of awareness. In detail see table 13 below.

Table 13: Major Households Level Barriers on Participation of Off-Farm Activity in the Study Area

N<u>o</u>	Major Households Level Barriers on Participation of Off-Farm Activity	Non Off-farm participation (99)		Off-farm participation (294)		Total (393)	
		Number	Percent	Number	Percent	Number	Percent
1	Lack of available land	36	18.18	21	4.06	57	7.97
2	Lack of awareness	42	21.21	112	21.66	154	21.53
3	Lack of available materials	15	7.57	119	23.02	124	17.34
4	Busy with agriculture activities	44	22.22	77	14.89	121	16.92
5	High rent for houses	13	6.57	5	0.98	18	2.51
6	Lack of coordination	1	0.50	4	0.77	5	0.70
7	Poor health situation of the household head	2	1.01	6	1.16	8	1.12
8	Lack of capital	16	8.08	124	23.98	140	19.58
9	Lack of experience	21	10.61	35	6.96	56	7.83
10	Too old	2	1.01	5	0.98	7	0.98
11	Lack of commitment	4	2.02	10	0.77	10	1.40
12	Others	1	0.51	2	0.39	3	0.42
	Total	198*	100	517*	100	715	100

NB: *Because of 1 (one) household has answered multiple barriers, the numbers of non off-participation and off-farm participation households in the study area is 198 and 517 which is greater than 99 and 294, respectively.

Source: Survey result, 2014/15

The survey also found that about 17.34 percent, 7.97 percent, 16.92 percent, 19.58 percent and 7.83 percent, of the respondents faced problems of lack of available

materials, lack of experience, busy with agricultural activities, lack of capital and lack of available land, respectively. With regard to the proportion of farmers who respond few rural households on major household barriers of off-farm participation are 0.70 percent, 1.12 percent, 0.98 percent, 1.40 percent and 0.42 percent faced lack of coordination, poor health situation of the household head, too odd, lack of commitment and other problems, respectively (Table 13).

5. Conclusion and Recommendations

5.1 Conclusion

In Ethiopia agriculture is a main stay of the economy. The development of agriculture has direct impact on the overall development of the country. However, agriculture is still largely traditional and subsistence type. Therefore, agriculture alone cannot provide sufficient livelihood opportunities to achieve food security. There are other methods to cope up the problem of food security like, rural off-farm employment.

Thus the main objective of paper is to analyze the determinants of rural household off-farm participation in Tigray regional state to increase farm production. To achieve this objective cross sectional data was collected from 393 sample households. And to collect the data needed to the study primary and secondary sources was used. All the information collected from the household was used to prepare the final output of the study. The method of data analysis was carried out in this study comprises both descriptive and econometric analysis. In econometrics analysis, the logistic regression model was selected for this study. The analysis of the logistic regression model was shown that changing household characteristics will change the probability that a given individual household becomes participate on off-farm activities.

Therefore, the model result indicated, out of the 12 factors included in the model 9 variables were found to have a significant influence on the probability of off-farm participate at less than 10 percent level of significance. The variables considered were family size in adult equivalent, cultivated land size in hector, the use of credit, number of livestock owned in tropical livestock unit, age, education, distance from main market in minute, household asset and fertilizer. Whereas, the remaining 3 of the 12 explanatory variables i.e. marital status, sex and irrigation were found to be no significant influence on the probability of off-farm participating.

The survey also found that about 17.34 percent, 7.97 percent, 16.92 percent, 19.58 percent and 7.83 percent, of the respondents faced problems of lack of available materials, lack of experience, busy with agricultural activities, lack of capital and lack of available land, respectively. With regard to the proportion of farmers who respond few rural households on major household barriers of off-farm participation are 0.70 percent, 1.12 percent, 0.98 percent, 1.40 percent and 0.42 percent faced lack of coordination, poor health situation of the household head, too odd, lack of commitment and other problems,

respectively.

5.2 Recommendations

This paper have investigated factors that affect participation of households on off-farm activities in Tigray regional state.. The measurement of factors that affect participation of households on off-farm is based on the perception of the respondents. By estimating the logistic model the study finds the following conclusions (**recommendations**):-

1. As this study has already identified in the econometrics analysis family size is found to be a significant and positively influence on household off-farm participating of the sample households in Tigray national regional state at less than five percent probability level. This implication indicates that, households with large family size, having children of productive age, could be participate in the off-farm activities. Therefore, increasing and strengthening education and health services in the region is a crucial factor to increase off-farm participation in rural areas.

2. Positive coefficient of cultivated land size in econometric analysis indicating that cultivated land size is significantly and positively influenced the rural household off-farm participating at ten percent level of probability.. The possible justification is that sample households who had larger farm size had better chance to participate on off-farm activities. Since sample households who had larger farm size had better chance to assess other additional income activities. Therefore, the region should follow community targeting process to increase diversification and to use effectively of their land. Improved farming methods to increase productivity should be also promoted. Furthermore, a better conservation practice so as to improve the farmers' cultivated land is a solution to produce more because the region's cultivated land was reached almost at higher level.

3. Total livestock owned is found positively and significantly related to the probability of participating on off-farm in the study area at less than one level of significance. The positive relationship is explained by the fact that total livestock owned 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 enabled them to participate on off-farm participation through provides milk and meat, and manure from livestock which is an important fuel for the sample households and used as a fertilizer. Therefore, the region should encourage farmers to use credit facilities, introduced a proper forage development programs, expanding veterinary service and disease prevention programs in the study area is crucial to increase livestock production and productivity.

4. The result of the logit model showed that access to credit has a significant and positive influence on off-farm participation in the study area at less than one percent level of significance. This was due to the fact that households which have the opportunity to receive credit would build their capacity to participate on off-farm more and an important factor to smooth condition on a better status and also a means to escape

vulnerability to food insecurity. So the region should create an opportunity to the rural household to use credit service from public agencies and private institutions to increase participation on off-farm activities. In addition, continuous monitoring and evaluation should also be used as an important instrument for effective use of credit at grass root level.

5. As one farmer is literate it is not difficult to be able to participate on off-farm participation. The results of the survey revealed that the variable under consideration is found positively and significantly related to off-farm participation at less than five percent probability level. The possible explanation is that education of the household is an opportunity to thing other income opportunity activities. So, the tasks related to increase the skills and production technique of farmers should be give emphasize to increase off-participation.

6. Fertilizer use is found statistically significant at five percent level of significance. Fertilizer enhances household off-participation by giving increase in crop production and then increase additional income. Therefore, management of land and water resources is also essential for sustainability of the livelihood participation of off-farm activities. Therefore, farmers who have use fertilizer are important to participate on off farm activities.

7. Age of the household head is found to be a significant and positively influence on household off-farm participating of the sample households in Tigray national regional state at less than ten percent probability level. This implication indicates that, as the age of the household head increases the farmer acquires more knowledge and experiences with possible positive impact on participation of off-farm activities. So, experience sharing is an important tool to increase off-farm participation.

8. Distance from main market in minute is found to be a significant and negatively influence on off-farm participating of the sample households in national regional state of Tigray at less than one percent probability level. This implication indicate that, households which have access to the main market, can easily transport their output from the production site and procure inputs from near-by areas. So, the rural policy should give more attention to developing the transport infrastructure in the area.

9. Household asset in Birr is found positively and significantly related to the probability of participating on off-farm in the study area at less than one level of significance. The positive relationship is explained by the fact that total household owned being a proxy for farmer's resource endowment, those sample farmers with large household asset have better chance to earn more income and then a household able to participate on off-farm participating . This empirical finding suggests that total household asset owned is important in explaining the probability of participate on off-farm in Tigray regional national state. Therefore, it is important to manage household assets of the rural farmer's household.

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