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# LIVELIHOOD ACTIVITIES: THE DETERMINANTS AND IMPORTANCE OF OFF-FARM EMPLOYMENT INCOME AMONG RURAL HOUSEHOLDS IN TIGRAY REGION, NORTHERN ETHIOPIA

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## ABSTRACT

*This study examined the livelihood activities: determinants and importance of off-farm employment income among rural households in Tigray region, using evidence from Endamokonni and Degua Tembien districts of Tigray region, northern Ethiopia. Results were based on data collected from a survey of 205 randomly selected rural households. The study found that Off-farm employment is relatively more important to the poorest group. But the better off households benefit much from farming. Given participation, the factors that affect the level of per capita off-farm employment income were analyzed using two-step Heckman selection model. This considered for possible self-selection in the estimation procedure. Households with large farm size, informally educated heads and those who live in Endamokonni district earned significantly higher income from wage work. Households with older heads, more adult males, more children with five years old or under, higher livestock holding and those who live far-off from major market earned lower off-farm wage income, in case they participated. Given participation, male-headed families earn higher income from off-farm self-employment than the female-headed counterparts. Number of adult male and children with six to ten years old in the family negatively and significantly related with the level of per capita self-employment income. This may be because off-farm self-employment income was expressed in per capita terms.*

## JEL CODE

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## KEYWORDS

Ethiopia, Heckman's Model, Off-farm Income, Rural Households.

## 1. INTRODUCTION

Development policies of rural sector have often targeted in improving farm productivity to combat the major economic problems like poverty, food insecurity and inequality among the rural families. However, there is growing evidence that the rural sector is more than farming in developing countries. The rural economy is not based solely on agriculture but also on a diverse array of off-farm employment activities (Reardon, Berdegue & Escobar, 2001). Off-farm employment is very broad concept. Generally, it consists of wage employment and self-employment activities that earn income in return to the households' labor supplied outside their own farm. Wage employment includes paid development work, farm wage, skilled and unskilled regular wage (salary) employment and casual daily works. Self-employment on the other hand, comprises selling firewood and charcoal, stone mining, grain and livestock trading, petty trading, weaving, mat making, pottery and handcraft etc. Households may also get incomes outside the farm and/or off-farm employment sources of income, which we referred as the non-labor income. It includes remittance income received from relatives and friends not presently living with the household, from pension, gifts, renting out assets, inheritances and government aids.

Wide range of literatures from developing countries has identified the significant role of off-farm employment on reducing rural poverty, inequality, and income vulnerability. In Latin America for example, rural households earn 40-45% of their income from nonfarm sources (Reardon et al., 2001). Moreover, several studies in Africa have reported that off-farm earnings account for a substantial share of farm households' income. According to Haggblade, Hazell, and Reardon (2007), off-farm employment income account for about 35% of rural incomes in Africa. DFID (2004) and Oluwatayo (2009) suggested that income from household members' participation in non-farm activities has been contributing significantly to farm households' welfare in Nigeria. The situation is likely to be similar in other countries of sub-Saharan Africa, except the result from Tanzania where share of off-farm income to total income of rural farm households is only 8% (Mduma & Wobst, 2005). Similar result is also found in Ethiopia. Davis (2003) on his study of "rural non-farm economy, livelihoods and their diversification: issues and options", has reported that some 20 % income of rural households in Ethiopia originates from nonfarm sources. Similarly, Hagos and Holden (2003) in their study in northern Ethiopia have documented that per capita off-farm income accounts for about 34% of households' per capita consumption expenditure. Despite of the few studies made on livelihood activities in Ethiopia, there have been no well documented recent studies which analyze for the livelihood (off-farm) activities in rural Tigray, Northern Ethiopia. Thus, the aim of this study is to provide empirical evidence on the livelihood activities of rural households in Tigray region (Northern Ethiopia): Describe and characterize livelihood activities, analyze the determinants of off-farm work income and the importance of off-farm income across different income groups. The study is conducted in Tigray region, Northern Ethiopia. The region belongs to the Sudano-Sahelian agro-climatic region of Ethiopia. Its climate is characterized by one long dry season from October to May followed by a short rain season from March to April in some parts of the region and the long rainy season mostly from late June to early September. The region is characterized by erratic rainfall and frequent droughts, and on average it receives between 550 and 650 mm rainfall annually (Nigisti, 2007). Tigray region has seven administrative zones, each of which is further divided into a number of districts and Kebeles. The seven zones are Eastern, Central, Southern, Southeastern, Northwestern, Western and Mekelle. The survey has been conducted in two rural districts of Tigray: Endamokonni and Degua Tembien districts located in the Southern and Southeastern Zones of Tigray respectively. Degua Tembien is located at 39°10' E longitude and 13°38' N latitude. The capital of the district is Hagereselam, which is located 50 km far from the regional capital, Mekelle city. The district has total 124,590 (115,815 rural and 8775 urban) projected population and 27,319 rural households in 2010 (CSA, 2007). The average altitude of the district is 2618 meters above sea level and its daily temperature ranges from 18°C to 25°C. The annual rainfall of the Woreda ranges from 600- 800 mm (Admasu, Kiros & Memhur, 2011).

The second site, Endamokonni, is found at a distance of 660 km from Addis Ababa and 120 km from Mekelle town. It is located at 12°47'N latitude and 39°32'E longitude with average elevation of 2400 meters above sea level (REST, 1996). According to the information obtained from the agriculture and rural development office of the district, Endamokonni has mean annual rain fall of 785 mm and mean annual minimum and maximum temperature of 9°C and 22°C, respectively. The district has a total population of 91,256 and total households of 20,465 (CSA, 2007).

The rural people in these districts are mainly dependent on rain fed subsistence agriculture. Crops like barely, wheat, pea, Teff, lentil and faba beans are mainly cultivated in the area. The main livestock types are cattle, sheep and goats. Livestock provides drought and draft power, food and income. Off-farm employment activities for e.g; petty trade and sale of labor are also important livelihood strategies in the study area. Wage labor employment opportunities are available locally on the farms of the better-off households, and in the nearby towns. The productive safety-net program (PSNP) is also playing very important role in reducing food insecurity.

The remaining part of this paper is organized as follows: Section two presents the literature review, which deals with the theoretical and empirical review on livelihood (off-farm) activities. Section three presents the data source, methodology and model specification. In this section the sources of data, the methods used to obtain the data and the theoretical and econometric models used to analyze the data set are presented. The analysis of empirical results are presented and discussed in section four. The last section is the conclusion and recommendations part of the study.

## 2. LITERATURE REVIEW

### 2.1. DEFINITION OF TERMS AND CONCEPTS

Off-farm employment: defined as activities from which the farmers earn income apart from their farm work. It may include agricultural wage work on other people's farm, non-agricultural wage-employment or self-employment in commerce, mining, manufacturing and transport, and service sectors. Thus, unlike non-farm employment off-farm employment, is broader concept used to denote all works (agricultural or non agricultural) performed outside the own farm.

Off-farm income: is the income earned from all sources excluded the income from the household's own farm or rented in plot.

Farm income: is the income from the farm households own farm or rented in plot, which includes net income from crops and animals.

Crop income: is obtained by subtracting gross costs from the volume harvested times median sales prices at the regional level.

Livestock income: consists of net income from sold live animals and both consumed and sold raw animal products, such as meat, eggs, milk, skin etc. Net livestock income is obtained by subtracting gross production expenditure from the quantity of animals sold times producer median prices and the quantity of produced raw animal products time's consumer median prices in the relevant region.

Household income: consists of all receipts in cash, in kind or in services that are received by the household or by individual members of the household at annual or more frequent intervals, but excludes windfall gains and other such irregular and typically one-time receipts (ILO, 2003). It is the sum of off-farm employment income, farm income, and non-labor income from rented out assets, remittance, inheritance, social benefits, and net transfers.

Household: is defined in this research as people living under the same roof and eating food from the same pot. That is, a household member who did not live independently during the survey time at least for six months.

Rural: is any locality that exists primarily to serve agricultural hinterland.

Rural household: is a household that lives in the countryside and that may involve in both farm and off-farm activities.

Kebele: is the lowest administrative unit of settled rural area.

### 2.2. THEORETICAL MODEL

The basis for the household's livelihood decision is the theory of agricultural household model, where the household has a dual role of producer and consumer. If markets are perfect, the household first maximizes profit by choosing different sets of income generating activities based on its resources and prices, and then maximizes utility by choosing between different levels of consumption and leisure given profits. However, in case the markets are imperfect production and consumption decisions become non-separable (Bardhan & Udry, 1999).

### 2.3. LIVELIHOOD DIVERSIFICATION

Different terms such as off-farm, on-farm and non-farm are used to show diversification of activities and incomes. According to Barrett and Reardon (2000), the rural households activities and the corresponding income can be grouped using a three-way classification by sector (e.g., farm versus non-farm), function (wage versus self-employment), and space (local versus migratory).

The classification of activities based on sector follows the distinctions of national accounting systems; as primary (agriculture, mining and other extractive activities), secondary (manufacturing), and tertiary (services). This leads directly to the distinction between agricultural or farm income and non-agricultural or non-farm income. Hence, It does not matter where the activity takes place (on the farm premises, in town or abroad), at what scale (in a huge factory or by a single person), with what technology, or whether the participant earns profit or labor income (wages or salary) from the activity (Barrett *et al.*, 2001).

The second is functional classification. This includes wage employment (i.e., involving in wage or salary contract) and self employment (e.g., entrepreneurial activity).

Given the sectoral and functional classification of an activity, the third one is spatial classification (local and migratory), which in turn holds some important sub categories (Barrett & Reardon, 2000; Barrett *et al.*, 2001). Local activities are divided in to two sub categories (i) "at home or on-farm" (ii) "local away from home or off-farm". On the other hand, migratory or "distant away from home" activities can be categorized further in to: (a) domestic rural (e.g., inter-zone migration), (b) domestic urban and (c) foreign. From the three ways of classification presented above, this study emphasis on spatial classification (on-farm/off-farm type).

People in most part of the world (rural or urban) diversify their income. They collect their income from different sources, hold their wealth in different assets or use their assets in more than one activity. Before, we try to state the rationale for households livelihood diversification it is better to define what income diversification refers to. The definition for income diversification differs among authors. Ersado (2003) defined income diversification as an increase in the number of sources of income or the balance among the different sources. Delgado and Siamwalla (1997) defined diversification as the switch from subsistence food production to the commercial agriculture. Others authors for example, Escobal (2001) define income diversification as an expansion in the importance of non-farm income. This definition of income diversification is linked to the concept of structural transformation at the national level, defined as the long term decline in the percentage contribution of agriculture sector to gross domestic product (GDP) and employment in growing economies. Income diversification can also be defined as the process of switching from low value crop production to higher value crops, livestock, and nonfarm activities. Thus, many analysis of income consider income diversification as strategies employed to earn cash income in addition to primary production activities from a variety of sources (Dercon & Krishnan, 1996).

The United Kingdom Department of Foreign and International Development (DFID) (2004) incorporate "a livelihood" which comprises the capabilities, assets and activities required for a means of living. Livelihood diversification thus, refers to attempts by individuals and households to find new ways to raise income and reduce risk, which differ by the freedom of choice. Livelihood diversification includes both on-farm and off-farm activities which are undertaken to generate income additional to that from the main household agricultural activities, via the production of other agricultural and nonagricultural goods and services, the sale of wage labor or self-employment and other strategies to spread risk (Oluwatayo, 2009).

### 2.4. EMPIRICAL LITERATURE REVIEW

Having seen the basic classifications of incomes and activities, and the definitions of livelihood diversification above, the reasons why households and individuals do diversify their income are presented below. Mostly the question, why do rural households diversify their livelihoods arises on livelihood studies. Barrett and Reardon (2000) have attempted to answer for this question on their study of income diversification and household livelihood diversification strategies in rural Africa. They stated that farm households diversification of activities emerge from diminishing or time-varying returns to factors of production, from market failures (e.g. for credit) or frictions (e.g. for mobility or entry into high-return niches), from ex ante risk management, and from ex post coping with adverse shocks. Where returns to productive assets (e.g. land, labor or livestock) vary across time or among individuals within a household or households within a community, individuals, or households will diversify their assets, activities and incomes.

In addition, incomplete markets (e.g. for land, labor, credit, or insurance) may induce farm households to diversify their livelihood. For example, a smallholder household endowed with much labor but relatively little land will in the absence of well-functioning land markets hence apply some labor to its own farm and hire some labor out for off-farm wage employment in agriculture. Because when individuals or households are not endowed with the ratio that maximizes returns and there are not well-developed asset markets through which they can exchange assets to achieve the optimal mix, diversification becomes the usual



response. Similarly, where markets for credit or insurance are incomplete, individuals are typically unable to smooth consumption even they desire credit to smooth the production or income variability. For many institutional, infrastructural, technological, and informational reasons, financial markets are usually incomplete in rural Africa. So, individuals must act outside of financial markets in order to reduce consumption variability driven by real income variability. Diversification is a primary means by which many individuals reduce risk (Barrett et al., 2001).

On the contrary, missing markets can discourage diversification. According to Reardon 1997 missing credit markets can hinder diversification into activities or assets characterized by substantial barriers to entry (as cited in Reardon et al., 2001). On the other hand, if off-farm options can be accessed easily, but credit markets are incomplete, non-farm earnings can be a crucial means for overcoming working capital constraints to purchasing necessary variable inputs for farming (e.g. fertilizer, seeds, equipment, labor) or to make capital improvements (e.g. bunds, ridges, irrigation) to one's farm (Woldehanna & Oskam, 2001).

Diversification also serves as a coping response for ex post shocks. When crops fail or livestock die, households must reallocate labor to other pursuits, whether formal off-farm employment (e.g. wage labor), informal off-farm employment (e.g. hunting), or non-agricultural activities (e.g. weaving and brewing). One implication of diversification as risk management rationale is that the need for self-insurance is a function of the availability of substitute social insurance, provided through transfers by the government, by non-profit organizations, by community or family members. Since social insurance can at least partly substitute for self-insurance, one would expect greater need for asset, activity, and income diversification where social insurance is relatively scarce. This might be indicated by the high dependence of African farm households on non-farm income, as governments, communities, and relief agencies offer meager and frequently slow safety nets, and the social foundations of traditional safety nets appears to be stretched (Barrett et al., 2001; Ellis, 2000).

De Janvry and Sadoulet (2001) have reported that low access of land, human capital, migration assets and ethnicity play negative role on non-agricultural income. Atamanov (2011) has also tried to estimate the determinants of non-farm earnings using double hurdle model for the participant households. According to this literature age increases the level of non-farm earnings from public and private organizations but doesn't affect the level of income from self-employment. Males reap high-income from both wage and self-employment activities than their female counterparts. Education positively affects non-farm income, even for self-employment income, though education does not affect participation in self-employment. Access to infrastructure and market characteristics also increases level of earning from wage and self-employment activities. Asset ownership in the form of livestock increases significantly earnings from non-farm activities.

Ibekwe, Eze, Ohajanya, Orebiyi, Onyemauwa, and Korie (2010) have reported a result that supports the distress diversification hypothesis, for they found a negative relationship between nonfarm-income and the farm output per hectare of land using a survey data from south east Nigeria. The study tries also to show the effect of other variables like education, age of the household head, farm size, household size and farm investment. Education of the head has positive and significant effect on the level of non-farm income at 5% significant level. The variables like farm size, household size and farm investment have a negative and significant correlation with non-farm income. The coefficient for age of the household head was not significant and negatively correlated with non-farm income.

Regarding to the income diversification of the farm households, studies found that the existence of substantial entry or mobility barriers (particularly in labor market and financial and credit) to high return niches within non-farm economy make the poor to have less diversified asset and income portfolio and enter only into less remunerative activities (Barrett, Bezuneh, & Aboud, 2001; Barrett & Reardon, 2000). Barrett et al (2001) has extended and explains the difference in income portfolios and livelihood diversification pattern are associated with labor market segmentation, barrier to entry, location and potential income growth.

Oluwatayo (2009) has made similar study on poverty and income diversification among households in rural Nigeria. Tobit regression model has used to show the determinants of livelihood diversification. Male headed, small sized family, non-poor households with formal education and better income and access to credit facility were found to affect the livelihood index positively. Besides, Determinants of income share from different sources of non-farm activities among rural households in the same country has explored by other group of researchers (Olugbenga, Adewunmi, John & Adebayo, 2011). The study indicates that education, experience in non-farm activity, and distance to urban center were the major determinants of income shares from different sources of non-farm activities.

Freese (2010) has documented findings from Burkina Faso; which are consistent to the results found from other sub-Sahara African countries. The empirical paper uses Heckman two-step selection model to determine the probability of participation and level of income generated in the non-farm sector. The regressions are applied to the pooled data, as well as the wealthiest and poorest expenditure quintiles respectively. The analysis shows education and proximity to community structure positively and significantly affects income from non-farm activities for the wealthier quintile and pool data. For the poorest quintile, distance to health centers, household age and number of adults influence the success in non-farm earnings.

The recent literature on off-farm labor market participation by Babatunde and Matin (2010) in rural Nigeria has also tried to analyze the determinants of participation in off-farm labor employment and incomes from them. Tobit model has been used to estimate the determinants of income from off-farm involvement. The result indicates family size and land size have positive effect on the level of off-farm income. Exceptional negative effect of family size is reported for self-employed and remittance incomes.

Berg and Kumbi (2006), Nigisti, (2007) and Bezabh et al, (2011) have also made studies on the determinants of nonfarm employment participation in different parts of Ethiopia. Woldehanna and Oskam (2001) have also made deep study in northern Ethiopia, Tigray on the paper titled "Economic Analysis and Policy Implication of Farm and Off-farm Employment". The literature tries to answer some questions among these I present here what I believe it could be in line with my study. Farmers engage in different off-farm activities to diversify their income and enable them to feed themselves during crop failure, but the main worry is whether it is possible to support farmers to enable them participate without scarifying the farm productivity. To address this problem they analyze the link between farm and off-farm activities and their determinants. Eventually, they found a substantial increase of farm income as a result of income diversification in general and promoting off-farm employment in particular. This may because off-farm income helps to finance farming activities such as purchase of farm labor and other inputs such as seeds, fertilizer and pesticides. Still there are contradictory hypothesis regarding off-farm employment that on the one hand it produce more cash and on the other hand less labor to be employed on the farm. But, the evidence implies the positive impact of off-farm employment on farm productivity outweighs than its compromising effect. This is because one if labor was unemployed/under employed on farm, off-farm employment may have no effect on farming, second farmers can make crop choice go friendly with off-farm work and thirdly if the marginal productivity of labor off-farm is better than on their farm still they can hire labor on their farm and supply their labor off-farm. Reardon 1997 confirmed that, if there are entry barriers and rationing in the labor market, diversifying income in to off-farm activities would be more difficult for poor than for rich households (cited in Reardon, 2001).

Hagos and Holden (2003) have examined the welfare impacts of credit access and program participation measured by changes in household's per capita expenditure, the change in household's level of off-farm income over time and others. They found significantly positive impact of credit on the level of off-farm income among households located in Kebelle that are close to major markets.

### 3. SIGNIFICANCE OF THE STUDY

The study is significant for it increases individuals' understanding regarding the livelihood activities in rural Tigray; factors that influence the level of off-farm employment income and the importance of off-farm employment incomes across the different income groups. The outcome of this study can also use for local administrators and NGOs in order to devise interventions that can help to improve the livelihoods of the rural poor. Particularly this paper can serve as a source of reliable information for farmers and policy makers. The findings can also use as reference for researchers who are interested to conduct further study on the field.

### 4. STATEMENT OF THE PROBLEM

Some studies, for example Freese (2010) in Burkina Faso, Raphael and Matin (2010) and Idowu, Awoyemi, Omonona, and Falusi (2011) in rural Nigeria, Mduma and Wobst (2005) in Tanzania, have documented the driving forces for off-farm labor participation. Woldehanna and Oskam (2001) have also analyzed the interaction between farm and non-farm activities, in Ethiopia. In spite of the few studies which analyze the driving forces for off-farm work participation and its impact on reducing economic problems like poverty, inequality, vulnerability etc. studies that examine for the livelihood activities (specifically for the determinants and importance of off-farm employment income) in rural Tigray are scarce.

Woldehanna (2000) has also reported that rural households in Tigray often involve in different off-farm activities outside their farm. However, those who participate may not equally reap the benefit from off-farm work. Thus, it needs an investigation to identify the factors that lead to this income differences among farm households. Hence, this study addresses the potential constraints and opportunities among rural households to benefit from certain off-farm activities; it also examines the importance of off-farm income across different income classes.

## 5. OBJECTIVES

The general objective of the study is to analyze the livelihood activities of rural households in Tigray region (Northern Ethiopia).

### SPECIFIC OBJECTIVES

The specific objectives of the study are to:

- ❖ Describe and characterize the livelihood activities of the study area
- ❖ Identify the factors that affect the amount of income earned from off-farm work
- ❖ Examine the importance of off-farm employment income among different income groups

## 6. HYPOTHESES

Table1 shows hypothesized/expected effects of the independent variables over off-farm employment income.

**TABLE1: EXPECTED SIGNS FOR EXPLANATORY VARIABLES IN THE MODEL**

Independent variables	Expected signs	
	Off-farm wage income	Off-farm Self employment income
1.Individual/household characteristics		
Age of the household head	-	-
Sex of the household head (male=1)	+	+
Education status of household head	+	+
Number of children 5 years old or under	-	-
Number of children 6-10 years old	-	-
Number of adult male in the household	+	+
Number of adult female in the household	+	+
2. Households' asset variables		
Per capita livestock holding	-	-/+
Cultivated farm size per capita	-	-
3.Financial constraint indicators		
Credit	-/+	+
Non-labor income	-	
4.Infrastructure and location characteristics		
Distance to major (Woreda) market	-	-
Distance to the nearest all weather road	-	-
District	+/-	+/-

## 7. ORGANIZATION OF THE STUDY

The remaining part of this paper is organized as follows: section eight presents research methodology. Section nine presents the empirical results while the last section concludes the paper with the potential policy implications of the study findings.

## 8. RESEARCH METHODOLOGY

### 8.1 DATA SOURCE AND DATA COLLECTION METHODS

In this survey both primary and secondary data were collected from different sources. A Semi-structured interview schedule was developed to collect the necessary primary data in which both quantitative and qualitative data were gathered from the sample respondents through face-to-face interview. The questionnaire included information on households demographic characteristics, livelihood activities that the households involve in, off-farm employment activities in which at least one member of the household participates in during the survey period, number of labor hours/days these individuals supplied to off-farm wage work and wage rate per day and annual earnings from off-farm self-employment activities. In addition, gross income from sale of crop, livestock and livestock products and value of crop and livestock or livestock by products used for household consumption and variable costs like expenditure on fertilizer, seed, pesticide, herbicide, purchased livestock feed, and expenditure for livestock medicine were collected. Qualitative data were also gathered from focus group discussion and informal discussions with farmers and personal observations. In addition, secondary data has been collected from available reports and records of the agriculture and rural development offices of the study districts, Ethiopian CSA Mekelle branch and published journals from websites and unpublished literatures from different sources.

### 8.2. SAMPLE AND SAMPLING METHOD

Multistage stratified sampling method was applied to select the respondents. The choice of the two districts was made purposively. The reasons why these districts were chosen were: first, there is a substantial variation in the nature and availability of off-farm activities. Second, there are variations between the two districts in their access to information, market and infrastructure facilities. The choice of Kebeles is made in such a way that: first the 23 rural Kebeles in Degua Tembien and 18 Kebeles in Endamokonni are clustered in to two, based on their distance to Hageresalam and Maichew towns respectively. Then one Kebele from the nearest and another one from the far-off clusters have been chosen from both districts randomly. For Endamokonni and Degua Tembien, the first cluster includes Kebeles within the radius of 10 kilometers, while the second cluster include Kebeles lie at radius larger than 10 Kilometers from Maichew and Hageresalam towns respectively. Kebele Shimta and Meswaeti are chosen from the nearest and far-off clusters respectively in Endamokonni district. Similarly, Kebeles Limat and Seret are chosen from the nearest and far-off clusters respectively in Degua Tembien district. Next, all Kushets from the kebeles chosen above have taken to choose our sample respondents. The respondent households are chosen from the list of household heads in each Kebele using systematic random sampling method. Total sample of 205 rural households, 96 households from Endamokonni and 109 from Degua Tembien are chosen using probability proportional to size.

### 8.3. METHODS OF DATA ANALYSIS

To examine the determinants of off-farm employment income sources, incomes from off-farm work were disaggregated in to off-farm wage income and off-farm self-employment income. This separation was preferred because we expected the factors that affect income from these activities may be different.

#### 8.3.1. ECONOMETRIC MODEL

We applied Heckman Selection model to identify the factors that affect off-farm employment income (off-farm wage employment and off-farm self employment income separately). Sample selection bias is a potential problem in predicting the income earned from off-farm work due to unobservability nature of the dependent variable for some observations. An estimate of off-farm income regression, that does not take selection bias in to consideration suffers from omitted variable problem, what we call it the effect of selection on incomes. Hence, Heckman selection model has been employed. This approach is chosen because it

considers for selection bias that could arise due to missed data. The most common version of the Heckman procedure is to estimate in two stages. In the first stage, a probit is estimated on the decision to work off-farm with data from both participants and non-participants, and then using the estimation result inverse mills ratio is calculated. In the second stage estimation of the OLS model on level of off-farm income using data from the participant households only while including inverse mills ratio to account selection bias is then undertaken. Alternatively, a single stage estimation procedure using a likelihood function can be carried out. In this study, the determinants of income from off-farm wage work and off-farm self employment were estimated using Heckman's two stage procedures. In order to fulfill objective two the following functional form is used.

$$Y_i = f(Z_{1i}, Z_{2i}, Z_{3i}, Z_{4i}) \quad (1)$$

The econometric model for the functional form stated in equation (1) can be specified as:

$$Y_i = C_{0i} + C_{1i}Z_{1i} + C_{2i}Z_{2i} + C_{3i}Z_{3i} + C_{4i}Z_{4i} + \varepsilon_i \quad (2)$$

Where,  $Y_i$  represents the amount of wage income and self-employment income.  $Z_1, Z_2, Z_3$  and  $Z_4$  denotes for the vector of independent variables used during analysis.  $C_{0i}, C_{1i}, C_{2i}, C_{3i}$  and  $C_{4i}$  represent for the row vectors of coefficients that have been estimated, and  $\varepsilon_i$  error term with standard properties. The model in equation (2) can be specified in more appropriate and compacted form as shown in equation (3) to estimate off-farm employment income (Green, 2003 and Verbeek, 2004).

$$\log l_i^* = X_{1i}'\beta_1 + \varepsilon_{1i} \quad (3)$$

Where,  $l_i^*$  implies individual household's off-farm employment income, It is observable for the participants. Yet it is unobservable for the non-participant households.  $X_{1i}'$  is a vector of observable factors that affect the level of off-farm employment income and  $\varepsilon_{1i}$  error term. Let the selection model for household's participation in some off-farm work be explained by the equation stated below. Here, the equation indicates that households participation depends on some value  $h_i^*$  of a latent variable.

$$h_i^* = Z_{1i}'\alpha_1 + \mu_{1i} \quad (4)$$

Thus, we can determine the participation and actual off-farm employment income from the selection equation as stated below.

$$h_i = \begin{cases} 1 & \text{if } h_i^* > 0 \\ 0 & \text{if } h_i^* \leq 0 \end{cases} \quad (5)$$

With the decision to participate in off-farm work given by  $h_i=1$  if individuals participated and  $h_i=0$  otherwise, where  $h_i$  is a variable indicates participation in off-

farm employment,  $Z$  is a vector of variables that affect households decision to participate in some off-farm activities and  $\mu_{1i}$  the corresponding error term. And the outcome equation (for this study actual off-farm employment income equation) is explained as:

$$\log l_i = \begin{cases} X_{1i}'\beta_1 + \varepsilon_{1i} & \text{if } h_i^* > 0 \\ \text{Unobserved} & \text{if } h_i^* \leq 0 \end{cases} \quad (6)$$

$$\text{Assuming: } \mu_{1i} \sim N(0, \delta^2) \\ \varepsilon_{1i} \sim N(0, 1)$$

$$\text{Corr}(\mu_{1i}, \varepsilon_{1i}) = \rho$$

The conditional expected income of individual households who participate in off-farm employment becomes,

$$\begin{aligned} E(l_i | h_i=1) &= X_{1i}'\beta_1 + E(\varepsilon_{1i} | h_i=1) \\ &= X_{1i}'\beta_1 + \rho\phi(Z_{1i}'\alpha_1) / \Phi(Z_{1i}'\alpha_1) \\ &= X_{1i}'\beta_1 + \rho\lambda \end{aligned} \quad (7)$$

If the correlation coefficient  $\rho=0$ , estimating the model using OLS gives unbiased result. The term  $\rho\phi(Z_{1i}'\alpha_1) / \Phi(Z_{1i}'\alpha_1)$  is known as inverse Mill's ratio; usually represents by  $\lambda$  and reflects for the selection variable that captures selection bias. Simple statistics like percentages, means and quartile groups were used to analyze the first and third objectives of the study.

## 9. RESULTS AND DISCUSSION

### 9.1. DESCRIPTIVE STATISTICS

Farm households in the study area were found to diversify their livelihood activities and income. Even though farm households mainly relied on agriculture, which consists of crop and livestock production or both, off-farm activities have been found to support the life of many poor farm households in Tigray.

To describe the livelihood activities in the study area, the main sources of income and corresponding rate of participation for the sample households by source of income is presented. Moreover, the composition of total household income by source has presented to show the importance of the different sources of income.

Table 2 shows the participation rate and composition of households' total income. About 97.6 % of the sample households derived their income from farming which accounted 61.1% (49.5% crop income and 11.6% livestock income) of the total annual household income. The remaining 39% of household income was obtained from different off-farm sources, which includes off-farm wage employment, off-farm self-employment and non-labor income. The result indicates that 73.7% of the sample households in the study area have at least one member in the household being involved in off-farm employment activities during the survey period. In this study off-farm employment activities are categorized in to off-farm wage employment and off-farm self-employment activities. About 56% of the households have reported some income from off-farm wage, which accounts for 22.5% of total household income. Wage employment in turn can be classified in to: paid public development work, manual off-farm work and non-manual (skilled) off-farm work (Woldehanna & Oskam, 2001; Ellis, 2000). But, for this study since non-manual (skilled) off-farm work is scarce, simply we categorized off-farm wage employment in to off-farm wage work excluded paid public development work and paid public development work (food for work/ cash for work program). Among the sample households 40.4% participate in food /cash for work program; which constitutes 2.4% of the total household income. Only 27.3% of the total sample households are involved in wage work excluded paid public development work. This accounts for 20.3% of the annual household income. Paid development work involves community soil and water conservation programs including forestation, construction of community services like school, health center, road, farmers training center and other community work done under the food for work program.

About 37.6 % of the sample households are involved in self-employed non-agricultural activities; which accounts only one-tenth of the total household income. It includes activities like grain and livestock trade, sell of handcraft, coffee/tea selling, stone and sand collection, fire wood and charcoal selling, shop-keeping, selling local drinks, petty trade and other local services. Most of the off-farm work participants respond that the income obtained from off-farm source is used for consumption and some farmers use it for buying oxen, fertilizer and farm instruments. But very few use it for investment in non-farm activities and none of the households uses off-farm employment income for saving. This gives us some insight that expanding off-farm sector could promote the farm sector. Because this enables farmers to get sufficient amount of income which in turn is used for farm investments.



**TABLE 2: HOUSEHOLD PARTICIPATION IN DIFFERENT LIVELIHOOD ACTIVITIES AND COMPOSITION OF TOTAL HOUSEHOLD INCOME**

Income by source	Participation rate (%)	Mean share of total income (%)
Total farm income	97.6	61.1
Crop income	96.6	49.5
Livestock income	74.2	11.6
Total off-farm income	82.4	38.7
Off-farm work income	73.7	32.8
Total wage income	56.1	22.5
Total wage income excluded paid public development work	27.3	20.3
Paid public development work	40.4	2.4
Self-employed income	37.6	10.3
Non labor income	17.1	5.9

Source: Computed from own survey data, (2012)

Note: All income sources are net costs. Crop income is computed by subtracting explicit variable costs (like costs for seed, fertilizer, herbicides or pesticides, hire labor, rent in oxen or motor etc) from the amount of own harvest consumed plus sold times by the prevailing market price in the area. Similarly, livestock income is calculated as the value of live animals and raw animal products/services sold and consumed net of some inputs such as purchased feed, hired labour and veterinary services. The method is used in reports on livestock income (FAO, 2011).

#### 9.1.1. CHARACTERIZING OFF-FARM EMPLOYMENT PARTICIPATION RATE BY SEX OF THE HOUSEHOLD HEAD AND DISTRICT

Table 3 indicates the participation rate of households in different off-farm employment activities by sex of the household head and district. In the survey data, 28.8% of the household heads were females. On average, 20.5% of the participant households were female headed. But, there is a difference in participation of female households in various off-farm employment activities across the study sites. Female headed households took larger percent for both off-farm self-employment and paid public development work participation than their male counterparts in Endamokonni district. This may be due to the availability of large market for self-employment activities that are appropriate for females. The reason why female headed households hold larger rate of participation than male headed households in food /cash for work program is because female headed households were poorer than male headed households in the area and the program usually targets to the poorest households that able to work. This is based on our survey data that indicates the average annual agricultural income for male and female-headed households were Birr 9363.35 and 4183.95 respectively. But, the reverse is true in Degua Tembien district: female-headed households take fewer participation rates in all off-farm activities. The following possible reasons can be forwarded: the main reason can be because of the difference in biophysical environment of the two sites. Other reasons can be due to the existence of small market for off-farm products /services appropriate for females in Degua Tembien, and also possibly because of the sample from Degua Tembien constitutes small number of female headed households by chance. In both districts female-headed households participate less in off-farm wage employment excluded paid development work. This is due the existence of less time available for females. Besides, traditionally the society considers that nonfarm wage work as belongs only for males. Another reason could be since employers mostly demand male labor for off-farm wage work.

**TABLE 3: OFF-FARM WORK PARTICIPATION RATE BY SEX OF THE HOUSEHOLD HEAD AND DISTRICT**

Type of off-farm activities	Endamokonni (N=96)		Degua Tembien (N=109)	
	Male	Female	Male	Female
Off-farm self employment	17.7	25	28.4	4.6
Total wage employment	37.5	27.1	40.4	8.3
Wage-employment excluded paid development work	19.8	10.4	23.9	0.9
Paid development work	25	26	22.9	7.3
Total off-farm work participation	46.9	32.3	58.7	10.1

Source: Computed from own survey data, (2012)

#### 9.1.2. IMPORTANCE OF OFF-FARM EMPLOYMENT INCOME ACROSS DIFFERENT ECONOMIC GROUPS

In this part, the relative importances of various income sources across different income strata of rural households were presented. A useful method of analyzing income composition across different economic groups is sorting by deciles, quintiles or quartiles. But, only 204 observations have full information to analyze income composition. Therefore, quartile group is appropriate in this case. In order to better reflect household's living standards the quartiles are constructed based on per capita household income. The first and the fourth quartiles could be used as proxy for the relatively poorest and richest groups respectively.

Table 4 shows income composition by per capita income quartiles. We found that the importance (share) of farm income increases with per capita household income while the importance of off-farm income decreases. The richest households (households with the highest per capita income) derived most of their income from farming which accounted 80.6% of their annual total income. The first quartile or lower 25% households, in contrast, derive their largest (66.5%) income from off-farm sources, which in turn constitutes 44.3% wage income, 10.3% self-employment income and 11.9% non-labor income. Though aggregate farm income contributed less for the poorest group, crop income was very important next to off-farm income for them, which accounted for over 58% of their overall income. Thus, households who were better in agricultural income obtained less from off-farm activities. This implies off-farm activities serve as a survival strategy for the rural poor in Tigray. Therefore, this is in line with the empirical argument that rural households in Africa engage themselves in off-farm /non-farm activities more out of necessity than choice (DFID, 2004).

The large contribution of wage income to the poorest group of households implies that off-farm wage does not require initial capital. Hence, the poor can enter easily. Finally, non-labor income consists of income received from relatives or friends, gifts, pension, remittance, renting out assets, inheritances and government food aid. In this study, we found that non-labor income decreases with an increase in per capita household income. This is because non-labor income, in our case, largely derives from government food aid; and government food aid is a program, which mainly targets to the poorest of poor.

**TABLE 4: AVERAGE COMPOSITION (%) OF ANNUAL NET HOUSEHOLD INCOME BY PER CAPITA INCOME QUARTILES**

Income source	Per capita income quartiles			
	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>
Total farm income <sup>1</sup>	33.1	55.3	75.6	80.6
Crop income	58.6	32.9	52.4	54
Livestock income	25.5	22.3	23.2	26.6
Total off-farm income <sup>2</sup>	66.5	44.3	24.3	19.3
Off-farm employment income <sup>3</sup>	54.6	39.8	20.4	16.3
Off-farm wage income	44.3	21.7	14.3	9.7
Off-farm Self employed income	10.3	18.1	6.1	6.6
Non-labor income	11.9	4.5	3.9	3

Source: Computed from own survey data, (2012)

<sup>1</sup>Total farm income=Crop income +Livestock income

<sup>2</sup>Total off-farm income=Off-farm employment income+ non-labor income

<sup>3</sup>Off-farm employment income=Off-farm wage income +off-farm self employment income

### 9.1.3. DESCRIPTIVE STATISTICS FOR THE DEPENDENT AND INDEPENDENT VARIABLES

Table 5 presents definition and descriptive summary of the variables used for the regression analyses. The result shows that while most of the sample households were male headed; the remained 25.85% were female headed. Over 52 % of the household heads in the sample were illiterate, 8.3% are informally literate while the rest 28.3% and 11.2% were formally literate with grades 1-6 and above grade 6 respectively. The mean age of the household heads in the sample was 45 years. The mean number of children with 5 years old or under in the household for the sample was 0.87. On average, there were 0.78 children with 6-10 years old per household for the sample.

On average, an individual farmer owned 0.21 livestock units. The average per capita farm size was 0.456 tsimdi, which is smaller than 1 tsimdi (0.25 hectare), the average landholding in Tigray. The mean annual per capita non-labor income of the sample households was Birr 72.39 with a 6% share of total net household income (see Table 2). Almost 65% of the sample households acquired loan either from formal or/and informal sources during the survey period. On average, it took 0.408 and 1.79 hours to reach the nearest all weather road and nearest major market from individual's home respectively.

TABLE 5: DESCRIPTIVE STATISTICS OF VARIABLES

Variable	Description	Mean/ percent	Std.dev
Offwpart	Dummy for participation in off-farm wage work Yes=1 Otherwise=0	56.10% 43.90%	
Offspart	Dummy for participation in off-farm self employment Yes=1 Otherwise=0	37.56% 62.44%	
pcoffwinc	Annual per capita household wage income (Birr)	218.739	383.384
pcoffsinc	Annual per capita household Self-employed income (Birr)	149.907	365.054
sex_hh	Sex of the household head Male=1 Female=0	74.15% 25.85%	
age_hh	Age of the household head (years)	45.12	12.475
educ_hh	Education status of the household head Illiterate=0 Informally literate=1 Grade1-6 for head=1 Grade above 6 for head=1	52.2% 8.29% 28.29% 11.22%	
child1	Number of children with 5 years old or under	0.873	0.836
child2	Number of children 6-10 years old	0.785	0.775
adumale	Number of adult male household members	1.444	0.972
adufem	Number of adult female household members	1.419	0.874
pctlu <sup>1</sup>	Per capita livestock holding (excluded oxen) in TLU	0.17	1.208
Pcfarmsize <sup>2</sup>	Per capita area cultivated by household in the survey year (tsimdi)	0.458	0.561
pcnlaborinc	Annual per capita non-labor income (Birr)	72.394	257.523
credit	Dummy whether the household demands loan during the survey year (yes=1) (No=0)	35.12% 64.88%	
dalwroad	Distance to nearest all weather road in hours	0.408	0.459
dmajormkt	Distance to nearest major market in hours 1.797 0.86	1.797	0.869
district	Dummy for study Woreda Endamokonni=1 DeguaTembien=0	46.83% 53.17%	

Source: Computed from own survey data, (2012)

<sup>1</sup>Tropical Livestock Unit conversion factors are for cattle=0.7, sheep or goats=0.1, horses=0.8, mules=0.7, donkeys=0.5, calves=0.15chickns=0.01;

<sup>2</sup>Tsimdi is equivalent to 0.25 hectare.

## 9.2. ECONOMETRIC RESULT ANALYSIS

### 9.2.1. ESTIMATION PROCEDURE

The data was tested for multicollinearity, hetroskedasticity and normality problems using different STATA 11. Multicollinearity test helps to identify highly correlated independent variables. In this case household size has shown serious multicollinearity problem; and we exclude from our model. The most commonly applied diagnostic test for multicollinearity problem is Variance Inflation Factor (VIF). As a rule of thumb, if the VIF of a variable exceeds 10, that variable is said to be highly colinear (Gujarati, 2004). In order to apply probit and Heckman's selection model normality and homoskedasticity of the error term should hold (Green, 2003). Hence, these assumptions required to be tested. We tested for heteroskedasticity (for the log-lin model) and normality of the error terms for the different regression outcomes. We use Breusch-pagan hetroskedasticity test to check existence of hetroskedasticity problem for errors. To check for normality of data, skewness and kurtosis as well as the Shapiro-Wilk and Shapiro-Francia tests are used (Park, 2008). The homoskedasticity (for the log-lin model), and normality assumption for the log-linear off-farm income models are not rejected. The level of per capita off-farm work income equations has transformed in to log-linear functional form for in an attempt to eliminate the heteroskedasticity problem.

### 9.2.2. HECKMAN TWO STEP MODEL ESTIMATES FOR OFF-FARM EMPLOYMENT INCOME

In this section, the determinants of income from off-farm wage work and off-farm self-employment sources are analyzed. This can help in particular to understand why some households are better able to derive income from specific off-farm activities than others. Since many households do not derive income from off-farm wage and off-farm self-employment activities, off-farm employment income is not observed for the non-participants. Hence, if we apply OLS using data from the participant samples only we may get biased and inconsistent results. For this reason, Heckman's two step selection model was applied to estimate the income equations, because Heckman model helps us to consider observations that have missed data. Heckman model was also used by other authors in similar contexts (Hagos & Holden, 2003; Brick et al., 2005).

The covariates that we used to analyze the participation in off-farm activities were also used to identify the factors that affect income from them. To avoid identification problem that could arise during estimation, the variable number of children with 6-10 years old was excluded from off-farm wage income equation and used only in the corresponding selection equation. Similarly, per capita non-labor income was excluded from the outcome equation for off-farm self employment. The results for the outcome equations of the Heckman models are presented in Table 6. Here, results for the outcome equations are estimation results for determinants of per capita off-farm employment income (per capita off-farm wage and per capita off-farm self-employment income) after correcting



for selection bias. The estimate for mills lambda for the off-farm wage participation,  $\lambda=1.456$ , given at the bottom of table 6 is statistically significant at 5% significant level (with,  $p=0.05$ ). Similarly the estimate for mills lambda for off-farm self-employment participation,  $\lambda= -1.372$  is significant at 10% level with ( $P=0.076$ ). This indicates the existence of selection bias. Hence, applying ordinary least square (OLS) method without correcting for selection bias can give us biased and inconsistent coefficients.

The first stage, which represents participation, is not discussed now; here we focused on the second stage, which described the determinants of off-farm employment income given that households participate in certain activities. Most of the explanatory variables relate with logarithm of per capita off-farm wage income as expected. But, education level for head (specifically grade 1-6), number of adult male and female in the household and per capita farm size contradicts to what we expect prior. Sex and education status for household head (informal and formal above grade 6) and distance to the nearest all weather road relates with level of off-farm self-employment income as expected. But, the sign of coefficients for age of household head, number of adult male and female in the household, per capita farm size and distance to the nearest market are found different from prior expectation.

Household and individual characteristics affect both the participation in off-farm employment and the corresponding earnings, although their sign is different for some of these variables. Variables that indicate household asset position significantly affect the level of off-farm wage income per capita; but their effect is not significant for off-farm self employment income. Access to infrastructure, represented by distance to the nearest all-weather road and distance to the nearest major market were not significant for off-farm wage employment participation. However, distance to the nearest major market significantly relates with off-farm wage income at 10% level. The dummy for study site (district) significantly affects both the likelihood of wage work participation and incomes from it. Most of the variables that affect off-farm self-employment participation become insignificant for the level of income from these activities. For example, credit, per capita non labor income, per capita total livestock units, distance to the nearest all weather road, distance to the nearest major market and dummy for study site significantly affects participation in off-farm self employment; while their effect is not significant for the level of off-farm self employment income.

Sex of the head, number of adult male in the house household and number of children with 6 to 10 year old significantly relates with the level of per capita off-farm self employment income. The detail explanations for the determinants of income from off-farm (wage and self employment) are presented below.

Male headed households found to earn higher income from off-farm self-employment than female headed counterparts. But the effect of sex of head on the level of per capita off-farm wage income is not significant, given participation. Higher earning for male-headed families favors with prior expectation. This is because most of the time females in the study area involve in traditional enterprises that earn low return and can perform at farmyards. Besides, females may not get enough time to involve in profitable activities like long distance trade that demands more time and resource. Therefore, females, if they provide with skill enhancing training and time saving technologies it is possible to improve their income from off-farm self employment.

Age and informal education for head have also identified as essential determinants of off-farm wage income. Being older for the head of the household lowers the level of off-farm wage income per capita. But, age doesn't have a significant effect on the level of income from off-farm self-employment. This is because as individuals get old they may be paid less or work less frequently in off-farm wage work as they physically become weak. Unlike wage work off-farm self-employment does not need much physical and mental energy. Informal education for household head positively and significantly affects per capita off-farm wage income. But, the coefficients for formal education (grade 1-6 and above 6 for head) are insignificant at 10% level. This is because in this study most of the off-farm wage income is derived from manual wage work and food/cash for work program, which does not need formal education at all. But, for informal education it is due to the existence of some social services that demand informal education, for e.g., priests paid for their service in churches. The effect of education (formal and informal) on off-farm self-employment income is not significant.

Number of adult male household members with 15 to 64 years old significantly decreases earnings from both off-farm wage and off-farm self-employment. This result is specific to the study sites. A lot of possible reasons can be provided for this result. First, most of the adults in the survey area were students during the survey period, thus they spent few time for off-farm wage work and earn less. Second possible reason is, those adults who are not students, even though they like to work the demand for wage labor in those districts is small. Thus, all adults who are willing and able to work for wage may not get job in the nearby towns; as an option they can go to Mekelle city, but it has transportation and other related costs. Therefore, their contribution to the off-farm earnings becomes less as off-farm earning is expressed in per capita terms. Similar reasons can be provided for off-farm self employment income.

The number of tropical livestock units per capita has a negative and significant effect for off-farm wage earnings. This is because as livestock management needs intensive labor it may compete for the scarce family labor that can allocate to off-farm wage work, hence lowers off-farm wage income. In addition, livestock holding is an indication of household wealth. Some of the wage income in our sample comes from cash / food for work program participation. But, the wealthy farmers can't be targeted for the program. Thus, livestock holding relates negatively both with the participation in off-farm wage work and income from it. Farm size increases off-farm wage income, given participation. This implies individuals with large farm size; unless they earn high income from off-farm wage they cannot be involved in it. This indicates the reservation wage for families with large farm holding is high.

Location and infrastructural characteristics as proxy by: district dummy, distance to the nearest all weather road and distance to the nearest major market have also significant effect on off-farm wage income. Distance to the major market lowers income from wage employment, but its effect for off-farm self employment income is not significant. This means that residence in far off areas hinders off-farm wage work participation, and in case they participate inadequate access to market limits wage income.

Finally, individuals in Endamokonni obtain significantly higher income from off-farm wage employment than those in Degua Tembien. This may be due the size of the nearest major market they can access easily. As Maichew town with total population of 37581 has larger market relative to Hagereselam town with a total population of 8022 CSA (2007), both the availability of wage employment and wage rate is higher in Maichew town than do in Hagereselam. Therefore, it is logical for households to get higher wage income in Endamokonni district than their counter parts in Degua Tembien.

TABLE 6: HECKMAN TWO STEP ESTIMATES FOR OFF-FARM EMPLOYMENT INCOME

Explanatory Variables	Log off-farm wage Income per capita		Log off-farm self employed income per capita		c
	Coef.	Std. Err.	Coef.	Std. Err.	
sex_hh(male=1)	0.345	0.333	0.992	0.594*	
age_hh	-0.042	0.019**	0.001	0.016	
Informally literate (yes=1)	1.237	0.560**	0.221	0.702	
Grade 1-6 for head (yes=1)	-0.096	0.381	0.429	0.369	
Grade >6 for head (yes=1)	0.322	0.554	0.068	0.533	
Adumale	-0.449	0.161**	-0.483	0.208**	
Adufem	-0.114	0.143	-0.243	0.164	
child1	-0.422	0.217*	0.243	0.211	
Child2	-----	-----	-0.495	0.201**	
Pcnlaborinc	-0.000	0.000	-----	-----	
Credit(yes=1)	-0.090	0.260	-0.056	0.353	
Pctlu	-0.182	0.109*	-0.010	0.137	
Pcfarmsize	0.477	0.237**	0.269	0.351	
Dalwroad	-0.060	0.292	-0.175	0.487	
Dmajormkt	-0.278	0.164*	0.422	0.279	
district(Endamokoni=1)	0.754	0.342**	-0.212	0.343	
Mills lambda	1.455	0.742**	-1.372	0.772*	
_cons	7.060	0.832***	6.282	1.019	
Number of observations	205		205		
censored observations	90		128		
uncensored observations	115		77		
Wald chi2 (30)	59.59		60.39		
Prob > chi2	0.0001		0.0004		

\*\*\*, \*\*and \* significant at the 1%, 5%, and 10% level, respectively

## 10. CONCLUSION AND RECOMMENDATIONS

### 10.1. CONCLUSION

In this study the livelihood activities of rural families in Tigray, Northern Ethiopia were analyzed. Specifically, the determinants of households' income earned from off-farm employment activities were analyzed. Besides, the main livelihood activities in the area were characterized and the importance of off-farm employment income across different income groups was examined using simple descriptive statistics. Since we expect the factors that affect incomes earned from different off-farm activities may be different, we disaggregated off-farm activities in to off-farm wage work and off-farm self employment.

The result shows that 73.7% of the sample households in the two districts participated at least in one of the off-farm activities and derive some income from these activities. On average, the sample households derived just over sixty percent of their income from farming and almost forty percent from off-farm sources. Off-farm employment accounted one third of the total net annual household income and the smallest portion comes from non-labor income sources: like remittance, pension, renting out assets, government aid etc. The poorest group of households were found to drive two thirds of their income from off-farm sources; in which the largest amount obtained from wage income, while off-farm self employment and non labor income sources constituted the smallest part. On the contrary, the relatively richest group derived about eighty percent of their income from farming and only nineteen percent was derived from off-farm sources. Hence, the share of off-farm income was negatively related with total per capita household income. This implies, off-farm employment is very important to the poorest. But the better off households benefit much from farming.

The regression result indicates the determinants of off-farm employment income given participation are not the same to the determinants of participation.

Age of the household head, number of adult male and number of children with 5 years old or below in the household, per capita livestock holding and distance to major market are significantly associated with lower per capita off-farm wage income. Families with informally educated household heads earn higher per capita off-farm wage income over households with illiterate heads. Per capita land holding is positively associated with the level of per capita off-farm wage income among the participant households. District dummy have significantly positive effect as in the participation equation.

Unsurprisingly, once they took part in some off-farm self-employment activities, male-headed households earned more than their female counterparts. Number of adult male and children with 6 to 10 years old in the family negatively and significantly related with earnings from off-farm self employment at 5% level. Poor access to infrastructure as proxy by distance to the nearest all weather road negatively related with off-farm earnings, but its effect was not significant even at 10% significant level.

### 10.2. LIMITATIONS

The study is undertaken in the southeastern and southern zones of Tigray, Degua Tembien and Endamokoni districts. That is, due to the existence of resource and time constraints the study is confined to these areas only. Among all other options of rural households' livelihood strategies, the scope of this study is mainly limited to off-farm employment in the two districts. Since farmers do not keep records and due to mind lapse, we face difficulty to get exact values for some questions.

### 10.3. RECOMMENDATIONS

Off-farm work plays very important role on the livelihood of the poorest of poor, because it is very important source of income for them next to crop income. Thus, respective bodies should work more on enhancing the livelihood of this segment of rural households by introducing interventions that improve crop production and support the off-farm sector in order to create job opportunities that poor households can participate and benefit directly.

Poor access for market and infrastructure lowers off-farm employment participation (though not significant for off-farm wage employment) and corresponding earnings (though not significant for off-farm self employment). Thus, local markets (towns) should be promoted by introducing infrastructure facilities like road, electricity, water and others in order to create new self-employment opportunities and make profitable for the already existed ones. Connecting rural centers with all weather roads can also help to reduce transaction costs related with searching wage employment.

Even though they have more probability to participate in off-farm self employment activities, female-headed households earn lower than their male counterparts from these activities. This is because most of them are involved in low return small scale traditional non-farm activities like: weaving, spinning, pottery, preparing local drinks, selling tea or coffee and shop keeping. Thus, they should be provide with skill enhancing training in order to improve the quality of commodities they provide and get attractive return from these activities. Besides, they should also be obtain market, which can help them to enlarge the scale of their enterprises, hence could reduce costs related with those activities and make them profitable.

Older household heads are less likely to participate in off-farm wage and earn less in case they participate. Thus, the governmental and non-governmental agencies should find sustainable aid to old ages because they cannot supplement their agricultural produce with other sources.

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