

Rural Households Livelihood Portfolios and Determinates of Livelihood Diversification in North-Western Ethiopia

MERSHA TEWODROS GETNET (✉ kukuget22@gmail.com)

University of Gondar College of Social Sciences and Humanities <https://orcid.org/0000-0002-0646-5429>

Mengistu Ketema

Addis Ababa University

Bamlak Alemu Alamirew

Addis Ababa University College of Development Studies

Girma Demilew

University of Gondar College of Business and Economics

Research

Keywords: Diversification, Tobit Regression, On-Farm, Off-Farm, Ethiopia

Posted Date: July 7th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-648494/v1>

License:  This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

RURAL HOUSEHOLDS LIVELIHOOD PORTFOLIOS AND DETERMINATES OF LIVELIHOOD DIVERSIFICATION IN NORTH-WESTERN ETHIOPIA

¹Mersha, Tewodros Getnet (Assistant Professor in University of Gondar, College of Social Science and the Humanity, Department of Development and Environmental Management Studies)

kukuget22@Gmail.com or tewodrosgetnet2010@gmail.com

²Mengistu Ketema (professor, Ph.D, Addis Ababa University)

³Bamlaku Alamirew Alemu (Ph.D, Associate Professor, Addis Ababa University)

⁴Girma Demilew (Ph.D.Assistant professor, University of Gondar)

1 ABSTRACT

Background: Regardless of the persistent image of rural areas in Ethiopia as a continent of subsistence farmers, over the past decades, there had been an outstanding tendency of rural economic diversification. Numerous motives prompt households and individuals to expand the range of assets, incomes, and activities. *This paper is devoted to characterize rural households' livelihood portfolios and examine the determinants of income diversification using primary data collected from two agro-ecological zones in north-western Ethiopia. To analyze, the data both descriptive and inferential statistics were used. Levels of household livelihood diversification were measured using Simpson Diversification Index (SDI). Censored regression models were employed to identify determinant factors affecting livelihood diversification.*

Result: *The result confirmed that households in the study area collected a significant portion of their income from the diverse farm and off-farm sources. Diversification into off-farm sources contributed 35% to total household income. The result confirms that factors linked to household livelihood diversification measured in Simpsons Diversification Index (SDI) are significantly determined by household head educational status, access for tanning, age of household head, family size, livestock ownership, ox ownership, land owned, the proportion of infertile land, access for road and agro-ecologies.*

Conclusion: *From these results, therefore due attention should be given to strengthening the role plaid by off-farm income in a rural area to facilitate the countries goal of a transformation. Therefore, policy measures need to be directed towards creating conducive conditions through the provision of education and tanning and improve households' access to credit and improve access to a road.*

Key Words: Diversification, Tobit Regression, On-Farm, Off-Farm, Ethiopia

1 INTRODUCTION

1.1 BACKGROUND OF THE STUDY

In Ethiopia, rural households depend on agriculture and other non-agricultural strategies for their livelihoods. Diversification of income sources (the allocation of productive assets among different income-generating activities) has been put forward as one of the strategies households employ to minimize household income variability and to ensure a minimum level of income.

[Bryceson \(2002\)](#) calls this process “deagrarianisation”, i.e. the shrinking role of agriculture in the household’s income and livelihood strategy. Many recent studies show that rural off-farm incomes in SSA are increasing and it played an important role in determining rural household incomes, consumption, expenditure, and household food security ([Haggblade et al., 2010](#)). The share of off-farm income to the total income ranges from 30% to 50% ([Ghimire et al., 2014](#) and [Losch et al., 2012](#)). This process of diversification in SSA has been commonly explained by the combinations of push and pulls factors, which determine the level and type of diversification strategy pursued by a given household ([Seid 2016](#)).

Despite the persistent image of Ethiopia as a continent of subsistence farmers, over the past decades, there had been an outstanding tendency of rural economic diversification. Rural farm households regulate activities to find new opportunities and to cope with risks. Numerous motives prompt households and individuals to expand the range of assets, incomes, and activities. These motives comprise different push and pull factors like household size, farm landholding, seasonality of agriculture, increasing price of agricultural inputs, risk aversion, and

earn more incomes (Mathewos and Nigatu 2016, Yishak 2017, Geremew et al. 2017, Seid 2016, Belaineh 2002 and Fikru 2008).

Subsequently, the diversity of rural livelihood is receiving increased attention in discussions in Ethiopia for rural poverty reduction (Prowse 2015, Worku 2016, Tsega and Mary 2013, Yishak et al. 2015, Adugna and Wagayehu 2012, Yisihake and Abebe 2015, Mathewos and Nigatu 2016, Yishak 2017, Geremew et al. 2017, Seid 2016, Yenesew et al. 2015, Woldehanna and Oskam 2001 and Brhanu 2016). However, in most of these studies diversification has been measured as either as the amount of income which is derived from off-farm sources (Tsega and Mary, 2013; Davis et al., 2010; Brhanu, 2016) or a number of portfolios (Yishak, 2017; Geremew et al., 2017; Geremew, 2017; Mohammed et al., 2018; Yenesew et al., 2015; Seid, 2016; Tsega and Mary, 2013), which may lead to a wrong conclusion in a case where a household gain most of their income from a single source while the rest only from more than one sources. On top of this, in all of these studies so far on diversification portfolios analyses, the values of plantation income were underestimated. Tree plantation is one of the economically acceptable opportunities of income diversification in most highland areas of Ethiopia and the Amhara regional state (Bekele 2011: BoEPLAU, 2015: Wubalem et al., 2019, Sirawdink et al., 2011; Tilashwork et al., 2013).

Alongside the main objective set in Ethiopian rural policy to attain food self-sufficiency by accelerating the transformation of subsistence agriculture to market-oriented agriculture, it has been not able to generate the desperately needed rural transformation. The possible reasons could be the little attention given to diversification to off-farm and non-farm employment in rural areas. For example, the goal set in the Growth and Transformation Plan (GTP) is silent on the role of the rural off-farm sector. One reason for this lack of emphasis could be the unavailability

of solid and up-to-date empirical evidence on the role and determinants of income diversification. Hence, from all the above backgrounds, it is essential in this research to evaluate the level of livelihood diversification considering both the type of income source and share of income and factors affecting a level of diversification. Precisely, the goal of this research is to characterize household livelihood portfolios, determine the extent of livelihood diversification and examine factors affecting the level of household income diversification in North-Western Ethiopia.

The result of this research will provide a clear picture for policymakers when planning for agricultural and rural development by identifying possible bottlenecks of a rural transformation. Further, the results of our study will also help to learn about which off-farm and non-farm economic activities to pay attention to and the infrastructure that will reduce entry barriers and facilitate easier access to these activities.

1.2 RESEARCH METHODS

1.2.1 Data type and data source

The study was conducted in three districts of the Central Gondar zone in Amhara regional State. Centre Gondar zone was formerly named as North Gondar zone along with current west and north Gondar zones. A combination of quantitative and qualitative data collected from primary and secondary sources was used. Following the livelihoods approach, in this research household was used as the unit of analysis for the sample survey, as it is considered a suitable unit of analysis for the study of livelihoods ([Ellis, 2000](#)). Thus, in the research list of households in each sample kebele's were taken to form a sample frame to select sample through random sampling techniques. Sample sizes of the study were determined by the Cochran formula. It was used for

its potential to allow calculating an ideal sample size given a desired level of precision, desired confidence level, and the estimated proportion of the attribute present in the population ([Cochran, 1977](#)). The formula is

$$n_0 = \frac{Z^2 pq}{e^2}$$

Where; e is the desired level of precision (i.e. the margin of error), p is the (estimated) proportion of the population that has the attribute in question, and q is $1 - p$. Thus, the assumption used for sample size determination in this research is as follows: a proportion of population assumed to have a positive relationship with rural areas is set at $p= 0.50$; the maximum tolerable error value of $e= 0.05$; and the desired level of confidence of 0.95, which corresponds to a Z- value of 1.96.

$$n_0 = \frac{Z^2 pq}{e^2} = \frac{(1.96)^2 (.5)(.5)}{.05^2} = 385 \text{ households}$$

1.2.2 Method of data analysis

There are several ways to measure livelihood diversification. For this research to measure the level of household livelihood diversification Simpson's Index of Diversity (SID) were used because SID takes into consideration both the number of income sources as well how evenly the distributions of the income between the different sources ([Minot et al., 2006](#) and [Jianmei and Peter, 2013](#)). Besides, in this study Simpson index of diversity is used because of its computational simplicity, robustness, and wider applicability ([Jianmei and Peter, 2013](#)). The formula for the Simpson index is given below:

$$SID = 1 - \sum_{i=1}^{N} P_i^2$$

Where SID is Simpson's index of diversity, N is the total number of income sources (including forest income) and Pi represents the income proportion of i-th income sources including farm

income and off-farm incomes, which are classified based on different empirical works of literature explained in the literature section. Its value lies between zero and one. The Simpson index of diversity is affected both by the number of income sources as well as by the distribution of income among different sources. The SID model is expressed in this study as:

$$SDI = 1 - \sum_{i=1}^7 \left\{ \left(\frac{C_i}{th_i} \right)^2 + \left(\frac{L_i}{th_i} \right)^2 + \left(\frac{W_i}{th_i} \right)^2 + \left(\frac{AW_i}{th_i} \right)^2 + \left(\frac{NAW_i}{th_i} \right)^2 + \left(\frac{NFSE_i}{th_i} \right)^2 + \left(\frac{NL_i}{th_i} \right)^2 \right\}$$

Where: C_i is crop income, L_i is livestock income, W_i is woodlot income, AW_i agricultural wage income, NAW_i is non-farm wage income, $NFSE_i$ is non-farm self-employment income, NL_i is non-labor income and th_i is total household income. In addition, as part of evaluating the share of the different livelihood portfolios and variations in the rate of livelihood diversification in the study area share of mean, number of income sources (NIS) and the share of each income sources were used. Total Household Income (Y) is given as:

$$Y = \sum_{i=1}^7 y_i$$

Where: Y is Total Household Income, y is an income coming from all sources i $i=1, 2, 3, 4, \dots, 7$, farm and off-farm incomes.

Furthermore, to examine factors affecting livelihood diversification Tobit regressions were estimated. As described above the value of livelihood diversification measured in Simpson Diversification Index (SDI) ranges between zero and 1. Thus, conventional linear regression methods have difficulties in explaining the qualitative difference between these zeroes and continuous observations. Tobit model is more suitable to find the parameter estimates if latent or censored sample presents in the dependent variable ([Gujarati, 2004](#)). It is specified as follows:

$$Y_i^* = \beta_0 + \beta_n X_i + \varepsilon_i$$

$Y = Y^* \text{ if } Y^* > 0; \text{ and}$

$Y = 0 \text{ if } Y^* \leq 0$

Where, Y is the value of SDI, β_0 is the constant term, β_n is parameters to be estimated, X is a set of household characteristics and ε is the error term. For different values of independent variables the equation to evaluate factors affecting household livelihood diversification is becomes:

$$SDI^* = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \dots + \beta_n X_n + \varepsilon$$

$SDI = SDI^* \text{ if } SDI^* > 0; \text{ and}$

$SDI = 0 \text{ if } SDI^* \leq 0$

where SDI is extent of livelihood diversification, β_0 is an intercept and to be estimated, β_1 to β_{14} are a vector of parameters to be estimated which measures the effects of independent variables on household investment of agriculture, X_1 to X_{14} are independent factors hypothesized to affect farm household investment and ε is normally distributed error term with mean zero and constant variance and captures all un-measured variables. The specific variables in the model are described by

Variable	Definition of the variable and its measurement		
Name	Symbol		
Dependent variables			
SDI (Simpson Diversification Index)	SDI	Continuous, level of livelihood diversification measured in (SDI).	Researcher Expectation
Independent variables			
Age of household head	AGE_HH	Continuous, Age of household head in years	-
Family size	FAM_SIZE	Continuous, Total sizes of household member takes the value of 1, 2, 3....	-
Sex of Household Head	SEX_HH	Binary, 1 if the household head is male and 2 if household head are female	±
Household head Education	HH_EDU	Binary, 1 if the household head is literate and 2 otherwise	+
Dependence ratio	DEPEND_RATIO	Continuous, the ratio of the number of dependents aged zero to 14 and over the age of 65, compared with the total population aged 15 to 64.	+
Farm Size	FARM_SIZE	Continuous, Land size holding of the household in hectare	-
Soil Quality	INFERTILE_LAN_D	Continuous, Proportion of landholdings perceived as "infertile in quality"	+
Livestock ownership	LIV_OWN	Continuous, Total livestock ownership in tropical Livestock unit (TLU)	+
Ox-ownership	OX_OWN	Continuous, Oxen owned by the households and take the value of (0, 1, 2, 3...).	+ 7
Road access	ROAD_DIS	Continuous, Walking distance to all weather roads in minute	-
Credit access	CREDIT	Binary, 1 if households were access credit within the last 5 years and 0 otherwise	+

Access for Tanning	TRAN_ACCSS	Binary, 1 head were access for any tanning in the last 5 years and 0 otherwise	±
Health problem	SIK_DAY	Binary, 1 if the their were health problems in the family in a year and 0 otherwise	±
Agro-ecology	AGRO_ECO	Binary, 1 if households live in highland agro ecologies, and 0 otherwise	±

. The study estimated this model using the Maximum Likelihood (ML) procedure.

Table 1:1: Discretions of variables included in the model

2 RESULT AND DISCUSSION

Livelihood diversification is the engagement of households in various portfolios of activities. Households in the study area are characterized by the presence of various livelihood activities. Some are farm-related and others are not. They include productive activities, investment strategies, and reproductive choices. To evaluate the rate of livelihood diversification, this study followed clustering livelihood activities based on strategies. Categorizing households based on strategies they pursue offers good insights into the analysis of outcomes like food security and

Variable	Definition of the variable and its measurement		
Name	Symbol		
Dependent variables			
SDI (Simpson Diversification Index)	SDI	Continuous, level of livelihood diversification measured in (SDI).	Researcher Expectation
Independent variables			
Age of household head	AGE_HH	Continuous, Age of household head in years	-
Family size	FAM_SIZE	Continuous, Total sizes of household member takes the value of 1, 2, 3....	-
Sex of Household Head	SEX_HH	Binary, 1 if the household head is male and 2 if household head are female	±
Household head Education	HH_EDU	Binary, 1 if the household head is literate and 2 otherwise	+
Dependence ratio	DEPEND_RATIO	Continuous, the ratio of the number of dependents aged zero to 14 and over the age of 65, compared with the total population aged 15 to 64.	+
Farm Size	FARM_SIZE	Continuous, Land size holding of the household in hectare	-
Soil Quality	INFERTILE_LAND	Continuous, Proportion of landholdings perceived as “infertile in quality”	+
Livestock ownership	LIV_OWN	Continuous, Total livestock ownership in tropical Livestock unit (TLU)	+
Ox-ownership	OX_OWN	Continuous, Oxen owned by the households and take the value of (0, 1, 2, 3...).	+
Road access	ROAD_DIS	Continuous, Walking distance to all weather roads in minute	-
Credit access	CREDIT	Binary, 1 if households were access credit within the last 5 years and 0 otherwise	+
Access for Tanning	TRAN_ACCSS	Binary, 1 head were access for any tanning in the last 5 years and 0 otherwise	± 8
Health problem	SIK_DAY	Binary, 1 if the their were health problems in the family in a year and 0 otherwise	±
Agro-ecology	AGRO_ECO	Binary, 1 if households live in highland agro ecologies, and 0 otherwise	±

livelihood security ([Alionovi et al. 2010](#)). Accordingly, sample households' livelihoods were grouped into sex-sub categories of livelihood portfolios. These sectors, income sources were identified based on empirical literature and FGD discussion. These categories are shown in Table 2:1. These income sources include, as specified in the table, crop income, and livestock, Non-Farm Employment (NFE), Plantation (P), Agricultural Wage Employment (AWE), and Non-Labor Income (NLI).

Table 2:1 Household livelihood portfolios and their rate of engagement

Livelihood Portfolios		Households engagement		Mean income share to the total income
Main-Category	Subcategory	Count	Percent	
On-Farm	Crop farming	372	95.6	45.08%
	Livestock raring	289	75.1	7.02%
	Tree Plantation	216	56.1	12.53%
Off-Farm	Non-farm employment	241	62.6	23.23%
	Agricultural wage employment	63	16.4	5.47%
	Non-labor income	194	50.4	6.64%

Almost all households (over 95.6%) in the study area were involved in crop farming. Besides a high level of engagement in crop production, households in the study area participate in different non-farm and wage farm activities. In the study, it was found that about 85% of households have access to some income from activities other than agriculture (crop production and livestock). From this 62.6 %, 56.1%, 16.4%, and 50.4% of respondents had reported that the participant and collect some portion of their total income from non-farm employment, plantation, and agricultural waged employment and from non-labor income, respectively (see Table 2:1). It is also indicated that the main source of income in the area, on-farm activity comprises about 65% of the total income on average (see Figure 2-1). The rest 35 % of households' income is from other engagement, where non-farm employment, agricultural wages employment, and non-labor income contributed 23.2%, 5.47%, and 6.6% of the total income, respectively (see Table 2:1).

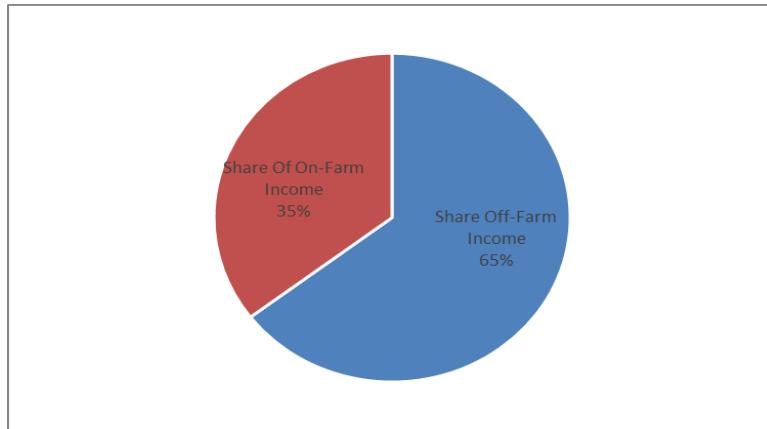


Figure 2-1: Mean-share of on-farm and off-farm livelihood portfolios

The finding of the study thus confirms the notion of heterogeneous livelihood activities pursued by rural households in the study area. This result is more or less similar to the finding by [Adugna and Wagayehu \(2012\)](#) in southern Ethiopia who reported that non-farm income constitutes 22.8% of the total income. Similar findings were also found by [Dereje and Desale \(2016\)](#) in his study of rural livelihood strategies and household food security in Oromia regional states. He noted that 37.2 % of the respondents supplement agricultural livelihood activities with non-farm livelihood strategies. Others undertake the non-farm as their main livelihood activities. [Beyene \(2008\)](#) also found that more than half of rural households have one or more members participating in activities outside agriculture.

2.1 Description of Livelihood Strategies in the Study Area

This section of the research deals with characteristics of diverse livelihood portfolios in the study area.

1.1.1 On-Farm Livelihood Strategies

The livelihoods of the surveyed households were mainly dependent on agricultural activities. In the study area majority of households undertook mixed farming activities, involving both crop production and animal husbandry.

Besides, different types of annual crops and long-term crops (trees) are grown in the study area. In the study area tree crop is one of the dominant long-term cash crops planted on the farm. It accounts for 12.53% of household total income and 19.38% of household on-farm income. Tree plantation is generally viewed as a shift from traditionally grown less remunerative crops to more remunerative crops. It is categorized as secondary agricultural activities ([Eurostar, 2013](#), and [Amanor-Boadu, 2013](#)). As described in Figure 1 4 significant portion of the household cultivate a tree as one form of the cash crop. About 55.1 % of households in the study area cultivate both long-term and annual crops. It is also indicated that households' mixing production of trees and other crops is high in highland areas (82%) than midland areas (34.4). Similar findings were also reviled by [Abebe \(2019\)](#), [Duguma \(2013\)](#), and [Hailemicael \(2012\)](#). According to these studies in Ethiopia production and sale of trees allows households to earn more than could be done by allocating the same resources to cereal food production. An increase in the demand of forest product such as wood for construction poles, timber, firewood, charcoal, fencing, posts, farm implements and source of income which makes Eucalyptus is the popular tree crops in the area. Out of many kinds of eucalyptus species, in the region E. Globulus and E. Camaldulensis are the most widespread of all. The two Eucalyptus species are normally altitude-based with E. Camaldulensis is being adaptable in the upper midland agro-ecology that is lower altitudes while E. Globulus is mostly found in highland agroecology meaning higher altitudes.

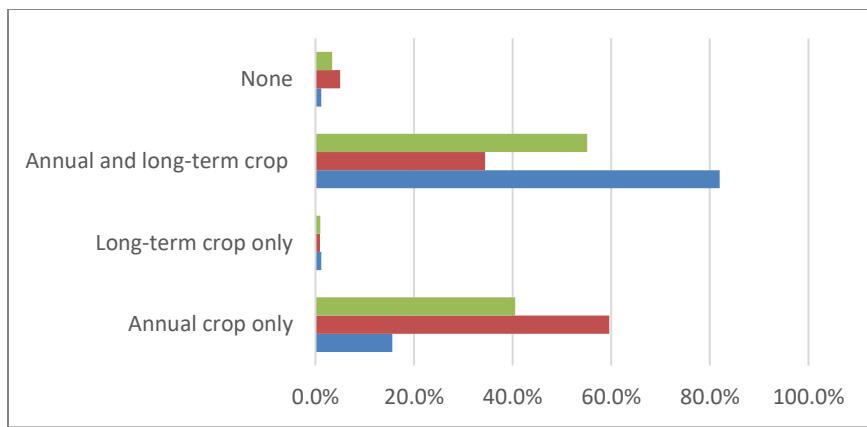


Figure 2-2: Annual and long term crop farming in the study area

1.1.2 Off-Farm Livelihood Portfolios

1.1.2.1 Non-farm employment (NFE)

The non-farm livelihood category consists of households whose main living is based on activities outside agriculture. These include wage labor in the non-agricultural sector, self-employment in own business, trade of grains, traditional brewing, and livestock. In addition to this, this cluster comprises households who derive their living from formal employment. It comprises two income sources or activities: Non-Farm Self-Employment (NFSE) and Non-Farm Wage-Employment (NFWE). As can be seen from Figure 2-3, 84 % of non-farm incomes were from Non-Farm Self-Employments (NFSE), whereas the rest 16 % of the income were from Non-Farm Wage Employment (NFWE).

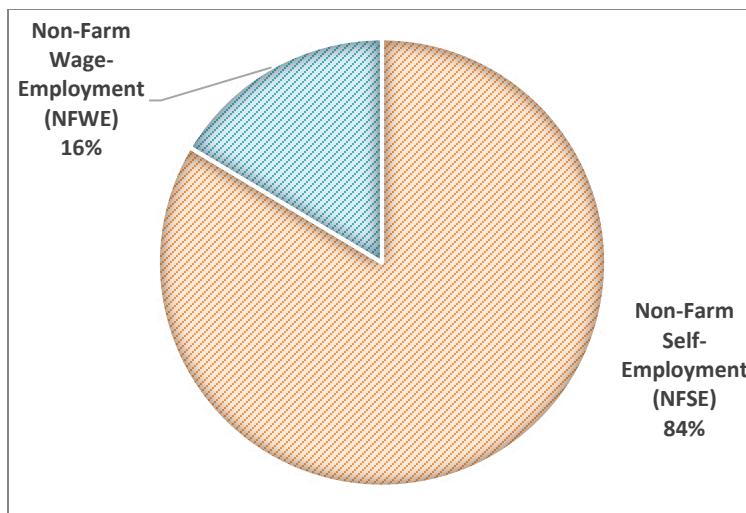


Figure 2-3 Mean share of Non-farm income sources

NFWE refers to wage income paid in cash to rural households who work in different non-farm activities. It could be professional or non-professional works. This includes working as a guard, charcoal preparation, cut trees, loading, assisting in construction, gardening, cleaning, digging ditches, and chiseling among others. On the other hand, NFSE denotes involvement of household in one's own business, for instance, in the form of trade, brewing, or other self-managed activities. It needs some managerial skills ([Woldehana 2000](#)). There were many forms of small businesses in the area which supported a number of households. This includes the income from own business such as petty trade, the seal of traditional drink (Araki, tea, coffee or Tela) and food, transportation using pack animals, etc. Traditional brewing is crucial home-based non-farm livelihood activity absorbing large labor mainly women. In the study area 10.1% household engaged in sailing of local drink and food. This includes sale of Tela, Teg, Areki/Katicala, coffee, tea etc. In the study area manly female head households' sell local drinks usually along with their petty trade. A female headed household aged 34 years old stated that:

“.....I have two children. After my husband died five years ago, I have been encountered with many problems since my children or I can't able to perform agricultural activities. We

were struggling to survive by share-cropping out the land we have for two years. However, the output we got from the land was not enough to cover our basic expenses. Therefore, for the last three years, I started traditional brewing under the constraint of labor to work in agriculture. I prepare Tela and Araki. By so doing, I cover my child's school and food for the family"

1.1.2.2 Agricultural Wage Employment (AWE)

Agricultural wage employment refers to agricultural-related activities which involve the supply of paid labor on farms other than those owned by household members. This includes in the study area contract weeding, milking, crop harvesting, contract farming, and keeping livestock among others. In contrary to involvement in non-farm employment, involvement in agricultural wage employment is generally limited in the study area (only 16.4%) (See Table 2:1). Relatively high levels of involvement in AWE were observed in midland households (18.8%) than highland households (13.2%). However, as indicated in the table the difference in income access from AWE across agroecology is not statistically significant at 5% probability level. This is due to the fact that only the poor and landless participate in this kind of employment. The same table also indicated that AWE income contributes only 5.46 % of the total incomes in the study area. Table 2:2 below indicated that on average AWE contributes 7542.8 ETB with a maximum value of 180000 ETB.

Table 2:2 : Descriptive statistics of agricultural wage employment

Agro-ecology	Agricultural wage employment (AWE) Income in ETB					χ^2
	Engagement		Max.	Mean	Std. Dev	
	Count	Percent				
Highland	22	13.2%	150000	6928.	24162.6	-.389
Midland	41	18.8%	180000	8013.7	29222.8	
Total	63	16.4%	180000	7542.8	27115.6	

It was revealed that contract weeding and harvesting are the most common activity in AWE. It is mainly performed by male household members who travel away from their residents to cash crop-producing lowland areas of Metema, Humera, and Kwara. Nevertheless, AWE mainly involves migration, there are also old households and households with many plots in the study area that contract their crop for others to remove weeds, tilling their farmland, and collect harvest based on an agreement of paying in either food or cash. Weeding which involves no migration is mainly done by female household members whereas farming, crop cutting, and collection are mainly carryout by men. Farmers whose plots are located in distant areas also contract their plots for the adjacent farmers for the purpose of weeding and protection.

1.1.2.3 Non-Labor Income (NLI)

Respondents in this study did not rely only on their labor but also get income from remittance, pension, and informal social support. Non-labor income includes all income as a gift, remittance, donation, aid, other transfer, and compensation. In the study area, as depicted in Table 2:1, 50.4% of households have gathered some income from NLI and the income on average contributes 6.64% of the total income. This income includes income from remittance, pension, and income from renting animals, land, and house. In Table 2:3 it is indicated that from the above-mentioned non-labor income remittance which involves 28% of households and generates a mean income of 2641.8 ETB is the main source. On the other hand, only 10.4% and 0.5% of households gather income from renting animals, land, or house and pension. On average households in the study area collect 897.6 ETB and 98.7 ETB from renting and pension respectively. The Chi-square test indicates that more households in the highland area have had access to non-labor income than midland households and the difference was significant at a 5%

probability level ($X^2 = 20.844$, sig. = 0.000). From FGD participants it was revealed that some households in the highland areas own houses in the nearby town and collect rent incomes.

Table 2:3 Household access and income from NLI

Non-Labor income (NLI) portfolios	Agro- ecology	Access		Mean	Std. Dev	χ^2
		Count	%			
Remittance Income	Highland	48	28.7	3088.6	11660.1	
	Midland	63	28.9	2299.5	6239.9	
	Total	111	28	2641.8	8996.1	
Rent Income	Highland	31	18.6%	1855.6	5190.3	
	Midland	9	4.1%	163.7	1051.3	
	Total	40	10.4%	897.6	3602.1	
Pension Income	Highland	2	1.2%	227.5	2398.9	
	Midland	0	0.0%	.00	.0000	
	Total	2	0.5%	98.7	1581	
Total Non-Labor Income (NLI)	Highland	132	79.0%	5341.7	12905	
	Midland	124	56.9%	3258.8	6577.1	
	Total	256	66.5	4162.3	9874.8	20.844***

2.2 Livelihood Diversification Index (LDI)

Besides measuring livelihood diversification as either as the amount of income which is derived from off-farm sources or on-farm sources, in this study household level of diversification were assessed following Simpson Diversification Index (SDI). Then, following the approach followed by [Ahmed and Melesse \(2018\)](#) in his study of livelihood diversification, in this study household level of livelihood diversification was classified into four categories based on the standard deviation. Thus, households were categorized as no diversification, low, medium, and high levels of diversification as described in Figure 2-4. Accordingly to the assessment, most households failed under the category of medium levels of diversification (56.6%). Only 5% of the population gathers 100 % of their income from only one source. Hence, zero levels of diversification. These groups of households are those who make their livelihood merely from crop cultivation. On the

other hand, 28% and 10.4% of households were under the categories of low and high levels of diversification, respectively.

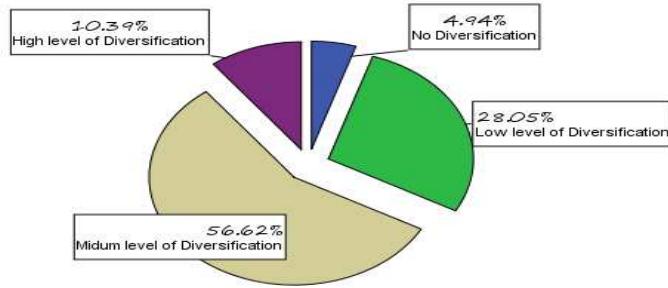


Figure 2-4 Households level of livelihood diversification

Additionally, Figure 2-5 shows the distribution of the number of livelihood strategies that households in the study area were engaged in during the survey year. Most (28.3.8%) of the households were involved in four livelihood strategies. Another 27.5%, 18.4%, 11.9%, 8%, 4.9%, 0.78% was involved in five, three, two, six, one and seven strategies, respectively.

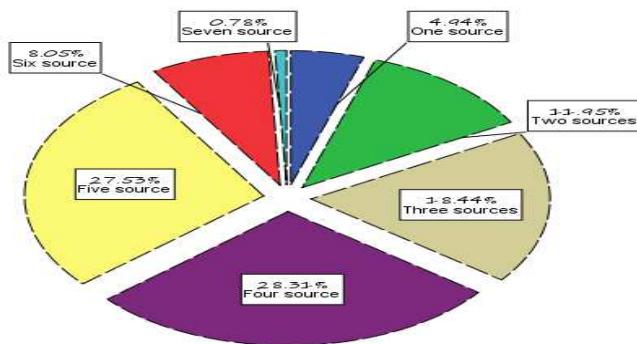


Figure 2-5: Classification of households based on number of livelihood portfolios they depend

2.3 ECONOMETRIC RESULT

Tobit regression model was fitted in order to estimate factors that influence livelihood diversification. To obtain computationally and statistically efficient as well as consistent estimators of the regression coefficients, it is important to make a couple of necessary assumption. The four basic assumptions underlying the Tobit model: Multicollinearity, homoscedasticity (constant variance), normality of residuals and independence of residuals were checked. Moreover, to test model fitness the likelihood ratio test was used. The Likelihood Ratio Chi-Square test i.e., $\chi^2 (14) = 217.62$; Prob > $\chi^2 = 0.000$ revealed that at least one of the predictors' regression coefficient is not equal to zero.

Table 2:4: Results of Tobit model for factors influencing livelihood portfolio diversification.

SDI	Coef.	Std. Err.
GENDER_HH		
Female -.0267652	.0397449	-0.67
HH_EDU		
Illiterate -.0928812	.0257332	-3.61***
CRE_ACCSS		
No -.0306853	.0218564	-1.40
TRAN_ACCSS		
No -.0621122	.0230801	-2.69***
SIK_DAY		
No .0105608	.0219746	0.48
AGE_HH .0042527	.0010306	4.13***
FAM_SIZE .0178872	.0080925	2.21**
DEPEND_RATIO -.0162698	.012366	-1.32
LIV_OWN .011937	.0034927	3.42***
OX_OWN -.0639348	.0109264	-5.85***
FARM_SIZE -.03031	.0165131	-1.84*
ROAD_DIS -.002128	.0004746	-4.48***
INFERTILE_LAND .0009282	.000391	2.37**
AGRO_ECO		
Midland -.0662346	.0229951	-2.88***
_cons .3833451	.0617464	6.21
+-----		
Number of Obs = 385	LR chi2 (14)	= 217.62
65 left-censored observations at SDI <= 0	Prob > chi2	= 0.0000
320 uncensored observations	Pseudo R2	= 0.9478
0 right-censored observations		

2.4 Discussion on Factors Influencing the Extent of Rural Household's Livelihood Portfolio Diversification

Household- level of income diversification and the shares of incomes from the different farm and non-farm activities are presented in Table 2:1. Both farm and non-farm activities are important sources of income for rural households in the sample. As indicated in Table 2:1, almost all households (over 95.6%) in the study area were involved in crop farming and it is the major contributor of the total household income. Diversification into off-farm sources contributed 35% to total household income. Moreover, based on SDI measurement of the level of livelihood diversification, only 5% of the population gathers 100 % of their income from only one source (See Figure 2-4). Hence, zero levels of diversification.

The results of the Tobit regression analysis conducted to estimate the determinants of income diversification are presented in Table 2:4. The results indicate that extent of household livelihood diversification is determined by a number of socio-demographic, economic, institutional, and ecological factors. As reviled in the model result, it was found that some factors had a positive effect on income diversification, whereas others had a negative effect. The results are summarized in Table 2:4 and the subsequent section comprehends discussion of significant variables.

1.1.3 Socio-Demographic Factors

The sex of household heads has a negative but insignificant relationship with the household level of diversification. The negative sign of this variable indicates that households headed by females are less likely to diversify their income sources. This finding (the negative sign) is supported by the findings of [Fufa \(2015\)](#), [Amanze et al., \(2015\)](#), and [Adepoju and Oyewole \(2014\)](#). It implies that male-headed households were able to participate in more livelihood portfolios and collect the diversified income. Perhaps this may be because as observed in the study area there is a traditional culture that leads to gender disparity which creates female-headed households having less information and chance to join in another form of income sources other than the usual agricultural activities.

Unlike the researcher's expectation, the age of household head positively influences the level of household income diversification at less than 1% probability level. This implies that as the age of household head increases, household's levels of engagement in diverse income portfolio also increases. Conceivably this could be due to the fact that aged household heads have more adult family members who might be engaged in various livelihood portfolios. Hence, those adult family members can engage in off-farm employment to support their family. This finding is consistent with the findings of [Vinefall \(2015\)](#), [Akpan et al. \(2016\)](#); [Gecho \(2016\)](#), and [Irohibe and Agwu \(2014\)](#). However, it is inconsistent with the researcher's expectation and money other similar researchers finding. These include the finding of [Senadza \(2012\)](#), [Fufa \(2015\)](#), [Agyeman \(2014\)](#), and [Amanze et al. \(2015\)](#) in Ethiopia. According to these researchers finding as the farmers' age increases their risk aversion behavior also increases. As a result older farmers hesitate to invest their money in a new business to diversify their income.

Households' family size measured in adult equivalent is another demographic factor. It has positive significant effect on income diversification at a 5% significance level. In another word, it indicates that as the number of family members measured in adult equivalent increases, the probability of the household to earn income from diversified sources increases. In a rural area, more family means more labor which able households to engage in diverse livelihood activities. Thus, in the Tobit result, it is indicated that an extra member increase in family size measured in Adult Equivalent (AE) would increase the household level of livelihood diversification by 0.018. This finding is consistent with the finding by [Adpoju and Oyewole \(2014\)](#); [Ghimire et al. \(2014\)](#), [Idowu et al. \(2011\)](#), and [Agata et al. \(2009\)](#). Perhaps it could be due to scarcity of land. When there is a large family size, as land is a fixed input there would be high numbers of under-employed family members whose marginal productivity is zero. Therefore, such households might try to find other alternatives employments and diversify their income sources.

In the study it is also found that, households headed by educated household heads had a positive and significant effect on the level of income diversification as education increases the household's opportunity of livelihood portfolios by providing the necessary skills. It also promotes job mobility and skill acquisition that could be needed to engage in other economic activities. This implies that being illiterate has a negative significant effect on income diversification. Education increases households' motivations to obtain income from self-employment and wage-employment activities in the non-farm sector. Thus, from the finding indicated by Table 2:4, education has the expected, that is, households headed by literate head have 0.092 more chance of engaging in diversified activities. This result is consistent with the results from [Awudu and Crole \(2001\)](#), [Birthal et.al \(2014\)](#), [Gecho \(2016\)](#), [Ghimire et al. \(2014\)](#), [Irohibe and Agwu \(2014\)](#), [Winters et al. \(2009\)](#), and [Idowu et al. \(2011\)](#) where education was found to be a key determinant of the diversification of income-generating activities. Besides households achievement in formal education, non-formal education through training increases a household's chance of diversification by providing skill and awareness about options other than agriculture. Thus, household who had received life skill training within the last five years increased their level of diversification measured in SDI by 0.062. A study by [Fufa \(2015\)](#) recognizes the positive role of paid non-farm training on income diversification.

1.1.4 Economic Factors

In rural areas, household wealth status is mainly determined by their livestock and land ownership. Livestock ownership measured in tropical livestock units was associated with a high level of livelihood diversification. It is because livestock in rural areas is a liquid asset that can be sold to cover household financial needs and for starting up a new business. This finding is consistent with the finding of [Teame \(2018\)](#). On the other hand, as depicted by the model result in Table 2:4, ox ownership of households is inversely associated with livelihood diversification. Ox ownership in the study area is an indication of access to animal plow since it is the only source of power in plowing. This result is probably because household who owns livestock may

not be forced to diversify their income outside agriculture particularly towards agricultural wage employment and other low rewarding non-agricultural employments.

The other most important asset and economic factor in rural areas is farmland. It was found that farm size had a negative and significant influence on the probability of household engagement in income diversification at less than 5% probability level. The possible reason for negative relation could be as farmers' holding increases they may not have extra time or labor to invest outside agricultural income sources as more time and labor is required to cultivate their land. In addition, households will not be forced to diversify their income sources through various means because they are likely to produce fairly enough food from their land. Similar findings were also revealed by [Tekle \(2019\)](#), [Amare and Belaineh \(2013\)](#), and [Yishak \(2017\)](#). Contrary to the above finding, proportion of farmland perceived as infertile land is positively associated with a high level of diversification at a 5% significant level. Because, households who have land but if the land is infertile, they have no option other than engaging in other off-farm employments to secure their life

1.1.5 Institutional Factors

Access to basic infrastructure and institutions has its own influence on household-level of livelihood diversification. The finding depicted in Table 2:4 indicated that household distance to all-weather roads is negatively associated with a household rate of livelihood diversification. This could be due to the fact that household access for road determines a household's movability, opportunities to engage in other income-generating activities outside their own location, and market access. In the area, the common non-farm activities such as daily laborer, petty works, selling of local drinks and handicrafts require access to market and road. Moreover, easy access

to transport could also imply proximity to other urban areas or nearby towns which are centers for non-farm and off-farm activities. Thus, access to transport significantly increased the level of income diversification at a 1% level of significance. This finding is consistent with the findings of [Asmah \(2011\)](#) and [Winters et al. \(2009\)](#).

Furthermore, from the result it is indicated that access to credit was positively correlated with income diversification among households in the study area. The more access a household has to formal credit, which is measured by its access to formal credit in the last five years, the higher the household diversifies its income. It is because it relaxes liquidity constraints ([Teame, 2018](#)). However, such an effect is not significant. It could be due to less developed credit access in the study area (only less than 50% of sampled households do have the access). In addition, societies in the locality depend on informal sources of credit, which substitute formal sources of credit. This result, the positive relationship, is analogous with the findings by [Fufa \(2015\)](#) and [Gecho \(2016\)](#).

1.1.6 Agro-ecology

The study area is characterized by diverse agro-ecologies. It is also one of the determinant factors in the study area. Households in highland agroecology diversify their income source more than households living in midland agroecology at one person significant level. A strong positive relationship was found between being living in a highland area and the extent of diversification. Households in the highland areas are likely to increase their SID by 0.066 points that as compared to midland agro-ecologies. Perhaps, this could be due to the high proximity of highland households to town and market as well as due to its high access for credit and education as compared to households living in rural areas.

3 CONCLUSION AND RECOMMENDATION

Despite the persistent image of Ethiopia as a continent of subsistence farmers, over the past decades, there had been an outstanding tendency of rural economic diversification. Only 5% of the population gathers all of their income from a single source. Therefore, zero levels of diversification. However, government policy and interventions so far have been paying attention to agriculture as the only and main sector. But other livelihood diversification strategies have been overlooked in the rural development policies and strategies of the country. Contrary to the policy focus, rural households in Ethiopia collect a significant portion of their income from secondary agricultural activities (tree plantation) and off-farm employment. A significant portion of households is cultivating trees as one form of the cash crop. Censured regression Tobit model exposed that ten explanatory variables were found to be significant determinant factors of the household extent of diversification measured in Simpson Diversification Index (SDI) up to less than 10% probability level. Thus are household head age and educational status; access for tanning, road and credit; livestock, ox and farmland ownership; family size, proportion of infertile land and agro-ecologies. Based on the findings of this study, it is essential to recommend policymakers give due attention to another source of income in rural areas dominantly engaged in agricultural activities. Therefore, initiatives that seek to increase access to education and training, credit, and road need to be strengthened to enhance opportunities for farm households.

ACKNOWLEDGEMENTS

The first author would like to thank University Of Gondar and Ethiopian Ministry Of Education for Ph.D candidate fund for supporting the cost of data collection.

AUTHORS' CONTRIBUTIONS

Mersha, Tewodros Getnet (main author) collected, analyzed, and interpreted the data and wrote the manuscript. The co-authors edited, commented, and suggested ideas in the manuscript preparation process. All authors read and approved the final manuscript.

AVAILABILITY OF DATA AND MATERIALS

All data and materials used in the study are presented in the main paper.

FUNDING

This research was fully funded by University of Gondar Under Ministry of education student fund.

DECLARATIONS

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

CONSENT FOR PUBLICATION

Not applicable.

COMPETING INTERESTS

The authors declare that they have no competing interests.

4 REFERENCE

- Abebe Birara Dessie, Tadie Mirie Abate, Taye Melese Mekie and Yigrem Mengist Liyew (2019). Crop diversification analysis on red pepper dominated smallholder farming system: Evidence from northwest Ethiopia. *Dessie et al. Ecological Processes* (2019) 8:50 <https://doi.org/10.1186/s13717-019-0203-7>
- Adepoju, A. O. and O.O. Oyewole (2014). Rural livelihood diversification and income inequality in local government area Akinyele, Ibadan, Oyo state, Nigeria: *Journal of Agricultural Sciences*, 59 (2): 175-186.
- Adugna Eneyew and Wagayehu Bekele (2012). Determinants of livelihood strategies in Wolaita, Southern Ethiopia. *Agricultural Research and Reviews* Vol. 1(5), pp. 153 -161.
- Agata P, Swetlana R, Christoph R, Thomas G, Jens-Peter L (2009). Income Diversification of Farm Households: Relevance and Determinants in Germany, Department of Agricultural Economics, University of Kiel Olshausenstrasse, Germany
- Agyeman Bernard Archibald Senyo (2014). Determinants of Income Diversification of Farm Households in the Western Region of Ghana: *Quarterly Journal of International Agriculture*. 53 (2014), No. 1: 55-72
- Ahmed Musa Hasen and Melesse Kumilachew Alamerie (2018). Impact of off-farm activities on technical efficiency : evidence from maize producers of eastern Ethiopia: *Agricultural and Food Economics*. 10.1186/s40100-018-0098-0
- Akpan, S. B., E.J. Udoh, and I.V. Patrick (2016). Sustaining Small Scale Farming: Evidence of Poverty and income Disparity among Rural Farming Households in South-South Region of Nigeria. *International Electronic Scientific Journal*, 9 (14): 9-23.
- Alionovi L., Mane, E. and Romano, D. (2010). Measuring Household Resilience to Food Insecurity: an Application to Palestinian Households: in *Agricultural Survey Methods*, by Benedetti et al. (eds.), John Wiley & Sons, April 2010.
- Amanor-Boadu, V. (2013). Diversification Decisions in Agriculture: The Case of Agritourism in Kansas. *International Food and Agribusiness Management Review* 16: 57-74.
- Amanze, J. O., C.I. Ezeh, and M.O. Okoronkwo (2015). Pattern of Income Diversification Strategies among Rural Farmers in Nnewi North Local Government Area of Anambra State: *Journal of Economics and Sustainable Development*, 6(5): 109-116.
- Amare Demissie and Belaineh Legesse. (2013). Determinants of income diversification among rural households: The case of smallholder farmers in Fedis district, Eastern hararghe zone, Ethiopia: *Journal of Development and Agricultural Economics* Vol. 5(3), pp. 120-128, Available online at <http://www.academicjournals.org/JDAE>
- Asmah, E. E. (2011). Rural Livelihood diversification and agricultural household welfare in Ghana: *Journal of Development and Agricultural Economics*, 3(7): 325-334
- Bekele M. (2011). Forest plantations and woodlots in Ethiopia: In Afr For Forum Work. Pap. Ser 1 (2011): 1-51.
- Belaineh Legesse (2002). Rural Livelihoods: Heterogeneous Perspectives, Objectives and Constraints (Cases from Kersa and Babile woredas): *Journal of Development Research*. Volume 24. Number 2. Addis Ababa, Ethiopia.
- Beyene, A. (2008). Determinants of off-farm participation decision of farm households in Ethiopia: *Agrekon*, Vol 47, No. 1

- Birthal, P. S., D.S. Negia, A.K. Jhab, and D. Singh (2014). Income Sources of Farm Households in India: Determinants, Distributional Consequences and Policy Implications: Agricultural Economics Research Review, 27 (1): 37-48.
- BoEPLAU (Amhara Regional Bureau of Environmental Protection, Administration and Use) (2015). Section III Volume VI. Tana sub-basin Land Use Planning and Environmental Study Project.
- Brhanu Tsegay Mesele (2016). Rural Non-farm livelihood diversification among farming households in Saharti Samre Woreda, South eastern Tigray: June, 2016 Addis Ababa, Ethiopia
- Bryceson Deborah (2002). The Scramble in Africa: Reorienting Rural Livelihoods: World Development 30(5):725-739.
- Cochran W. G. (1977). Sampling Techniques, 2nd Ed., New York: John Wiley and Sons, Inc
- Davis J, Winter.Carletto G, Coarrubias K, Quinones W, Zezza A, Stamoulis K, Azzarri C, Digiuseppe S, (2010). A Cross-Country Comparison of Rural Income Generating Activities; World Development, Vol. 38 (1), pp.48-63.
- Dereje Mengistie and Desale Kidane (2016). Assessment of the Impact of Small-Scale Irrigation on Household Livelihood Improvement at Gubalafot District, North Wollo, Ethiopia: Journal Article MDPI, Basel, Switzerland
- Ellis, F., (2000). Rural Livelihoods and Diversity in Developing Countries, Oxford: Oxford University Press
- Eurostat (2013) Agriculture, forestry and fishery statistics: Eurostat Pocketbooks, Luxembourg, 2013, doi 10.2785/45595
- Fikru Tesfaye (2008). A case study of non-farm rural livelihood diversification. Masters Thesis, Addis Ababa University: Retrieved on Dec 11/2014 from <http://www.jstor.org/action/showPublisher>
- Fufa, M. (2015). Factors responsible for income diversification among rural households in Agafa District, Bale Zone, Oromia National Regional State, Ethiopia.
- Gecho, Y. (2016). Rural Farm Households' Income Diversification: The Case of Wolaita Zone, Southern Ethiopia: International Journal of Sustainable Development Research, 2 (2): 6-17.
- Geremew W. (2017). The Nexus between livelihood diversification and farmland management strategies in rural Ethiopia: Cogent Economics & Finance, 5, 1275087 <http://dx.doi.org/10.1080/23322039.2016.1275087>
- Geremew Worku Kassie, Sangho Kim and Francisco P. FellizarJr (2017). Determinant factors of livelihood diversification: Evidence from Ethiopia: Journal of Cogent Social Sciences (2017), 3: 1369490 <https://doi.org/10.1080/23311886.2017.1369490>
- Ghimire R., Huang W, Shrestha, R.B (2014). Factors affecting nonfarm income diversification among rural farm households in central Nepal: Int. J. Agric. Manag. Dev. 4 (2), 123e132
- Gujarati N. D. (2004). Basic econometrics. Fourth Edition: The McGraw-Hill Companies, New York: 1-1003.
- Hagblade S., Hazell P. and Reardon T. (2010). The Rural Non-farm Economy: Prospects for Growth and Poverty Reduction: World Development, 38(10): 1429- 1441Hansson et al., 2013).
- Hailemicael, B. (2012). The Contribution of Eucalyptus Woodlots to the Livelihoods of Small Scale Farmers in Tropical and Subtropical Countries with Special Reference to the Ethiopian Highlands.:Thesis, Swedish University of Agricultural Sciences.
- Idowu, A. O., J.O.J. Aihonsu, O.O. Olubanjo, and A.M. Shittu (2011). Determinants of income diversification amongst rural farm households in Southwest Nigeria: Economics and Finance Review, 1(5): 31-43
- Irohibe, I. J. and A.E. Agwu (2014). Assessment of food security situation among farming households in rural areas of Kano State, Nigeria: Journal of Central European Agriculture, 15(1): 94-107.
- Jianmei Zhao and Peter J. Barry (2013). Implications of different income diversification indexes: the case of rural China: Economics and Business Letters 2(1),13-20, 2013
- Lalisa Alemayehu Duguma (2013). Financial analysis of agroforestry land uses and its implications for smallholder farmers' livelihood improvement in Ethiopia: Agroforest Syst (2013) 87:217–231 DOI 10.1007/s10457-012-9537-1
- Losch B., Freguin-Gresh S., White E. T. (2012). Structural transformation and rural change revisited: Challenges for late developing countries in a globalizing world. Agence Française de Developpement and the World Bank: Washington, DC: World Bank Publications
- Mathewos Mentamo a, Nigatu Regassa Geda (2016). Livelihood diversification under severe food insecurity scenario among smallholder farmers in Kadida Gamela District, Southern Ethiopia: Elsevier. <http://www.elsevier.com/locate/kontakt> 9 771212 411601 0
- Minot, Nicholas, Epprecht, Michael., Tran, Thi, Tram, Anh and Le Quang, Trung. (2006). Income Diversification and Poverty in the Northern Uplands of Vietnam: Research Report, International Food Policy Research Institute.
- Mohammed Adem, Esabalew Tadele, Habtamu Mossie & Mezegebu Ayenalem (2018). Income diversification and food security situation in Ethiopia: A review study, Cogent Food & Agriculture, 4:1, 1513354. <https://doi.org/10.1080/23311932>.
- Prowse M (2015). The Determinants of Non-Farm Income Diversification in Rural Ethiopia: Journal of Poverty Alleviation and International Development 6(1):109-130
- Seid, A. S. (2016). Determinants of Rural households Livelihood Strategies: Evidence from Western Ethiopia: Journal of Economics and Sustainable Development, 103 - 109.
- Senadza, B. (2012). Non- farm Income Diversification in Rural Ghana: Patterns and Determinants. African Development Review, Vol. 24, No. 3, 233-244.
- Sirawdink, F., Zerihun, K., Amsalu, N., Nardos, Z. and Seife, B. (2011). Allelopathic effects of Eucalyptus camaldulensis Dehn: On germination and growth of tomato: American-Eurasian J. Agric. and Environ. Sci., 11 (5): 600-608, 2011. ISSN 1818-6769
- Teame, G. (2018). Income Diversification of Rural Households in Zoba Mackel, Eritrea. Archives of Business Research, 6(8), 89-98
- Tekle Leza (2019). Household participation in livelihood diversification choices and its effects on household income of smallholder farmers in Boloso Sore District of Wolaita Zone, Ethiopia: Journal of Science and Inclusive Development Vol. 1, No. 2, DOI: 10.20372/jsid/2019-34, 2019 Wolaita Sodo University

- Tilashwork, C., Collick, S., Enyew, A., Lehmann, J. and Steenhuis, T. (2013). Eco-hydrological impacts of Eucalyptus in the semi humid Ethiopian
- Tsega G. Mezgebo and Mary O Shaughnessy (2013). Growth, Peri-urbanization and Income Diversification: Evidence from Peri-urban Tigray, Northern Ethiopia. Ministry of Agriculture and Rural Development of Ethiopia and Irish Aid for Ethiopia.
- Vinefall, E. (2015). Income Diversification among Female-Headed Farming Households: Örebro University, Orebro University School of Business, Örebro University, Sweden.
- Winters, P., Essam, T., Zezza, A., Davis, B., & Carletto, C. (2010). Patterns of rural development: A cross-country comparison using microeconomic data: *Journal of Agricultural Economics*, 61(3), 628–651. doi:10.1111/j.1477-9552.2010.00265.x
- Woldehana T. and A.Oskam (2001). Income diversification and entry barriers: evidence from the Tigray region of northern Ethiopia. *Food policy* vol.26 No.4 August 2001:315-343.
- Worku Ifa Dadi (2016) Livelihood Diversification as Household Strategies. A Case Study Of Rural Kebeles Around Gelan Town, Oromia, Ethiopia.Addsi Ababa University.:A Thesis Submitted to the Department of Geography and Environmental Studies Presented in Partial Fulfillment of the Requirements for the Degree of Master of Arts in Geography and Environmental Studies. Addis Ababa University.
- Wubalem Tadesse, Alemu Gezahgne, Teshome Tesema, Bitew Shibabaw, Berihun Tefera, Habtemariam Kassa (2019). Plantation Forests in Amhara Region: Challenges and Best Measures for Future Improvements: World Journal of Agricultural Research Science and Education Publishing, 2019. Vol. 7, No. 4, 149-157 . <http://pubs.sciepub.com/wjar/7/4/5>
- Yenesew, S. Y., Eric, N. O., and Fekadu, B. (2015). Determinants of livelihood diversification strategies: The case of smallholder rural farm households in Debre Elias Woreda, East Gojjam Zone, Ethiopia. African
- Yishak Gecho (2017). Rural Farm Households' Income Diversification: The Case of Wolaita Zone, Southern Ethiopia. Social Sciences. Vol. 6, No. 2, 2017, pp. 45-56. doi: 10.11648/j.ss.20170602.12
- Yishak Gecho, GezahegnAyele, Tesfaye Lemma, Dawit Alemu (2015). Rural Household Livelihood Strategies: Options and Determinants in the Case of Wolaita Zone, Southern Ethiopia: Social Sciences. Vol. 3, No. 3, 2015, pp. 92-104. doi: 10.11648/j.ss.20140303.15
- Yisihake Ergicho Aababbo and Abebe Markos Sawore (2015). Assessing Determinant Factors of Income Diversification among Rural Farm Households in Ethiopia: The Case of Leemo and Anileemo Districtsa, Hadiya Zone, South Nation Nationalities People Region: International Journal of Science and Research (IJSR)ISSN(Online):2319-7064