ORIGINAL ARTICLE

Synergy or Trade-Off between Agricultural and Non-Agricultural Livelihood Portfolios in Rural Areas of North-Western Ethiopia

Mersha, Tewodros Getnet[1] Mengistu Ketema[2] Bamlaku Alemu[3] and Girma Demilew

Abstract

Recent studies show that non-agricultural employment and income sources are increasing in rural areas. Therefore, the objective of this study was to evaluate the synergy or tradeoff between a household's agricultural and non-agricultural livelihood portfolios. A sequential embedded mixed research design was employed. Primary data was collected from 385 smallholder farm households selected in a three-stage sampling procedure to select districts, Kebeles, and households. Both descriptive and inferential statistics were employed to analyze the data. It was found that, although agricultural activities are the main source of livelihood, non-agricultural income accounts for nearly 47% of the total income in the study area. Analysis of the effect of non-agricultural income revealed a mixed effect on on-farm investment. While the effect of household engagement in non-farm employment and plantations was found to be positive, the effect of unearned income and agricultural wage employment was negative. Thus, identifying the right type of non-agricultural employment to be promoted is crucial to creating a mutually complementary vicious cycle between non-agricultural and agricultural activities.

Keywords: Non-Agricultural Employment, Non-Labor Income, Tobit Model, Farm Input

1. BACKGROUND

Rural populations in developing countries generate a large proportion of their income from agriculture. Agriculture is one of the dominant economic sectors in most parts of the world (Mark et al., 2022). It remains at the top of the global development agenda as it is linked with the leading two Sustainable Development Goals (SDGs) of reducing poverty and ending hunger, achieving food security, improving nutrition, and promoting sustainable agriculture by 2030 (UN, 2017). However, since the late 1990s, there has been an increased recognition that Africans diversify their livelihood strategies (Work, 2016). Different studies show that rural non-agricultural incomes in SSA are increasing and play

1. *Assistant Professor in University of Gondar, College of Social Science and the Humanity, Department of Development and Environmental Management Studies*

2 *Chief Executive Officer, Ethiopian Economics Association*

3 *Ph.D., Associate Professor, Addis Ababa University*

DOI: ***https://doi.org/10.20372/erjssh.2022.0901.09***

an important role in determining rural households' incomes, consumption, expenditure, and household food security (Eshetu et al., 2022). Non-agricultural activities, regardless of function, are defined as any activities that are not related to agricultural activities on one's own farm (Saith, 1992). The share of non-agricultural income to total income ranges from 30% to 50% (Ghimire et al., 2014; Losch et al., 2012). In Africa, diversification is more extensive than in other developing regions (Abimbola and Oluwakemi, 2013). 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 (Peprah, 2011).

Despite the persistent image of Ethiopia as a continent of subsistence farmers, over the past ten years, there has been an outstanding tendency for rural economic diversification. Subsequently, the diversity of rural livelihoods is receiving an increased attention in discussions on rural poverty reduction. Though livelihood diversification is an important strategy by which rural people may work to achieve sustainable livelihoods, it is one that generally operates in amalgamation with other strategies that also contribute to the foundation of sustainable livelihoods. Hence, it would be misleading to see this growth in non-agricultural and agricultural wage activity in the rural economy in isolation from agriculture, as both are linked through investment, production, and consumption. These income sources also form part of the complex livelihood strategies adopted by rural households (Davis et al., 2010). However, there is a dearth of studies about the effects of non-agricultural and agricultural wage portfolios on farm performance, particularly with regard to the efficiency and productivity of smallholder agricultural production in Ethiopia. Much of the research on off-farm work in developing countries, including the little that relates to Ethiopia, has focused on the impact of working outside the farm on household welfare and food security (Prowse, 2015; Worku, 2016; Yishak, 2017). What is unclear, particularly in the Ethiopian context, is the effect of non-agricultural and agricultural wage employment on the productivity of smallholder farmers, which is the main sector of food producers in the country.

Apart from the existence of a dearth of empirical evidence on the impact of non-agricultural and agricultural waged employment on agriculture in Ethiopia, the question of whether off-farm income competes with or complements farm income is empirical because it has been inconclusive from theories and previous empirical research. Researchers examined various aspects of farm investment and discovered mixed evidence: the liquidity-relaxing effect, which implies a potential increase in farm expenditure and investment (Babatunde, 2015 and Benjamin, 2017); and the lost-labor effect, which implies a potential allocation of labor away from the farm (Kassa et al., 2017 and Nasir and Hundie, 2014). In all of these studies, incomes other than agriculture were comprehended as single sources of income, which may not give room to see the effect of different forms of non-agricultural employment on smallholder agriculture. On top of this, in these studies, attention was not given to the role played by tree plantations as one form of rural livelihood. On the contrary, small-scale plantation has become popular among rural households in the study area, and it has become one of the economically acceptable opportunities for income diversification in Ethiopia (Wubalem et al., 2019).

Consequently, the relationship between agricultural and non-agricultural livelihoods is theoretically ambiguous; it must be determined empirically. Determining the effect of non-agricultural employment on smallholders' agriculture will help in the formulation of policy to address some of the challenges of rural poverty and low agricultural productivity among smallholder farmers in Ethiopia and other developing countries. This calls for future empirical research to understand the impact in a local context. Hence, the aim of this study was to evaluate the synergy or trade-off between a household's agricultural and non-agricultural livelihood portfolios.

2. RESEARCH METHODS

1.1. RESEARCH DESIGN AND SAMPLING TECHNIQUES

The intention to gain a deeper understanding on the consequence of farm household livelihood strategies necessitated focus on selected sample districts. Thus, the study is conducted in three districts of Central Gondar Zone in Amhara Regional State. These are Wegera, Lay-Armachio and Gondar Zuria Districts (Figure 2:1). To select districts for the study, the strategic location of the districts for the promotion and scaling-out of the research findings to other districts for livelihood analysis in the zones was considered.

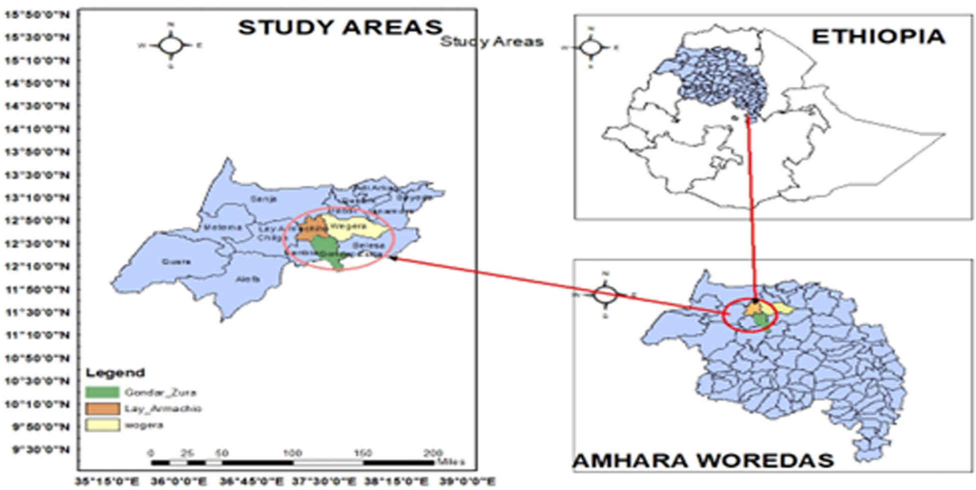

Figure 2:1: Map of Ethiopia and location of the study areas

Because of the nature of the research objectives set and the research questions raised, the current study used a sequential embedded mixed method, where qualitative data was used as a supportive data set. The supportive data set was gathered before and after data collection and analysis of the primary data type of a specific study using the sequential embedded mixed method. The supportive data set (e.g., qualitative data) is typically used first to understand the research context and participants, as well as to develop survey instruments. They are then used to follow up on and explain quantitative results. The quantitative data for this dissertation was based on a "single-round cross-sectional survey" with some retrospective questioning. FGDs and KIIs were used to collect qualitative information.

The data was collected through a sample survey selected from the locality. For this study, the Cochran formula was used for its potential to calculate an ideal sample size given a desired level of precision, a 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.

3. METHOD OF DATA ANALYSIS

For examining the synergy or trade-off between farm household non-agricultural engagements and household agriculture, both descriptive and inferential statistics were used. Prior to the econometric estimation, a preliminary descriptive analysis was employed to determine statistical measures such as means, frequency, and standard deviation. Qualitative data was also used to complement the quantitative data; description and evidence support in explaining relationships that are not uncovered in survey data (Bryman, 2006).

Furthermore, the functional relationship between non-agricultural and agricultural portfolios and their determinant factors is a problem of multivariate nature that can be examined through econometric analyses. To explain the data, a truncated regression model was used. In this case, the dependent variable is censored at a lower value of zero. As a result, in these types of data, the conventional ordinary least squares (OLS) method is inconclusive and should no longer be used to estimate regression parameters (Tobin, 1958). Thus, for inferential analysis, the Tobit model was employed. A Tobit model is most easily defined as a limited dependent variable regression model, originally developed by the Nobel laureate Israeli economist, James Tobin (1958). The data was analyzed with the help of STATA and SPSS software. Therefore, following John (2016), the Tobit model can be mathematically represented as:

$Yi^* = \beta_0 + \beta n + X_I + \varepsilon_I$
$Y = Y^*$ if $Y^* > 0$; and
$Y = 0$ if $Y^* \leq 0$

Where: Yi*is a latent variable for the ith household, X is a vector of independent variables that are expected to influence the dependent variable (Table 3:1), βn are parameters under estimation and ε is the error term which is assumed to be normally distributed, with a zero mean and a constant variance. For different values of independent variables the equation to evaluate the impact of off-farm income and woodlot plantation and other controlled socio-economic and institutional variables becomes:

$$Yi^* = \beta 0 + \beta i X1 + \beta 1 X2 + \beta 2 X3 + \beta 3 X4 + \ldots \beta n Xn + \varepsilon$$

Where Y* is the monetary value of smallholder farmers' investment in crop intensification per cultivated land, β0 is an intercept to be estimated, β1 to β15 are a vector of parameters to be estimated, which measures the effects of independent variables on household investment of agriculture, X1 to X15 are independent factors hypothesized to affect farm household investment and Ɛ is normally distributed error term with mean zero and constant variance and captures all un-measured variables. The parameters β0, βi, and Ɛ of the Tobit model were derived using the Maximum Likelihood Estimation (MLE) method.

According to Gujarati (2004), MLE is a large sample method that can be applied to regression models that are non-linear in the parameters. Therefore, maximum likelihood estimates of the unknown parameters are calculated by maximizing the log-likelihood.

Table 3:1Summary of explanatory and dependent variables used in Tobit model

Variable	Symbol	Definition and its Measurement
DEPENDENT VARIABLE		
On-Farm technology adoption	CROP_INP	Continuous, sum of money household expense yearly per cultivated land for fertilizer, improved seed and Insect and pesticides in ETB[1]
INDEPENDENT VARIABLES		
Age of HH head	AGE	Discrete, Age of household head in years
Family size	FAM_SIZE	Continuous, total sizes of household members in Adult Equivalent (AE) takes the value of 1, 2, 3….
Sex of HH Head	SEX_HH	Binary, 1 if the household head is male and 2 if the household head is female
Education status of household head	EDU_HH	Categorical, Education level of household (1 if do not attend formal education, 2 if attend primary education; and 3 attend secondary education and above)
Adult literacy rate	ADLR	Continuous, Percentage of people ages 15 and above who can both read and write
Land	LAN-OWN	Continuous, Land size holding of the household in hectare
Livestock ownership	LIVESTK	Continuous, Total livestock ownership in tropical Livestock unit (TLU)
Market access	D_MARKET	Continuous, Walking distance to market in minute
Road access	Rode_Dis	Continuous, Walking distance to all weathered road in minute
Credit access	CREDIT	Binary, 1 if households had access to credit within the last 5 years and 0 otherwise
Non-farm Income	NFI_AE	Continuous, annual profit of household from NFSE and NFWE per Adult Equivalent (AE) in ETB
Agricultural wage employment	AWE_AE	Continuous, annual households AWE income per Adult Equivalent (AE) in ETB
Non-Labor income	NLI_AE	Continuous, annual households NLI income per AE in Birr
Plantation income	PlANT_AE	Continuous, annual households plantation income per Adult Equivalent (AE) in ETB
Agro-ecology	AGRO_ECO	Binary, 1 if a household lives in 1 highland area and 2 if it is in midland agro-ecology
Note: -, + and ± negatively related, positively related and theoretically not determined respectively		

1 ETB refers to Ethiopian currency

4. RESULTS AND DISCUSSION
1.2 ADOPTION OF IMPROVED AGRICULTURAL TECHNOLOGIES

Improved seed, fertilizers, insecticides, and pesticides are among the modern farm inputs available in Ethiopia to increase crop productivity (Araya and Sung-Kyu, 2019). Despite the fact that mineral fertilizers are widely considered as a major option for addressing the crisis of nutrient depletion, their use among smallholder farmers in the area is different. Figure 4:1shows that in the study area, 77.4% of households added fertilizer to their land to increase soil fertility during the 2012/13 E.C cropping season. The rest, 22.6%, do not use fertilizer on their farmland for different reasons. In terms of agroecology, more fertilizer adopters were recorded in the highland areas (91.6%) than in the midland areas (66.5%). This figure is higher than the number indicated by Milkessa and Atnafu (2020). In Milkessa and Atnafu's (2020) study on the analysis of determinants of adoption and use intensity of organic fertilizer, they found only 32 percent of adopters. In this research, households were also asked to indicate the most important reason that hinders them from using modern farm inputs. The most frequently mentioned reasons for abounding fertilizer on their farmland are its expensiveness and its perceived impact on the land (Figure 4:1).

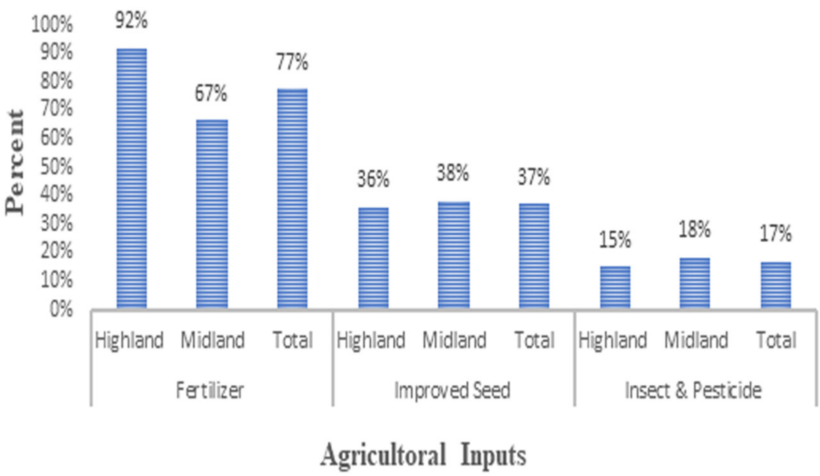

Figure 4:1: Household modern farm input use in various agroecology

The other important farm input in the study area is improved seed varieties. Seed is a key input for improving crop production and productivity. For instance, the study by Gezahagn (2021) indicated that a high-yielding, disease-resistant wheat variety improves households' production by 20%. Despite the release of several improved crop varieties in Ethiopia in the study area, there has been limited use of improved seeds. According to Figure 4:1, less than half of households (37%) used new seed varieties during the 2012/13 E.C cropping season. As indicated in Figure 4:1, slightly higher levels of improved seed were observed in midland agroecology (38%) than in highland agroecology (35.9%). The majority of households did not use improved seed due to its cost (Figure 4:2). Temesgen (2019) in his study also found that the unavailability of improved seeds at the right place and time are the key factors accounting for the limited use of improved seeds in Ethiopia.

As indicated in the figure, the application of PIS is limited in the study. Only 16.9% of households used pesticides during the 2012/13 E.C cropping season. Relatively higher levels of PIS users were observed in midland agroecology than in highland agroecology. For this limited use, households indicated different reasons. Figure 4:1 indicated that the majority of households do not use pesticides and insecticides because they believed that pesticides and insecticides have an impact on the land, which accounts for 37.5% of the reasons. In addition, households have mentioned lack of availability (22%), no information (18.9%), expensiveness (17%), and no land (4%) as reasons for abandoning the use of pesticides and insecticides on their farm. However, FGD discussants revealed that there is an increasing trend in pesticide use for improving agricultural production. However, key informants indicated that farmers are using pesticides, usually without expert recommendations, by accessing them from shops. This could lead to a risk to life and property, as indicated in many pieces of research like Deribe et al. (2011).

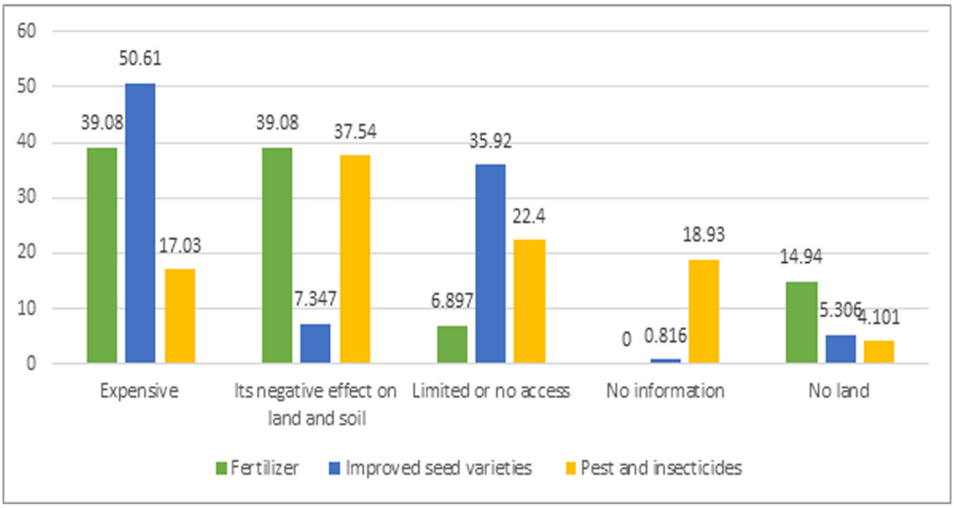

Figure 4:2: Households reason for abandoning use of farm input

1.3 ECONOMETRICS MODEL RESULTS

The dependent variable in this research is smallholder households' yearly expenditure on farm inputs to increase their productivity. This includes three (3) different commonly used types of inputs measured in cash value. These included cash expenses incurred to buy fertilizer, improved seed, and chemicals. Prior to the actual analysis employing the model, the basic assumptions underlying the Tobit model were checked: multicollinearity, homoscedasticity (constant variance), and independence of residuals. Furthermore, in order to test for the goodness of fit, the likelihood ratio tests were used. The model likelihood ratio test of the chi-square of 197.61 degrees of freedom (DF = 15) with a p-value of 0.0000 means that the joint significance test of all variables in the model is significant at $P \leq 0.001$, implying that the variables correctly predict the model. As a result, the null hypothesis was rejected. This explains why the model has explanatory power.

In the model, overall, 14 covariates were used as independent variables in the regression. The variables used in the Tobit regression analysis were included based on a priori theoretical considerations. Lastly, a dummy variable to capture agro-ecological variations was added to the model (Highland/Midland). The total number of covariates, therefore, became 15 (Table 3:1). As can be seen in Table 1:4, household heads' educational status, credit access, sex of household head, amount of land cultivated, livestock possession, market distance, non-farm income, agricultural wage income, plantation income, and agroecology significantly affect crop intensification (see model result in Table 4:2).

Table 4:2 : Tobit regression result on the effect of off-farm employment in household farm expenditure

VARIABLES	COEFFICIENT	STANDARD ERROR	P>|T|
_CONSTANT	7297.245	1002.447	7.28***
SEX_HH Female	-5193.861	853.8537	-6.08***
HH_EDU Illiterate	-992.1759	413.3776	-2.40**
CRE_ACCSS No	-704.1141	397.374	-1.77*
Age_HH	-21.35779	18.17972	-1.17
Famly_Size	-54.63202	105.005	-0.52
Adult_EDU	.9491477	6.993213	0.14
Land_Size	-852.3175	281.375	-3.03***
Liv_Own	126.3786	72.65326	1.74**
DIS_Market	-8.313009	4.126069	-2.01**
DIS_Road_	-4.694482	8.511898	-0.55
AWI_AE	-.5803712	.1976706	-2.94***
NLI_AE	.0626895	.0931366	0.67
NFI_AE	.1586756	.0587575	2.70***
PLAN_AE	.1410316	.0633182	2.23**
AGR0_ECO Midland	-1475.327	432.5562	
/sigma	3467.043	142.1165	-3.41***
Number of observations = 385 left-censored observations =70 right-censored observations = 0 uncensored observations= 315 LR chi2(15) = 202.41 Prob > chi2 = 0.0000 Log likelihood = -2985.4758 Pseudo R2 = 0.0528			
Note: ***, **, * significance levels at P<0.01, P<0.05 and P<0.1, respectively			

5. DISCUSSION

1.4. CONTROLLED SOCIO-ECONOMIC VARIABLES IN THE MODEL AND AGRICULTURAL INTENSIFICATION

Based on prior knowledge, there were different demographic and socio-economic factors that were identified as contributing to the household decision to invest. As described in the model result, most of the socio-economic control variables largely behaved as expected. For instance, the education of the household head was positively and significantly ($P \leq 0.05$) associated with input expenditure. The positive effect of education signifies that more awareness and skills raise the need and use of productivity-enhancing farm technology, including fertilizer, improved seed, and others. Similar findings were also revealed by Abdulai and Huffman (2014). As expected, the accessibility of good financial services was positively linked with the household's use of farm implements. Access to credit was associated with more spending on inputs. This variable is positive and significant ($P \leq 0.05$). Similarly, Abdulai and Huffman (2014) note that access to credit is considered as an important determinant of productivity growth. Moreover, it was expected that the association between crops and livestock in a mixed farming system is positive and strongly significant at a 1% probability level. Livestock contributes to crop productivity as households invest income from livestock to buy improved crop inputs during harvest time.

On the other hand, unlike researchers' expectations, land size, which can be considered a household's wealth, has a negative and statistically significant ($P \leq 0.05$) influence on the probability of household use of improved crop inputs. This could be due to the fact that households with more land may not have enough money to buy improved farm inputs for all of their lands, as input per hectare of cultivated land was considered. Consistent findings were also found by Desiere and Jolliffe (2018) and Gollin and Udry (2019). It was also found that household walking distance to the market is negatively associated with household use of improved farm inputs at $P \leq 0.05$. Farms located near markets, therefore, are able to use purchased inputs and can produce more products for sale. This finding is in line with the studies conducted by Buckmaster (2014) and Norton et al. (2014).

1.5 NON-AGRICULTURAL EMPLOYMENT AND AGRICULTURE

For households in the study, a significant portion of their income comes from non-agricultural activities (47%). As described by the Tobit model result in Table 1:4, non-farm employment income has a positive impact at $P \leq 0.001$ level on input spending, assuming other factors are constant. This may suggest a complementary relationship between input expenditure and non-farm employment. This may be due to investing the income from non-farm work in farm intensification. By so doing, households in rural areas overcome liquidity limitations and enhance agricultural investments as well as efficiency. Similar findings were reported by Pfeiffer et al. (2009) and Ruben (2001).

Though most studies disregard the income from plantations during their livelihood portfolio assessment, tree plantation is a wide-spreading economic activity in the study area, mainly attributed to the degradation and limited access to the natural forests. Tree plantation in the form of a woodlot, as well as a boundary, is common. Fast-growing tree species such as Eucalyptus Globulus and Eucalyptus camaldulensis are among the preferred species for woodlot plantation in the study area (Sultan et al., 2018). Though there is a dilemma on the environmental impact of eucalyptus plantations (Zegeye, 2010; FAO, 2009; Kidanu, 2004; Getahun, 2002), in this research it was found that households with woodlot plantations use more improved farm inputs than households that don't have a plantation. As indicated in the model result, the relationship between household income from the sale of trees and investment in improved farm inputs to increase crop productivity is positive and significant at $P \leq 0.05$ level. It means that the sale of Eucalyptus poles and other products has the potential to raise farm incomes, which may be used to buy agricultural inputs. Moreover, key informants argued that the tree stand itself helps the farmer access credit to buy farm implements from informal sources and microfinance as it can be used as collateral. It is also important for the farmer as it can be used by the farmer to make farm implements and fence the land covered by crops.

Contradictory to the above findings, agricultural wage employment (AWE) was negatively, but significantly related ($P \leq 0.001$) to households' on-farm investment. Agricultural wage employment refers to agricultural-related activities that involve the supply of paid labor on farms other than those owned by household members. For individual farmers, it is a way of using their under-exploited time and labor resources in ways that enhance their household incomes (Hansson et al., 2013). This finding points to an important issue of competing needs between farm and off-farm investments; hence, it warrants more attention. Evidence obtained from KIIs specified that most households involved in agricultural wage employment involve seasonal temporary migration. The destination is the cash crop-producing areas of Metema and Humera, Quara, Sanja, and other lowland areas in the Amhara regional state. Nevertheless, AWE mainly involves migration. There are also old households and households with many plots in the study area that contract their crops to others to remove weeds, cultivate their farmland, and collect the harvest based on an agreement to pay in either food or cash. During one of the in-depth interviews, a man aged 32 years old and involved in waged agricultural employment stated that:

> *"I am the head of the family who is responsible for supporting my family with all their needs. Due to insufficient production from my own farm, I have been engaged in off-farm agricultural wage employment during the summer season. Due to this, I only go to my farm irregularly."*

The above case shows that if households engaged in agricultural wage employment that takes place in a season parallel to their own farm activities, there might be a competitive effect. Moreover, since the poor are expected to engage in AWE, the income gained from AWE may probably be used for households' consumption flattening (ex-post risk strategy) rather than being invested in ex-ante farm production.

6. CONCLUSION AND RECOMMENDATION

It was found that non-agricultural income has a mixed effect on farm investment. While the effect of household engagement in non-farm employment, non-labor income, and plantations was found to be positive, the effect of agricultural wage employment was negative. This suggests that the disaggregated category of off-farm employment is integrated with on-farm activity and their investment behavior in a different way. The greater availability of nonfarm jobs and plantation-earned incomes has played an important role in reducing credit constraints for on-farm investment. On the other hand, farm wage employment (FWE), which is another off-farm functional category, has undesirable labor withdrawal effects and diverts the attention of farm households. A rise in agricultural wage employment leads to a decline in the expenditure on inputs. It could be due to the fact that the poor are expected to engage in AWE, so the income gained may probably be used for households' consumption flattening (ex-post risk strategy) rather than being invested in ex-ante farm production. Moreover, AWE is also taking place in parallel with a peak season of on-farm activities. Expenditure on farm inputs was also found to be influenced by the household's access to credit, household head education level, sex of household head, land size, livestock ownership, and agro-ecology of the household. From a policy perspective, the findings suggest that, unless more propitious conditions are created, income from AWE and unearned income is not likely to be invested in on-farm agriculture. Identifying and promoting the right type of off-farm employment to be promoted is crucial to creating a virtuous cycle between nonagricultural and agricultural activities. Therefore, the government, both at the central and at the district council level, should first ensure increased access and opportunities for non-agricultural employment, particularly those related to non-farm employment activities. In the same vein, the synergy between farm and non-agricultural activities, in particular the role of the latter in supporting the former, needs to be recognized in a holistic approach to enable rural development.

REFERENCES

Abdulai, A., & Huffman, W. (2014). The adoption and impact of soil and water conservation technology: An endogenous switching regression application. *Land economics*, 90(1), 26-43.

Adepoju, A. O., & Obayelu, O. A. (2013). Livelihood diversification and welfare of rural households in Ondo State, Nigeria. *Journal of Development and Agricultural Economics,* 5(12), 482-489.

Eneyew, A., & Bekele, W. (2012). Determinants of livelihood strategies in Wolaita, southern Ethiopia. *Agricultural Research and Reviews*, 1(5), 153-161.

Getahun, A. (2003). *Eucalyptus farming in Ethiopia: the case for eucalyptus woodlots in the Amhara region.*

Buckmaster, A., Alwang, J., Peterson, E., & Rivera, M. (2014). Going the distance: how does market access affect demand for IPM packages?. *Journal of Integrated Pest Management,* 5(1), B1-B7.

Babatunde, R. O. (2015). On-farm and Off-farm works: Complement or substitute? Evidence from Nigeria. *Maastricht School of Management Working Paper, 2.*

Anang, B. T. (2017). Effect of non-farm work on agricultural productivity: Empirical evidence from northern Ghana (No. 2017/38). *WIDER working paper.*

Peprah, J. A. (2011). Women, livelihood and oil and gas discovery in Ghana: An exploratory study of Cape Three Points and surrounding communities. *Journal of sustainable development,* 4(3), 185.

Bryman, A. (2006). Integrating quantitative and qualitative research: how is it done?. *Qualitative research,* 6(1), 97-113.
Statistical, C. (2007). *POPULATION AND HOUSING CENSUS OF ETHIOPIA ADMINISTRATIVE REPORT* Central Statistical Authority Addis Ababa. 2012.

Wan, J., Li, R., Wang, W., Liu, Z., & Chen, B. (2016). Income diversification: A strategy for rural region risk management. *Sustainability,* 8(10), 1064.

Chi, T. T. N., & Yamada, R. (2002). Factors affecting farmers' adoption of technologies in farming system: A case study in Omon district, Can Tho province, Mekong Delta. *Omonrice,* 10, 94-100.

Cochran, W. G. (1977). *Sampling techniques.* John Wiley & Sons.

Davis, B., Winters, P., Carletto, G., Covarrubias, K., Quiñones, E. J., Zezza, A., ... & DiGiuseppe, S. (2010). A cross-country comparison of rural income generating activities. *World development,* 38(1), 48-63.

Deribe, E., Rosseland, B. O., Borgstrøm, R., Salbu, B., Gebremariam, Z., Dadebo, E., ... & Eklo, O. M. (2011). Bioaccumulation of persistent organic pollutants (POPs) in fish species from Lake Koka, Ethiopia: the influence of lipid content and trophic position. *Science of the total environment,* 410, 136-145.

Desiere, S., & Jolliffe, D. (2018). Land productivity and plot size: Is measurement error driving the inverse relationship?. *Journal of Development Economics,* 130, 84-98.

Gollin, D., & Udry, C. (2021). Heterogeneity, measurement error, and misallocation: Evidence from African agriculture. *Journal of Political Economy, 1*29(1), 1-80.

Ellis, F. (2000). *Rural livelihoods and diversity in developing countries.* Oxford university press.

Senou, M. M., Ouattara, W., & Acclassato Houensou, D. (2019). Financial inclusion dynamics in WAEMU: Was digital technology the missing piece?. *Cogent Economics & Finance,* 7(1), 1665432.

Kudama, G. (2021). Determinants of improved wheat variety adoption in Horo district, Oromia Region, Ethiopia. Int J Econ Bus Adm, 7, 48-55.

Ghimire, R., HUANG, W. C., & Shrestha, R. B. (2014). *Factors affecting nonfarm income diversification among rural farm households in central Nepal.*

Gujarati, D. N. (2003). *Basic Econometrics*" fourth edition McGraw-Hill. New York.

Haggblade, S., Hazell, P., & Reardon, T. (2010). The rural non-farm economy: Prospects for growth and poverty reduction. *World development*, 38(10), 1429-1441.

Kassa, H., Birhane, E., Bekele, M., Lemenih, M., Tadesse, W., Cronkleton, P., ... & Baral, H. (2017). Shared strengths and limitations of participatory forest management and area exclosure: Two major state led landscape rehabilitation mechanisms in Ethiopia. *International Forestry Review*, 19(4), 51-61.

Kothari, C. R. (2004). *Research methodology: Methods and techniques.* New Age International.

Losch, B., Fréguin-Gresh, S., & White, E. T. (2012). *Structural transformation and rural change revisited: challenges for late developing countries in a globalizing world.* World Bank Publications.

Musumba, M., Palm, C. A., Komarek, A. M., Mutuo, P. K., & Kaya, B. (2022). Household livelihood diversification in rural Africa. *Agricultural Economics,* 53(2), 246-256.

Mentamo, M., & Geda, N. R. (2016). Livelihood diversification under severe food insecurity scenario among smallholder farmers in Kadida Gamela District, Southern Ethiopia. *Kontakt,* 18(4), e258-e264.

Nasir, M., & Hundie, B. (2014). The effect of off farm employment on agricultural production and productivity: Evidence from Gurage Zone of Southern Ethiopia. *Journal of Economics and sustainable Development,* 5(23), 85-98.

Milkessa, D. & Atnafu, G. (2020). Analysis of Determinants of Adoption and Use Intensity of Organic Fertilizer in Ejere District, West Shoa, Oromia, Ethiopia. A Thesis Submitted To Department Of Economics in Partial Fulfillment of Requirements for Degree of Master Science in Economics (Economic Policy Analysis). AddisAbeba University

Norton, G. W., Alwang, J., & Masters, W. A. (2014). *Economics of agricultural development: world food systems and resource use*. Routledge.

Pfeiffer, L., López□Feldman, A., & Taylor, J. E. (2009). Is off□farm income reforming the farm? Evidence from Mexico. *Agricultural economics,* 40(2), 125-138.

Weldegebriel, Z. B., Folloni, G., & Prowse, M. (2015). The Determinants of Non-Farm Income Diversification in Rural Ethiopia. *Journal of Poverty Alleviation & International Development*, 6(1).

Ruben, R. (2001). Nonfarm employment and poverty alleviation of rural farm households in Honduras. *World development,* 29(3), 549-560.

Kidanu, S. (2004). *Using Eucalyptus for soil & water conservation on the highland vertisols of Ethiopia*. Wageningen University and Research.

Sultan, D., Tsunekawa, A., Haregeweyn, N., Adgo, E., Tsubo, M., Meshesha, D. T., ... & Ebabu, K. (2018). Efficiency of soil and water conservation practices in different agro-ecological environments in the Upper Blue Nile Basin of Ethiopia. *Journal of Arid Land,* 10(2), 249-263.

Teka, A., & Lee, S. K. (2020). Do agricultural package programs improve the welfare of rural people? Evidence from smallholder farmers in Ethiopia. *Agriculture,* 10(5), 190.

Tobin, J. (1958). Estimation of relationships for limited dependent variables. *Econometrica: journal of the Econometric Society,* 24-36.

Dadi, W. (2016). *Livelihood Diversification As Household Strategies. A Case Study of Rural Kebeles Around Gelan Town, Oromia, Ethiopia* (Doctoral dissertation, Thesis MA in Geography and Environmental Studies Addis Ababa University, Addis Ababa, Ethiopia).

Tadesse, W., Gezahgne, A., Tesema, T., Shibabaw, B., Tefera, B., & Kassa, H. (2019). Plantation forests in Amhara region: challenges and best measures for future improvements. *World J. Agric. Res,* 7(4), 149-157.

Gecho, Y. (2017). Rural farm households' income diversification: The case of Wolaita Zone, Southern Ethiopia. *Social Sciences,* 6(2), 45-56.

Zegeye, H. (2010). Environmental and socio-economic implications of Eucalyptus in Ethiopia. *Ethiop Inst Agric Res*2010, 184-205.