DETERMINANTS OF RURAL LIVELIHOOD STRATEGIES AND INCOME DIVERSIFICATION AMONG PASTORAL AND AGRO-PASTORAL HOUSEHOLDS IN SOUTHERN ETHIOPIA

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Abstract

Apart from farming, engaging on non-farm and/or off-farm income activities and diversifying income earning means lie at the heart of livelihood strategies to improve the level of food security and poverty status of pastoralist and agro-pastoral households in southern Ethiopia. This study analyses the determinants of the level of income diversification and livelihood strategies of pastoral and agro-pastoral households in Malle District of South Omo zone, southern Ethiopia. A multi-stage sampling technique involving stratification and random sampling techniques were used to select 196 representative household heads. Descriptive statistics, Simpson Index of diversity, Multivariate Probit and Two-limit Tobit models were employed. The results of the study show that farmers participated in farming, non-farm income, petty trade and off-farm income livelihood strategies. The factors influencing livelihood strategies are age, sex, family size, educational level, farm size, main market distance, size of livestock holding, cooperative membership, use of credit, and transport access. Moreover, the factors influencing the level of income diversification are sex, family size, educational level, livestock holding size, crop failure, distance of nearest main market, income from farm, and share of non & off farm income. Based on the finding, the government should emphasize on strengthening agricultural production system with due attention parallelly given to strengthening all non-farm and off-farm income earning activities by expanding the provision of rural finance, gender mainstreaming program, formal education, farmer cooperative formation, livestock production system, and rural road construction among pastoralists and agro-pastoralists of the study area.

Key words: Livelihood Strategies, Income Diversification, Multivariate Probit and Two-limit Tobit models and Southern Ethiopia.

INTRODUCTION

Ethiopia is among the top fastest growing economy in Sub Saharan Africa, and its economy is mainly based on agriculture. It contributes about 34% of total Gross Domestic Product (GDP), more than 70% of total employment opportunities, 70% of the raw-material requirements for local manufacturing industries, and about 70% of total export (IMF 2018; WB, 2018). However, the contribution of agriculture sector is not as expected due to rain-fed farming system which is vulnerable to environmental and climate-related shocks. In addition, the sector is also characterized by subsistence farming with decreasing farm sizes, lower productivity, and less use of modern agricultural technologies (FDRE, 2011; Sisay *et al*., 2015). As a result, the contribution of the sector for poverty reduction and enhancement of food security has been limited over the past years. However, widening livelihood diversification choices and diversification of income source supplement the effort of food insecurity and poverty reduction in rural Ethiopia particularly in pastoralist areas.

Ethiopian pastoralists and agro- pastoralist inhabit the largest livestock population in Africa and more than 61% of its area (PFE, 2008). They raise a large portion of the national herd, estimated about 42% of the cattle, 7% of the goats, 25% of the sheep, and 20% of the equines (PFE, 2010). The county is among the top holder of various livestock species in the world (FOA, 2018). The sub-sector contributes to the food supply in terms of meat and dairy products. The contribution of export of meat, live animals, and animal products increased from 11.4 percent of the total value of export in 2004/5 to 13 percent in 2015. However, livestock production has declined its contribution to the aggregate economic growth by 5.8 percent per annum from 2004/5 to 2015/16 while its share to total agricultural output

similarly declined by 23.6 percent during the same time (National Bank of Ethiopia, 2017). Despite such resource potential and export market opportunity, its productivity has been decreasing from time to time due to various reasons.

According to the information from the South Omo zone, pastoralist and agro-pastoralists live in harsh physical conditions with risky climatic regimes. Due to feed shortage for the farmers, mobility is considered as key characteristics of pastoralist and agro-pastoralists which enabled them to withstand diverse environmental related shocks over the last years in the area. However, in recent years, various empirical studies such as Anna (2002), Demisse and Workneh (2004) and Eneyew (2012) explain that the incidence of climate change overtime increased the frequency of drought, rainfall variability, and the incidence of new livestock diseases, change of land use pattern, degradation of natural resources, and declining agricultural yield in pastoralist and agro-pastoralists areas of southern Ethiopia. As a result, it undermines the mitigation and adaptation strategies of food insecurity and poverty among pastoralist and agro-pastoralist household heads of the study area.

One of the solutions for pastoralists and agro-pastoralists to cope up and develop the resilience of food insecurity and poverty is through diversification of diverse livelihood strategy choices by engaging in multiples of activities such as farming, widening the sources of non-farm income and off-farm income activities, and diversifying income earning means (Ayalneh, 2002; Yenesew *et al.,* 2015; Baharu, 2016). Moreover, enhancing the productive capacity of asset holding means can also be used as an additional strategy for alleviation of poverty, food insecurity and improvement of the livelihood of citizens in rural Africa like Ethiopia (Barrett et al., 2001).

In the previous empirical literature, there are various studies that examined determinants of livelihood diversification in rural Ethiopia. Some of the recent studies are Baharu (2016), Eneyew (2012), Dilruba and Belderbos (2012) and Yenesew *et al.* (2015*)*. In addition, there are also some specific studies on determinants of income diversification in rural Ethiopia such as Ibrahim and Onuk (2009) and Gecho (2017). However, studies on both determinants of livelihood strategy and income diversification like Barrett et al. (2001) are limited in Ethiopia particularly in pastoralist and agro-pastoralists areas. Such studies may help to identify the constraints and challenges related to widening of livelihood strategy options and income diversification thereby helping for the development of policy recommendations. Therefore, this study aims to identify the factors influencing the level of income diversification and livelihood strategies among pastoralist and agro-pastoralist households in Malle District of South Omo Zone, southern Ethiopia.

MATERIALS AND METHODS

Study Area

The study was conducted in Malle district of South Omo Zone, southern Ethiopia. It is one of the eight rural districts found in South Omo Zone that is characterized by pastoralist and agro-pastoralist areas. The district lies within an area of 1,432 km^2 and the total population is about 96,014 of which men comprise 50.6% and women make up 49.4% (CSA, 2013). According to the information obtained from the district office, Malle is found 799 km south of Addis Ababa. The mean rainfall ranges between 400-1200mm while the mean annual temperature is 28.50°c. The altitude of the district ranges from 501 to 1440 m.a.s.l. The district is located at 5°20'0"- 60° 0' 0" N latitude of 360 40'0" E - 37010'0"E longitude (CSA, 2013).

Data Types and Methods of Data Collections

The study used both primary and secondary data sources. Primary data were collected from sample by using structured questionnaire, key informant interviews, and focus group discussion. In addition, secondary data were collected through consulting various literatures and official government reports pertaining to the livelihood strategies and income diversification of the study area.

Sampling Technique and Sample Size Determination

Multi stage sampling technique was used to select sample pastoralist and agro-pastoralist households. In the first stage, stratification based on agro-ecology was made. The study classified areas into highland and low land area. In the second stage, 2 kebeles (lowest administrative unit) out of 6 agro-pastoral high land kebeles were selected and 2 kebeles out of 6 pastoral low land kebeles were selected using random sampling in proportion to their total population size. In the third stage, a total of 196 agro-pastoral and pastoral households were selected randomly in proportion to their total size and were interviewed. The sample size was determined based on Yamane (1967) sample size estimation formula.

Method of Data Analysis

In order to analyze the data, combinations of the descriptive statistics, Multivariate Probit model, Simpson diversity index, and two-limit Tobit econometrics model were used and detail specification with their justification are provided in subsequent sections:

A. Multivariate Probit model: In a single equation econometrics model such as binary Probit mode, information on a farmer's use of one livelihood strategy does not alter the likelihood of adopting other livelihood strategies at a time. However, a

simultaneously econometrics model such as Multivariate Probit model estimate several correlated binary outcomes jointly by allowing for the potential correlation between unobserved disturbances and the relation between use of different livelihood strategies. Failure to capture unobserved variables and their interrelationships among different rural livelihood strategies lead to a bias and inefficient parameter estimates (Greene, 2012). The model is specified as;

$$\left.\begin{aligned} Y_{1i} &= X_1^{'}\beta_{1i} + \varepsilon_{1i} \\ Y_{2i} &= X_2^{'}\beta_{2i} + \varepsilon_{2i} \\ Y_{3i} &= X_3^{'}\beta_{3i} + \varepsilon_{3i} \\ Y_{1i} &= X_4^{'}\beta_{4i} + \varepsilon_{4i} \end{aligned}\right\} \quad (1)$$

Where Y_{1i} represents strategies that are adopted by the i^{th} household head, (i = 1,2,3 and 4 are farming, non-farm income, petty trade business and off farm income, respectively), $X_1^{'}$ to $X_5^{'}$ are the respective vectors of covariates determining the endogenous variables, β_1 to β_4 represent a vector of unknown parameters to be estimated and ε_1 to ε_4 are error terms. The error terms of Multivariate Probit Model (MVP) based on Greene (2012) follows distributed normal with a mean of zero and variance covariance matrix V, where V has values of 1 on the diagonal matrix and zero correlations among off-diagonal elements.

The MVP model is specified as:

$$\begin{pmatrix}\phi_1\\ \phi_2\\ \phi_3\\ \phi_4\end{pmatrix} \sim \begin{pmatrix}0\\0\\0\\0\end{pmatrix}\begin{pmatrix}1 & \rho_{12} & \rho_{13} & \rho_{14}\\ \rho_{21} & 1 & \rho_{22} & \rho_{23}\\ \rho_{31} & \rho_{32} & 1 & \rho_{34}\\ \rho_{41} & \rho_{42} & \rho_{43} & 1\end{pmatrix}$$

(2)

$$E[\emptyset_{1i}|X_1,,,X_4] = E[\emptyset_{2i}|X_1,,,X_4] = E[\emptyset_{3i}|X_1,,,X_4] = E[\emptyset_{4i}|X_1,,,X_4] = 0 \quad (3)$$

$$Var[\emptyset_{1i}|X_1,,,X_4] = Var[\emptyset_{2i}|X_1,,,X_4] = Var[\emptyset_{3i}|X_1,,,X_4] = Var[\emptyset_{4i}|X_1,,,X_4] = 1 \quad (4)$$

$$\text{Cov}[\emptyset_{1i}|X_1,,,X_4] = Cov[\emptyset_{2i}|X_1,,,X_4] = Cov[\emptyset_{3i}|X_1,,,X_4] = Cov[\emptyset_{4i}|X_1,,,X_4] = \rho \quad (5)$$

Where $\emptyset_1$ *to* $\emptyset_4$ are correlated disturbances MVP; $\rho's$ are correlations between endogenous variables.

Assuming that every outcome is a success, the probabilities that enter the likelihood function of the simulation are explained as:

Probability ($Y_{1i}^* = 1\ Y_{2i}^* = 1, Y_{3i}^* = 1,\ Y_{1i}^* = 1, Y_{2i}^* = 1$)

$$\left.\begin{aligned} &= \Psi_2(X_1' Y_{1i}^*, X_2' Y_{2i}^*, X_3' Y_{3i}^*, X_4^* Y_{4i}^*, \rho)\\ &= \Pr(\phi_{1i} \le \beta_1' X_1, \phi_{2i} \le \beta_2' X_2, \phi_{3i} \le \beta_3' X_3, \phi_{4i} \le \beta_4' X_4, \phi_{5i}\end{aligned}\right\rangle$$

(6)

Where $\emptyset$ is the multivariate normal density function.

A. Measurement of Income Diversification Level: The forms of income diversification used by the pastoralist and agro-pastoralist households were determined by income diversification index using the Simpson Index of diversity which measures the shares of the respective farm household's income derived from various sources (Ashebir *et al*., 2015). The income diversification index is given as:

$$SID = 1 - \sum_i^n P_i^{\,2} \qquad \text{and} \qquad P_i = \frac{K}{\sum K_i}$$

(7)

Where, SID is Simpson Diversity Index, n is the total number of income sources, P_i represent i^{th} income proportion of i^{th} household head and K is i^{th} income and $\sum K_i$ is total income of i^{th} household head.

C. Two-limit Tobit model: is censored regression model used when the decision to diversify income and its extent are assumed to be jointly determined by same variables. Besides, Tow-limit Tobit model is appropriate when the observations in the data set is bounded between 0 to 1 values. Simpson Index of diversity of income is also truncated bounded between 0 and 1 and hence the use of this model is well justified. Following Greene (2012) the mode is specified as: -

$$Y_i = \begin{cases} L \;\; if & Y_i^* \leq L \\ Y_i^* \;\; if & L \;\; L < Y^* < \mathrm{U} \\ U \;\; if & Y_i^* \geq U \end{cases}$$

(8)

Where Y_i is the observed dependent variable, in this case Simpson diversity index of household i (unobserved for values ≤ 0 and ≥ 1) and L=lower limit U =upper limit.

The likelihood function of this model is specified as:

$$L(\ \beta,\delta|Y_iX_iL_{1i}L_{2i}) = \pi_{Y_i-L_{1i}}\emptyset\left(\frac{L_{1i}-\beta'X_i}{\delta}\ \right)\ \pi_{Y_i=Y_iY_i^*}\emptyset\left(\frac{Y_i-\beta'X_i}{\delta}\ \right)\ \pi_{Y_i-L_i}\emptyset\left(\frac{L_{2i}-\beta'X_i}{\delta}\ \right) \quad (9)$$

Where $L_{1i} = 0$ (lower limit) and $L_{2i} = 1$ (upper limit) are normal and standard density functions.

McDonald and Moffitt (1980) proposed useful decomposition techniques of total marginal effects. Based on the likelihood function of the model stated in equation (9), the total marginal effect is divided into the three marginal effects as follows:

The unconditional expected value of the dependent variable:

$$\frac{\partial E(Y_i)}{\partial X_i} = [\emptyset(Z_U) - \emptyset(Zl)]\frac{\partial E(Y_i)}{\partial X_i} \quad + \quad \frac{\partial[\emptyset(Z_u)-\emptyset(Z_1)]}{\partial X_i} + \frac{\partial(1-\emptyset(Z_u)}{\partial X_i} \quad (10)$$

The expected value of the dependent variable conditional upon being between the limits

$$\frac{\partial E(Y^*)}{\partial X_i} \quad = \quad \beta k(1 + \frac{\{Z_1\emptyset(Z_1-Z_u\emptyset(Z_u)\}2}{\{\emptyset(Z_u)-\emptyset Z_1\}^2} \quad -[\quad \frac{\{\varphi(Z_1)-\varphi Z_u)\}^2}{\{\varphi(Z_u)-\varphi(Z_1)\}^2} \quad (11)$$

The probability of being between the limits:

$$\frac{\partial[\emptyset(Z_u-\emptyset(Z_1)]}{\partial X_i}=\frac{\beta k}{\delta}(\emptyset(Z_1) - \emptyset(Z_U) \quad (12)$$

Where φ is the cumulative normal distribution,$\emptyset$ is the normal density function, $Z_l=\frac{-\beta\imath x}{\delta}$ and $Z_u = \frac{(1-\beta x)}{\delta}$ are standardized variables that came from the likelihood

function given the limits of yi, and $\delta$is the standard deviation of the model. Based on the review of previous empirical literatures, Table 1 below explains the definitions of variables, measurement, and expected hypothesis.

Table 1

Summary statistics and description of continues and categorical variables

					Expected sign	
Variables	Mean /%	Std. Dev	Min	Max	Livelihood strategy	Income diversification
Age in years	41.9	12.8	21	76	_	_
Family size in adult equivalent	6.4	2.4	1.8	15.6	+	+
Farm size in hectare	0.71	0.53	0	3	+	+
Livestock in TLU	11.6	9.7	0	33.2	_	+
Market distance from home in KM	7.4	0.15	0.15	27	_	+
Farm experience in years	18	12.7	3	50	_	_
Total farm income in Birr	8,702	7,938	120.00	40,316	+	+
Share of non/off-farm income in Birr	0.33	0.28	0	1	+	+

Simpson diversity index	0.28	0.3435	0	0.74		
Sex (male)	86				+	+
Access of transport	39				–	–
Use of fertilizer	28.6				+	+
Use of improved seed	34.2				–	–
Residing agro-ecology – highland	67				-	+
Cooperative membership	28				+	+
Use of credit	29				+	+
Crop failure	83.1				–	–

Source: Survey data, 2018

RESULTS AND DISCUSSIONS

I. Determinants of Livelihood Strategies' Choice Model Result

This section examines the factors influencing household head's decisions to use combinations of four livelihood strategy choices. The commonly employed

livelihood strategies in the study area are engaging on farming, off-farm income, non-farm income activities and small petty trade activities that are mainly used by agro-pastoralist and pastoralist household heads and the result of multivariate Probit model is presented in Table 2 below. The result shows that the correlation coefficients of error terms are statistically significance at 1% indicating that livelihood strategies choices are complementarities among themselves. Moreover, likelihood ratio test statistics of Wald χ^2 (56) value of 150.79 of the model indicate that there is a significant joint correlations which is statistically significant at 1% levels justifying estimation of the Multivariate Probit that considers power of significance of explanatory variables on dependent variables. The result of the model further indicates that the null hypothesis that there is no correlation between residual of four equations $\rho_{21} = \rho_{31} = \rho_{41} = \rho_{32} = \rho_{42} = \rho_{43} = 0$ is not rejected. This implies that household's decisions to implement more than one livelihood strategies are not strictly independent. The correlation value of ρ_{31} and ρ_{42} are statistically significant at 5% and 10% significance levels respectively suggesting separate choices of livelihood strategies from both non-farm and off-farm income livelihood strategies are not implemented in the study area. Therefore, the use of a multivariate Probit model is justified due to the fact one or more livelihood strategies are not mutually exclusive in the study area.

Age of household head has negatively and significantly influenced the probability of participation in non-farm livelihood strategy at 10% level of significance. This negative result implies that younger household heads implement non-farm income livelihood strategy more than older aged household heads due to

the fact that older household heads lack physical strength to deploy their labor for additional non-farm activities. This result is similar with the findings of previous studies by Negussie (2011) and Bahiru (2016) in their respective studies. Moreover, male household heads as compared with female have positively and statistically affected the probability of participation in farming livelihood strategy at 5 % statistical significance level. This could be explained by the fact that agricultural activities require physical strength by their nature.

Family size of household heads has positive and statistically significant effect on the probability of participation on farming, non-farm, petty trade and off-farm livelihood strategies at 5%, 10%, 10% and 1% significance levels respectively. This result indicates that large families are more likely to practice on multiple farming activities due to the fact that they will rectify the shortage of labor to undertake different activates at a time. This result is also consistent with the findings of Yirga (2007) in his study.

Educational level of household heads has positively and statistically influenced the probability of participation on non-farm and petty trade strategies at 5% and 10% statistical significance levels respectively. The result could be justified due to the fact that educated household heads gain the required skills and knowledge that enables them to involve in non-farm income activates and various business activities.

Farm size of household heads has positively and significantly influenced the probability of agricultural framing livelihood strategy at 5 % significance level whereas it negatively affected the probability of non-farm and petty trade livelihood strategies at 1% significance level. The positive relationship of farm land size with

likelihood of agricultural farming livelihood strategy implies that farmers who have large farm size are spending more time on the farm cultivations and producing agricultural outputs compared with those who have small area of land. On the other hand, non-farm and petty trade livelihood strategies are not demanding land size.

Livestock size has positively and statistically influenced the probability of participation in farming and off-farm livelihood strategies at 10 % and 5 % levels of significance respectively. This positive result indicates that household heads that have more livestock size might use income from livestock rearing for strengthening farming and off-farm activities.

Access to transport of household head has positively and statistically influenced the probability of participation of farming strategy at 1%, petty trade and off- farm income strategies at 5% statistically significant levels. The result could be justified due to the fact that household heads who have access to transportation are more likely to participate in farming, petty trade and off-farm livelihood strategies than those who do not have because transport facilitates marketing of goods and services.

Farming experience of household heads has positive and statistically significant effect on the probability of participation in farming and non-farm livelihood strategies at 5% significance levels. The result indicates that experienced household heads are more likely to practice multiple farming activities due to the fact that they realize its benefit and have accumulated the required skills of managing various activities at a time.

Agro-ecology has positively and statistically influenced the probability of participation in off-farm livelihood strategies at 10 % level of significance. This

positive result indicates that household heads who live in high land areas are more likely to participate in off-farm livelihood strategy compared with households who reside in the low land agro-ecology areas. The possible reason is there is limitation of encouraging opportunities such as resource limitation, low access to infrastructure, low access to transportation, and long distance to main market centers that in the lowland (pastoral) areas compared to agro-pastoral households residing in high land areas.

Cooperative membership status of household head has positive and statistically significant effect on the probability of participation in farming and petty trade livelihood strategies at 1% and 5% significance levels respectively. The result indicates that household heads who are members of cooperatives are more likely to participate in farming and petty trade livelihood strategies than those who are not. This positive result suggests that farmer cooperatives would provide the required support for farming and petty trade activities.

The of use of credit by household heads has positive and statistically significant influence on the probability of participation in petty trade at 5% and in off- farm income strategies at 10% statistically significant levels. This positive result could be attributed to the fact that household heads who use credit from rural financial institutions are more likely to participate in petty trade and off-farm livelihood strategies than those who do not use as engaging in other livelihood strategies needs finance. This result of this study also agrees with the finding of Baharu (2016) and Dilruba (2012).

Table 2
Multivariate Probit model result for determinants of livelihood strategies choices

Variables	Farming strategy	Non-farm income strategy	Petty trade strategy	Off-farm income strategy
	Coefficients	Coefficients	Coefficients	Coefficients
Age	0.008	-0.013*	-0.008	0.006
Sex	0.521 **	-0.123	0.087	0.329
Family size	0.070**	0.482*	0.057*	0.162***
Educational level	-0.018	0.325**	0.444***	0.192
Farm size	0.064**	-0.432*	-0.508*	-0.186
Livestock size	0.025*	-0.032	.0292	0.035**
Market distance	-0.050**	0.024	-.0362	-0.017
Access to transport	0.547***	0.362	0.625**	0.623**
Use of fertilizer	0.307	-0.237	-0.134	0.110
Use of Improved seed	0.281	-0.236	-0.207	-0.129
Farming experience	0.028**	-.0324**	-0.019	-0.012
Agro-ecology	-0.094	0.003	0.338	0.368*
Cooperative membership	0.548**	0.338	0.338*	0.001
Use of credit	-0.690	0.006	0.579**	0.257*
Constant	0.798	0.735	-0.474	-1.270**
Log likelihood	416.591			
Wald chi^2 (56)	150.79 ***			

Note *, ** and *** statistical significant level at 1%, 5% and 10%, respectively.

Source: Model result, 2018

II. Determinants of Income Diversification Model Result

Two-limit Tobit model was employed to identify factors influencing the status and level of income diversification among pastoral and agro-pastoral households' farmers and results are presented in Table 3. The likelihood ratio statistics with a value of 81.77 statistically significant at 1% levels of significance

indicate that the independent variables are simultaneously influencing the dependent variable and hence the model has good explanatory power. Further, the model results show that all coefficients of the variables hypothesized to influence income diversification have the expected sign and of the twelve variables included in the model eight are found to have statistically significant effects and the remaining four variables are found to have no statistically significant effect.

Sex of household head has positive and significant influence on the level of income diversification at 10% level of significance. This implies that female headed household heads are less likely to diversify their income than male headed household heads in the study areas. This might be due to the fact that female-headed households in agro-pastoral communities are usually endowed with less resource and less access to participate on off-farm income activities due to the influence of culture. As a result, being male headed household head increases the probability of income diversification by 4.8 percent. This result agrees with the prior finding of Gecho (2017) in his study.

Family size in the household has positive and significant influence on the level of income diversification at 10% level of significance indicating that household heads with more family size are more likely to diversify their income than others. The possible explanation for this result is that income diversification needs engagement in various non-farm and off-farm income activities at a time which might requires more family labor. As a result, an increase in family size by one family member in adult equivalent leads to a 16.2 percent increase in the probability of income diversification. The relationship between family size and

income diversification was reported to have a similar result in an earlier study by Ibrahim and Onuk (2009).

Table 3

Tow-limit Tobit model result for determinants of income diversification

Variables	Coefficients	Std. Err.	Marginal Effect
Age	-0.002	0.002	-0.0010
Sex	0.073*	0.043	0.0481
Family size	0.016*	0.009	0.0103
Educational level	0.036**	0.015	0.0334
Farm size	0.098	0.061	0.0546
Livestock size	0.008**	0.003	0.0087
Crop failure	-0.126**	0.056	-0.01162
Main market distance	-0.018***	0.004	-0.0885
Access to transport	-0.069	0.052	-0.0450
Farm experience	0.006	0.005	0.0039
Farm income	0.127***	0.028	0.0852
Share of non & off farm income	0.172**	0.068	0.1129
Constant	0.439***	0.119	
Log likelihood	-63.854918		
LR chi^2 (12)	81.77***		

Note: *, ** and *** at 10%, 5% and 1% statistical significance levels, respectively

Source: Model result, 2018

Education level of the household head has positive and significant effect on the level of income diversification at 5% level of significance. This implies that the likelihood of income diversification is higher for household heads with more formal education level. The possible reason is that higher educational qualification

tends to open more employment opportunities for income generation activities due to the fact that education has a power for making people to be aware of more opportunities for generating income from different sources. On average, each additional year of education of the household head increases the probability of income diversification by 3.3 percent. This result is similar with the findings of similar studies Baharu (2016) and Eneyew (2012).

Livestock holding size has positive and significant influence on the level of income diversification at 5% level of significance indicating that household heads with large number of livestock are more likely diversify income. The possible reason is that household with relatively more livestock make use of the income obtained from livestock for expanding non-farm income activities. A unit increase in the TLU leads to an increase in the probability of income diversification by 0.87 percent. A similar study by Fikru (2008) found a similar result.

Crop failure has negative and significant relationship with the level of income diversification at 5% significance level indicating that household heads that face crop failure are less likely to diversify income than those who do not. This is because farmers who face crop failure during the cropping season might not get necessary income for expanding non-farm income activities. This indicates that households that face crop failure during the cropping season have a 1.16% decreased probability of income diversification compared to households that do not face crop failure.

Distance from main market has negative and significant relationship with the level of income diversification at 1% significance level. This indicates that

household heads who are far away from market centers are less likely to diversify income source compared to those who are closer. This is because household heads who are far away from main market centers face greater transaction and transport costs and lack incentive in participation various activities. One more km walking distance to the main market center decreases the probability of diversifying income by 5.8 percent. Studies by Eneyew (2012), Samuel (2012) and Yenesew *et al.* (2015) also found similar results while the current result contradicts with the finding of Baharu (2016).

Farm income has positive and significant relationship with the level of income diversification at 1% level of significance. The positive result of income obtained from farm suggests that household heads that obtain relatively large income from both crop and livestock production diversify income than those that have less income. The possible reason is that those household head obtaining sufficient income from farming are more likely to overcome financial constraints and hence engage in alternative income-generating activities. The result shows that each additional one birr from farm income increases the probability of household head to diversify income by 8.5%. Similarly, household heads that have obtained more income from the share of non-farm and off-farm income have a positive and significant relationship with income diversification at 5% statistical significance level. This result implies that each additional increase of the share of non/off-farm income in % increases the probability of household head to diversify income by 11%. The implication of this is that increase in the share of non/off-farm income would increase income diversification.

CONCLUSION AND RECOMMENDATIONS

The livelihood of pastoral and agro-pastoral societies does not only depend on rearing of livestock and crop production, but it also relies on different survival activities which substitute the accumulation of additional capital. While agriculture remains the backbone of the study area's farmers, farmers are looking for different livelihood strategies to minimize the adverse effects of natural disasters. Livelihood strategies and income diversification sources have provided one the main coping strategy for attainment of food security and reducing poverty in the study area. But, there are different factors influencing both livelihood strategies and income diversification of households in the study area. Determinants of livelihood and income diversification of the study area cannot be focused only on the agriculture sector alone. Therefore, the regional and local governments should put more emphasis on strengthening the agriculture sector along with providing due attention for enlarging various opportunities of livelihood strategies and income diversification sources among agro-pastoralists of the study area.

Moreover, the result suggests that policy and strategy makers should expand formal educational opportunities, ensure gender equality mainstreaming through strengthening women's assets and socio-economic and political empowerments, strengthen livestock production system by widening coverages of veterinary services and disseminating high-yielding breeds of livestock's, strengthen farmer's cooperative formation by building offices and warehouse store in each district, construct roads that connect to main market outlets, introduce labor saving technologies, and create in income generation opportunities from both farm and share of non-farm engagements. Finally, the local and regional government should encourage diversification of livelihood strategies options by expanding the

provision of rural financial institutions so that enlarging livelihood diversification income sources options would be made possible afor pastoral and agro-pastoral households of the study area.

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