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Assessing the determinants of farm households' choice of livelihood diversification strategies in Sub *Zoba Debarwa*, Eritrea

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Smallholder rural farm households face increasing pressure to diversify their livelihood strategies to supplement their meager and unstable agricultural productivity. The objective of the study was to assess the determinants of smallholder rural farm households' choice of livelihood diversification strategies in sub-Zoba Debarwa, Zoba Debub, and Eritrea. Data were collected from 201 randomly selected rural households from six villages. The results of the study revealed that the majority (80.5%) of the farmers were able to diversify their livelihoods into either off-farm or non-farm or combined income activities, whereas the remaining 19.4% of the households were unable to diversify and rely only on farming for their livelihood. The multinomial logit model of the household demonstrated that the sex of the household head, level of education of the household head, age of the household head, average education of members, invalidism, family size, remittance, farm experience of the household head, livestock holding, farm size, irrigation size, and access to credit services have a significant effect on livelihood diversification strategies. Thus, these results have implications for the design of rural development policies that stimulate rural farm households to participate in non/off-farm activities and strengthen their livelihood security.

Key words: Livelihood diversification strategies, multinomial logit, non-farm, on-farm, off-farm, rural households.

INTRODUCTION

In sub-Saharan African countries, agriculture is the most predominant activity and the main source of livelihood for rural households. According to the World Bank (2022), the agricultural sector contributes around 15% to the Gross Domestic Product of the countries in the region. Therefore, enhancing agricultural production has the potential to offer a strong option for spurring growth, overcoming poverty, enhancing food security, and ensuring sustainable ecological development. Although enhancing agricultural production is considered essential, highly subsistence farming on its own is increasingly unable and has failed to provide a sufficient means of livelihood for most farming households in sub-Saharan African countries. Hence, rural farmers do not specialize in crop production or livestock production; rather, they diversify their income sources and try to use all possible

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options of activity portfolios both in farming and non-farm activities to survive and improve their standard of living, and secure from risks and cope with economic and environmental shocks that affect both crop and livestock production.

A livelihood comprises the assets (natural, physical, human, financial, and social capital), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by an individual or a household (Ellis, 2000). A livelihood is sustainable whenever it can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation.

It also contributes net benefits to other livelihoods at the local and global levels in the long and short term (Chambers and Conway, 1991).

Livelihood diversification can be defined as the maintenance and continuous alteration of a highly-varied range of activities and occupations to develop household well-being, minimize household income variability, reduce the adverse impacts of seasonality, and provide employment or additional income (Challa et al., 2019; Ellis, 2000; Barrett et al., 2001). It serves as a survival technique against high susceptibility to disasters and shocks, scarcity of resources, and poverty; or to find widening options and incentives to boost income and living conditions (Ellis, 2000; Ayana et al., 2021).

The achievements or outputs of livelihood strategies, such as more income, increased well-being, reduced vulnerability, improved food security, and a more sustainable use of natural resources, are called livelihood outcomes.

Households' motivation to diversify their livelihoods is attributable to both pull and push factors. The pull factors are positive and may attract farm households to pursue additional livelihood activities to improve their living standards. They include income, education level, market access, and other factors that provide incentives for farm households to accumulate capital and thus expand their range of income activities outside farming (Haggblade et al., 2007; Shen, 2004). On the other hand, push factors are negative factors that may force farm households to seek additional livelihood activities within or outside the farm. These factors consist of poverty, unemployment, household size, fluctuating food prices, drought, flooding, environmental degradation, etc., that would drive households by pressure and not the desire to diversify (Haggblade et al., 2007).

About 65% of the Eritrean population depends on rain-fed crop production and livestock rearing in traditional smallholder systems (World Bank, 2022). Like rural farm households in other parts of Eritrea, farmers in Zoba-Debub primarily produce basic staples for the subsistence of their households. Furthermore, their agricultural activities are characterized by backward production technologies, poor access to modern inputs, small and fragmented land size, erratic rainfalls, and a drought-prone area, leading to increasing soil erosion and land degradation, aridity, pervasive tropical diseases, weak and limited outreach of agricultural extension services, and inadequate technical skills. Therefore, we considered Sub-Zoba Debarwa to provide a general overview of livelihood diversification strategies adopted by rural farm households in Zoba Debub, Eritrea. The rural farm households in the study area do not generate enough income to feed and meet their basic household needs by relying solely on agriculture. As a result, they diversify their activities towards non/off-farm livelihood strategies to cope with agricultural risks and enhance their income and food provision. However, their choice of strategies varies significantly with households' ownership of different livelihood assets. Therefore, it is imperative to identify the factors that determine rural farm households' choice of non/off-farm livelihood activities in the study area. In addition, to the best of our knowledge, no prior studies have been conducted on determinants of households' choice of livelihood diversification strategies in Zoba-Debub. The primary objectives of the study are, therefore, to examine the extent of livelihood diversification among rural farm households in the study area; to assess factors that determine farm households' choice of these livelihood diversification strategies; and to recommend some policy options that would further enhance their livelihood diversifications.

Rural households' livelihood strategies

Livelihood strategies comprise the range and combination of activities and choices that people undertake to achieve their livelihood goals. Different methods are used by scholars to classify livelihood strategies in rural areas, but most commonly, economists group households' livelihood strategies by shares of income earned from different sectors of the rural economy (Brown et al., 2006). Thus, based on the sustainable livelihood framework, the classification of rural livelihood strategies proposed by Ellis (1998) and Department for International Development (DFID, 1999) is adopted for this study. Accordingly, rural livelihood diversification is the grouping of on-farm, off-farm, and non-farm activities to earn a living. On-farm activities are livelihood strategies that focus on both crop production and animal husbandry activities. According to Yizengaw et al. (2015), off-farm activities refer to agricultural activities that take place outside the person's own farm. These activities include local daily wage labor at the village level or in neighboring areas in return for cash payment or agricultural work at another person's farm in return for part of the harvest in kind. Moreover, natural resource-based activities like selling firewood and charcoal are other sources of off-farm income for some households. On the other hand, non-farm activities refer to activities that take place

outside the agricultural sector. These include handicraft activities (weaving, spinning, carpentry, house mudding, poet making, remittance, etc.), petty trade (grain trade, fruits and vegetables trade), selling of local drinks, trading of small ruminants and cattle, and remittance transfers within and across nations.

Determinants of rural households' livelihood diversification: Previous empirical works

Various research works have examined the determinants of rural households' livelihood diversification at different places all over the world. Consequently, a wide range of variables that determine farm households' decision to engage in diversified livelihood activities are identified. These variables, among other things, include those related to household's socio-economic, demographic and communication factors.

Gender inequalities are apparent in livelihood diversification, with male-headed households having better livelihood diversification options than their female-headed counterparts. For example, studies conducted by Kassa (2019) and Kassie et al. (2017) in Ethiopia, Asmah (2011) in Ghana, Olale et al. (2010) in Kenya, and Rahman and Akter (2014) in the north-western region of Bangladesh reported that being a male-headed household increases the likelihood of participation in on-farm, off-farm, and non-farm income diversification activities. On the other hand, using a Multinomial logit model, Yizengaw et al. (2015) in Ethiopia, Kuwornu et al. (2014) in Ghana, Simtowe (2010) in Malawi, and Oluwatayo (2009) in Nigeria reported that the likelihood of diversification from farming is more associated with female-headed households than their male-headed counterparts.

The role of education, which represents human capital endowment, as a determinant of households' choice of livelihood diversification strategy has also been emphasized in the literature. Using different techniques in different parts of Ethiopia, Gecho (2017), Kassa (2019), Debele and Desta (2016), Aababbo and Sawore (2016), Tamerat (2016), Demissie and Legesse (2013), Eneyew (2012), Sisay (2010), Asmah (2011) and Kuwornu et al. (2014) in Ghana; Saha and Bahal (2010) and Khatun and Roy (2012) in West Bengal and Olale et al. (2010) in Western Kenya reported that improvements in household head's level of education increases the likelihood of household's engagement in diversified economic activities. On the other hand, the studies conducted by Bryceson (2002), Author and Bryceson (2002) in rural SSA countries, Demeke and Regassa (1996), MoLSA (1997), Woldehanna (2000) and Kassie (2013) in Ethiopia, and Oluwatayo (2009) in Nigeria found that educational level of farm households has a negative impact on livelihood diversification.

Previous studies show mixed results on the relationship between head of household's age households' livelihood diversification. For example, Tizazu et al. (2018), Dinku (2018), Gebru et al. (2018) and Gebreyesus (2016), Kassie et al. (2017), Asfir (2016), Kassa (2019) and Breman (1996) claimed that well established and experienced older household heads may become more resistant towards diversified livelihood activities. Thus their capability to engage in multiple sources of income declines with the increase in age. However, Olale et al. (2010), Wanyama et al. (2010), Khatun and Roy (2012), Teame (2015), Minot et al. (2006), Barrett et al. (2001) and Block and Webb (2001) reported that households experience on livelihood options and the desire to diversify increase with head of household age. They have argued that aged household heads have a larger family size and are likely to have extra and unemployed labor, and accumulated assets that may allow the household to allocate outside the agricultural sector.

In most studies, farm size is negatively related to households' decision to engage in diversified livelihood strategies. For example, Yizengaw et al. (2015), Gebreyesus (2016), Eneyew (2012), Fikru (2008), Yenesew et al. (2015), Ibekwe et al. (2010) and Kuwornu et al. (2014) showed that smallholder farm households are more likely to diversify as the amount of cultivated land is not enough to make a sufficient living from farm production alone. On the other hand, Challa et al. (2019), Gebru et al. (2018), Kebede et al. (2014), and Awudu and CroleRees (2001) argued that landholding, as a degree of wealth, has positive impact on participation in diversified livelihood strategies among rural households. Moreover, household's access to irrigation opportunities make multiple cropping and generating agricultural surplus and income possible. The surplus income gained from irrigation helps households to strengthen their economic capacity and participate in different non-farm livelihood diversification activities, particularly self-employment activities (Gebru et al., 2018; Khatun and Roy, 2012).

Family size is one of the important factors that determine household's decision to engage in diversified livelihood activities. Reardon (1997) had observed that family size affects the ability of a household to supply labor to the farm. In a large family, some members could remain engaged in farming while others could choose to participate in non-farm activities. In line with this, Neog and Buragohain (2020), Tizazu et al. (2018), Kassie et al. (2017), Asfir (2016), Mentamo and Geda (2016), Tamerat (2016) and Sisay (2010) found that family size has positive influence on a household's decision to choose diversified livelihood strategies. However, Gebru et al. (2018) and Eneyew (2012) have reported that family size has the effect of reducing the probability of a household being in the highly diversified category.

Distance to the market is also important determinants of livelihood diversification. Researchers use walking distance to the nearest tarmac road or town as a proxy

for distance to the market. For instance, Challa et al. (2019), Tizazu et al. (2018), Gebru et al. (2018), Kassie et al. (2017), Teame (2015), Gebreyesus (2016), Amare and Belayneh (2013) and Wanyama et al. (2010) have provided a strong evidence of positive effect of proximity to the market on diversification, particularly in trade and service provision. On the contrary, Yenesew et al. (2015) and Eneyew (2012) reported a negative effect thus bringing to the fore the inconsistency of evidence about the relationship between distance to the nearest market and rural household's decision to engage in diversified livelihood activities.

Regarding livestock holding of households, Dinku (2018), Tizazu et al. (2018), Gebru et al. (2018), Amare and Belayneh (2013) and Demisse and Workineh (2004) revealed that households with more livestock holding do have the capacity to participate in lucrative non/off-farm employment activities. Because it amplifies their opportunity to create other assets by exchanging and selling of their livestock herds. However, Gebreyesus (2016), Yenesew et al. (2015), Yisehak et al. (2014), and Eneyew (2012) argued that rural households obtaining the required amount of cash from livestock may not need to engage in non/off-farm activities for additional income.

Dependency ratio is measured as the ratio of dependents (people younger than 15 and older than 64) to the productive members (ages 15 to 64) in a household. According to Tizazu et al. (2018), Gebru et al. (2018), Saha and Bahal (2010), Khatun and Roy (2012), Saikia (2016) and Mphande (2016), an increase in the dependency ratio exposes a household to a serious shortage of productive labor. Thus, it is negatively correlated with likelihood of livelihood diversification. Moreover, Roy and Basu (2020), Teame (2015), and Anshiso (2016) demonstrated that households having economically active adult members enjoy the benefit of additional human resources who can participate in diversified activities. Similarly, with regards to the health status of household members, Asmah (2011) argued that the tendency to engage in non/off-farm work reduces when the burden of disease is high in a household.

Many researchers have claimed with very poor resource-base, lack of access to formal and informal credit (financial capital) may act as a constraint to diversification for most of the rural households in the SSA (Ellis, 1998; Reardon, 1997). Studies by Teame and Woldu (2016) and Teame (2015) in Eritrea, Anshiso (2016), Gebreyesus (2016), Khatun and Roy (2012) and Khatun and Roy (2012) reported that households' access to credit facilities relaxes their liquidity constraints and thus increases the likelihood of diversification. Contrary to this result, Neog and Buragohain (2020), Dinku (2018) and Apata (2010) reported that higher access to formal and informal credit facilities is very important for agricultural intensification. Moreover, Neog and Buragohain (2020), Dinku (2018), Gebru et al. (2018), Anshiso (2016) and Adugna and Wagayehu (2012)

reported that increasing in the amount of remittance plays a vital role in enhancing and smoothing household's income, consumption, saving and investment patterns, strengthen social network/social capital. Thus it strengthens household's access to diversification opportunities like trade and service provisions.

It is clear from the preceding discussion that various factors influence livelihood diversification choice of rural farm households in different countries. However, the effect of these factors differs in their magnitude and sign in different countries in relation to different livelihood outcomes. Thus, the study intends to identify and verify the effect of these factors in influencing rural households' choice for livelihood diversification strategies from the Eritrean context.

RESEARCH METHODOLOGY

Data type and methods of data collection

The study employed multistage sampling techniques to select the study Sub-Zoba, villages, and households. In the first stage, Sub-Zoba Debarwa was purposively chosen due to its subsistence farming nature, susceptibility to drought, high population density, land degradation, and small fragmented farm size. This selection aimed to provide a comprehensive overview of diversification strategies adopted by farmers in Eritrea within the broader context of Zoba-Debub, which comprises twelve Sub-Zobas. Moreover, majority of the total labor force, in the study area, is engaged in agriculture, mostly producing cereal crops, pulses and vegetables. However, non-agricultural livelihood activities are prevalent including casual daily labor, petty trade, handcrafting and service provision. Its geographical location is 150 5' 42" North, 380 50" 1' East. Moreover, the elevation is 1850 m above sea level. It has mountainous topography with laterite underline by basaltic geology. The climate ranges from moderate to somewhat semi-wet and rainfall is from 400 mm to more than 700 mm. In general rainfall is not much reliable in most of the areas in the region. In addition, to the best of our knowledge, no prior studies have been conducted on options and determents of livelihood diversification of smallholder farmers in the Sub-Zoba. We, therefore, considered Sub-Zoba Debarwa to provide a general overview of the diversification strategies adopted by the farmers in Zoba Debub, Eritrea. At the second stage, six villages were randomly selected from the list of 28 villages in Sub-Zoba Debarwa. The selected villages were Shiketi, Adi-logo, Emni-tselim, Tera-Emini, Adi-Watot and Adi-Geda. Finally, from the sample frame of residents obtained from the administration of each village and based on their population, random samples of 30 to 40 farm households were randomly selected from each village. Thus, a total of 201 farm households were randomly selected for the study.

A structured questionnaire was employed to collect data at a farm household level through face to face interview with the head of the household or her spouse.

The list of explanatory variables, their units of measurements and hypothesized relationships with the dependent variable are shown in Table 1.

Econometric model specification

In this study, household choice of livelihood diversification activities was analyzed based on the Random Utility Model (RUM). The RUM

Table 1. Variables definitions, units of measurement and expected signs.

Variable	Description	Type	Value	Expected sign
Gender	Gender of HoH	Dummy	1=male, 0=female	+/-
Age	Age of HoH	Continuous	Number of years	+/-
HoHEDU	Education level of HoH	Continuous	Number of completed years	+
DEPEND	Ratio of dependency in the family	Continuous	Ratio	-
FAMISIZ	Number of HH members	Continuous	Number	+/-
AVEDU	Average education level of HH members	Continues	Number of completed years	+
INVA	HoH with preexisting health condition	Dummy	1= yes, 0= no	-
REMI	Remittance	Dummy	1= yes, 0= no	+
LIVESTO	Livestock ownership in TLUs	continuous	Units	+/-
FARMEXP	Farming experience of HoH	Continuous	Number of Years	-
DISROAD	Distance to the tarmac road	Continuous	Number of kilometer	-
FARMSIZ	Size of cultivated land	Continuous	Hectares	+/-
IRRIGASIZ	Size of irrigated land	Continuous	Hectares	-
CREDIT	HH access to credit facilities	Dummy	1= yes, 0= no	+/-

assumes that household choice is driven by utility maximization depending on the choice attributes that appeal to each household. In RUM households are assumed to maximize utility by selecting an alternative from a set of obtainable alternatives that capitalize on individual utility (Kennedy, 2003). This rule implies an underlying utility function that contains the attribute of alternatives and individual characteristics that describes an individual's utility valuation for each alternative. The utility function states that an individual chooses an alternative which has a utility greater than all utilities in the individual's choice set (Pryanishnikov and Zigova, 2003).

In this study, four mutually exclusive livelihood diversification strategies, which are: on-farm only, on-farm plus non-farm, on-farm plus off-farm, and on-farm plus off-farm plus non-farm are identified. Thus, to identify the determinants of smallholder farming rural households' decision to choose from these set of alternatives, multinomial logit model was used. The multinomial logit model, which is used in the study, is adopted from Greene (2012). The assumption is that given its asset of endowment, a rational household (i) choose among the four mutually exclusive livelihood strategies (j=0,1,2,3) that maximizes its utility (U_{ij}). However, it is not possible to directly observe the utilities; rather the choice made by the farmer which maximizes the utility. Hence, for the ith farm household faced with J choices, the utility of choice j is decomposed into deterministic ($X'_{ij}\theta$) and random (ε_{ij}) part:

$$U_{ij} = X'_{ij}\theta + \varepsilon_{ij} \tag{1}$$

If a household selects choice j in particular, then it is assumed that U_{ij} is the maximum among the J utilities. Hence, the statistical model is driven by the probability that choice j is made, which is

$$\text{Prob } (U_{ij} > U_{ik}) \qquad \text{for all other } k \neq j. \tag{2}$$

Let Y_i be a random variable representing a set of discrete, mutually exclusive choices of livelihood diversification options available to a household that indicates the choice made. If the J disturbances are independent and identically distributed with Gumbel (type 1 extreme value) distributions,

$$F(\varepsilon_{ij}) = \exp(-\exp(-\varepsilon_{ij})), \tag{3}$$

Then

$$\text{Prob } (Y_i = j) = \frac{\exp(X'_{ij}\beta)}{\sum_{j=0}^{J}\exp(X'_{ij}\beta)} \tag{4}$$

Which leads to what is called the multinomial logit model, where the X' represents a vector of explanatory variables, while β is a vector of coefficients, which obviously differ from choice to choice. Multinomial logit models, which are widely used in studies exploring the livelihood diversification choices among farm households, are applicable when the dependent variable is qualitative and has more than two categories (attributes).

The model for a household diversification choice is

$$\text{Prob } (Y_i = j \mid X_i) = \frac{\exp(X'_i\beta_j)}{\sum_{j=0}^{3}\exp(X'_j\beta_j)}, \quad j = 0,1,2,3 \tag{5}$$

However, all the four probabilities cannot be estimated independently. A convenient normalization that solves the problem is to choose one category as a base (reference or comparison) category, and set its coefficient values as zero ($\beta_0 = 0$). This arises because the probabilities sum to one, so only J parameter vectors are needed to determine the J+1 probability. Therefore, the probability that a household with characteristics "X" chooses livelihood strategy j, P_{ij} is modeled as:

$$\text{Prob } (Y_i = j \mid X_i) = P_{ij} = \frac{\exp(X'_i\beta_j)}{1+\sum_{j=1}^{3}\exp(X'_j\beta_k)}, \quad j = 0,1,2,3 \tag{6}$$

The probability expressions in Equation 6 are nonlinear. However, the model implies that we can compute J log-odds, i.e., logits that are linear functions of the explanatory variables, and the parameters can be estimated by maximum likelihood estimation as follows:

Table 2. Summary statistics, expected signs and description of variables used in the study.

Variable	Mean	Std. Dev	Min	Max
AGE	52.61	12.925	27	80
HoHEDU	5.5	3.036	0	13
DEPEND	0.8242	0.90229	0	6
FAMISIZ	5.27	1.950	1	10
AVEDU	5.49	2.010	0	12
LIVESTO	1.82	1.040	0.1	4.86
FARMEXP	28.09	15.424	0	64
DISROAD	31.44	16.295	1	120
FARMSIZ	1.13	0.706	0.25	3
IRRIGASI	0.1244	0.264	0	1.1

	Value	Frequency	%
Gender	Male	152	75.6
	Female	49	24.4
INVA	Yes	36	17.9
	No	165	82.1
REMI	Yes	83	41.3
	No	118	58.7
CREDIT	Yes	72	35.82
	No	129	64.17

Source: Computed from own survey data.

$$\ln\left[\frac{P_{ij}}{P_{ik}}\right] = X'_i(\beta_j - \beta_k) = X'_j\beta_j \quad if \ k = 0 \tag{7}$$

The coefficients in this model are difficult to interpret. It is tempting to associate β_j with the jth outcome, but that would be misleading. Thus, by differentiating Equation 6, it was found that the partial (marginal) effects of the variables on the probabilities as:

$$\varpi_{ij} = \frac{\partial P_{ij}}{\partial X_i} = P_{ij}\left[\beta_j - \sum_{k=0}^{J} P_{ik}\beta_k\right] = P_{ij}\left[\beta_j - \bar{\beta}\right] \tag{8}$$

where the marginal effects measure the expected change in the probability of a particular choice being selected with respect to a unit change in the independent variable. In our empirical model, the outcome variable, household livelihood diversification choice, captured four livelihood strategies. These are on-farm only, On-farm+Non-farm, On-farm+Off-farm, and On-farm+Off-farm+Non-farm, where the on-farm only is serving as the reference category in the model.

FINDINGS AND DISCUSSION

Descriptive analysis

Table 2 presents the descriptive and summary statistics

as well as description and expected sign of selected socioeconomic characteristics of the sampled households. The results of the study revealed that about 80.6% of the total sampled households pursued some level of diversification in their livelihoods, with 40.7% of them engaged in On-farm+Non-farm livelihood strategy. Moreover, 18.4 and 21.4% of the households are engaged in On-farm + Off-farm and in On-farm+Off-farm+Non-farm livelihood strategies, respectively. Only 19.4% of households did not diversify and relay only on farming activity.

The study also demonstrated that the mean age of household head is about 53 years and 75.6% of the sampled household is male headed. The study further revealed that on the average, there are 5.27 members in a household. This indicates that the respondents have a relatively large household size with a mean dependency ratio of 82.42%. The survey data also indicated that majority (48.2%) of the household heads had attended primary level of education, while 29.3 and 18.4% had attended junior and secondary levels of education, respectively. Moreover, 1% of the household heads had tertiary level of education, and only 3% of the respondents were illiterate. Moreover, the average the levels of education of household head as well as

household members were 5.5 and 5.49 completed years of schooling, respectively.

Since all the sampled households engaged in farming, the average farming experience of household head is about 28 years. The size of cultivable land possessed by a household is minimal. On the average, a farm household possesses 1.13 hectares of cultivable land. In addition to this, 22.3% of the respondents have access to irrigational activity with an average of 0.1244 ha of land. Moreover, the average waking distance to the nearest market is around 31.44 min. Using FAO (1984) livestock conversion factor, on the average a household owns 2 Tropical Livestock Units (TLU). The study also revealed that large proportion (64.17%) of farmers had no access to credit. Finally, the study revealed that 41.3% of the sampled households receive remittance and 21% of the household heads have preexisting health condition (invalidism) while the remaining are free.

Econometric analysis and discussions

Table 3 reported the result of the estimated multinomial logit model (Equations 7 and 8). The values of the categorical variable (household choice of livelihood strategy) are assumed to have no natural ordering. Thus, the on-farm only choice of livelihood strategy is selected as the reference category and the results of the study are interpreted relative to this livelihood strategy choice. Multicollinearity test was first carried out, using variance inflating factor (VIF) test, to check for the existence of serious multicollinearity problem among the explanatory variables. Thus, continuous and categorical independent variables, with VIF values greater than 10, are dropped from the model to correct multicollinearity problem. The Pseudo R^2 of 0.607 indicates that the multinomial logit model predicts about 60.7% of rural households' choice of livelihood diversification strategies. Moreover, the Wald Chi-square statistic result, which is used to test the overall significance of variables, is statistically significant at 1% level, implying that the explanatory power of the factors included within the model is satisfactory.

As hypothesized in the study, gender of household's head is found to have positive and significant influence in all livelihood diversification strategies, compared to the base category. Its coefficients are positive and significant at 5% for On-farm+Non-farm and 10% for On-farm+Off-farm and On-farm+Off-farm+Non-farm, respectively. This implies that, keeping the effect of other variables constant, the probability of choosing On-farm+Non-farm, On-farm+Off-farm and On-farm+Off-farm+Non-farm strategies increase by 5.28, 4.095 and 7.11%, respectively for male headed households as compared to female headed households.

This may be due to the fact that in rural Eritrea men usually control resources, so they have much higher chance to participate in income diversification activities than females who customarily engage in domestic works

responsible for preparing food, child caring and home management activities, that are difficult to be monetized. As expected, age of household head was also found to significantly and negatively influence households' choice of On-farm+Off-farm livelihood strategies at less than 1% level of

significance. Holding all other variables in the model constant, as age of the household head increases by one year, the probability of household's choices of On-farm+Off-farm livelihood strategies decrease by 0.895% relative to the base category. This implies that younger farmers are more likely to engage in Off-farm than older farmers. The possible explanation is that as age of a farm household increase and the farmer gets older and older, the capability to diversify into many livelihood activities diminishes, and they prefer to concentrate into on-farm agricultural activities for the purpose of maximizing their subsistence consumption needs.

The study also hypothesized that level of education of household head is one of the most important determinants of livelihood diversification. In the study, it was found to have a negative and significant effect on households' choice of On-farm+Non-farm and On-farm+Off-farm livelihood diversification strategies, at 5% level of significance. As household head's years of schooling increases by one year, the likelihood that a household will choose On-farm+Non-farm and On-farm+Off-farm livelihood strategies declines by 1.07 and 2.38%, respectively. On the other hand, average level of education of household members has positive and significant influence on household choice of On-farm+Non-farm, On-farm+Off-farm and On-farm+Off-farm+Non-farm livelihood strategies at 1, 5 and 1% levels of significance, respectively.

The likelihood that a household will choose On-farm+Non-farm, On-farm+Off-farm and On-farm+Off-farm+Non-farm strategies increase by 3.75, 0.077 and 1.78%, respectively compared to the reference category. This implies that households with higher average level of education of household members tend to diversify their livelihood options through opting for salaried jobs and self-employment activities.

The result of the multinomial logit regression also revealed that family size has a positive and statically significant influence on household's diversification choice to On-farm+Off-farm livelihood strategy, at 5% level of significance. The marginal effect revealed that with the increase in family size by one member, the probability of households' livelihood diversification into On-farm+Off-farm livelihood strategy increases by 0.39%, compared to the base category. The possible explanation is, having a large family size can allow family members to practice in activities that need large amount of labor force. In addition to this, healthy individuals always have strong enthusiasm and incentive to work in different activates as they have full physical fitness. Therefore, based on the result of this study, having a household head with preexisting health condition decreases the likelihood of

Table 3. Multinomial logit model results of households' choice of livelihood strategies.

	Household livelihood strategies								
	On-Farm+Non-Farm			On-Farm+ Off-Farm			On-Farm+Off-Farm+Non-Farm		
Variable	Coeff.	P-value	Marg.eff	Coeff.	P-value	Marg.eff	Coeff.	P-value	Marg.eff
CONST	4.60478	0.195	-	-0.430651	0.882		-4.006423	0.136	
GENDER	2.75161 **	0.024	0.052827	1.975852*	0.086	0. 040955	2.390259*	0.053	0.071105
AGE	-0 .09575	0.188	-0. 00066	-0.154556***	0.008	-0.00895	-0. 0900672	0.105	-0.00072
HoHEDU	- 0.39385 **	0.044	-0. 01073	-0.363356**	0.044	-0.02378	-0. 1027528	0.619	0.014027
DEPEND	0.002462	0.579	0. 000172	0.0000158	0.997	0. 000139	-0.0038102	0.385	-0.000372
FAMISIZ	0.24750	0.387	0. 00156	0.5989957**	0.014	0.003927	0.279824	0.276	0.006618
AVEDU	1.3999 ***	0.000	0.037524	0.6772779**	0.019	0.000772	0.835304***	0.003	0.017815
INVA	2.69965 *	0.062	0.167659	-0.9349852	0.419	-0. 01742	-2.28898*	0.098	-0. 203048
REMI	1.52015 *	0.067	0.050865	-1.094099	0.170	0. 19004	1.618833**	0.013	0.161543
LIVESTOK	-3.19907 ***	0.000	-0.14328	0.1011596	0.812	0.03812	0.2361369	0.602	0.071480
FARMEXP	-0 .10044 **	0.028	-0.00553	0.0653754	0.101	0. 006185	0.0230134	0.513	0.000842
DISROAD	-0.006540	0.851	0. 000019	0.0029643	0.871	0. 001211	-0. 019469	0.404	-0.001696
FARMSIZ	-1.93978 **	0.045	-0. 09962	0.3472206	0.404	0. 025746	0.6744161	0.128	0.07654
IRRIGASI	-9.0232*	0.070	-0. 45989	1.71165	0.121	0.140509	2.866837	0.18	0. 328455
CREDIT	5.48068 ***	0.000	0. 227396	0.1457893	0.856	-0. 07215	0.4097297	0.646	-0.066317
Number of obs				201					
Wald Chi^2(42)				129.2					
Prob > Chi^2				0.000					
Pseudo R^2				0.607					

***,**,* indicate coefficients are statistically significant at 1, 5 and 10% significance level, respectively.
Source: Computed from own survey data.

household's diversification towards On-farm+Off-farm+Non-farm by 20.30%, which is statistically significant at 10% level of significance. However, having a household head with preexisting health condition increases the likelihood of household's diversification into On-farm+Non-farm by 16.77% and it is statistically significant at 10% level of significance.

In this study, remittance has positive and significant influence on households' choice to diversify their livelihood strategies into On-

farm+Non-farm and On-farm+Off-farm+Non-farm activities, compared to the reference category, at 10 and 5% significance levels, respectively. As remittance increases by one more unit, their probability of diversifying into On-farm+Non-farm and On-farm+Off-farm+Non-farm livelihood activities increase by 5.09 and 16.15%, respectively.

Possible reason for this result can be households use remittance to start-up new business outside of their farming and help

households to own better farm assets.

As hypothesized, household's livestock holding is negatively and significantly related to On-farm+Non-farm livelihood diversification strategy at 1% level of significance. Moreover, as the livestock holding increases by one TLU, the likelihood of rural farm households' choice of On-farm+Non-farm livelihood strategies decreases by 14.33%, holding the effect of other factors constant.

The result reveals that, in the study area,

livestock are the source of cash income. Thus, the large livestock holding creates better opportunity to earn more income from livestock production.

Therefore, households who obtain the required amount of cash from livestock may not need to involve in non-farm activities for additional income whereas farmers with lower livestock holding may be obliged to diversify their livelihoods into non/off-farm activities to fulfill household needs.

The farm size and irrigated land size are significantly and negatively related to household's choice of On-farm+Non-farm livelihood strategy, at less than 5 and 10% levels of significance, respectively. The negative coefficients indicate that households with large farm and irrigated land size are less likely to choose diversified livelihood strategies; rather they rely more on agriculture. Keeping the effect of other variables constant, the likelihood that that a household will diversify into non-farm activities decreases by 9.96 and 45.99% with an increase of farm size and irrigated land size by one hectare, respectively. The possible reason can be a smaller amount of farm or irrigated land is not enough to the households to make a sufficient living from farm production alone, pushing them to work in supplementary non/off-farm livelihood activities. Moreover, farming experience of household head has negative influence household's choice of On-farm+Non-farm livelihood strategies at 5% significance level. As farming experience of household head increase by one year, the likelihood of household's choice for On-farm+Non-farm livelihood strategy decreases by 0.55%, keeping the effect of other variables constant. This implies that most experienced farmers don't want to engage or invest in other activities outside farming; rather they want to specialize in and expand their farming activity.

Finally, access to credit has positive and statistically significant relationship with the likelihood of a household' choice for On-farm+Non-farm livelihood strategy, compared to farming, at 1% level of significance. Keeping the effect of other variables constant, the probability of choosing On-farm+Non-farm livelihood strategy is higher by 22.74% for a household who have access to credit as compared to those who have no access to credit. Since resource-base is very poor for most of the rural households and credit market are imperfect, access to credit facilities relaxes their liquidity constraints and thus increases the likelihood of diversification.

CONCLUSION AND RECOMMENDATIONS

Majority (80.5%) of the smallholder farmers in the study area use diverse livelihood strategies, to achieve their prioritized livelihood objectives. The male headed households have higher tendency to pursue diversified livelihood strategies.

Moreover, the study reveals that the level of education of majority of the household heads is at elementary level,

their average age is in the productive range and on the average households have five members. However, the dependency ratio is very high. The multinomial logistic regression result depicts that household head's gender, education, farm experience, average education of household members, invalidism, remittance, livestock holding, farm size, irrigation size and access to credit service have significant effect on household's choice of On-farm+Non-farm livelihood strategy. The result also shows that household head's gender, education, age, farm experience, average education of household members and family size significantly affect choice of combination of On-farm+Off-farm livelihood strategy. Furthermore, gender of household head, average education of household members, invalidism, irrigation size, remittance significantly affect household's choice of On-farm+Off-farm+Nonfarm livelihood strategy.

Based on the finding of this study, rural development policies should be aimed at enhancing households' asset base which is critical for their choice of livelihood diversification strategies. Moreover, policies should focus on mainstreaming gender equality of the non/off farm rural development strategies and empowering female-headed households to participate in diversified livelihood activities. It is also recommended that access and outreach of formal credit facilities and their institutional arrangement needs to be improved so as to enhance the livelihood diversification of rural households. Similarly, the existing access to education of rural households should be improved.

Finally, due to the nature and scope of the objective of this study as well as time and budget constraints, this research was limited to assessing the determinants of livelihood diversification choice of smallholder farmers in a specific region.

However, the study area can serve as a representative of the region and thus the results have implications for the design of rural development policies that stimulate rural farm households to participate in non/off-farm activities and strengthen their livelihood security. Thus, further research must focus on cross-comparison of livelihood diversification among different regions of the country and on the effect of livelihood diversification on poverty reduction, food security and better nutrition and sustainable use of resources and the environment.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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