



Effect of Livelihood Diversification on Food Security Status of Rural Farm Households in Ganye Local Government Area, Adamawa State, Nigeria

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Abstract: This paper examined livelihood diversification as a survival strategy and a means to escape food insecurity among rural farm households in Ganye, Adamawa state, Nigeria. Although still of central importance, farming on its own is increasingly unable to provide a sufficient means of survival in rural areas thus necessitating the need for diversification. A multistage sampling technique was used to collect primary data from 230 rural household heads using structured questionnaire. Data collected were analysed using descriptive and inferential statistics. The result revealed that 80.43% of the respondents were male and 69.57% were married. Majority (76.08%) were educated and are mostly (73.91%) had farming as their primary occupation. Similarly, they undertake other diverse livelihood income activities which are mostly unskilled non-agricultural activities of which 52.17% moderately diversify, 37.83% had low diversification and only 10% were highly diversify. Food security condition was not much improved as about 56.96% of the households were unable to meet their daily food. The logit regression result showed that diversification was influenced by age, sex, educational level, primary occupation, household size, farm size, membership of cooperative, access to credit and total annual income and is significant at various levels. Rural farmers should be encouraged to participate in varied income generating activities in both agriculture and non-agricultural ventures to enhance their income and break the vicious cycle of poverty and impoverishment. The provision of soft loans at reduced interest prices will catalyse involvement in non-farm income generating activities thereby creating a boost in household income and consequently, welfare.

Keywords: Livelihood; Diversification; Food security; Rural farm household; Ganye

1. Introduction

Diversification aims to reduce the overall risk of an investment portfolio without diminishing the return potential. By spreading capital out into an assortment of different investments, the impact of a decrease in value to the portfolio in the event one investment suffers losses is greatly dampened (Wondim A.K., 2019).^[1] A household livelihood diversification strategy was used to curtail risk and uncertainty (Sharma, 2010).^[2] Livelihood diversification is the process of carrying out activities by rural household to survive and improve their standard of living (Weldegebriel and Prowse, 2013).^[3] Achiba (2018)^[4] also defines livelihood diversification is an active social process of individual or household diversification, involving the maintenance and continuous adaptation of a highly diverse portfolio of activities over time in order to secure survival and improve standards of living.

Rural people have diversified their livelihood means and income earning portfolio across farm, non-farm and off-farm activities. Thus, non-farm income generating activities have become an essential

component of livelihood strategies among rural households (Bezu et al., 2012);^[5] Khatun and Roy 2012;^[6] Agyeman et al., 2014).^[7] According to Ovwigho (2014),^[8] farmers particularly, the rural farm families usually engage in different non-farm income generating activities apparently to balance the shortfall of income due to the seasonality of primary agricultural production and create a continuous stream of income to cater for the various household needs.

Rural livelihoods diversification is generally accepted as desirable and a key focus of poverty reduction strategies in developing countries (Bezu, et al., 2012).^[5] Rural livelihood diversification is defined as the process by which rural farm households construct an increasingly diverse portfolio of activities and assets in order to survive and to improve their standard of living.^[6] The rural livelihood diversification from farming is one of the rural households' strategies for survival in developing countries. The rural people diversify into farm and non-farm activities to explore opportunities through which they increase and stabilize their incomes or to supplement farming in order to improve the welfare or living standard of their household.^[1]

The rural livelihood diversification from farming is one of the rural households' strategies for survival in developing countries. While the income is often considered to be a straight forward indicator of material resources, and income is, robustly and positively, associated with longevity (Davis et al., 2017).^[9] Diversification patterns reflect individuals' voluntary exchange of assets and their allocation of assets across various activities so as to achieve an optimal balance between expected returns and risk exposure conditional on the constraints they face (Kanu et al., 2014).^[10] Many reasons induce rural diversification out of farming. Sometimes diversification is born of desperation, sometimes of opportunity.^[4] Risk may play a role, but is not a necessary condition for individuals to choose to diversify (Igwe et al., 2020).^[11] Some diversification is related to diminishing or time-varying returns to labour or land. Some is attributable to market failures (e.g., for credit) or frictions (e.g., for mobility or entry into high-return niches). And still another cause is risk management, either ex ante mitigation through portfolio choice or ex post coping through adaptation to shocks.^[11]

Past studies conducted in rural Nigeria showed a higher incidence of food insecurity among household heads primarily engaged in agriculture than those engaged in non-farming activities. This implies that farming households were more food insecure than non-farming households. This is expected, as agriculture in the rural areas of Nigeria is largely characterized by low capital involvement, use of crude implements, poor infrastructural and storage facilities and human drudgery. This circumstance ultimately leads to lower average earnings and inability to meet the food requirements of the family (Adepoju and Adejere, 2013).^[12] The number of incomes generating activities a household head is involved in is a measure of the ability of households to withstand economic shocks. Household involved in diverse activities tend to be more food secure (Awotide et al., 2012;^[13] Aidoo et al., 2013;^[14] Frimpong & Asuming-Brempong, 2013).^[15]

2. Problem Statement

Food insecurity has been on the increase in most rural areas in Nigeria (Oni et al., 2011).^[16] Rural food shortages in Adamawa state results largely from low productivity, agricultural shocks and decreasing purchasing power (Fiona et al., 2011).^[17] This problem is being exacerbated by many factors, notably; population explosion and climate change (Adebayo et al., 2012;^[18] FAO, 2012).^[19] In the last three decades, the land tenure system have been confronted with problems of fast population growth and competing economic use of agricultural land. Adamawa state has an annual population growth rate of 2.9% of which Ganye is one of the local governments (UNFPA, 2014).^[20] This has prompted changes in land tenure systems with increasing land fragmentation and rapid soil degradation resulting in reduced farm yield and income (Bamire, 2010;^[21] Austin et al., 2012).^[22]

In recent years, farmers in the State have also been faced with the problems of crop failure, or low yield arising from climate variability particularly the delayed onset of rains and the increasing length and frequency of dry spells during the growing season. This aggravated the famers' losses, which consequently increase the

incidence of poverty and malnutrition in the state.^[18] Poverty has remained prevalent in Adamawa (Fiona et al., 2011).^[17] The state has about 75.41% of its citizens below the poverty line of \$1.25 per day (National Bureau of Statistics [NBS], 2020).^[23] Ayantoke K. et al. (2011)^[24] stated that, there is a connection between poverty levels in rural Nigeria and the level of food security. In fact, food insecurity is considered a measure of poverty in many societies since it reduces access to food (Adeniyi & Ojo, 2013).^[25] Therefore, food security of households will improve if household poverty is reduced (Adewuyi & Hayatu, 2011;^[26] Phillip et al., 2009).^[27]

Achieving food security is still a challenge due to the global approach being employed instead of formulating and applying solutions based on specific locations with an understanding of the social system and livelihood activities (Food and Agricultural Organization [FAO], 2002).^[28] In fact, food insecurity is no longer seen simply as a failure of agriculture to produce sufficient food at the national level, but instead as a failure of livelihoods to guarantee access to sufficient food at the household level (Ncube, 2010).^[29] Majority of the recent research works that have been done so far on issues related to food security are relatively broad and considers the problem from national or regional point of view (Adewuyi and Hayatu, 2011;^[26] Ayantoke K. et al., 2011;^[24] Fiona et al., 2011;^[17] Asogwa and Umeh 2012;^[30] Adepoju and Adejere, 2013;^[12] Adeniyi and Ojo, 2013;^[25] Adamu, 2014).^[31] However, despite the increasing global and national concern of improving food security, the contributions of diverse livelihood income activities on food security status of rural farming households, especially in the study area is not well documented. Therefore, in order to formulate effective policies for promoting food security, it is imperative to analyse the effect of livelihood income activities on food security status of rural farming households in Ganye Local Government Area of Adamawa state, Nigeria.

2.1. Objectives of the study

The broad objective of the study is the "Effect of Livelihood Diversification on Income and Food Security Status of Rural Farm Households in Ganye Local Government Area of Adamawa State, Nigeria".

The specific objectives were to:

- describe the socio-economic characteristics of the rural households,
- identify and describe the livelihood activities of the respondents
- assess the level of diversification of livelihood activities by the respondents
- determine the annual income of the respondents
- determine the factors that influence diversification of livelihood activities of the respondents
- determine the food security status of the respondents
- identify the constraints to diversifying livelihood activities by the respondents in the study area

Hypothesis

H_0 = Diversification of livelihood activities does not affect food security status of the respondents.

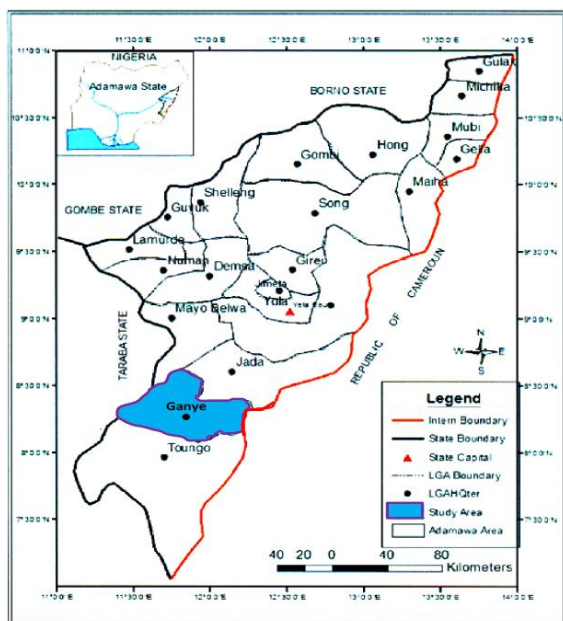


Fig. 1. Map of Adamawa State Showing the Study Areas (Source: Adebayo (2020))

3. Methodology

The study was carried out in Ganye local government areas of Adamawa State (Fig. 1). Ganye local government areas lies between latitude 8°12' - 8°40' North and longitude 11°37' - 12°15' East. It is bounded by Jada to the north, Mayo-belwa to the northwest, Toungo to the south, Taraba state to the west and Cameroon Republic to the east. Ganye has a land mass of 2,011.47 km² and a projected population of 240,686. The mean annual temperature of the study area for maximum is 32.3°C and minimum 19.6°C while the average annual rainfall total is 1,231 mm with a distinct dry season which begins in November and ends April and the wet season begins in April and ends in October or sometimes in November. The areas are located within the Guinea Savannah zone of the Nigeria's vegetation zones. The major economic activity in the area is agriculture. Food crops grown in the area are maize, sorghum, cowpea, cassava and potatoes. While cash crops such as groundnuts, rice, yam and sugarcane are produced in large quantities. Major livestock reared in the zone are cattle, sheep and goats (Adebayo and Zemba, 2020;^[32,33] Akosim et al., 2020;^[34] Kadams et al., 2020;^[35] Zemba et al., 2020).^[36]

3.1. Sampling Technique and Sample Size

A multi stage sampling technique was used to collect primary data from 230 rural farming households in the study area using questionnaire, selected from twelve communities namely Santasa, Sangasumi, Sanyigmi, Gamu, Dalebbi, Dimgam, Gurum, Gurum-Novon, Yebbi, Sugu, Jaggu and timdore respectively. The respondents were randomly selected from each community proportionate to the number of the household in each community.

3.2. Method of Data Analysis

The tools that was used in analysing the results of the research include simple descriptive statistics such as mean, frequency and

percentages and inferential statistics such as Diversification index, Logit model and Pearson correlation was used to test the hypothesis.

3.3. Descriptive Statistics

The simple descriptive statistics are frequency distribution, percentages and mean. These were used to describe the socio-economic characteristics of the respondents, their livelihood activities, income and constraints to livelihood diversification.

3.4. Diversification Index

The Simpsons Index of Diversity (SID) was used in this study to estimate the degree of income diversification among rural households. The SID takes into consideration both the number of income sources as well as how evenly the distributions of the income between the different sources. Following Amurtiya et al. (2016),^[37] Dia et al. (2022)^[38] and Sultana et al. (2015),^[39] Simpson Index of Diversification was used to ascertain the level of livelihood diversification among the respondents. Diversification was related to the number of source of income and the balance among them. The index is mathematically expressed as:

$$SID = \sum_{i=1}^n P_i^2 \quad (1)$$

Where: SID = Simpson Index of Diversity, n = number of income sources, P_i = Proportion of income coming from the source i , the value of SID is within the range from 0 and 1. When SID is less than 0.01 (No diversification), SID is equal 0.01 – 0.25 (Low diversification), SID is equal to 0.26 – 0.50 (Average diversification), SID greater than or equal to 0.51 (High diversification).

3.5. Binary Logit (BNL) Model

The Binary Logit (BNL) Model was employed in this study. In this model, the data on the dependent variable (diversification of livelihood activities) is bi-variate, that is, diversified livelihood activities or not diversified. The BNL model was therefore, employed due to the nature of the decision variable. For such a dichotomous outcome, the BNL model is the most appropriate analytical tool (Fosu-Mensah B.Y et al., 2012;^[40] Pur et al., 2016).^[41] The implicit form of the model is expressed as:

$$Y = \ln \left(\frac{\phi_i}{1-\phi_i} \right) = \beta_0 + \sum_{j=1}^k \beta_j X_{ij} + \varepsilon_i \quad (2)$$

where:

Y = Dependent variable (i.e, the binary variable; $Y = 1$ for a household that diversified livelihood activities and $Y = 0$ for otherwise.

β_0 Intercept

β_i = Estimated parameters

X_i = Explanatory variables

$i = 1, 2, 3, \dots, n$ number of explanatory variables

ε_i = the matrix of unobserved random effects, $\frac{\phi_i}{1-\phi_i}$ is "odds", and

$\ln \left(\frac{\phi_i}{1-\phi_i} \right)$ is the logarithm of "odds".

Table 1. Exogenous variables in the binary logit regression to test diversity.

Variable	Measurement	Expected sign
Age (X1)	In years	±
Sex (X2)	Binary variable (1=male, 0=otherwise)	+
Formal Education (X5)	Years	±
Primary Occupation (X8)	Binary (1=farming, 0=otherwise)	±
Households Size (X4)	Number	+
Farm Size (X6)	Naira	+
Membership of Cooperative (X7)	Binary (1= yes, 0 = No)	±
Access to Credit (X8)	Binary (1= yes, 0 = No)	±

Equation (2) can be manipulated to give the odds ratio using equation (3):

$$\frac{\phi_i}{1-\phi_i} = \exp(\beta_0 + \sum_{i=1}^k \beta_i X_i) \quad (3)$$

The probability of the extent of access was calculated using equation (3):

$$\phi_i = \frac{\exp(\beta_0 + \sum_{i=1}^k \beta_j X_{ij})}{1 + \exp(\beta_0 + \sum_{i=1}^k \beta_j X_{ij})} \quad (4)$$

Equation (4) is intrinsically linear since the logit is linear in X_i (Gujarati, 2004);^[42] it indicates that probability ϕ_i lies between zero and one and vary non-linearly with X_i . The equation for calculating partial effects of continuous variable is denoted by:

$$\frac{\partial \phi_i}{\partial x_i} = \phi_i(1 - \phi_i)\beta_j \quad (5)$$

The partial effects of the discrete variables will be calculated by taking the difference of the mean probabilities estimated for the respective discrete variable, $X_i = 0$ and $X_i = 1$.

The marginal effects measure the expected change in probability of a particular choice being made with respect to a unit change in an explanatory variable (Greene, 2003).^[43]

The BNL model is explicitly expressed as follows:

$$Y = \ln\left(\frac{\phi_1}{1-\phi_1}\right) = \beta_0 + \sum_{j=1}^k \beta_j X_j + \beta_1 X_1 + \beta_2 X_2 \dots \dots + \beta_8 X_8 + \varepsilon_i \quad (6)$$

Y = Dependent variable (i.e, the binary variable; $Y = 1$ for a household that diversified livelihood activities (Simpson index) and $Y = 0$ for otherwise. The independent variables were defined in Table 1.

3.6. Food security index

Food security index was employed to determine the food security status of the respondents, the households were classified into food secured and food insecure using the food security index. The food security index formula is expressed as:

$$FSi = \frac{\text{Per capita food expenditure for the } i\text{th household}}{\frac{2}{3} \text{mean per capita food expenditure of all households}} \quad (7)$$

Where; FSi = Food security index, $FSi > 1$ = Food secure i^{th} household, $FSi < 1$ = Food insecure i^{th} household.

Table 2. Distribution of Socio-economic characteristic of the respondents (N=230)

Variable	Frequency	Percentage
Age (Years)		
20 – 29	40	17.39
30 – 39	58	25.22
40 – 49	108	46.96
50 – 59	19	8.26
60 and above	5	2.17
Mean = 43.47 Years		
Sex		
Male	185	80.43
Female	45	19.57
Marital status		
Single	30	13.04
Married	160	69.57
Widowed/Divorced	40	17.39
Educational Level		
No Formal Education	55	23.92
Primary Education	70	30.43
Secondary Education	82	35.65
Tertiary Education	23	10.00
Primary Occupation		
Farming	170	73.91
Trading	25	10.87
Civil Servant	19	8.26
Artisan	16	6.96
Household Size		
1 – 5	76	33.04
6 – 10	120	52.18
11 and above	34	14.78
Mean = 7 People		
Farm Size		
<1	35	15.22
1 – 5	140	60.87
6 – 10	55	23.91
Membership of Cooperative		
Yes	97	42.17
No	133	57.83
Access to Credit		
Yes	62	26.96
No	168	73.04

Source: Field Survey 2022

A food secured household is therefore those households whose per capita monthly food expenditure falls above or equal to two thirds of the mean per capita food expenditure. On the other hand, a food insecure household is those whose per capita food expenditure falls below two-thirds of the mean monthly per capita food expenditure (Titus and Adetokunbo, 2007).^[44]

3.7. Testing of Hypothesis

Hypothesis was tested using Pearson Product-Moment Correlation Coefficient (PPMCC). To measure a relationship between livelihood activities and food security. The correlation coefficient is a number that summarizes the direction and degree (closeness) of linear relations between two known variables. Mathematically expressed as:

$$r = \frac{\sum XY - \frac{\sum X \sum Y}{n}}{\sqrt{[\sum X^2 - \frac{(\sum X)^2}{n}][\sum Y^2 - \frac{(\sum Y)^2}{n}]}} \quad (8)$$

Where:

Table 3. Distribution of Livelihood Diversification Strategies of rural Households

Variable	Frequency*	Percentage
Agricultural Activities		
Arable crop farming	201	87.39
Livestock farming	178	77.39
Apiculture	67	29.13
Non-Agricultural Activities		
Civil Service	34	14.78
Carpentry	42	18.26
Tailoring	31	13.47
Grinding	34	14.78
Firewood gathering/sales	64	27.83
Masonry/Bricklaying	30	13.04
Trading	48	20.87
Revenue from leasing out land/rent	42	18.26
Butchery	38	16.52
Casual wage labour	65	28.26
Electrician/Mechanic	34	14.78
Charging/sales of recharge card	28	12.17
Barbing/Hairdressing/Plating	45	19.56

Source: Field Survey 2022

*Multiple responses were allowed, percentage total greater than 100.

r = Pearson's correlation coefficient, n = number of paired scores, X = number of livelihood activities of the respondents, Y = food security of the respondents, XY = the product of the two paired scores.

4. Results and Discussions

4.1. Socio-economic Characteristics of the Respondents

The socio-economic characteristics of the respondents are presented in Table 2 on such variables as age, sex, marital status, level of education, primary occupation, household size, farm size, membership of cooperative and access to credit. The result in Table 2 indicates that majority of the respondents (72.18%) were between ages 30 and 49 with a mean age of 43.47 years. This is an indication that those within this age bracket were active enough to participate in multiple livelihood activities to earn a living. The study reveals that a greater proportion of the respondents (80.43%) in the study area were males, the married (69.57%) dominated involvement in income generating activities in the study area. Such households are bound to enjoy the benefits of increased labour supply and supplementing the family's means of livelihood. Respondents' educational level in the study area shows that 76.08% were literate with diverse levels of formal education; from primary to tertiary. This implies a very high level of literacy (ability to read and write) abides in the study area which would enable the entrepreneurs to better utilize effectively and efficiently available resources as well as diversify livelihood. Majority (73.91%) of the respondents had farming as their primary occupation, with mean household size of seven people, 52.18% had farm size between 1 – 5 hectares, 57.83% do not belong to cooperative and 73.04% had no access to credit facilities.

4.2. Livelihood Diversification strategies of rural households

Farming households combine a range of different livelihood strategies to make a living since barely no any household was found

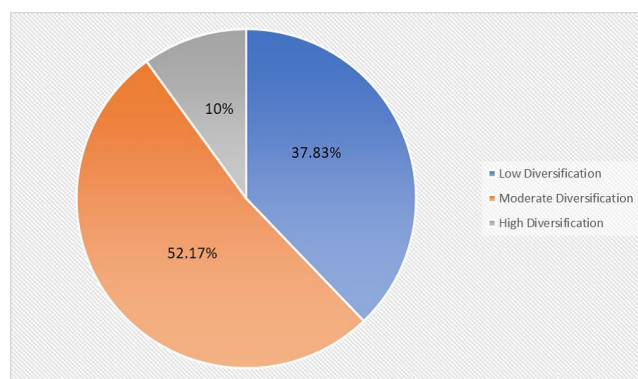


Fig. 2. Distribution of respondents according to their level of diversification (N=230). Source: Field Survey 2022

to depend on one activity but used a host of activities and opportunities offered by farm and non-farm sectors. The different livelihood strategies engaged in by the rural households are presented in Table 3. The result of the various livelihood strategies adopted by the households shows that arable crop farming, livestock farming and apiculture were identified and accounted for 87.39%, 77.39% and 29.13%. Arable crop farming (87.39%) was the most prevalent livelihood strategy among the respondents. This was followed by livestock rearing. The result therefore indicates that the respondents are majorly agrarian rural dwellers. They depend mostly on the proceeds from their farms to survive and meet their daily food and other necessary requirements. This is in agreement with the finding by Echebiri et al. (2017)^[45] who opined that most rural far households in Abia State, Nigeria depends on proceeds from their farms to meet their daily food and other necessary requirements.

Also based on those engaged on non-agricultural activities it was found that 28.26% were engaged in casual wage labour, 27.83% were engaged in firewood gathering/sales 20.87% were engaged in trading, 19.56% were engaged in barbing, hairdressing, and plating, 18.26% were engaged in leasing out land and renting out properties and carpentry, 16.52% were engaged in butchery, 14.78% were in civil service or private sector, 14.78% were engaged in grinding, 14.78% were Electrician or Mechanic, 13.47% were engaged in tailoring, 13.04% were engaged in brick laying while 12.17% were Charging phones and sales of recharge card respectively. The result showed that agriculture still remains the major source of rural income for rural farming households. This study agrees with study conducted by Babatunde and Qaim (2010)^[46] and Oyewole et al. (2015)^[47] who find out that on patterns of livelihood diversification in rural Nigeria arable crop production which is mainly subsistence in nature is the most important single source income to most rural households.

4.3. Level of diversification among the respondents

Analysis of the respondents' level of diversification in Fig. 2 shows that, only 10% of the respondents have a high diversified livelihood source. Respondents with moderate and low livelihood represented 52% and 38% respectively. This is not surprising, because establishing and owning business will require huge amount of capital. It should be noted that diversification in this context of this study means that having other sources of livelihood in addition to your primary

Table 4. Logit Regression Result for Determinants of Livelihood Diversification of Rural households

Variable	Coeff.	Std. Err.	Z-Stat	P-Value	Marginal Effect
Constant	6.141577	2.456745	2.50***	0.000	
Age	-0.2033102	0.03098072	-5.11***	0.000	0.8160251
Sex	1.872596	0.8071849	2.32**	0.020	6.505161
Educational level	0.1073944	0.0470678	2.28**	0.023	1.113373
Primary occupation	-3.389929	1.350433	-2.51**	0.012	0.0337111
Household size	-2747984	0.1158919	-2.37**	0.018	0.7597252
Farm size	0.8842635	0.2393642	3.69***	0.000	2.421201
Membership of cooperative	0.3252158	0.1401297	2.32**	0.020	1.384329
Access to credit	1.714399	0.5447068	3.15***	0.002	5.553339
Total Annual income	6.55e-06	3.53e-06	1.86*	0.064	1.000007
Diagnostic Statistics					
Chi-square 162.06***					
Log likelihood -55.914359					
Pseudo R2 0.5917					
Specification test					
Hat	1.083897	0.1675769	6.47***	0.000	
Hatsq	0.0470135	0.033367	1.41	0.159	
Goodness-of-fit test					
Pearson Chi2(220) = 207.34					
Correctly classified 72.02%					

Source: Computed Field Data 2022. Note: *** = Significant at 1%, ** = Significant at 5%, * = Significant at 10%

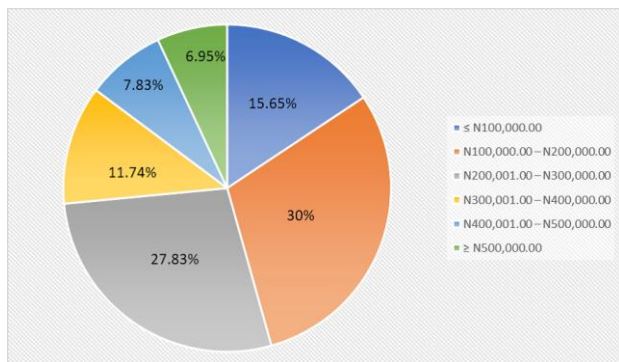


Fig. 3. Distribution of respondents by annual income. (Source: Field Survey 2022)

occupation. The study shows that rural farming households in the study area do not depend on one source of livelihood. This strategy was adopted to ensure secured livelihood and reduce poverty and food insecurity. Diversification makes smooth flow of income to the household by reducing both predictable and unpredictable fluctuations. Predictable seasonal fluctuations in income can be enhanced by combining enterprises and activities that generate returns during different times of the year. Unpredictable fluctuations are those which create an unexpected loss in income, may be reduced by a diversified portfolio of economic activities (Saha and Bahal, 2014).^[48] This result does not agree with study conducted by Challa et al. (2019)^[49] in rural Ethiopia who posited that most rural households had low diversification in income sources, but agrees with the studies conducted by Idowu et al. (2014)^[50] and Oyinbo and Kehinde, (2016)^[51] which revealed that farming households mostly had moderate diversification of livelihood.

4.4. Analysis of the respondents' income

The respondents' distribution of annual income was presented in Fig. 3. It indicated that 15.65% of the respondents earn less than N100,000.00 annually as income from various livelihood activities

while 30%, 27.83%, 11.74% and 7.83% had their annual income between N100,000.00 – N200,000.00, N200,001.00 – N300,000.00, N300,001.00 – N400,000.00 and N400,001.00 – N500,000.00 respectively. Only 6.95% had their annual income from various livelihood activities above N500,000.00. This shows that the level of income generation in the study area is moderately high despite the low of non-agricultural activities in the study area.

4.5. Econometric Model Results

As specified in the methodology part of this research, logistic regression model was used to identify factors affecting livelihood diversification in the study area. Under this section important variables which were hypothesized to influence the household decision to participate into different livelihood diversification are considered. The analysis was made using STATA 11 version. The hypothesized variables were tested for the existence of multicollinearity.

4.6. Multicollinearity and degree of association

Before conduction the econometric analysis it is vital to look at the problem of multicollinearity among the continuous explanatory variables and verify the degree of association among dummy explanatory variables which otherwise, the parameter estimate would seriously be affected by the existence of multicollinearity among variables. To this end the Variance Inflation Factor (VIF) and contingency coefficients were used to test the degree of multicollinearity among the continuous variables and to check the degree of association among the discrete variables. The value of VIF for continuous were found to be small that is VIF less than 10, with an average of 1.10 indicating no problem of multicollinearity. As a rule of thumb, if the VIF of the continuous variable exceeds 10 that variable is said to be highly collinear (Gujarati, 2004).^[42]

The goodness-of-fit determines the accuracy of the model prediction approximates to the observed data. In this study, the

result of the goodness-of-fit test shows that the overall goodness of fit is reflected in a non-significant of Pearson Chi-square p-value which is p-value 0.7202. This implies that the data has a good-fit in explaining the relationship. The model adequacy test shows p-value for hat to be 0.000 which is highly significant and p-value for hatsq is 0.159 which is non-significant. The non-significant of hatsq suggest good model adequacy (Table 4).

4.7. Model results interpretation

Logit regression model result indicated that all the 9 hypothesized explanatory variables were found to be significant influence on livelihood diversification on rural farm households in the study area. These include age, sex, educational level, primary occupation, household size, farm size, membership of cooperative, access to credit and total annual income were determining farmer's participation into livelihood diversification (see Table 4).

4.7.1. Age

The results showed that age of the farming household heads was found to have negative effect on diversification of livelihood activities and significant at $P < 0.01$. This implies that an increase in age would decrease diversification of livelihood activities. This is because the older the farmers the less their willingness to take risks. Marginal effects results of the model revealed, other variables being kept constant, the likelihood of a rural households' choice of livelihood activities decrease by 81.6% for increasing one additional year. This may be due to the fact that older people may likely not to have a greater tendency to engage in several income generating activities because the likelihood declines as they get older. As respondents grow older their likelihood of diversifying reduces. Less access to land to youngster population and increase in service and construction sectors have better opportunity for youngsters than old farmers to diversify livelihood activities (Kassie et al., 2017).^[52] According to the Asfir (2016),^[53] age affects livelihood diversification negatively since older farmers were well established, more experienced in agricultural production, more resistant to new ideas and information hence less likely to diversify their livelihood.

4.7.2. Sex

The sex of the respondents was a significant factor affecting livelihood diversification in the study area. It was significant at $P < 0.05$ level and have positive effect on diversification of livelihood activities with marginal effect of 6.51, this implies that male respondents were about 6.51 more likely to diversify compared to their female counterpart. Male have responsibility for provision of household needs of their families, hence greater involvement in income diversification for economic empowerment (Tasie et al., 2012).^[54] Similar findings are also reported elsewhere in Western Kenya (Olale and Henson, 2012)^[55] and in Nigeria (Idowu et al., 2013).^[56]

4.7.3. Educational Level

As expected the variable of education positively and significantly related with the household livelihood diversification into agricultural

and non-agricultural activities at 5% probability level. This indicated that those farmers with high educational level are more likely to diversify livelihood. This is due to most probably educated person gain better skills, experience and knowledge which help them engage in diversifying. The marginal effect revealed the likelihood of literate household heads diversifying livelihood is 111%. In other words, additional one year of education can increase the chance of diversifying by 111%. This study is in line with the study conducted by Debele and Desta (2017)^[57] that education is very important variable that can help farmers diversify livelihood to overcome food security.

4.7.4. Primary occupation

The variable has negative and significant effect on livelihood diversification at 5% probability level. This indicate that farmers that depend more on their primary occupation hardly diversify their livelihood. Marginal effect result of the model that other things remain constant their likelihood of diversifying is reduced by 3.3%. This may be due to the fact that they are skeptical about diversifying their livelihood.

4.7.5. Household size

The household size was found to have negative effect to the sources of livelihood and statistically significant at $P < 0.05$ with marginal effect of 0.7597252. This implies that increase in household size reduces the likelihood of diversifying by 75%. This may be due to the fact that increase in household reduces resources needed for diversification. This agrees with the study by Fadipe et al. (2014)^[58] who posited that household with young dependants mostly have less contribution to livelihood diversification.

4.7.6. Farm size

The variable is positively and significantly affected livelihood diversification among household heads in the study area at 1% probability level. Marginal effect result of the model revealed that all other things being constant the likelihood of diversifying into livelihood activities increases by 2.421201 times. This indicates keeping the effect of all other variables constant, a hectare increase in farm size increases income by in the area by 242% which in turn helps the household to diversify livelihood. This agrees with Amurtiya et al. (2016)^[37] who posited that an increase in farm size of the farmer increases his income there by diversifying livelihood.

4.7.7. Membership of cooperative

The variable has a positive and significant effect on diversification of livelihood at 5% probability level. This indicates that belonging to farmers' organization would significantly influence farmers into livelihood diversification activities. Marginal effect of the model revealed keeping other variables constant, the likelihood of diversifying into livelihood activities increases by 138%, for household the engages into cooperative organization. This study is in with Echebiri et al. (2017)^[45] who revealed that farmers who belong to farmers' organization would significantly be influence into diversifying livelihood activities besides farming.

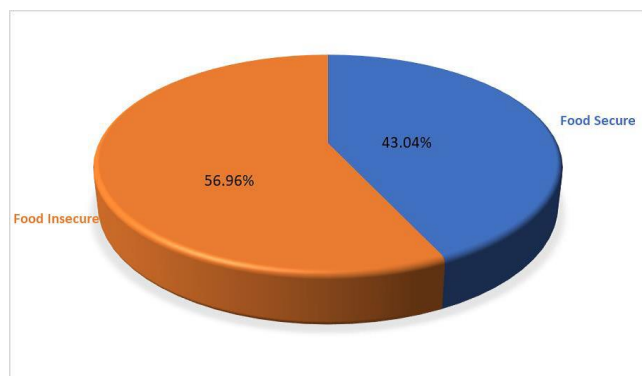


Fig. 4. Distribution of respondents Food Security Status. (Source: Field Survey 2022)

4.7.8. Total Annual Income

The variable of total annual income was a continuous variable and measured in term of total amount of income for household from livelihood activities. Income had a positive effect on livelihood diversification and is significant $P < 0.01$ level of probability with marginal effect of 4.6618. This implies that respondents with high income are about four times more likely to diversify than those with less income. According to Ito and Kurosaki (2009) farmers find off-farm employment as an activity to deal with risks of farming. In this study total annual income was found to be positively related to the sources of livelihood activities. This implies that as income increases sources of livelihood activities increased for both male-headed farming households and female-headed farming households. Babatunde and Qaim (2010)^[46] support that high income earners can easily mobilize productive resources and are more diversified than low income earners.

4.7.9. Access to credit

This was found to have a positive and significant effect on the level of diversification of livelihood activities at $P < 0.01$ probability level with marginal effect of 3.89. Marginal effects result of the model revealed that, other things being constant, the likelihood of diversifying livelihood activities is about four times (3.89) for those who get credit access than their counterparts. This implies that when the farmers have access to credit facilities it will aid the households to diversify their livelihood. This finding is in line with the study by Ambachew and Ermiyas (2016);^[59] credit access is found to have a positive impact on likelihood of choosing livelihood diversification strategies and Debele (2013);^[60] credit is an important component, which can help the poor households undertake various types of livelihood strategies. It also agrees with the finding by Fabusoro et al. (2010)^[61] and Adetayo, (2014)^[62] who reported that access to credit has a positive influence on diversification of livelihood.

4.8. Food security status of farm households

Food security index estimation using expenditure method was used to classify the respondents into food secure and food insecure households in a bid to establish the food security status of the individual households (Fig. 4). A food secured household is therefore, those whose per capita monthly food expenditure is at least two-

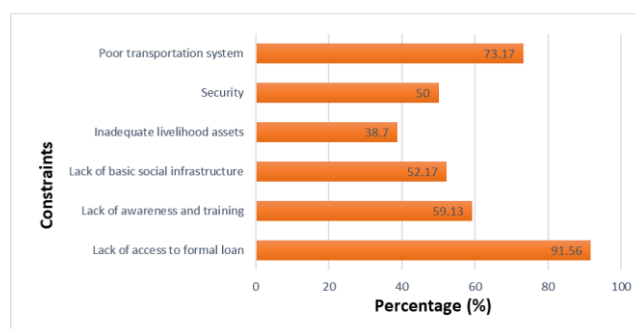


Fig. 5. Constraints to Livelihood Diversification in the study area. Multiple responses percentage total greater than 100. (Source: Field Survey 2022)

thirds of the mean per capita monthly food expenditure. On the other hand, a food insecure household is that whose per capita monthly food expenditure is less than two-thirds of the mean monthly per capita food expenditure. The mean per capita food expenditure per month was estimated to be ₦ 9,113.34 and this value was used as food security index. The food security line which is two third of the mean per capita food expenditure per month was ₦6,075.56. This implies that, all respondents whose per capita monthly food expenditure falls less than ₦6,075.56 was regarded as being food insecure. This is because; it is an indication that these households were unable to meet their expected food expenditure. Respondents with values equal or above ₦6,075.56 are regarded as being food secure. The findings on Table 4, indicates that 43.04% of the respondents were food secure while 56.96% were food insecure. This implies that, the incidence of food insecurity among the respondents is high and this is in agreement with the findings of Adepaju and Adejere (2013)^[12] who reported that, there is high incidence of food insecurity in rural Nigeria with North East sub-region having about 56% food insecure households.

4.9. Constraints to Livelihood Diversification among Rural Farm Households

Constraints to livelihood diversification among the respondents in the study area were presented in Fig. 5. The result revealed that lack of access to formal loan (91.56%), Lack of awareness and training (59.13%), Lack of basic social infrastructure (52.17%), Inadequate livelihood asset (38.70%), insecurity (50.00%) and Poor transportation system (73.17%). This implies that most of the respondents could not access credit for investment into a much profitable non-farm sector. Because of these constraints, most of the respondents are into activities with low entry barriers in term of technical skills and capital/equipment. The study agrees with that of Khatun and Roy 2012;^[6] who reported that lack of credit, lack of infrastructure, lack of awareness and training and poor asset base were the major constraints to livelihood diversification. Similar studies by Ewebiyi and Meliudu (2013)^[63] have identified lack of infrastructural facilities, inadequate livelihood asset and poor transportation system as the constraints to livelihood diversification.

Table 5. Correlations result: effect of livelihood diversification on income and food security (FS)

Variable	Livelihood Diversification	Food Security
Pearson correlation	1	.1821***
Livelihood Diversification	Sig (2-tailed)	.000
N	230	230
Pearson correlation	.1821***	1
Food Security	Sig (2-tailed)	.000
N	230	230

4.10. Effect of livelihood diversification on food security status of the farm households

Pearson correlation analysis was carried out to examine how livelihood diversification affects households' food security as presented in Table 5. A positive correlation at 1% was found to exist between livelihood diversification and food security. This implies that increase in the number of livelihood activities engaged in by a household increases her tendency towards food security. Therefore, livelihood diversified households are more food secured and vice versa.

5. Conclusions

The result of this study has revealed that rural farming households' involvement in livelihood diversification activities is as a result of overwhelming need to increase households' income portfolio and to maintain livelihood. The quest for improved standard of living which has been sought after by rural dwellers and their sympathizers would be met with higher successes when rural people realize the potentiality and effectiveness of livelihood diversification in the overall scheme of rural poverty reduction especially in rural communities of low-income countries. It is therefore, the general conclusion of this study that livelihood diversification is a positive undertaken and an antidote to the chronic menace of poverty and food insecurity ravaging rural areas. This is because it enables rural people increase their income portfolio and ensures households from insufficiency of food, thereby improving their food security status, while equally lessening their vulnerability to hunger, diseases and mortalities.

6. Recommendation

Based on this study it is recommended that:

1. Rural farmers should be given opportunity to participate in varied income generating activities in both agriculture and non-agricultural activities and rural development programmes which would enhance their livelihood diversification activities and living standard be initiated and encouraged;
2. The effect of education on household food insecurity cannot be over-emphasized therefore strengthening both formal and informal education and vocational or skill training should be promoted to reduce food insecurity in the study area;
3. Access to credit can create an opportunity to be involved in economic activity that generates revenue to households;

4. Development partners operating in the study area should implement provision of credit to eligible households using targeting criterion that reflects actual characteristics of food insecure households.

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Conflicts of Interest

The authors declare no conflict of interest.

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