FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 9 April Special Issue, 2025, pp 152 - 159
DOI: https://doi.org/10.33003/fjs-2025-09(AHBSI)-3398

THE NEXUS BETWEEN LIVELIHOOD DIVERSIFICATION AND NUTRITION SECURITY AMONG FARMING HOUSEHOLDS IN NIGERIA

***[1]Ojoko E. Ada, [1]Chinalurum, C. Amadiegwu and [2]Dada G. Emmanuel**

[1]Department of Agricultural Economics, Federal University Dutsin-Ma, Katsina State, Nigeria.
[2]Department of Agricultural Economics, University of Ibadan, Ibadan, Nigeria.

*Corresponding authors' email: eojokoada@gmail.com

ABSTRACT

In a country where millions of farming household heads struggle to feed their families in the face of economics hardship, the need to diversify income sources becomes inevitable. This study therefore examined the determinants of livelihood diversification among farming households in Nigeria. Using secondary data from the generalized household survey (GHS) 2018/2019 wave 4, this study investigated the relationship between nutrition security and livelihood diversification among farming households in Nigeria. The data was analyzed using descriptive statistics, nutrient adequacy ratio (NAR), and two stage least square regression model. Results from the computed mean adequacy ratio (MAR) showed that 54% of the farming households were found to be nutrition insecure, while 46% were nutrition secure. The profiling of nutrition security status of the farming households showed that majority of farming households were nutritional insecure. The mapping also indicated that farming households in North central, Northwest, South-south and Southwest were more nutrition secure than farming households in the Northeast and Southeast. The two stage least square (2SLS) regression result revealed that age had a substantial negative impact on nutrition security, while sex, education, household size, and livelihood diversification had favourable positive significant effects. The study therefore conclude that a strong and favourable correlation exist between nutrition security and livelihood diversification. The study recommends the need to improve nutrition security in Nigeria through nutrition education and sensitization programs on dietary diversity and micronutrient adequacy as well as enlightening of farmers on the need to consume more of foods that are rich in micronutrients.

Keywords: Livelihood diversification, Nutrition security, Nutrient Adequacy Ratio, Herfindahl index, Nigeria

INTRODUCTION

The Agricultural sector is the primary source of income for farming households and contributes significantly to the gross domestic product of Nigeria and other developing nations. It also employ the substantial majority of the labour force in the country. However, the small scale farmers who dominate the agricultural landscape and food production witness external forces that hamper their productivity, thus, diversification becomes necessary in order to generate income for both farm expansion and non-farm businesses, as well as to solve the immediate paramount needs of the farming households, which include food in the required quantity and quality, shelter, health care and payment of fees (John *et al.*, 2020).

Mahama and Nkegbe (2021) opined that livelihood diversification is a typical occurrence among households with several sources of income, which can differ between households with varying socioeconomic and geographic characteristics. It could be employed for survival, adaptation, or as a risk management tactic to maintain income in the face of threats to one's means of subsistence. As a result, it helps to increase the level of living for the populace, which in turn helps farming households' food and nutritional security.

Many households all over the world especially in developing countries, Africa and Nigeria inclusive suffer from malnutrition or under nutrition (FAO, 2021). From a conceptual approach, malnutrition arises from hunger which has a link with poverty emanating from food insecurity. According to Yusuf (2016), it has been a matter of access rather than availability, which jeopardizes utilization, hamper the nutritional security of households and as a result create the need for multiple income streams. More so, studies on dietary intake and nutrient adequacy has shown that deficiency of micronutrients leads to chronic under nutrition which is a major challenge in achieving nutrition security (Gomez *et al.*, 2020). It is evident that a varied diet increases the likelihood of consuming enough micronutrients, which is a key aspect of diet quality. A varied diet may, however, also be linked to more high-energy foods and nutrients, which is why assessing nutrition security has been a thing of concern. Because of the potential for these varied diets to cause unhealthful weight gain and chronic non-communicable diseases, micronutrients are used in the evaluation of nutrient adequacy (Gomez *et al*., 2020). Also, according to International Dietary Data Expansion Project (INDDEX, 2018), Micronutrient deficiencies continue to be a major cause of malnutrition in low-income nations, making them especially important from a nutritional standpoint. Micronutrients, particularly iron, iodine, zinc, and vitamin A, are critical for healthy growth and development in both newborns and children as well as adults for sustained work productivity, safe pregnancies, and general physical and mental well-being. Molani-Gol *et al*. (2023) assert that deficiencies resulting from low-quality diets and repetitive eating habits that are high in energy-dense and low in micronutrients are mainly caused by insufficient intake of micronutrients. This is particularly true in Nigeria, where Fadare *et al*. (2018) assert that diets typically contain suboptimal amounts of iron, iodine, zinc, and vitamin A.

In keeping with the aforementioned, the goal of this study is to ascertain how Nigerian agricultural households' nutrition security and livelihood diversification are related.

MATERIALS AND METHODS

The study area is Nigeria. Nigeria is a country in West Africa that is roughly 923,768 square kilometers in size. Its

boundaries are shared by the Atlantic Ocean and Lake Chad to the south, the Niger Republic to the north, Cameroon to the east, and Benin to the west. The Federal Capital Territory and the 36 states make up the nation. There are 774 Local Government Areas spread throughout the provinces and the Federal Capital Territory (Ideki, *et al*., 2024). Nigeria is located at 10°00' N latitude and 8°00' E longitude. Nigeria's coastal regions and interior, as well as the plateau and lowlands, have the most temperature differences. The average yearly temperature on the plateau is typically between 21°C and 27°C, whereas it is typically higher than 27°C in the inner lowlands. Nigeria has an average yearly temperature of 26.9°C, with monthly averages ranging from 24°C in December and January to 30°C in April. Precipitation averages 1,165.0 mm per year (Eregha, *et al*., 2014). Nigeria experiences rainfall all year round, with April through October seeing the most significant amounts and November through March seeing the least amount (World Bank, 2021). Nigeria's population was estimated by Worldometer to be 221,364,133, using the United Nations data as of June, 2023. The North-Central, North-East, North-West, South-East, South-South, and South-West geopolitical zones make up the nation. The agro-ecological zones are used to divide the vegetation profile: the humid forest (parts of South-West, South-East, North-Central, and South-South), the moist savannah (some parts of South-West, South-East, and mainly South-South), and the dry savannah (North-East, North-West, and part of North-Central). The mid-altitude zone, the fourth agro-ecological zone, mostly encompasses a tiny portion of North-Central Nigeria.

This investigation made use of secondary data. The necessary variables were taken out of Wave 4 of the Living Standard Measurement Survey-Integrated Survey on Agriculture (LSMS-ISA) with a sample size of 4,881 from the General Household Survey Panel 2018-2019 Data (GHS-Panel).

Model Specifications

The Nutrient Adequacy ratio (NAR)

The Nutrient Adequacy Ratio (NAR), which can be expressed as a percentage or a ratio, is the product of an individual's nutrient consumption and the current recommended allowance of the nutrient for an individual's age and sex. This recommended allowance is known as the Recommended Dietary Allowance (RDA) in the United States and as the Recommended Nutrient Intake (RNI) in many other countries. Depending on whether a nutrient is stated as a percentage or a ratio, the NAR is capped at 100% or 1 if the intake of that nutrient exceeds the RDA/RNI. As a result, nutrients with extremely high intake (NAR value > 1) cannot mask nutrients with very low intake (low NAR value), when nutrients are averaged to determine the MAR (INDDEX, 2018).

After determining the NAR for every nutrient, the Mean Adequacy Ratio (MAR) is computed by summing the NAR values. One of the markers used to assess each person's nutritional intake is the Mean Adequacy Ratio (MAR). This index uses the current recommended intake for a set of nutrients of interest to quantify the overall nutritional adequacy of a community based on an individual's diet. The equations below show how the Nutrient Adequacy Ratio (NAR), on which the MAR is based, works (Majili *et al*., 2017):

$$\text{NAR} = \frac{Actual\ nutrient\ intake\ of\ a\ nutrient\ (per\ day)}{recommended\ daily\ allowance\ of\ nutrient} \quad (1)$$

$$\text{MAR} = \frac{\sum NAR(truncated\ at\ 1)}{Number\ of\ nutrients} \quad (2)$$

Based on the foregoing, the nutrients used to estimate nutrition security in this study are Calcium, Iron, Folate, Niacin, Riboflavin, Thiamin, Vitamin A, Vitamin B6, VitaminB12, Vitamin C, and Zinc.

Two Stage Least Square Model

The method used to estimate the parameters of the simultaneous equations model is called "two stage least square estimates," and it involves applying the least squares method to one equation of a system at a time. The goal of this method is to eliminate the simultaneous equation bias as much as possible. In this method, ordinary least squares are applied in two stages: first, to reduced form equations in order to obtain an estimate of the exact and random component of the exogenous variable; second, to replace the endogenous variable that appears in the model as an explanatory variable with the estimated value from the first stage estimates, and once more using ordinary least squares to obtain estimates of the structural parameters (Bigyan, 2010).

The model is generally estimated as:

$Y_i = b_{i1}Y_1 + b_{i2}Y_2 + \ldots b_HY_H + \gamma_{i1}X_1 + \ldots\gamma_{iL}X_L + \mu_i$ (3)

Where the Y*i* 's denotes endogenous factors (I = 1, 2..... H,)

X_i's denote predetermined factors (I = 1, 2..... L)

b's represent the coefficient of endogenous factors, γ's represent the coefficient of predetermined factors.

Initially, we reduce the form equations using ordinary least squares to get the following estimation of the π as shown below:

$Y_1 = \pi_{11}X_1 + \pi_{12}X_2 + \ldots\ldots\ldots + \pi_{1L}X_L + V_1$ (4)

$Y_2 = \pi_{21}X_1 + \pi_{22}X_2 + \ldots\ldots\ldots + \pi_{2L}X_L + V_2$ (5)

$Y_1 = \pi_{H1}X_1 + \pi_{H2}X_2 + \ldots\ldots\ldots + \pi_{HL}X_L + V_H$ (6)

A set of estimated values for endogenous factors is created by utilizing the reduced form coefficients that were acquired in the initial stage: $\hat{y}_1, \hat{y}_2, \ldots\ldots\ldots \hat{y}_H$.

In the second phase, we replace the ŷ's in the structural equation to acquire the changed functions,

$Y_i = b_{i1}\hat{Y}_1 + b_{i2}\hat{Y}_2 + \ldots b_{iH}\hat{Y}_H + \gamma_{i1}X_1 + \ldots\gamma_{iL}X_L + \mu_i$ (7)

The two stage least square estimate of the structural parameters is obtained by applying the ordinary least square approach to the converted structural equation.

$Y_i = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + Z_i + \mu$ (8)

Where,

Y_i = Nutrition security (MAR)

β_0 = constant

X_1 = Livelihood diversification index (number)

X_2 =Age (years)

X_3 = age square

X_4 = Sex (male = 0, female =1)

X_5 = household size (number of people)

X_6 = education in years

X_7 = marital status (married =1, not married = 0)

X_8 = farm size (ha)

Z = instruments (Credit access, Membership of Cooperatives and geopolitical zones)

μ = error term

Recommended daily allowance (RDA)

Table 1 showed the Recommended Daily Allowance (RDA) for the various nutrients based on gender which was used in computing the Nutrient Adequacy Ratio (NAR) of 307.27, and the Mean Adequacy Ratio (MAR) of 0.063. This was further used in computing the nutrition security status of the farming households. Thus, farming households were categorized into being nutrition secure or insecure based on the MAR threshold (0.063). Households that fall on the MAR threshold or above were considered nutrition secure while those that fall below the MAR threshold were nutrition insecure.

Table 1: Recommended daily allowance for farming households

Nutrients	Adult male	Adult female
Calcium	1000mg	1000mg
Iron	8mg	18mg
Folate	400mg	400mg
Niacin	16mg	14mg
Riboflavin	1.3mg	1.1mg
Thiamin	1.2mg	1.1mg
Vitamin A	900mcg	700mcg
Vitamin B6	1.3 – 1.7mg	1.3 – 1.5mg
VitaminB12	2.4mcg	2.4mcg
Vitamin C	90mg	75mg
Zinc	11mg	8mg
∑NAR = 307.27;	MAR = 0.063	

Source: United States Department of Agriculture. Dietary Guidelines for Americans, 2020-2025.

RESULTS AND DISCUSSION

Level of nutrition security among farming households

Based on the computed MAR (0.063), 46% of the farming households were classified as nutrition secure, while 54% of the households were nutrition insecure as shown in Figure 1. The implication of this is that farming households in the study area are more nutrition insecure than being nutrition secure. This results is consistent with Clement's (2014) research, which suggested that although food access and availability are important, food use, or nutrition, is more important. As what is consumed is not what matters, but the ability of that which is consumed to meet nutritional requirements of the consumer. Furthermore, the inconsistent food security experienced by Nigerian agricultural households has consistently led to poor dietary intake, a critical factor in the country's nutrient inadequacy (Akinyele, 2009).

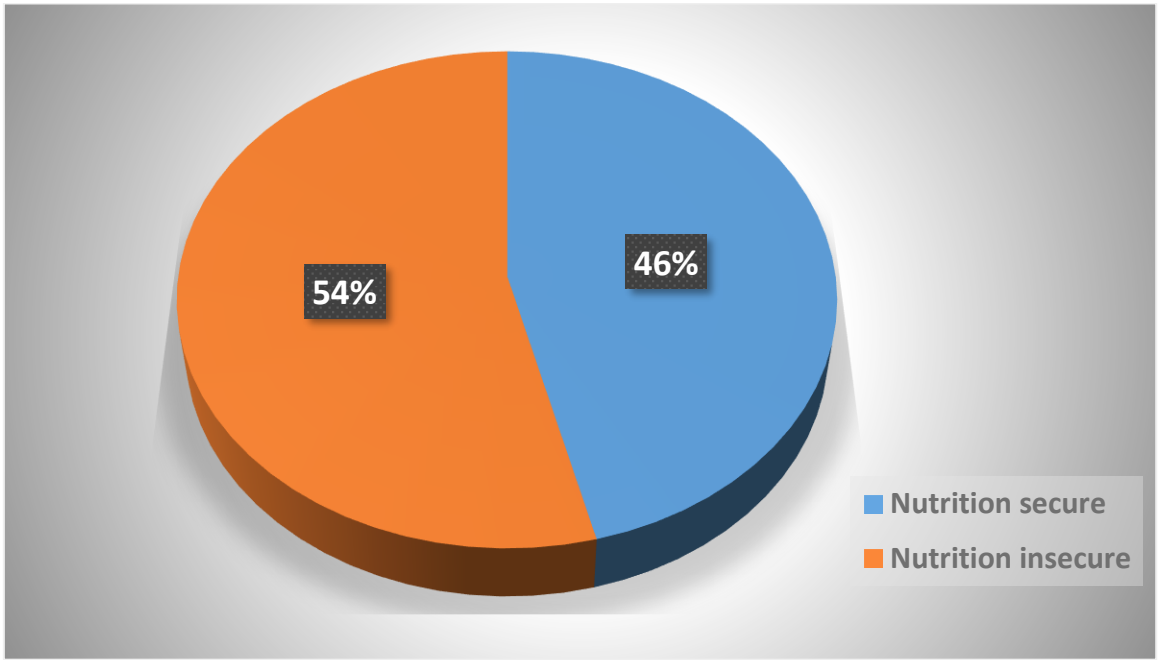

Figure 1: Nutrition security status of farming households in Nigeria
Source: Author's computation from GHS Data (2018/2019)

Profile of nutrition security across socio-economic characteristics of the farming households

Figure 2 showed the profiling of nutrition security across the socio-economic characteristics (quantitative) of farming households. The result based on age showed that those within the age of ≤ 30 (68.52%) and 31- 40 (62.14%), were more nutrition insecure than other age groups. This could be due to the fact that even though those within this age group are in their productive age, yet their ability to diversify might be low due to high level of dependence associated with these age groups, thus, they are more nutrition insecure. But the middle aged group were more nutrition secure (53.21%) than other age groups. Those who had household size of 1 – 5 persons (72.26%) were more nutrition insecure than those who had more than 6-10 persons (56.99%) and those whose household size was >10 persons (29%). This implies that increased household size can contribute to increased labour which increases productivity and in turn leads to increased access to food and by extension improved nutrition. Households that were >10 were more nutrition secured (71.00%) than those who were 6-10 persons (43.01%) and those whose household size ranged from 1-5 (23.73%). This agrees with Donye *et al.* (2016), who found out that increased household size, increases the responsibilities of a farming household head to seek for other means of catering for his household instead of relying solely on one livelihood activity.

The result also showed that households whose farm size was <1 hectare (57.16%) were more nutrition insecure than those whose farm size where 1-5 hectares (49.29%) and >5 hectares (33.7%) thereby revealing that increased farm size could

improve food production which in turn makes access to food easy and in the long run, bring about nutrition security. Farming households who had farm size >5 hectares were more nutrition secure (66.30%) than those whose farm size were 1-5 hectares (49.29%) and those whose farm size are > 1 hectare (42.84%). This is consistent with Sallawu *et al.* (2016) research findings, who stated that most farmers with small farm size are majorly subsistent farmers and thus, would need to increase their sources of income in order to improve their standard of living, and thereby become food and nutrition secure.

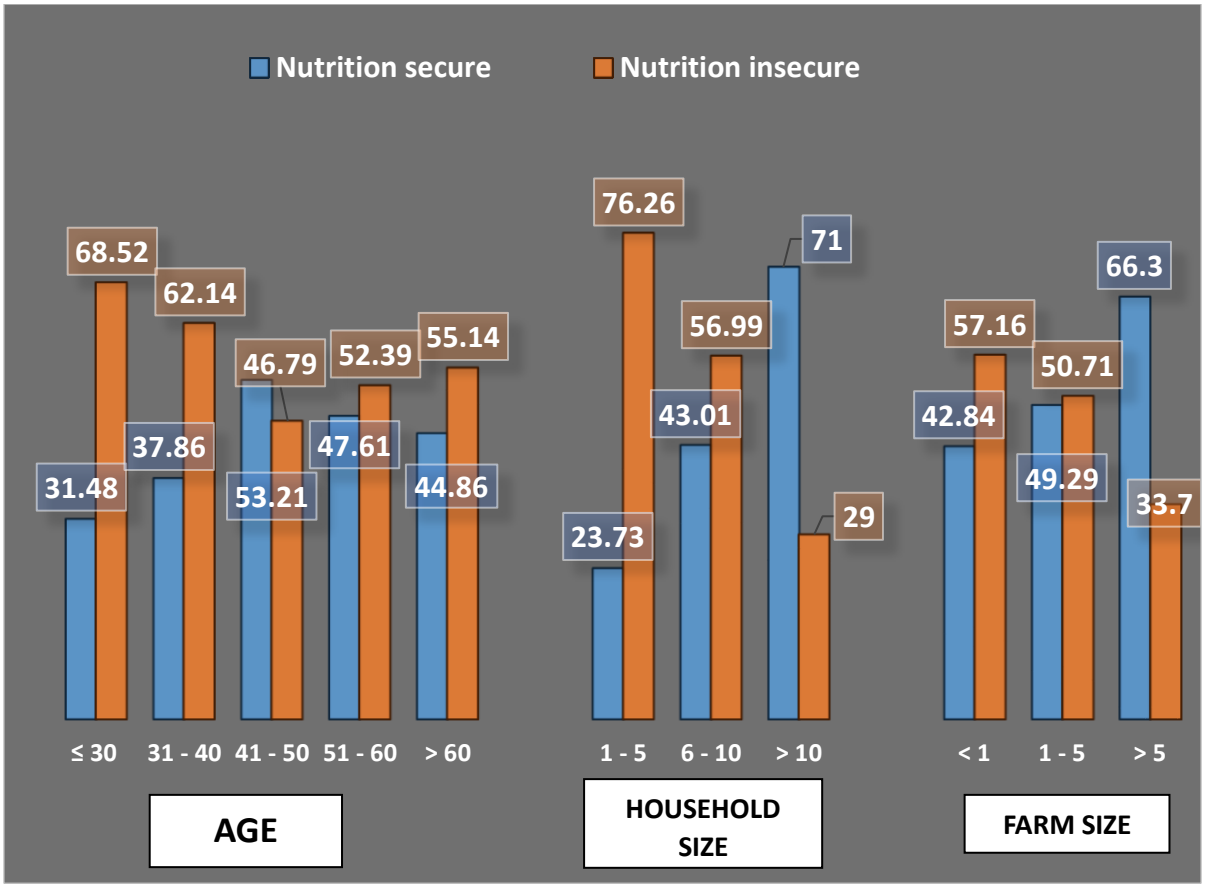

Figure 2: Profile of nutrition security across socio-economic variables (quantitative) of farming households in Nigeria.
Source: Author's computation from GHS Data (2018/2019)

Figure 3 showed the profiling of nutrition security across the socio-economic characteristics (qualitative) of farming households. The distribution of the sampled households that were nutrition insecure showed that the female household heads were more nutrition insecure (68.68%) than the male household heads (52.02%), while the male household heads were more nutrition secure (47.95%) than the female (31.32%). This is consistent with the findings of Clement (2014), who linked the cause to the economic gap between families headed by men and women. He reasoned that this was because homes headed by women are typically more susceptible to food insecurity than households headed by men, which leads to nutrition insecurity. The unmarried (68.78%) were more nutrition insecure than the married (51.64%). This can be pointed to the fact that most married households are able to produce required labour that aids livelihood diversification in contrast to their unmarried counterparts, thus, they are able to improve their living standards which reflects in their ability to consume healthy and nutritious foods that promotes nutrition security. The married were more nutrition secure (48.36%) than the unmarried (31.22%). This is true, seeing that the married have a larger household size that could provide the needed labour that would increase livelihood activities and thereby improve nutrient intake as opined by Amurtiya *et al.* (2016).

The result also revealed that those who had no formal education (57.7%) were more nutrition insecure than those people who were educated in one way or another. Those who had formal education were more nutrition secure (43.30%) than those who had no formal education. Thus, showing that one's level of education determines to a great extent the person's ability to embrace improved technologies and practices as opined by Oladimeji *et al.* (2019), also according to Sallawu *et al.* (2016), farming households' limited educational attainment surely hinders their capacity to adopt modern improved techniques of production or operations and their income diversification patterns. The result further buttressed that there was no much difference between the nutrition security status of those who were members of a cooperative (54.29%) and those who were not members of a cooperative (53.93%). Furthermore, those who had access to credit were more nutrition insecure (58.05%) than those who did not have access to credit (53.06%), while those who had no access to credit were more nutrition secure (46.94%), than those who had access to credit (41.95%). This could be because that majority of the respondents in this study area had no access to credit, which would have been a boost to livelihood diversification and nutrition security of these households.

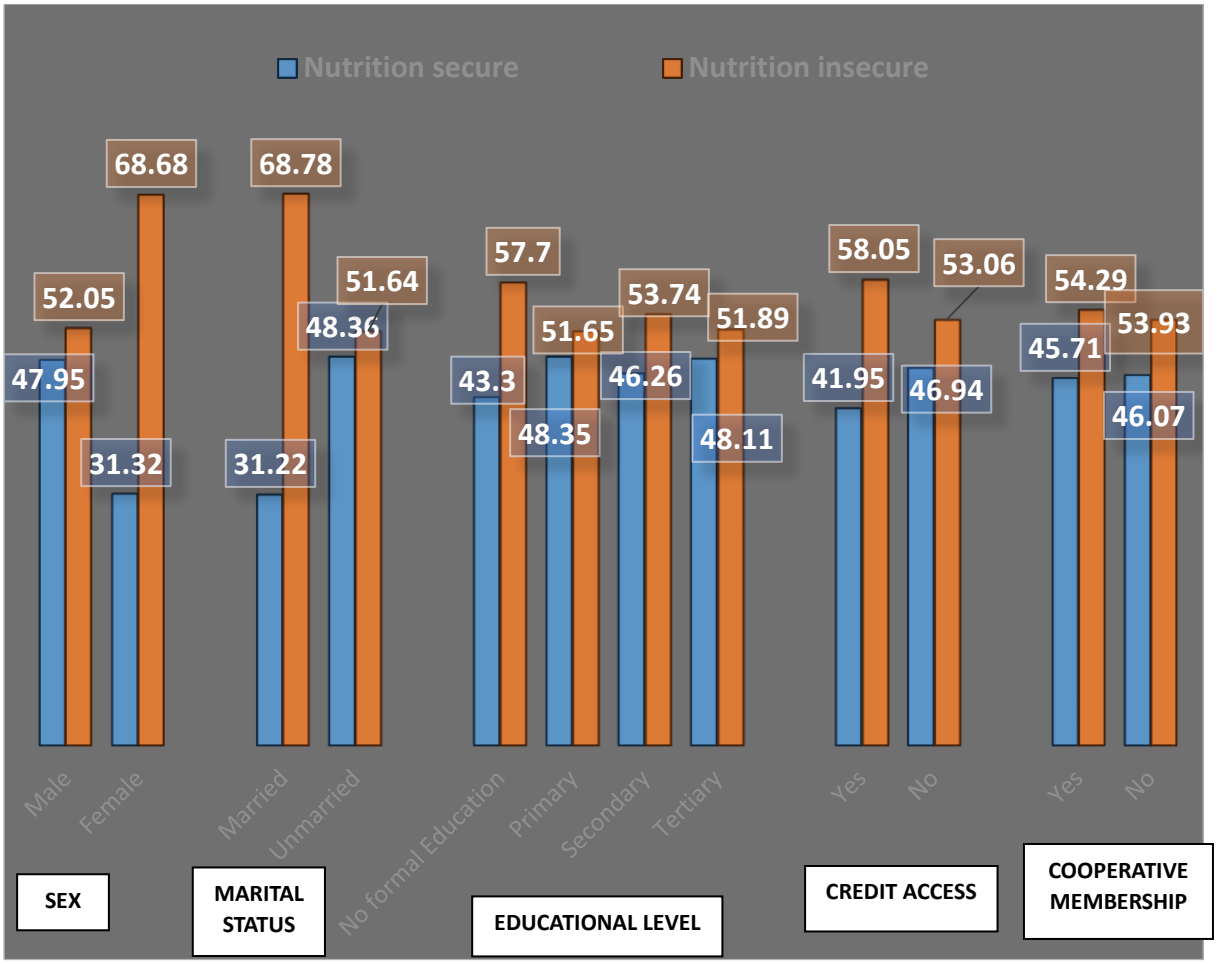

Figure 3: Profile of nutrition security across socio-economic variables (qualitative) of farming households in Nigeria.
Source: Author's computation from GHS Data (2018/2019)

Mapping of nutrition security across geopolitical zones of farming households in Nigeria

The mapping of nutrition security across the geopolitical zones in Nigeria is as shown in Figure 4. The distribution showed that 56.45% of farming households in the North-central were nutrition secure, while 43.55% were nutrition insecure, in the Northeast 38.69% were nutrition secure, while 61.31% were nutrition insecure. In the Northwest 52.43% were nutrition secure, while 48.57% were nutrition insecure, in Southeast 31.33% were nutrition secure, while 68.69% were nutrition insecure, in South-south 54.48% were nutrition secure, while 45.52% were nutrition insecure, and in the Southwest 41.87% were nutrition secure while 58.13% were nutrition insecure. From this result, it could be seen that people in North-central, North-west, and South-south were more nutrition secure than those in the Northeast, Southwest and Southeast. This could be as a result of some factors such as their food consumption and crop production patterns.

Cereals are significant staple meals in Nigeria, which are eaten across the country. However, a higher consumption of starchy foods is seen among the Southern parts of the country as equated with the Northern parts of Nigeria. According to the findings of Akinyele, (2009), the Northwest showed the least consumption of starchy foods, while the southern parts of Nigeria consumed more protein and processed foods than the North. Also, the consumption of fruits and vegetables varied among the zones with the Southeast having the highest and Southwest having the lowest consumption pattern. Numerous factors have been linked to food and nutrition insecurity in Nigeria. These include the country's often high food prices, the impact of insurgency-related conflict (particularly in the Northeast), armed banditry, kidnapping, pastoralist/farmer crises, communal issues, cattle rustling, and climate change. The Northeast, North Central, and South-South are the three zones mostly affected by these conflict events (Idris *et al*., 2020), which could also lead to nutrition insecurity.

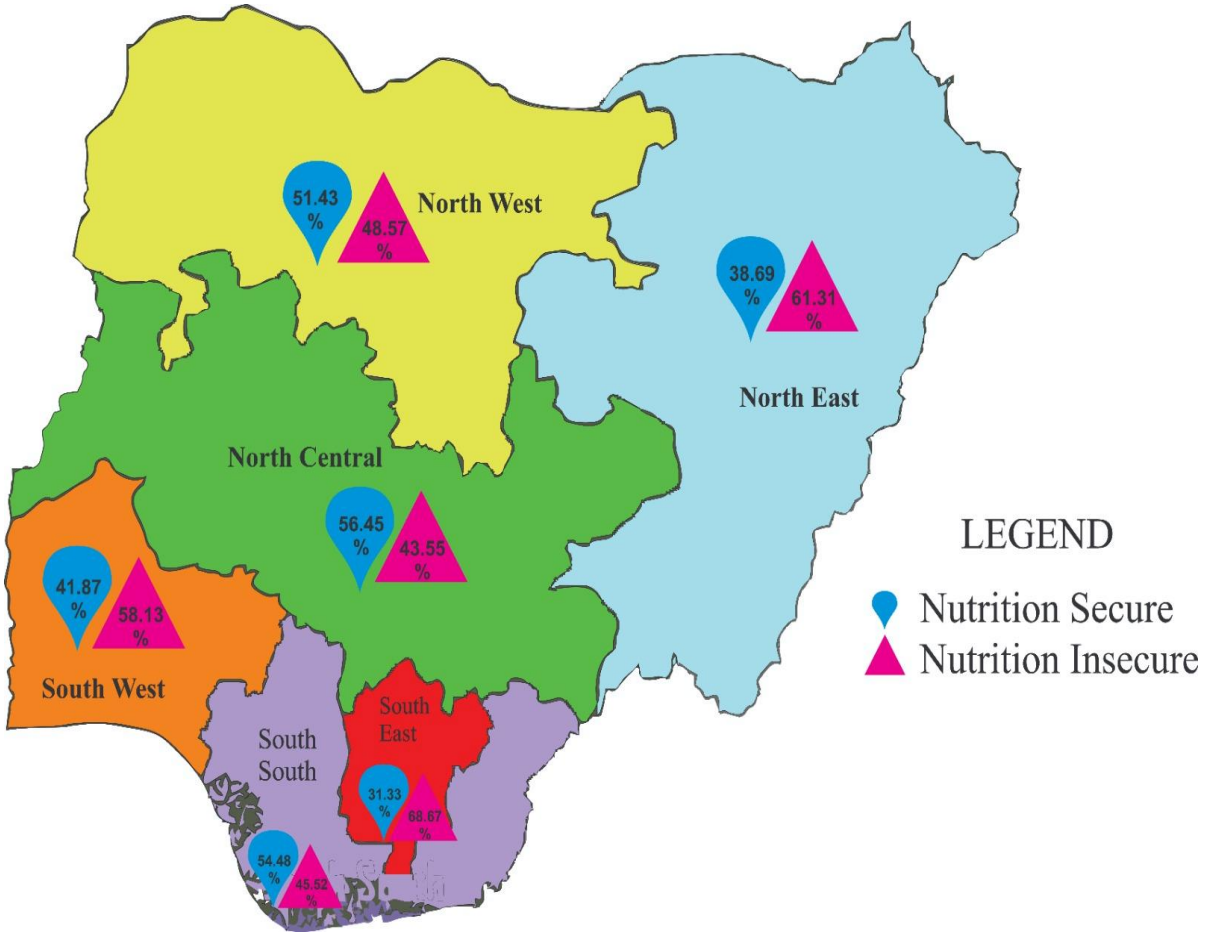

Figure 4: Mapping of nutrition security across the geopolitical zones of farming households in Nigeria.
Source: Author's computation from GHS Data (2018/2019)

Effect of livelihood diversification on nutrition security of farming households

The Two Stage Least Square (2SLS) regression on the effect of livelihood diversification on nutrition security among the farming households was presented in Table 2. The probability value of 0.0000 ($p< 0.05$) showed that model has a good fit. This study also employed the use of the 'robust' option for the two-stage least square regression, which ensured that the results were void of heteroskedasticity. From the result, it is seen that livelihood diversification index, sex, age square, household size and education had a positively significant relationship with nutrition security, while age of farming households was negatively significant.

As shown in Table 2, livelihood diversification had a positive and significant correlation with nutrition security at $p< 0.01$, thereby indicating that an increase of one unit in livelihood diversification will contribute to 0.094 increase in nutrition security. This outcome suggests that an increase in livelihood diversification will contribute to increase in the nutrition security level of the farming households, this is because, increased diversification leads to increased income, which results in greater access and utilization of food, thereby increasing the nutrition status of the households. This concurs with the result of Clement (2014), who reported that the more diversified a household is, the more food secure they are likely to be. From the result, the positive and significant relationship between male farming household heads and nutrition security in the study area at $p< 0.1$, implies that the more male farming household heads participate in diversifying their sources of income, the more nutritional status of farming households increase. This aligns with the work of Ayantoye *et al.* (2017), who reported in their findings that the likelihood of diversifying income increases with the number of households led by men, which consequently improves the food security and nutrition status of a farming household. Age of respondents was found to be negatively significant at $p<0.01$, showing that age lessens the impact of livelihood diversification on farming households' nutritional security by -0.0004. This implies that the more aged the respondents are the less productive and less likely they are to diversify. This agrees with the research findings of Sanni *et al.* (2016) and Echebiri *et al.* (2017), who reported in their work that age of the household head was found to have a negative correlation with food security, suggesting that as a household head ages, there is a decrease in the likelihood that the family will be food secure and, consequently, nutrition insecure.

The respondents' household size had a positively significant impact on nutrition security in the study area at $p<0.01$, showing that as household size increases, nutrition status of the farming household increases by 0.004. This suggests that married persons are more likely to diversify since they often lead larger homes with access to less expensive labour for a range of economic activities. This is consistent with the works of Amurtiya *et al.* (2016), who reported that married people have higher percentage of income than their unmarried counterparts possibly because of their relatively larger households. Also, Obi-Egbedi *et al.* (2016), reported that in many African economies, having a big family size may present a chance to increase the family labour supply for both

on- and off-farm activities in rural households. However, this contradicts the findings of Echebiri *et al.* (2017), who opined that the chances for being food secure decreases with an increasing household size which was attributed to the fact that large family size creates more pressure on the household's expenditure because more food and non-food expenditure will increase. Similarly, formal education was positively significant to nutrition security as could be seen in the result on the table, that primary education, secondary education and tertiary education were positively significant at p< 0.05, showing that the more learned farming households are, the more likely they are to access and make use of useful livelihood information thus, bringing about an increase in livelihood diversification and by extension increasing their standard of living which in turn improves their nutritional status. This confirms the assertion by Sallawu *et al.* (2016), that education enhances the ability to engage in diversified income and Obasi and Enyia (2017) opined that increase in educational attainment increases the odds to diversify and thus, increase the income of farming households resulting in improved nutritional status.

Table 2: Effect of livelihood diversification on nutrition security among farming households

Variables	Coefficient	Std. Error	Z	P>|z|
Livelihood diversification index	0.094	0 .025	3.78	0.000***
Sex	0.006	0.004	1.68	0.093*
Age (years)	-0.0004	0 .000	-2.86	0.004***
Age square	0.0005	0 .000	2.67	0.008*
Marital status	0.001	0.003	0.29	0.769
Household size	0.004	0.000	26.17	0.000***
Primary Education	0.006	0.001	4.34	0.000***
Secondary Education	0.012	0 .001	7.80	0.000***
Tertiary Education	0.008	0.003	2.78	0.005**
Farm size (Ha)	0.0004	0.000	1.28	0.199
Constant	-0.038	0.018	-2.08	0.038

Number of observations = 4,881 Wald chi2(10) = 858.20
Root MSE = 0.04073 Prob > chi2 = 0.0000
R-squared = 0.0161

Instrumented: Livelihood Diversification
Instruments: credit, cooperative, geopolitical zones
Source: Author's computation from GHS Data (2018/2019)
Legend: *, **, *** means significance at 10%, 5% and 1% respectively.

CONCLUSION

This study has shown a connection between household nutrition security and the diversification of livelihoods among Nigerian farming households. The study also showed that age, sex, education, and household size has an impact on the nutrition security of the farming households. In effect, livelihood diversification remains an important factor that cannot be underestimated in nutrition security policies. Similarly, the findings from this study has shown that the fight against malnutrition in Nigeria cannot be won independent of farming households engaging in livelihood diversification. Evidently, this study has produced a fresh viewpoint on the connection between household nutrition security and livelihood diversification.

RECOMMENDATION

It is therefore recommended that greater dietary diversity of foods containing high level of micronutrients be ensured in light of these findings for the farming households, and this could be achieved through nutrition education and sensitization programs on nutrition action plans in Nigeria. Furthermore, achieving the Sustainable Development Goals (SDGs) of "no poverty, zero hunger, and good health and wellbeing" will need policy makers to balance their nutrition action plans and poverty reduction initiatives. Also, considering that the bulk of the farming households experienced nutritional insecurity, this study recommends that farmers be enlightened by extension agents on the need to consume more of foods that are rich in micronutrients. The study therefore suggests a more elaborate research that covers both micro and macro-nutrients for future studies.

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