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Effects of Production Diversity on Nutrition of Farming Households in Nigeria.

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ABSTRACT

Diets in Nigeria, across population and all income quintiles are lacking diversity and continue to include too many calories from staple foods and too few from nutritious foods such as vegetables, fruits, pulses and nuts, and some animal source-foods. In 2018, about eight out of every ten children between 6 and 23 months were fed an insufficiently diversified diet that fell short of a daily minimum. The paper therefore assessed the extent and effect of farm production diversity on farm household's dietary diversity in the country using a cross sectional data from national representative sample of five states drawn from five geopolitical zones of Nigeria. Simpson Diversity Index, Household Dietary Diversity Score (HDDS) and regression technique were used for data analysis. Results showed a positive effect of agricultural production diversity on household dietary diversity score. Household size, sex of household head, extension service and asset ownership all exert positive and significant effect on dietary diversity of households practicing farm diversification. Effect of extreme rainfall on dietary diversity is negative and significant for households practicing agricultural production diversification. The result shows the importance of access to extension service in enhancing agricultural production diversity and strengthening dietary diversity of the farming households. The study recommends reinforcement of agricultural extension service to boost the diversity and level of agricultural production. This in turn could lead to improvement in dietary diversity and nutrition security among rural farming households. In conclusion, the importance of ownership of assets should be emphasised at implementation of agricultural development programmes for the rural farming households for advancing dietary diversity in the rural sector.

1. INTRODUCTION

Agricultural production diversity is the cornerstone of long-term food supply which underpins the productivity, resilience and, ultimately, the security of all food systems. In Africa, more than 250 million people are undernourished and is growing faster than anywhere in the world (FAO, 2021). Agriculture has the capacity of influencing nutrition primarily through increased food intake from own production and also through the channel of increased incomes from diversification into higher value crops, including horticulture, or livestock rearing (Kadiyala *et al.,* 2012). Understanding the nexus between farm production diversity and dietary diversity is especially relevant in smallholder agriculture and in sub-Saharan Africa (SSA). On the one hand, undernutrition rates are severe and more widespread among those involved in agriculture. Lack of dietary diversity is undoubtedly the major cause of micronutrient malnutrition in sub Saharan Africa (FAO, 2013).

In Nigeria, food security remains a challenge, where 40 per cent of the population lived below the national poverty line and many experienced food shortages(IFPRI,2021). Over the past few years, high inflation rates arising from multiple demand and supply shocks, compounded by policy distortions and constraints of the COVID-19 global pandemic as well as the ravaging effect of climate change and insecurity problem in the country, have increased poverty and made food less affordable (NBS 2020, World Bank,2021). Malnutrition is equally a major problem in Nigeria. According to UNICEF et al 2021, about 12 million children under-five (35 percent), in the country are stunted. At the same time, roughly 21 million Nigerians over the age of 15 are overweight and 12 million are obese, about 20 percent and 11 percent, respectively (Adeloye et al 2021). According to Ecker et al,2020, coexistence of multiple forms of malnutrition is prevalent and has grown rapidly in both urban and rural areas.

Admittedly, diets in Nigeria, across population and all income quintiles are lacking diversity and continue to include too many calories from staple foods and too few from nutritious foods such as vegetables, fruits, pulses and nuts, and some animal source-foods. In 2018, about eight out of every ten children between 6 and 23 months were fed an insufficiently diversified diet that fell short of a daily minimum of five out of eight food groups, while the proportion of children lacking the minimum dietary diversity was greatest, 83 per cent in the lowest wealth quintile of the Nigerian population. Even among the highest wealth quintile, a large majority of children, 63 per cent consumed inadequately diversified diets (NPC and ICP 2019). Ensuring agricultural production diversity is critical in meeting the challenge of food insecurity and healthy nutrition in the country since achievement of the sustainable goal of ending hunger, and increasing access to healthy diets is a priority focus of the 2022-2025 Mid-Term Plans of the Food and Agriculture Organization (FAO,2021) in which Nigeria is an important participant. Although Nigeria is well noted for vast food production, malnutrition is still a major challenge due to poor diversity coupled with climate change and high insecurity. The prevalence of poor nutrition is of concern especially when the availability and accessibility of nutritionally adequate foods are limited and/or uncertain.

Over the years, the Nigerian government has embarked on myriad of agricultural policy and programme initiatives such as national accelerated food production programme, green revolution, Nigerian Vision 20: 2020, agricultural transformation agenda, agricultural promotion policy under which the country implemented the Anchor's Borrower Programme to promote agricultural diversification of essential crops of high nutrient quality especially in rural areas of the country. Examples of such crops are cassava, potatoes, rice, soybean, maize, fruits and vegetables. Diverse crop cultivation can boost productivity and improve the stability of agroecosystems, whereas a lack of diversification can have a negative knock-on effect on global diet quality (Jones, 2017). Some of the international programmes incorporating nutrition in Nigeria includes Agribusiness investment (2018-2023), Agricultural extension and advisory services activity (2020-2025), and Rural resilience (2019-2024) (USAID, 2021). Agricultural diversification can help ensure nutrition security by improving farmer adaptability and reducing vulnerability, which is crucial, given the predicted climate changes and the heavy reliance of smallholder farmers on rain-fed crops enabling agricultural households to avert the risk of poor income from cultivation of few crops. Several studies have found a positive relationship between agricultural diversification and household nutrition. In Tunisia, Mali, Zambia, Malawi and Bangladesh, agricultural diversification was found to have a positive effect on nutrition (Gaillard *et al.,* 2022; Douyon *et al.,* 2022; Nkonde *et al.,* 2021; Jones *et al.,* 2014; Kabir *et al.,* 2022). In Indonesia, study showed that agricultural diversification is associated with decline in nutrition diversity (Mehraban and Ickowitz, 2021). However, in Nigeria, there is paucity of literature on the effect of agricultural production diversity on nutrition. Hence, this study builds from limited evidence on the connection between agricultural production diversity and farm household nutrition using a cross sectional data from national representative sample from five geopolitical zones of Nigeria. The paper assessed the extent of farm production diversity of the rural farm households and determine the effect of farm production diversity on farm household's dietary diversity in Nigeria. Examining these objectives in Nigeria is paramount given the

widespread nutrition deficiencies (malnutrition) among rural households. It will also inform policies/strategies that would promote farm diversification and nutritional enhancement.

1.2 Structure of the Paper

The paper is organised into four sections. Following this introductory section is section two which contained the methodology deployed to achieve the objectives of the study from which the paper was culled. Section three discussed the results of the study. The paper is rounded off in section four with summary of major findings and policy implications.

2. METHODOLOGY

2.1 Scope of the Study, Types and Sources of Data

The study covered five geopolitical zones in Nigeria. The five geo-political zones included North-Central (Niger State), North-West (Sokoto state), South-East (Enugu State), South-South (Delta State), and South-West (Oyo State). There was insecurity problem in the sixth geopolitical zone of the country, (North-East), hence it could not be covered. Importantly, the study made use of primary data. The data were collected through structured interviews which were administered in a survey conducted in 2020. The data collected included household demographic data, household socioeconomic characteristics, agricultural production and marketing, enterprise production and management, input use, food consumption, and other farm and farmer specific characteristics. Data on household characteristics included household size, farm size, off-farm working hours per person; livestock ownership and cash crop production and access to credit and extension. Data on characteristics of the household head as the main decision maker included sex, age, and level of formal education attained by the household head. Further, data on the incidence of droughts, floods, crop and livestock yield failure that was experienced by the agricultural households in the past few years were collected.

2.2 Sampling Technique

Multistage sampling procedure was adopted in the study in which a random selection of one state per geopolitical zone was carried out. In this regard, five of the six geopolitical zones of the country were covered. In each of the selected states, one local government and a village community in each local government was randomly selected. In each village community a minimum of fifty farm households that are engaged in cultivation of crops and rearing of livestock were purposively selected for the field survey.

2.3 Measurement of Production Diversity.

Production diversity indicator was computed using Simpson's diversity index. This was calculated based on the crop group cultivated or livestock group reared by the households. In this measurement, livestocks such as cattle and small ruminants owned by households were converted to tropical livestock units(TLUs) at the standard conversion rates of 0.7 for cattle and 0.1 for small ruminants (Majekodunmi et al ,2017). The Simpson Diversity Index (SDI) representing the production diversity by the household was estimated as:

$$\lambda_i = 1 - \sum_{j=1}^{n} (S_{ij}^2) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where, λ_i is SDI, which is production diversity index (PDI) of the i^{th} household, n is the number of crop group cultivated or livestock group (type) kept, S_i is the share of farmland area cultivated with crop group j or Tropical Livestock Units (TLU) share for Livestock group(type) j reared by the i^{th} household. The SDI combines indicators of crop/ livestock richness and abundance. A high score indicates not only that there are many species in the farm, but also that they are distributed evenly across the farmed area. A zero score indicates that one species occupies the whole farmed area, that is, complete specialization. The Simpson diversity index have been used as farm production diversity indicators in similar studies such as Hirvonen and Hoddinott, 2017; Olivier Ecker, 2018; and Bellon et al 2020.

2.4 Measurement of Household Dietary Diversity Score.

Household Dietary Diversity Score (HDDS) was computed from the qualitative recall by head of household of all foods consumed during the previous 24hour. From the recall, a categorisation of the foods consumed into the various food groups according to the FAO was done. A final recompiling of the food groups into 14 food groups and attributing 1point for each group consumed. For each household, HDDS was the sum of these points. This ranged from zero for no food intake in the previous 24hour to 14 for maximum diversity.

2.5. Estimating the Effects of Production Diversity on Household Dietary Diversity Score

The study explicitly analyzed the effect of production diversity on household dietary diversity score by means of simple regression technique using the model specified in equation (2).

$$HDDS_i = \alpha_0 + \alpha_1 PD_i + \alpha_n Z_n + \varepsilon_i \ldots\ldots\ldots (2)$$

Where, $HDDS$ is the household dietary diversity score of the i^{th} household, PD is production diversity index of the i^{th} household, α_0 is constant term, $\alpha_1 \ldots . \alpha_n$ are estimated coefficients, ε_i is an error term.

3. RESULTS AND DISCUSSION

3.1 Socio-Economic Characteristics of Respondents

The socio-economic characteristics of the respondents as shown in table 3.1 explained the background of the farmers in the farming households. The results showed the dominance of male, about 58 per cent, while the female was about 42 per cent. The age distribution of the farmers showed that majority of them, 56.40 per cent, fell within 31 and 50 years, while 28.95 per cent were above 50 years. About 15 per cent of the farmers fell within 30 years and below. The average age of the farmer in the sample was 44years, suggesting that many of the farmers were within productive age. They have the tendency to plant more crops and keep more livestock as a means of adaptation to risks. Younger farmers are more likely to use agricultural diversification to avoid production risks (Huang et al 2014).

Further, the results in table 3.1 showed that 71.38 per cent of the farmers have formal education while 28.62 have no formal education. Among those with formal education, about 27 per cent have attained primary education, 36 per cent have attained secondary education while about 9 per cent have attained tertiary education. Marital status showed that about 80 per cent of them were married with average household size of 8, while 4 per cent were single. Majority of the farmers, about 63 per cent, have a larger household size between 6 and 15, suggesting a greater responsibility in terms of feeding a large number of people with well diversified diets.

Moreover, the table showed that majority of the respondents have farming as primary occupation while about 4 percent have non-farming as primary occupation. Secondary occupation revealed about 31 per cent were engaged in trading and business while 16 per cent were artisan. This suggests that the farming households also diversified into non-agricultural activities to avoid risks. About 81per cent of the farmers belong to association while 19 per cent do not belong to any association. Membership of association can provide opportunity for the farmers to access information from extension services. In addition, membership of farmer organizations and cooperative can serve as platform for knowledge exchange, and empowerment of farmers. Farming experience revealed that an average farmer has about 22 years of experience in agricultural activities.

Table 3.1: Socioeconomic Characteristics of Respondents.

Gender	**Percentage**
Male	57.62
Female	42.38
Total	100.00
Age of respondents	**Percentage**
≤30	14.66
31-40	28.20
41-50	28.20
51-60	18.80
>60	10.15
Total Mean age = 44.26 years	100.00
Years of formal education	**Percentage**
None	28.62
Primary	27.14
Secondary	35.69
Tertiary	8.55
Total	100.00
Mean=6.84 years Std dev= 6.21	
Marital status	**Percentage**
Single	4.09
Monogamous	56.13
Polygamous	23.79
Separated/Divorced	5.58
Widow/widower	10.41
Total	100.00
Household size	**Percentage**
≤5	28.62
6-10	49.07
11-15	14.13
16-20	5.20
≥20	2.97
Total Mean= 8.26 Std dev.=7.66	100.00
Primary occupation	**Percentage**
Farming	95.90
Non-Farming	4.10
Total	100
Secondary occupation	**Percentage**
None	37.50
Farming	5.86
Civil service	1.95
Artisan	16.02
Trading/business	30.86
Other	7.81
Total	100.00
Association membership	**Percentage**
Yes	81.04
No	18.96
Total	100.00

Source: Field Survey, 2020.

3.2 Access, Sources and Amount Received of Agricultural Loan.

The result on access to agricultural loans by the agricultural households is summarized in table 3.2. As shown in the table, credit access by the sampled households was very low. Only 23 per cent of the households have received loans in the past two seasons. Average amount of loan received by those that have access was N227,850. The most common source of loan is association and cooperative. About 55 per cent of the households obtained loan from the association or cooperative, about 22 percent got their loan from friends and family, 20per cent obtained loan from bank while 3per cent of them obtained loan from money-lender. The result implies that access to credits from formalised institutions for financing agricultural activities is very limited among the sampled agricultural households.

Table 3.2: Access to Loans since the past Two Seasons

Accessed loans in past 2 seasons	**Percentage of Households**
Yes	22.68
Mean value of loans= N227, 850	
Sources of Loans	
Bank	20.00
Association/cooperative	55.00
Friend/family	21.67
Money lender	3.33

Source: Field Survey, 2020.

3.3: Extent of Agricultural Diversification among the Farming Households.

The results in table 3.3 explained the extent of agricultural production diversity among the farming households. The extent of production diversity among the households are classified into three (Chalmers Mulwa and Martine Visser,2019). First, is the level that is regarded as high. This includes the range of diversification indices that are greater than 0.7. The second category is referred to as medium or moderate. This covered the indices that ranged between 0.4 and 0.7, while the third category includes indices that are less than or equal to 0.4. This is regarded as low diversification implying low level of agricultural production diversity. The extent of production diversity for the combination of crop and livestock enterprises showed high intensity of diversity among the households with about 78 per cent of households characterized as high level of agricultural production diversity. About 18 per cent of the households are characterised as medium level of production diversity. Only 4percent of the households are characterised as low level of production diversity.

The results indicate that majority of the households are highly diversified into planting many crop types and rearing of many livestock types, hence, mixed farming system of agricultural practice is widely practiced among the sampled households. The results in the same table reveal that majority of the households practicing crop diversification alone were classified as medium with 54 per cent of the households that fell within this group. About 38 per cent of the farmers under crop diversification were highly and well diversified into planting many types of crops. About 8 per cent of the households were characterised as low production diversity.

Regarding livestock diversification, about 37 percent of the households exhibited high level of diversification in livestock. Further, about 28 per cent of the households moderately diversified into production of livestocks while another 35 per cent of the sample households exhibited low level of diversification in livestock production, suggesting that those households produced few numbers of livestock types.

Table 3.3: Agricultural Production Diversity.

Level of Diversification	**Crop Diversification**	**Livestock Diversification**	**Combination of Crop and Livestock Diversification**
	Percentage of Households	Percentage of Households	Percentage of Households
High (>0.7)	37.55	37.17	78.44
Medium (0.4-0.7)	54.28	27.88	17.84
Low (≤0.4)	8.18	34.94	3.72

Field Survey,2020.

3.4 Household Dietary Diversity

The result of the dietary diversity score is summarised in table 3.4. The table showed that the highest proportion, about 50 per cent, of the households consumed between six and eight varieties of food groups while about 12 per cent consumed between nine and fourteen varieties of food groups. Moreover, about 38 per cent of the farm households consumed between one and five varieties of food groups.

Table 3.4: Household Dietary Diversity Score

Household Dietary Diversity Score (HDDS)	Percentage of Households in the HDDS
1-5	38.28
6-8	49.81
9-14	11.90

Source: Field Survey, 2020.

3.5 Effects of Production Diversity on Dietary Diversity

As households intensify crop diversification, more diversified food groups will be produced and available for household consumption. Households with higher crop diversity have the tendency to consume a well-diversified food within the households (Makate et al 2016). The results in table 3.5, revealed a positive effect of crop production diversity on household dietary diversity score, suggesting that higher crop diversification increases the diversities of food consumption in the households. The results imply that crop diversification creates the opportunity for the households to improve their dietary diversity. This is possible because crop production diversity will improve yields, stability and crop insurance, if one crop fails, the farmer can depend on the other crop. In this regard, crop diversification could be a significant climate smart option because it creates reliable avenue for improving household food security and diet options which could help smallholder farmers in building resilience to the risks associated with climate change and variability. The results conform with the earlier findings of Makate et al 2016, and Mugendi Njeru,2013). Crop diversification not only allows more efficient utilization of agro-ecological processes but also provides diversity for human diet and improve income which improves the purchasing power for the household for buying other foods.

Coefficient of extension services in table 3.5 is positive and significant at 1 per cent indicating that an increase in extension services will result into an increase in the household dietary diversity. The extension services will ensure that knowledge is accessible to farmers on a range of agricultural products, technologies and practices that will support diversification and increased diversified food supply to the households for better nutrition and diversified diets. The result is in conformity with the findings of Christine Heumesser and Holger Kray (2019) who observed that positive outcomes in terms of food consumption and dietary diversities can be achieved through farmer training such as farmer field school that focuses on food security messaging through an effective extension delivery system.

Furthermore, among the households with crop diversification, the household size has a positive and significant effect on household dietary diversity. Among the agricultural households that are engaged in livestock production only, livestock diversification positively influenced the household dietary diversity and the coefficient (0.66) of the variable is statistically significant at 5 per cent level suggesting that one per cent increase in livestock diversification will result into 0.66 per cent increase in household dietary diversity. Other variables that exert significant effects on the dietary diversity of farm households included sex of household head, household size, credit access, extension services, asset ownership and extreme rainfall. Sex of household head, household size, extension services and ownership of assets all positively influenced household dietary diversity whereas credit access negatively influenced dietary diversity of the households.

Table 3.5: Effects of Agricultural Production Diversity on Household Dietary Diversity Score.

	Crop Diversification Equation [1]	Livestock Diversification Equation [2]	Combined Equation [3]
Sex of HH	0.944***	0.853***	0.961***
	(0.229)	(0.233)	(0.232)
Age of HH	-0.010	-0.014	-0.013
	(0.012)	(0.012)	(0.012)
Marital Status	0.214	0.238	0.150
	(0.306)	(0.301)	(0.310)
Farming experience	-0.009	-0.0004	-0.008
	(0.012)	(0.012)	(0.012)
Household size	0.078***	0.071***	0.091***
	(0.022)	(0.024)	(0.022)
Credit access	-0.373	-0.479*	-0.472*
	(0.251)	(0.250)	(0.250)
Extension Services	0.866***	0.951***	0.828***
	(0.231)	(0.239)	(0.233)
Asset Ownership	0.076***	0.095***	0.074**
	(0.028)	(0.030)	(0.029)
Farm size	0.0001	0.0001	4.2E-05
	(0.0001)	(0.0001)	(6.5E-05)
Crop diversification Index	1.828***		
	(0.612)		
Livestock Diversification Index		0.663**	
		(0.3280)	
Agric. Diversification			0.430*
			(0.231)
Crop and Livestock failure	0.254	0.154	0.268
	(0.259)	(0.265)	(0.273)
Extreme rainfall	-0.466	0.622*	-0.588*
	(0.325)	(0.322)	(0.324)
High Temperature	-0.111	0.058	-0.094
	(0.228)	(0.239)	(0.230)
Constant	3.605***	4.507***	4.454***
	(0.849)	(0.755)	(0.775)
R-Squared	0.3503	0.3373	0.3356
Prob>F	0.000	0.000	0.0000
No of obs	250	250	250

***,**,* = significant at 1%, 5% and 10% respectively
*Standard errors in parenthesis
Source: Author's Computation.

4. Summary of Major Findings and Policy Implications.

Agricultural production diversity is very crucial to meeting global challenge of food insecurity and healthy nutrition. Achieving the sustainable goal of ending hunger, and increasing access to healthy diets is a priority focus of the 2022-2025 Mid-Term Plans of the Food and Agriculture Organization. Although sub Saharan Africa is well noted for vast food production, malnutrition is still a major challenge due to poor diversity coupled with climate change and high

insecurity. In Nigeria, an estimated number of 2 million children suffer from severe acute malnutrition which seems to be higher in rural areas. Irregular rainfall affects diversity of crop grown which in turns affects the availability and accessibility of nutritious food. This paper assessed the extent of farm production diversity of the rural farm households and determines the effect of farm production diversity on farm household's dietary diversity in Nigeria using a cross sectional data from national representative sample of five geopolitical zones of Nigeria. Simpson Diversity Index, Household Dietary Diversity Score (HDDS) and multiple regression were used for the analysis.

Result shows that about 78% of households were classified into high level of agricultural production diversity and they were practising mixed farming. Among crop farmers, about 38% of them were classified into high level of production diversity. Among the livestock farmers, households exhibited high level of diversification. Household dietary diversity score revealed that about 50% of the farming households consumed between six and eight varieties of food groups. Result showed a positive effect of crop and livestock diversity on household dietary diversity score. Household size, sex of household head, extension service and asset ownership all exert positive and significant effect on dietary diversity of households practicing crop, livestock and integrated farm diversification. Credit access exerts negative and significant effect on dietary diversity among farmers practicing livestock and integrated crop and livestock production. Effect of extreme rainfall on dietary diversity is negative and significant for households practicing livestock production or integrated crop and livestock diversification.

This result showed three major policy implications for nutrition security in Nigeria and beyond. Crop and livestock diversification positively and significantly influenced household dietary diversity. This study therefore, recommends policy strategies that would incorporate the integration of plant and animal production as this would not only improve nutrition diversity but would also encourage income diversity. This result is also impressive in that it encourages climate action (organic farming/soil nutrient replenishment). Access to extension services significantly contributed to dietary diversity. This shows the critical role of access to extension service (information dissemination) in agricultural production. The study recommends the provision of agricultural extension service to boost crop and livestock production and improve nutrition among rural households. Ownership of assets (wealth accumulation) influenced household dietary diversity. Therefore, the inclusion of asset-based programmes among rural households would advance dietary diversity.

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