

EFFECT OF CROP DIVERSITY ON RURAL FARMING HOUSEHOLDS' DIETARY DIVERSITY

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Abstract: Dietary diversity is crucial particularly in developing world where diets consist of mainly starchy staples and lack nutrient rich foods for improved dietary diversity and quality, the importance of crop diversity in nutrition and health needs to be clearly understood. The study examined the effect of crop diversity on rural farm household dietary diversity in Agricultural Development Project ZONE B of Kogi State, Nigeria. Primary data was used for the study. A total sample size of 120 farmers was used for the study. Data was collected with the use of structured questionnaire. Descriptive statistics, Simpson's index, household dietary diversity scores (HDDS) and Poisson regression model were used in the analysis. Based on the result from the analysis, majority of the farmers in the study area were male (75.83%), the mean age was 47years, majority of the farmers were married with an average household size of 8 members. The mean crop diversity index of the farmers was estimated at 0.69. The dietary diversity scores among respondent households were found averagely to be 9. The crop diversity practiced among the respondents was found in this study to have positive and significant effect on the dietary intake of the rural farm households. The study concluded that crop diversity have positive effect on rural farm household dietary diversity in Zone B Kogi State ADP at 1% significance level. The study recommended that policies geared towards improving smallholder farmers' crop diversity should be encouraged in the study area to improve farmers' dietary diversity.

Keywords: Crop Diversity; Dietary Diversity; Rural; Households; Nigeria

1. Introduction

Food Summit defined food security as the state “when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life.” The Food and Nutrition Research Institute of the Department of Science and Technology (FNRI-DOST) calls hunger a severe form of food insecurity. Prolonged hunger may lead to malnutrition, illness, mental and physical growth retardation, among many other complications (Declaro-Ruedas, 2019). The concept of “nutrition sensitive agriculture” assumes that agricultural production practices have the potential to positively affect the

underlying determinants of nutrition (Ruel *et al.*, 2013). Although this assumption is intuitively a sensible one, especially if the focus is narrowed to food crop production, empirically, it has proven difficult to support, not least because the causal pathways hypothesized to run between agriculture and nutrition are long and winding. Even though agricultural advances have been impressive in past decades, progress in improving the nutrition and health of poor rural households in developing countries has not followed suit (Demeke *et al.*, 2017). As such, understanding the capacity of farming systems to contribute to improved nutrition outcomes is gaining ground as an objective among economists and other development professionals (Carletto *et al.*, 2015).

The importance of food in the productivity and development of a nation cannot be over emphasized because it is a basic necessity of life. Adequate food intake, in terms of quantity and quality is important for a healthy and productive life (Opaluwa *et al.*, 2018). On its own, agriculture would influence 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). The evidence on the link between agriculture and nutrition has so far been tenuous. On the one hand, under nutrition rates are severe and more widespread among those involved in agriculture. This evidence is more pronounced when the households or regions with agricultural predominance are compared with non-agricultural regions (Dahiya and Viswanathan, 2015). Lack of dietary diversity is undoubtedly the major cause of micronutrient malnutrition in sub Saharan Africa (FAO, 2013; Thompson and Meerman, 2013). Imbalanced diets resulting from consumption of mainly high carbohydrate based-diets also contribute to productivity losses (Weinberger, 2004). Consequently, micronutrient malnutrition is currently the most critical for food and nutritional security problem (Ruel, 2003) as most diets are often deficient in essential vitamins and minerals.

Obstacles often faced by the farmers to undertake farming process usually are because of limited capital owned, the limited production capacity of causing relatively stagnant farm productivity among others (Teddu, Ali, & Salman, 2018). In Nigeria, most rural and urban households consume mainly staples as their main food, which are high in carbohydrates, but low in nutrients and vitamins. Staple food items might increase energy availability but do not improve nutritional outcomes if not consumed in conjunction with micro-nutrient rich foods (Kennedy *et al.*, 2007). The effect of crop diversity on household dietary diversity is imperative to know in order to evaluate the dietary quality and progress of nutritional outcome in a population. Dietary diversification is one of the four main strategies advocated internationally for the improvement of micronutrient intake and status, especially in undernourished individuals (Maunder *et al.*, 2001). Studies have shown that an increase in dietary diversity is associated with socio-economic status and household food security (household energy availability) (Hoddinot and Yohannes, 2002). Crop diversification means raising of a variety of crops involving intensity of competition amongst field crops for arable or cultivable land. According to Swades and Shyamal (2012), Crop diversification in the developing Countries is a pungent applied concept to remove the plight of subsistence agricultural economy and to ensure diversified nutrition status of the poor countrymen. Crop diversification is intended to give a wider choice in the production of a variety of crops in a given area so as to expand production related

activities on various crops and also to lessen risk. Vegetables in general, and traditional African vegetables in particular, are rich in micronutrients and other health-promoting phytochemicals; nutrient-dense vegetables complement staple foods and improve the nutritional quality of diets (Weinberger and Swai, 2006). Consumption of diverse vegetables have been found to significantly improves nutrition (Settle and Garba, 2011) through access to diverse mineral, micronutrient and vitamin-rich products (Hounsome *et al.*, 2008; Uusiku *et al.*, 2010).

More recently some studies have attempted to establish the relationships between cropping pattern and dietary diversity of households (Thompson and Meerman, 2010; Pellegrini and Tasciotti 2013; Smale *et al.*, 2013). Apart from these studies, Herforth (2010) and Jones *et al.* (2014) determined the relationship between farm diversity and dietary diversity among households in African countries and concludes that there is a strong relationship between dietary and farm diversity. Despite the high burden of under nutrition and an acceptance of the important roles of food access and dietary quality, studies which examine relationship between crop diversity, dietary diversity and food security as a whole are still scanty in rural part of Nigeria particularly. Also, to the best of our knowledge as at the time of carrying out the study, none of the existing studies empirically examined the relationship between crop diversity and dietary diversity in Zone B Kogi State agricultural development project (ADP).

Hence, this research filled this gap and provides empirical information on the effect of crop diversity on rural farm households' dietary diversity in Zone B Kogi State ADP. The outcomes of this study could be used to guide the Federal and State governments when formulating new approaches and interventions to address agricultural production activities, dietary quality and ultimately food security in rural households in Nigeria. The study will enable policy makers and relevant stakeholders to identify the areas of need among rural farm household and possibly help recommend solutions to areas of likely problems. It is hoped that the information from this study will be incorporated into extension service delivery and also aid policy makers in terms of formulation of "nutrition-sensitive" policies. Finally, the findings will add to the existing body of knowledge and will form the basis for future research by those who would be interested in this area of research. Based on the above background, this study is attempted to examine the effect of crop diversity on rural farming households' dietary diversity in Zone B area Kogi State agricultural development project. Specifically, the study aims to: (a) identify the socio-economic characteristics of the rural farming households in Zone B area Kogi State agricultural development project; (b) examine the pattern of crop diversity practiced by the respondents in the study area; (c) examine the rural household dietary diversity in the study area; and, (d) assess the relationship between the respondents crop diversity and their dietary diversity in the study area.

2. Method

This study was carried out in zone B of Kogi Agricultural Development Project (KADP) which has six extension blocks namely Ejume, Dekina, Odenyi, Gboloko, Ankpa and Abejukolo in Kogi state of Nigeria. The extension blocks are divided into 35 extension circles found in four local Government areas, namely Ankpa, Bassa, Dekina, and Omela. The zonal headquarter is located in Anyigba Dekina Local Government Kogi State. Geographically, the zone usually experiences two distinct seasons, the wet

and the dry seasons. The wet season usually starts from the middle of March to October while the dry season covers the period between November and early March. This area falls within the rich savannah region which is known to be ideal for crop production. There are large available lands for farming. Agriculture is the most important economic activity in the area as majority of the population derives their livelihood from it. Agricultural activities in the area are still at subsistence level, which invariably makes the farmers vulnerable to poverty. The soil is viable for growing crops such as yam, maize, cowpea, soybean, potatoes, melon, cassava, sorghum, cashew, rice, cocoa, oil palm among others.

A structured questionnaire was used to collect the data for the study. The questionnaires was administered and verified for consistency during pretesting. A multiple stage sampling technique was used for the selection of the respondents. Four extension blocks was randomly selected from the six extension blocks in the zone. Three farming community was randomly selected from each of the four blocks making a total of twelve farming communities. This was then followed by the random selection of ten (10) respondents from each community giving a total of 120 respondents for the study.

Primary data was used for the study. Data was collected using a well-structured questionnaire. The questionnaire was divided into sections: (A) socio-economic characteristics of the rural farming households in the study area; (B) pattern of crop diversity practice by the respondents (C) the rural household dietary diversity

Data collected from the field was subjected to both descriptive and inferential statistical analysis.

Objectives 1 was attained using descriptive statistics such as mean, frequency and percentage.

Objective 2 was attained using Simpson's index

$$\text{Simpson index (D)} = \sum n(n-1) / N(N-1)$$

Where;

n = total number of a particular crop

N = total number of all the crop

Objective 3 was achieved using household dietary diversity score (HDDS)

Objective 4 was realized using Poisson regression model

The Poisson Maximum Likelihood Estimator requires that the data be Poisson distributed with density function of Poisson regression model as given by (Animashaun, 2012):

$$F(y_i/x_i) = \frac{e^{-\lambda(x)} \lambda_i(x)^{y_i}}{\Gamma(1+y_i)} \quad - \quad - \quad - \quad 1$$

Where;

$\lambda_i = \exp(\alpha + X_i\beta)$ and $y_i = 0, 1, \dots, i$ is the number/count food eaten by the household X = a vector of predictor variables

Following (Animashaun, 2012) the expected number of the events, y_i

$$E(y_i/x_i) = \text{var}[y_i/x_i] = \lambda = \exp(\alpha + X_i\beta) \quad - \quad - \quad 2$$

For $i = 1, 2, \dots, m$

Determinants of Household Dietary Diversity

Based on the model above, the implicit functional form of the model estimated to examine the determinants of dietary diversity is specified as:

$$Y = \alpha + \beta X_1 + \beta X_2 + \beta X_3 + \beta X_4 + \beta X_5 + e \quad - \quad - \quad 3$$

Where;

Y = Household dietary diversity

X_1 = Simpson's index (crop diversity)

X_2 = Household Farm size

X_3 = Household Annual income

X_4 = Farming experience of household head

X_5 = Access to extension

e = error term

α = constant

β = parameter coefficients to be estimated

3. Results and Discussion

This section (Table 1) presents the Socio-economic characteristics of respondents in the study area include: age, gender, marital status, educational level, household size, farm size and annual income.

Table 1. Socioeconomic characteristics distributions

Socioeconomics Variables	Frequency	Percentage
Gender		
Male	91	75.83
Female	29	24.17
Age		
21-30	13	10.83
31-40	25	20.83
41-50	43	35.83
>50	39	32.50

Marital Status		
Single	12	10.00
Married	91	75.83
Divorced	5	4.17
Widow	12	10.00
Household Size		
1-5	37	30.83
6-10	66	55.00
11-15	11	9.17
>15	6	5.00
Educational Status		
No Formal education	18	15.00
Primary education	21	17.50
Secondary education	27	22.50
Tertiary education	54	45.00
Farm Size		
1-2 ha	22	18.33
3-4 ha	31	25.84
5-6 ha	27	22.50
>6 ha	40	33.33
Annual Farm Income		
< ₦100,000	29	24.17
₦100,000- ₦499,999	68	56.67
₦500,000- ₦1,000,000	20	16.66
>₦1,000,000	3	2.50
Total	120	100.00

Source: Field Survey, 2019

From the result in Table 1, a greater percentage of the respondents were male (75.83%) while the other percentage (24.17%) was female. This indicates that there are more male headed household heads in the study area since household heads were sampled. Male dominance among the respondents can be attributed to the labour intensive nature of farming activities in rural areas. The result of the analysis shows that 10.83% of the respondents fall within the age range of 21 to 30, those within the age of 31 to 40 were 20.83%, 35.83% were within the age of 41 to 50 and 32.50% were above 50 years of age. Majority of the respondents were less than 50 years old. The mean age of household heads was 47 years (with a standard deviation of 13.0). This result suggests that respondents in the study area were still relatively young people. This relatively shows that youths are the majority in farming activities in the study area. The result of the analysis shows that 75.83% of the respondents were married, 10% were single, 10% of the respondents were widows and 4.17% of the respondents were divorced. This implies that majority of the respondents will possibly have additional responsibilities to their spouses and children. The significance of marital status on agricultural production can be explained in terms of the supply of agricultural family labor. It is expected that family labor would be more available where the household heads are married.

From table 1 the result indicates that higher percentage of the farmers in the study area have a household size ranging 6 to 10, 30.83% have a household size between 1 to 5, 9.17% have a household members between 11 to 15 and a household size of 15 and above with the toll percentage of 5%. The mean household size in the area of study is approximately 8 persons. The significance of household size in agriculture hinges on the

fact that the availability of labour for farm production. The implication of this finding is that the quantity of food intake will be affected and dependency ratio will be affected. As indicated in the table 1, only (15%) of the respondents did not have any form of education, 17.50% had primary education, 22.50% had secondary education and 45% had tertiary education. The result shows 18.33% of the respondents in the study area have a farm of size between 1 to 2 hectares, 25% of the farmers have a farm size of between 3 and 4 hectares, and 5 to 6 hectares were owned by 22% of the farmers and 33% of the farmers owned 6 and above hectares of farmland. The average farm size in the study area was 2.7 ha. Farm sizes have implication for food security.

The result indicate that 24.17% of the respondents generated less than ₦100,000 from farming annually, 56.67% of the farmers generated annual farm income between ₦100,000 to ₦499, 999, 16.66% of the farmers generated annual farm income between ₦500,000 to ₦1000,000 and more than ₦1000,000 annual farm income were generated by 2.5% of the farmers in the study area. This also has great implication for food security. This is in line with FAO (2001) report that household must have sufficient income to purchase the food they are unable to grow.

Pattern of crop diversity practiced by the respondents

Table 2 presents the extent of crops diversification, here the study utilized descriptive statistics and Simpson’s index to describe the extent of crop diversification among the farming households.

Table 2. Pattern of Crop diversity practiced by respondents

No of crops cultivated	Frequency	Percentage
1-3	52	43.33
4-6	52	43.33
7-9	16	13.34
Summarized Simpson’s index statistics		
Mean	0.69	
Standard deviation	0.12	
Minimum	0.32	
Maximum	0.88	

Source: Computed from field survey data, 2019

Table 2 showed the summary result from the analysis of the pattern of crop distribution practiced by individual households within the study area. From table 2 it shows that 43.33% of the household cultivated about 1 to 3 different crops, 4 to 6 crops were cultivated also by 43.33% of the respondents and 13.34% of the respondent cultivated greater than 7 crops. The minimum number of crops cultivated by the respondents was 1 and the maximum was 8 with about 4 different crops being an average number of crops cultivated by the respondents within the study area The average Simpson's index was 0.69, with a minimum of 0.32 Simpson's index and 0.87 as the maximum Simpson's index within the study area. Crop diversification can be used as a tool to increase farm income, improve nutrition, generate employment, alleviate poverty, conserve soil and water resources and is reckoned as an important strategy to overcome many of the emergencies faced by developing countries (Joshi *et al.*, 2004).

Pattern of household dietary diversity distribution

Table 3 reveals the Dietary Diversity Scores (DDS) of the respondents. The section presents result from the survey of 24 hour food recall of 16 food groups by households sampled.

Table 3. Distribution of household dietary diversity

Scores	Frequency	Percentage
4	2	1.67
5	19	15.83
6	12	10.00
7	8	6.67
8	8	6.67
9	5	4.17
10	9	7.50
11	19	15.83
12	21	17.50
13	13	10.83
14	3	2.50
15	1	0.83
Total	120	100.00
Summary Statistics of DDS		
Mean	9.30	
Standard deviation	3.02	
Category of Dietary Diversity		
Poor dietary diversity	2	1.67
Middle dietary diversity	47	39.17
Rich dietary diversity	54	45.00
Richest dietary diversity	17	14.16

Source: Computed from field survey, 2019

The result shows the proportion of the households in percentage consuming the different food groups. The table shows the pattern of household dietary diversity of the rural households within the study area. About 1.67% of the respondents household consumed 4 different food groups within 24 hours recall period, 15.83% consumed 5 different food groups, 6 different food groups were consumed by 10% of the household, 7 different food groups were consumed by 6.67% of the household, also 6.67% of the household consumed 8 different food groups, 9 food groups were consumed by 4.17% of the household, 10 food groups were consumed by 7.50% of the household, 15.83% of the respondents consumed 11 food groups, 12 food groups were consumed by 17.50% of the respondents, 10.83% of the respondents household consumed 13 food groups, 2.50% consumed 14 food groups and 0.83% ate 15 different food groups. The minimum and maximum numbers of food groups consumed by the respondents' household were 4 and 15 food groups respectively. On average, approximately 9 food groups were consumed by the respondents. The dietary diversity score (DDS) of the individual household ranged from 4 to 15 were categories into four (4) groups, the household with poor dietary diversity ranged 0 to 4 were 1.67%, household with middle dietary diversity which ranged 5 to 8 were 39.17%, household with rich dietary diversity ranged 9 to 12 were 45% and household with highest dietary diversity scores ranged 13 to 16 food groups were 14.16%.

Relationships between crop diversity and rural household dietary diversity

The relationships between crop diversity and dietary diversity in the study area were assessed using Poisson regression model and presented in table 4 below. Explanatory variables involve in this assessment includes Simpson’s index, farm sizes, annual income, farming experience and access to extension services

Table 4. Relationships between crop diversity and rural household dietary diversity

Variables	Coefficient	Std. error	p> z
Simpson’s index	2.0400	0.3681	0.000
Farm size	0.0172	0.0383	0.653
Annual income	3.93e-07	1.63e-07	0.016
Farming experience	-0.0004	0.0024	0.866
Access to extension	0.1158	0.0680	0.865
Constant	0.6231	0.2544	0.014
Log-likelihood	262.94929		
Pseudo R ²	0.1329		
LR X ²	80.61		
prob.>X ²	0.0000		

Source: computed from field survey data, 2019

Table 4 presents the result of Poisson regression model analysis on the factors influencing farming household dietary diversity in rural areas of ZONE B ADP Kogi State. Explanatory variables involve in this assessment includes Simpson’s index, farm sizes, annual income, farming experience and access to extension services.

The result showed that the probability of households having high dietary diversity in the study is determined by Crop diversity and annual income. The coefficient of crop diversity was found to be positive and significant at 1% implying that dietary diversity increases with increase in crop diversity among the farming households. The positive and significant effects of the crop diversity of the farming household heads increase the probability of households being nutritionally secure. The coefficient of household heads annual farm income was found to be positive and significant at 5% implying that dietary diversity (nutrition status) increases with increase in annual farm income. The positive and significant effects of the annual farm income of household heads increase the probability of households being nutritionally secure. Studies have attempted to find the relationship between land cropping pattern and dietary diversity of households. In light of this, Jones *et al.*, (2014) examined the relationship between farm diversity and dietary diversity among households and concluded that there is a strong relationship between dietary diversity and farm diversity in Malawi based on a national representative sample survey implemented from March 2010 to March 2011 as part of a World Bank Living Standards Assessment study. Also, Herforth (2010) specifically examined these relationships in the context of Tanzania and Kenya and concluded that crop diversity was significantly associated with household dietary diversity. Djokoto *et al.*, (2017), Pellegrini and Luca (2014), Smale *et al.* (2013) and Thompson and Meerman (2010) have attempted to study this relationship and established that crop diversity and household dietary intake of household are significantly related.

4. Conclusion

From the results of the research, the study concluded that crop diversity and annual farm income contributed significantly to rural household dietary diversity in the study. The outcome of the study suggests that when diverse crops are grown, whether for market sale or for own consumption, this increases household nutritional security and allows households to access a more diverse set of foods. Based on the findings of the research, the following recommendations were made; Crop diversification should be encouraged within the study area. Policy which improves rural farm household income should be put in place as well as things that can help increase farm household off-farm income should be encouraged

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