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PERCEIVED EFFECTS OF CROP DIVERSIFICATION ON FOOD SECURITY OF FARMERS IN KWARA STATE NIGERIA

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OPEN ACCESS

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SUMMARY

This study was conducted to examine perceived effects of crop diversification on food security status of maize-based farmers in Kwara State, Nigeria. A multi-stage sampling technique was employed to obtain data from 183 maize-based farmers using an interview schedule. The data were analyzed using Herfindahl indexing, Food Consumption Score of the World Food Programme for determining household food security and Chi-square test. The results showed that the extent of crop diversification was moderate for slightly above half of the respondents (51.4%). The majority of the respondents (91.3%) had acceptable food consumption (>35), which corresponds to their food security situation. Crop diversification among the farmers indicated positive and significant influence of crop diversification on the food security status of the farmers at 1% level of significance using chi-square. More than half of the respondents perceived that crop diversification had strong effects on increased access to food preferences for an active and healthy life (56.3%), access to utilizable and digestible food (57.4%) and access to sufficient food (53.6%). The study concluded that crop diversification practices contributed to food security by increasing access to preferred sufficient, utilizable and digestible food for active and healthy life of maize-based farmers in Kwara State. Thus, extension agents should increase awareness of the importance of crop diversification for the farmers' output in the study area.

Key words:
crop diversification, food preference, sufficient food, input subsidies

Abbreviations:
WFP - world food program; FCS - food consumption score; LGAs - local government areas; KWADP - Kwara state agricultural development program

INTRODUCTION

Being a farmer comes with a lot of risk. In the aspect of crop production, the risk of crop failure has been one of the major challenges facing crop farmers (Douyon et al., 2022; Komolafe et al., 2014). Crop failure has negatively affected the yield, income and food security of farmers in Nigeria (Kwara State inclusive). Some of the major causes of crop failure are the effects of unfavourable climate change (drought, flood, heat stress etc.), pest infestation, soil infertility, high cost of improved technologies such as pest/climate resistant varieties and fertilizers (Komolafe et al., 2019). Climate change is an unexpected variation in climatic conditions and it can negatively affect crop growth leading to poor crop yield, low income of farmers and consequently food insecurity in farming households.
However, an unfavourable change in weather for one crop may be favourable to another crop. Crop diversification therefore is recognized as one of the solutions to the above mentioned problems and a secure pathway for agricultural development (Nayak & Kumar, 2018). Crop diversification can increase farmers' resilience against the adverse impacts of climate change on food crops. The main purpose of crop diversification practices employed by

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farmers in the developing world is to avert crop loss in order to ensure food security, increase farm incomes and reduce vulnerability to poverty (Appiah-Twumasi & Asale, 2022; Komolafe et al., 2022; Schroth & Ruf, 2014). Previous studies related to the influence of crop diversification on household food security independently found that crop diversification is a viable agricultural practice to sustain small-scale agricultural production as well as to ensure household food security and nutrition in central Malawi (Mango et al., 2018), Northern Ghana (Baba & Abdulai, 2020) and Southern and Central Mali (Douyon et al., 2022). However, empirical data on the contribution of crop diversification to food security among farmers in Nigeria is scarce in literature. Particularly in Kwara State, there is a dearth of knowledge on the effect of crop diversification on food security. It is against this background that this study focused on investigating the perceived effects of crop diversification on food security status of maize-based farmers in Kwara State.

The main objective of the study was to investigate the effects of crop diversification on the food security status of maize-based farmers in Kwara State, Nigeria. The specific objectives were to:

i. examine the extent of crop diversification among the farmers;
ii. determine the food security status of maize-based farmers;
iii. determine the perceived effects of crop diversification on the food security status of maize-based farmers;
iv. identify constraints faced by maize-based farmers on crop diversification.

A null hypothesis was proposed for the study (H0): the extent of crop diversification does not affect the food security status of maize-based farmers in Kwara State.

MATERIAL AND METHODS

This study was carried-out in Kwara State, North Central zone of Nigeria. The state covers 32,500 km^2 land area in the Guinea Savannah Vegetation. Geographically, the State is situated between latitude 7^0 201 and 11^0 051 north of the equator; longitude 2^0 51 and 6^0 451 east of the prime meridian. Kwara State consists of LGAs and four agro-ecological zones (Fig. 1).

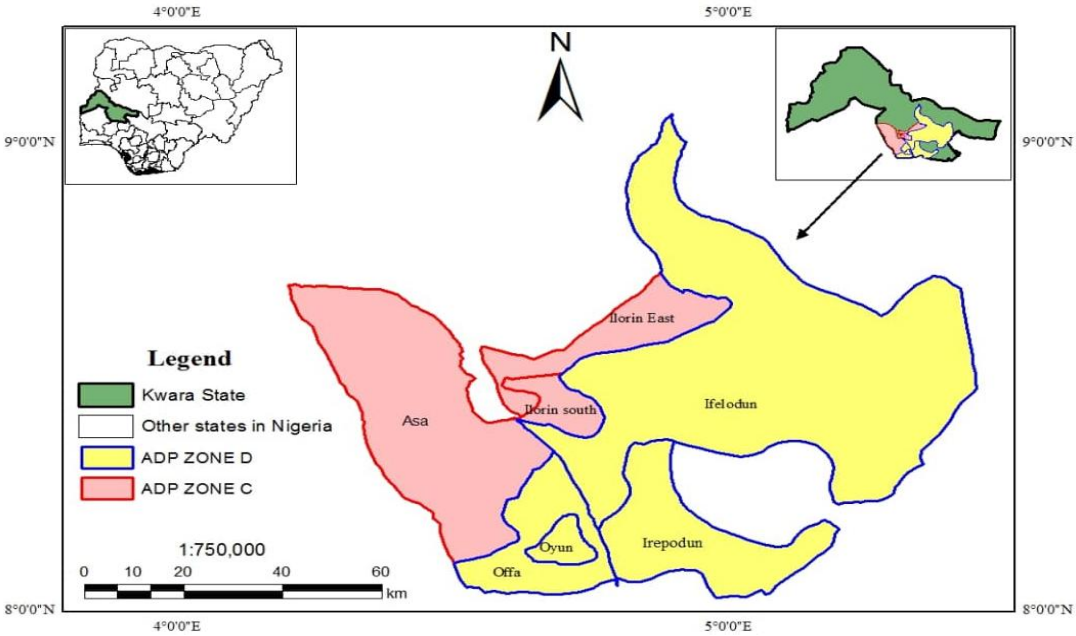


Figure 1. The study area

All registered maize-based farmers by KWADP were considered as population for the study. Respondents for the study were selected through a four-stage procedure. In the first stage, two (2) ADP zones were selected, constituting 50% of the existing zones. These were Zones C and D (Fig. 1). The choice of zones was based on the evidence of high maize cultivation. In the second stage, four (4) LGAs in each of these two zones were randomly selected. In this stage, 8 LGAs were selected. In the third stage, 2 farming communities in each of these eight LGAs were randomly selected. In this stage, 16 farming communities were selected. Lastly, the population of maize-based farmers in these

communities was collated, from which about 55% of registered 336 maize-based farmers in zones C and D were randomly selected. Altogether, the study sampled 183 maize-based farmers.

Instrument for Data Collection and Measurement of Variables

A structured interview schedule was designed and carefully examined by experts in the field of Agricultural Extension and Economics at Kwara State University to validate the contents of the instrument before it was administered with the assistance of trained enumerators. The instrument was considered reliable following a value of 0.78 Cronbach's alpha coefficient obtained.

Crop diversification

A list of possible crops commonly grown by the maize-based farmers, including maize, cassava, cowpea, soybean, sweet potato and yam, were presented to the respondents and they were asked to choose Yes or No to indicate multiple crops cultivated on the same plot, i.e. diversification. The values of 1 and 0 were assigned respectively. Decision on the extent of diversification was as follows: 1–4 crops = low diversification, 5–8 crops = moderate diversification and above 9 = high diversification

Food security

Nine (9) food groups presented to the respondents included main staple, pulses, vegetables, fruits, meat/fish, milk, sugar, oil and condiments. The respondents were asked to indicate the actual number of days they were able to consume each of the items.

Food consumption score (FCS) was used as a measure of food security status in this study. Previous studies employed FCS as a measure of household food security (Mango et al., 2018). Food consumption score is a composite score based on dietary diversity, food frequency and relative nutritional status of different food groups.

From a qualitative reminder of consumption and consumption frequency during the last 7 days, we calculated the score consumption of food households as a proxy for the coverage of needs micronutrients. This score was calculated according to the mathematical method named the Food Consumption Score (FSC). The FSC is inspired by the World Food Program (WFP, 2015), using the frequency of consumption of the nine food groups consumed during the last seven (07) days preceding the survey by households. Those nine food groups comprise staple, pulses, vegetables, fruits, meat/fish, milk, sugar, oil and condiments. The FCS was calculated according to Grando et al. (2022) as follows:

$$FCS = A\ staple\ X\ staple + A\ pulse\ X\ pulse + A\ vegetables\ X\ vegetables + A\ fruits\ X\ fruits + A\ meat/fish\ X\ meat/fish + A\ sugar\ X\ sugar + A\ milk\ X\ milk + A\ oil\ X\ oil + A\ condiment\ X\ condiment$$

Where:

AI - weight assigned to the food group is constant (staple = 2, pulses = 3, vegetables = 1, fruits = 1, meat/fish = 4, milk = 4, sugar = 0.5, oil = 0.5 and condiments = 0)

XI - number of days of consumption relative to each food group (≤7 days).

Thus, the conventional thresholds defined by the WFP to determine the three food consumption groups were used:

- Poor food consumption: FCS<21 corresponds to a situation of **severe food insecurity**;
- Food consumption at the limit of acceptability, 21.5<FCS<35, which corresponds to a situation of **moderate food insecurity**;
- Acceptable food consumption: FCS>35 which corresponds to a **food security** situation.

Data analysis

Descriptive statistics including the use of frequency counts, percentages, mean scores, ranking and standard deviations were employed in analyzing and presenting objectives 1, 2, 3 and 4. Chi-square analysis was used to analyze hypothesis of the study.

The hypothesis of the study, which assessed the relationship between the number of crops planted on the same plot (crop diversification) and the number of food varieties consumed in the last 7 days (food security), was tested with Chi-square analysis. The formula for the Chi-square test of independence according to Kostalova (2010) was adopted and expressed as:

$$X^2 = \sum_{i-1}^{r} \sum_{f-1}^{c} \frac{O_{ij} - E_{ij}}{E_{ij}}$$

Where;
X^2 - Chi-square value,
O_{ij} - Observed frequency of the ith row,
E_{ij} - Expected frequency of the ith row,
r - Number of rows in the contingency table,
c - Number of columns in the contingency table.

RESULTS AND DISCUSSION

Demographic characteristics of the respondents

Table 1 shows that 97.3% of the respondents were male. This implies that the maize-based farming in the study area is basically done by males. The dominance of males in maize farming may be connected to the rigours attached to maize farming activities. The findings further show that 63.4% of the respondents are aged 60 and above. This indicates that the majority of the maize-based farmers in the study area are getting older. It may affect the farmers' efficiency to perform rigorous tasks and their decision to adopt improved practices such as crop diversification, which could in turn affect food availability as well as food security in the long run. Also, the results indicate that 77% of the respondents are literate. Literacy levels of the farmers may influence their decision-making and the adoption of innovation which could bring about improvement in one's livelihood and food security. A larger proportion of the respondents (89.1%) cultivate between 1 to 5 acres of maize, showing that the maize-based farmers in the study area are small-scale farmers. Being a small-scale farmer is likely to influence one's level of crop diversification as farmers may not have enough land to practise crop diversification.

Table 1. Demographic characteristics of the respondents

Crops	**Frequency**	**Percentage**
Sex:		
Male	178	97.3
Female	5	2.7
Age (years):		
20 – 39	13	7.1
40 – 59	54	29.5
60 and above	116	63.4
Years spent in school:		
0	42	23.0
1 – 6	12	6.6
7 – 12	76	41.5
13 and above	53	29.0
Farm size (acres):		
Less 1		
1 – 5	163	89.1
6 – 10	19	10.4
10 and above	1	0.5

Source: Field survey, 2022

Crop diversification by the respondents

Regarding the diversity of the cultivated crops, Table 2 shows that maize and cassava were cultivated by all (100%) of the respondents. This indicates that cassava and maize are commonly grown crops in the study area. Maize and cassava are staple crops mostly used by the Nigerians for varieties of food. Therefore, the demand for these crops is high and most profitable for the farmers. Other crops commonly grown among the respondents were soybean (71.6%) and yam (71.0%), while sweet potato was grown by less than half (43.7%) of the respondents.

Table 2. Crops grown by respondents

Crops	Frequency	Percentage
Maize	183	100.0
Cassava	183	100.0
Cowpea	157	85.8
Soybean	131	71.6
Sweet potato	80	43.7
Yam	130	71.0
Sorghum	9	4.9
Rice	13	7.1
Millet	5	2.7
Guinea corn	6	3.3

Source: Field survey, 2022

Further classification of crops grown on the same plot (Tab. 3) shows that 51.4% of the farmers practised moderate crop diversification, 32.2% practised low crop diversification, while 16.4% practised high crop diversification. This implies that the extent of crop diversification was moderate among the maize-based farmers in Kwara State.

Table 3. Extent of crop diversification among the respondents

Crops	Frequency	Percentage	
1 – 4	59	32.2	Low
5 – 8	94	51.4	Moderate
9 – 12	30	16.4	High
Total	183	100	

Source: Field survey, 2022

Sources of information on crop diversification

Table 4 shows that the majority of the respondents obtained the extension information on crop farming through fellow farmers (mean=1.85) ranked first position, cooperative group (mean=1.44) ranked second position, radio (mean=0.93) ranked third position, social media (mean=0.55) ranked fourth position and television (mean=0.54) ranked fifth position. In other words, fellow farmers, cooperative group meetings and radio are the leading sources of information for crop farming and agricultural development while agricultural extension agents ranked 8th position as the majority of the farmers (73.2%) never had access to the agents. This could negatively affect the quantity or quality of crop output, income and food security of the farming households. This finding is also in line with the study by Onya et al. (2019), who found that the majority of the farmers cultivating several annual crops in Abia State had no access to agricultural extension agents.

Table 4. Respondents' sources of information on crop diversification

Sources	Always f (%)	Sometimes f (%)	Never f (%)	Mean (SD)	Ranking
Fellow farmers	156 (85.2)	27 (14.8)	0	1.85 (0.356)	1st
Cooperative group	121 (66.1)	22 (12.0)	40 (21.9)	1.44 (0.829)	2nd
Radio	10 (5.5)	151 (82.5)	22 (12.0)	0.93 (0.414)	3rd
Social media	19 (10.4)	62 (33.9)	102 (55.7)	0.55 (0.677)	4th
Television	7 (3.8)	84 (45.9)	92 (50.3)	0.54 (0.572)	5th
Agro-dealers	4 (2.1)	79 (43.2)	100 (54.6)	0.48 (0.543)	6th
Agricultural extension agent	24 (13.1)	25 (13.7)	134 (73.2)	0.40 (0.711)	7th
Printed newspaper	5 (2.7)	57 (31.1)	121 (66.1)	0.37 (0.537)	8th

Source: Field survey, 2022

Food security status of the respondents

Individual farmers were grouped based on the number of days of consumption relative to each food group in the last 7 days and weight assigned to the food group (Tab. 5). The results reveal that the majority (91.3%) of the respondents were food secure. The average number of the food consumption score for all respondents was 83.0, which indicates food security. Normal range of the FCS is from 0 to 112 according to World Food Program (WFP) internal decision-making, while FCS>35 are considered acceptable, 21–35 borderline and <21 poor. Therefore, the above score of 83 is considered acceptable and the maize-based farmers in Kwara State are considered to be food secure.

Table 5. Food security status of the respondents

Score range of food consumed	Status	Frequency	Percentage	Mean
Poor food consumption: FCS<21 corresponds to a situation of severe food insecurity	Severely food insecure	2	1.1	
Food consumption at the limit of acceptability, 21.5<FCS<35, which corresponds to a situation of moderate food insecurity	Moderately food insecure	14	7.7	
Acceptable food consumption: FCS>35 which corresponds to a food security situation	Food secure	167	91.3	83.0
Total		183	100.0	

Source: Field survey, 2022

Perceived effects of crop diversification on food security

Based on the results presented in Table 6, more than half of the respondents agreed that diversification of crops on the same plot of land positively affects their access to preferred food items needed for healthy and active living (56.3%), access to utilizable, sufficient and digestible food (57.4%) and access to sufficient food (53.6%). The majority further indicated that crop diversification moderately improves their food availability and stability over time (77.6%), provides access to save food (71.0%), access to nutritious food which meets household dietary needs (63.4%) and access to nutritional food of households (63.9%). Based on the ranking order of the responses, it can be concluded that access to preferred nutritional food needed for healthy and active life, access to utilizable, sufficient and digestible food, and access to sufficient food were ranked first, second and third position and were perceived by the maize-based farmers in Kwara State as the most significant effects of the diversified cropping system.

Table 6. Perceived effects of crop diversification by respondents

Effects	High f (%)	Moderate f (%)	Low f (%)	Mean (SD)	Ranking
Access to preferred food items	103 (56.3)	74 (40.4)	6 (3.3)	2.53 (0.562)	1st
Access to utilizable, sufficient and digestible food	105 (57.4)	68 (37.2)	10 (5.5)	2.52 (0.601)	2nd
Access to sufficient food	98 (53.6)	69 (37.7)	16 (8.7)	2.45 (0.652)	3rd
Access to dietary diversity of food	86 (47.0)	87 (47.5)	10 (5.5)	2.42 (0.595)	4th
Access to nutritional quantity of food needed	61 (33.3)	117 (63.9)	5 (2.7)	2.31 (0.518)	5th
Access to nutritious food for dietary needs	58 (31.7)	116 (63.4)	9 (4.9)	2.27 (0.544)	6th
Food is available and stable over time	38 (20.8)	142 (77.6)	3 (1.6)	2.19 (0.434)	7th
Access to save food	41 (22.4)	130 (71.0)	12 (6.6)	2.16 (0.516)	8th

Source: Field survey, 2022

Constraints faced by the respondents on crop diversification

Table 7 indicates that inadequate provision of subsidized agricultural resources for diversification of crops (mean=2.88) ranked first position, unfavourable experience of growing some crops on the same plot (mean=1.92) ranked second position, risk of growing multiple incompatible crops (mean=1.91) ranked third position, unpredictable rainfall patterns (mean=1.73) ranked fourth position, lack of adequate knowledge for growing multiple crops (mean=1.68) ranked fifth position while risk of poor economic gains when crops are not chosen through market evaluation (mean=1.48) ranked tenth position as the least significant constraint indicated by the respondents. This implies that inadequate provision and access to subsidized agricultural resources to the famers practising crop diversification, unfavourable experience of growing some crops on the same plot and risk of growing multiple incompatible crops were the leading constraints facing the maize-based farmers in Kwara State in practising crop diversification.

Inadequate access to subsidized agricultural resources indicated as the leading constraint in the practice of crop diversification may not indicate the absence of the provision of agricultural input subsidies to arable crop farmers in Nigeria but these responses may have been triggered by ineffective implementation of the subsidy providing programmes that limited its expected benefits among small-scale farmers. One prominent example of such subsidy programmes is the Growth Enhancement Support Scheme (GESS), an e-Voucher-Based Input Subsidy Program aimed to deliver subsidized farm inputs to small-scale farmers. Empirical evidence shows that GESS was negatively affected by its politicization, non-commitment of some staff, the inability of the governments to release funds to agro-dealers resulting in late delivery of inputs and the lack of support service (extension) to the farmers (Michael et al., 2018; Nwaobiala & Ubor, 2016).

Table 7. Constraints faced by the respondents on crop diversification

Constraints	Severe f (%)	Less severe f (%)	Not severe f (%)	Mean (SD)	Ranking
Inadequate provision of subsidies to the famers adopting crop diversification	167 (91.3)	10 (5.5)	6 (3.3)	2.88 (0.415)	1st
Unfavourable experience of growing some crops on the same plot	4 (2.2)	161 (88.0)	18 (9.8)	1.92 (0.339)	2nd
Risk of growing multiple incompatible crops	4 (2.2)	159 (86.9)	20 (10.9)	1.91 (.352)	3rd
Unpredictable rainfall patterns	6 (3.3)	121 (66.1)	56 (30.6)	1.73 (0.515)	4th
Lack of adequate knowledge for growing multiple crops	3 (2.7)	114 (62.3)	64 (35.0)	1.68 (0.524)	5th
Unfavourable social norms and household demographics for growing some crops on the same plot	6 (3.3)	103 (56.3)	74 (40.4)	1.63 (0.548)	6th
High rate of pest infestation of diversified cropping system	3 (1.6)	109 (59.6)	71 (38.8)	1.63 (0.517)	7th
Inadequate contact with extension officers on crop diversification	6 (3.3)	87 (47.5)	90 (49.2)	1.54 (0.562)	8th
Non-suitability of land for growing multiple crops	7 (3.8)	81 (44.3)	95 (51.9)	1.52 (0.573)	9th
Risk of poor economic returns when crops are not acceptable in the market	4 (2.2)	79 (43.2)	100 (54.6)	1.48 (0.543)	10th

Source: Field survey, 2022

Test of the hypothesis: There is no significant relationship between the crop diversification and the food security status of the maize-based farmers in Kwara State.

The results displayed in Table 8 show the chi-square test between the level of crop diversification and the food security status of the respondents. The result shows that crop diversification among the farmers is significantly associated (X^2=12.265; p<0.01) with the food security status of the maize-based farmers in Kwara State. Hence, the null hypothesis of the study was rejected while the alternative is accepted.

Furthermore, the Cramer's V of 0.248 indicated positive and significant influence of diversification of crops on the farmers' food security status. Gamma value of 0.745 or 74.5% implies that crop diversification is 75% better to predict the food security status of the maize-based farmers in Kwara State. This indicates that increase in the level of crop diversification has high probability to increase food security in terms of food availability, accessibility and sufficiency for consumption among the maize-based farmers in Kwara State. The results found in this study are in line with the findings by scholars who indicated that crop diversification had positive and significant effects on household food security of the farmers (Adjimoti & Kwadzo, 2018; Baba & Abdulai, 2020) and that cultivation of several crops is an instrument to sustainably achieve food security (Ijaz et al., 2019). Through cultivation of different crops, farmers are empowered to ensure access to sufficient nutritional food for household members (Baba & Abdulai, 2020).

Table 8. Results of Chi-square test

	Food security status			
	Chi-square (X^2)	p-value	Gamma	Cramer's V
Crop diversification	12.265	0.000*	0.745	0.248

CONCLUSION

This study assessed farmers' perceived influence of cultivating multiple crops on the same plots of land to achieve food security for farm households in Kwara State. Based on the findings, certain conclusions were reached. The leading sources of information on crop diversification were fellow farmers, cooperative groups, radio and social media. The major crops grown by the maize-based farmers in Kwara State were maize, cassava, cowpea, soybean, sweet potato and yam. The extent of crop diversification among the farmers was moderate. The majority of the maize-based farmers who practise crop diversification in Kwara State were food secure. The maize-based farmers in Kwara State engaged in crop diversification mainly to ensure food security through increased access to preferred sufficient, utilizable and digestible food for active and healthy life. The major constraints faced by the farmers included: inadequate provision of subsidies to the famers adopting crop diversification, unfavourable experience of growing some crops on the same plot, risk of growing multiple incompatible crops.

It is recommended that farming households should be encouraged to intensify combining enterprises and off-farm activities that could generate more income for the households because off-farm income significantly influences food security. Also, extension agents should increase awareness of the importance of crop diversification for the farmers' output in the study area.

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